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Special Issue: Four Essays in the History of Science in Atlantic Canada

Guest editors: Melanie Frappier, Suzanne Zeller, Eric Mills

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On the cover / en couverture: *Photo collage of two figures from Sara Spike's article, Mayflowers and Sleeping Johnnies: Nature-Study, Local Knowledge, and A. H. MacKay's Phenological Research in Rural Nova Scotia, 1892-1925. Photos by Sara Spike.*

Four Essays On the History Of Science In Atlantic Canada

Eric L. Mills
Dalhousie University and University of King's College, Halifax

> The word "science' suggests, among other things, precision, clarity, certainty. Yet, paradoxically, the word itself is decidedly ambiguous Depending on context it can mean a general body of knowledge, a specific subdivision of that body, a philosophical outlook, a mode of thought, a code of procedure, a profession as an entity, or the membership of that profession. It can refer to an element in education, in politics, in social organization, in the military, or in the economy. And in the context of a geographical region it can embrace all those senses.

SO WROTE THE AMERICAN HISTORIAN R.V. BRUCE in 1990, opening a book titled *Science and Society in the Maritimes Prior to 1914*. Bruce went on to compare the development of science in the Maritime Provinces with that in the USA, and New England in particular, noting that links between the New England States and Canadian Maritime Provinces were stronger than with Europe or Britain, but also the growing influence of European science in the United States which was then passed on to some degree to the Maritime Provinces. The great American western frontier dominated through natural history and geology in the growing United States, whereas in Canada, applied sciences, what Suzanne Zeller has called "inventory sciences," supported the utilitarian interests of the colonizers and their governments. The United States could boast several cities with important scientific cultures, whereas in Eastern Canada the critical mass (my words, not Bruce's) of populous cites with scientific cultures could not be achieved—as he said, "Science then as now … needed cities." And whereas in the United States life scientists dominated the sciences, in Canada geology and agriculture took center stage. Scientific controversies, none greater than the response to Darwinism, appear to have been resolved more easily in the scientifically-literate parts of the United States than in Canada. Finally, Bruce notes that a large proportion of American scientists in the nineteenth century supported themselves by teaching, followed by those employed in government, whereas in the Maritime Provinces government science dominated, largely in agriculture, and increasingly in geology. To this one should add that in much of Canada until well within the last three decades of the nineteenth century most of the "scientific" work appearing in print was by educated amateurs from the professions, business, or the military.

Regionally-focussed synoptic studies of the history of science in Canada are few and far between, and perhaps are not only unfashionable but may be misconceived in terms of recent concentration on the social history of science. The example of the admirable *Histoire des Sciences au Québec*, first published in 1987 and expanded in 2008, suggests otherwise, as does the success of symposia on the environmental history of the Atlantic Provinces. They are

 Eric Mills, "Four Essays on the History of Science in Atlantic Canada," *Scientia Canadensis* 42, 1 (2020): 1-4.

matched for most of Canada only by Zeller's more expansive *Inventing Canada* (1987), concentrating on the roles of science in nineteenth-century British North America. All of these provide a feast of information, examples, and ideas for an expanded historiography of Canadian science. Newfoundland — to expand the eastern provinces from Maritimes to Atlantic Provinces — enters the canon of history of science in Canada primarily through the unfulfilled promise of Steele's intriguing and tantalizing *Early Science in Newfoundland and Labrador* (1987), and by the chronological and historical development of society implied and described in George Rose's *Cod: the Ecological History of the North Atlantic Fisheries* (2007), which weaves Newfoundland society into the history of Newfoundland's greatest resource. Historians and histories of Newfoundland have, in general, avoided any mention of science in the past of the island, including Sean Cadigan's environmentally-aware *Newfoundland and Labrador: a History* (2009).

Examining very recent works on the history of science in the Atlantic Provinces reveals emphases on organizations, but primarily on people. Organizations and people come together intriguingly and comprehensively in Suzanne Zeller's mining of the archives of the Nova Scotian Institute of Science, founded in 1862, in which she documents how a mid-nineteenth century regional scientific society reflected its context and was forced to adapt as science and society changed around it. Richard Field has examined the remarkable life and ideas of the early nineteenth century surveyor, naturalist, and philosopher of environment Titus Smith, Jr. (1768-1850). Elizabeth Haigh's biography of the physician-geologist-entrepreneur Abraham Gesner (1797-1864), best known as the inventor of kerosene, shows the opportunities available in mid-nineteenth century to an ambitious polymath in the Maritime Provinces (as they became), also the impediments to success in a developing society before science had become institutionalized. For New Brunswick alone, Ronald Rees's biography of W.F. Ganong (1864-1941) gives an entrée into recent knowledge of the Natural History Society of New Brunswick and the work of a naturalist, physiographer, and social historian in the generation after Gesner.

This far from synoptic listing of recent works on the history of science in Atlantic Canada provides a little background for four new essays on science on the East Coast, ranging from the mid-nineteenth century well into the twentieth century. They begin with reactions to Darwinism in Nova Scotia among early members of the Nova Scotian Institute of Science. Andrew Reynolds, Christie MacNeil and Mitchell Jabalee in "The Reception of Darwinism in mid-to late Nineteenth-Century Nova Scotia" examine early addresses to the Institute, between 1864 and 1879, centering on the reception of Darwinism among members of the Nova Scotian Institute of Natural Sciences (as it was called until 1890). Only one speaker was a physician and not one was a scientist, but there was, typically, a considerable variety of opinion, mostly but not all contra Darwin, centering on compatibility between science and religion, and in the case of some speakers accepting modified versions of natural theology. In a fascinating snippet from a brief summary of the discussion in the Sydney, NS, Mechanics Institute in January 1872, after a lecture on "Mind", the authors document the tension between acceptance and rejection of Darwin's "development hypothesis."

Alexander H. MacKay (1848-1929) was Superintendent of Education for Nova Scotia from 1891 to 1926 and President of the Nova Scotian Institute of Science from 1899 to 1902. One would not expect him to be the subject of the CBC News in the 21st century, but such is the case. MacKay was the proponent of, and major actor, in a more than two-decade-long project to gather seasonal information on such phenomena as the dates of bird arrival, first flowering of several plants, and other seasonal signals, now collectively termed "phenology." This has proved a gold mine for climate-change researchers. Sarah Spike, in "Mayflowers and Sleeping Johnnies: Nature-Study, Local Knowledge, and A. H. MacKay's Phenological Research in Rural Nova Scotia, 1892-1925," shows how this project, in the hands of MacKay and the "compilers" he chose to manage the data coming in from schools all over the province, was aimed (at least in part) at modernizing rural society, and that the data, far from being unbiased, were evaluated and edited in ways that modern users have not taken into account.

Googling "UFOs in the Middle Ages" brings a sobering and disconcerting medley of pseudoscience and historical information. During at least the past 1200 years, humans have reported Unidentified Flying Objects (UFOs) such as celestial arrows and spears, ships disgorging anchors and other-worldly sailors, knights in battle, flaming shields, dragons, globes, disks, and bloody suns, in their heavens. As Matthew Hayes and Noah Morritt describe in "Michael W. Burke-Gaffney and the UFO Debate in Atlantic Canada, 1947-1969," the Reverend Dr. Michael Burke-Gaffney (1896-1979), a professional astronomer at St Mary's University in Halifax, chose to use the modern UFO debates of the late 1940s through the 1960s as a means to educate the East Coast populace in astronomy and scientific method by emphasizing the unlikelihood of an extraterrestrial origin of UFOs and their susceptibility (eventually) to the systematic methods of science. He was convinced of what Hayes and Morritt call "the power and scope of scientific knowledge" to explain the temporarily inexplicable. Their essay shows the context and extent of Burke-Gaffney's attempt, and how it eventually fell afoul of changes in society in the Maritimes and elsewhere.

Nearly surrounded by the North Atlantic Ocean and its adjacent seas, the Atlantic Provinces have paid coherent scientific attention to marine fisheries and other aspects of marine science since the 1890s. Historians have responded to this unity of purpose in a number of recent publications, the first of which, Jennifer Hubbard's *A Science on the Scales* (2006) set a standard and the agenda for a good deal of subsequent research, including a symposium volume published in 2016 on the region's most influential fixed biological station at St Andrews, NB. A magnificent resource — not strictly speaking a historical work — is the 2014 volume *Voyage of Discovery* marking the 50th anniversary of the Bedford Institute of Oceanography (BIO) in 48 chapters covering all aspects of work based at BIO. This is a splendid source book for historical research on the marine sciences in Atlantic Canada. My paper "Too Late For Action." A.G. Huntsman, M.L. Fernald and the Belle Isle Strait Expedition of 1923," concluding this issue of *Scientia Canadensis*, is far less ambitious. It outlines the interesting byways that appear through close examination of little-known aspects of the early work of a seemingly well-known marine scientist like the influential A.G. Huntsman (1883-1972). My hypothesis that Huntsman in 1923, nominally establishing the factors governing the abundance of Atlantic Cod in Labrador and Newfoundland waters, was on the verge of an ecological concept similar to Evelyn Hutchinson's ecological niche as a multi-dimensional hyperspace. This leap into semi-supported hypothesis will be, I hope, as stimulating as my colleagues' contributions in the preceding three essays.

I want to thank Melanie Frappier and Suzanne Zeller, who originated the idea for this special issue. I would also like to thank Aidan Hayes who copyedited the submissions for this special issue. Denisa Popa and Raphäel Pelletier, PhD students hired by the Canadian Science and Technology Association for the summer of 2020, proofread the issue.

Reception of Darwinism in mid-to late Nineteenth-Century Nova Scotia

Andrew Reynolds, Christie MacNeil, Mitchell Jabalee

Abstract: *Reaction to Darwin's theory of evolution within the natural history community of nineteenth-century Nova Scotia focused on his use of hypothesis to account for a diversity of facts about the origin of species. Critics here, as elsewhere, faulted Darwin's reasoning for straying from proper Baconian inductive method. Those locally engaged in natural history were inclined to stick closely to a descriptive inventory of the colony's (after 1867, the province's) natural resources. More fundamentally, Darwin's approach challenged the mission of natural theology to support a providential reading of the natural world and humanity's place within it. A review of publications in the Proceedings and Transactions of the Nova Scotian Institute for Natural Science and a private-diary account of a discussion emerging from a Mechanics Institute lecture during the 1860s and '70s reveals how members reacted critically to Darwin's science while insisting on the compatibility of science and religion.*

Résumé : *Parmi les cercles de naturalistes néo-écossais du XIXe siècle, les réactions vis-à-vis de la théorie de l'évolution de Darwin se concentraient surtout sur son utilisation d'hypothèses pour expliquer une diversité de faits liés à l'origine des espèces. Ici comme ailleurs, les critiques ont souvent reproché à Darwin le fait que son raisonnement s'écartait de la méthode inductive proprement baconienne. Dans la région, ceux qui s'intéressaient à l'histoire naturelle étaient plutôt enclins à s'en tenir à un inventaire descriptif des ressources naturelles de la colonie (devenue province en 1867). Plus fondamentalement, l'approche de Darwin remettait en question l'orientation de la théologie naturelle, qui soutenait une lecture providentielle du monde naturel et de la place de l'humanité en son sein. Un examen des textes tirés des Proceedings and Transactions of the Nova Scotian Institute for Natural Science et d'un compte rendu trouvé dans un journal personnel faisant mention d'une discussion soulevée à la suite d'une conférence de l'Institut de mécanique dans les années 1860-1870, révèle comment les membres ont généralement critiqué la science de Darwin tout en insistant sur la compatibilité de la science et de la religion.*

Keywords: Darwinism, Nova Scotia, ways of knowing, natural history, natural theology

> *"About thirty years ago there was much talk that geologists ought only to observe and not theorise; and I well remember some one saying that at this rate a man might as well go into a gravel-pit and count the pebbles and describe the colours."* ***Charles Darwin to Henry Fawcett, 18 Sept. 1861***

DARWIN'S REMARK BELIES A FRUSTRATION with a simplistic kind of Baconian inductivism, according to which the scientist must take care to observe nature free of the biasing influence of prior hypotheses or other 'idols of the mind.' Hypotheses (or general ideas) were supposed to reveal themselves to the scientist's mind only after the accumulation of facts obtained by means of

 Andrew Reynolds, Christie MacNeil, and Mitchell Jabalee, "Reception of Darwinism in mid-to late Nineteenth-Century Nova Scotia," *Scientia Canadensis* 42, 1 (2020): 5-28.

objective observation. Darwin's remark also alludes to what John Pickstone described as the 'natural historical' way of knowing.[1] Description, sorting, classifying: these are activities central to the tradition of Natural History. What was once called Natural Philosophy, on the other hand, involves the attempt to discover the laws and causes of phenomena, and relies on the 'analytical' way of knowing whereby things are broken down conceptually and perhaps physically into more fundamental elements. The process of explaining why things occur the way they do or why objects possess the outwardly observable properties they have, often relies on positing elements or forces that are either invisible or only indirectly detectable with the naked senses. Explanation and the identification of general laws frequently require the proposal and testing of hypotheses; and so Darwin [**Fig. 1**], in his very next line, remarked: "How odd it is that anyone should not see that all observation must be for or against some view if it is to be of any service!"[2] Darwin's fame rests, of course, on his willingness to put forth bold hypotheses in order to explain a diversity of natural historical phenomena with resort to key concepts such as the community of descent, natural selection, pangenesis, and the formation of coral atolls through the gradual subsidence of sea-bed geology, to name a few.[3] So, while Darwin was an exceptionally capable natural historian, the pains he took to make careful observations on a wealth of subjects were motivated by a desire to identify and to test explanatory hypotheses using the analytical way of knowing and its closer association with theory and experiment.

In addition to the *natural historical*, the *analytical*, and the *experimental* ways of knowing, Pickstone also identifies a fourth more ancient and widespread activity which he calls *world reading*. This he describes as a hermeneutical approach to interpreting the world and one's experiences in it as a kind of text full of meaning and significance. It includes what one typically thinks of as a philosophical or religious approach to reflection upon the natural world. In the nineteenth century this took the form of 'Natural Theology', the attempt to understand God the creator through the study of his creations as illustrated by works such as Bishop Paley's *Natural Theology or Evidences of the Existence and Attributes of the Deity* (1802) and the *Bridgewater Treatises* (1833-1840).

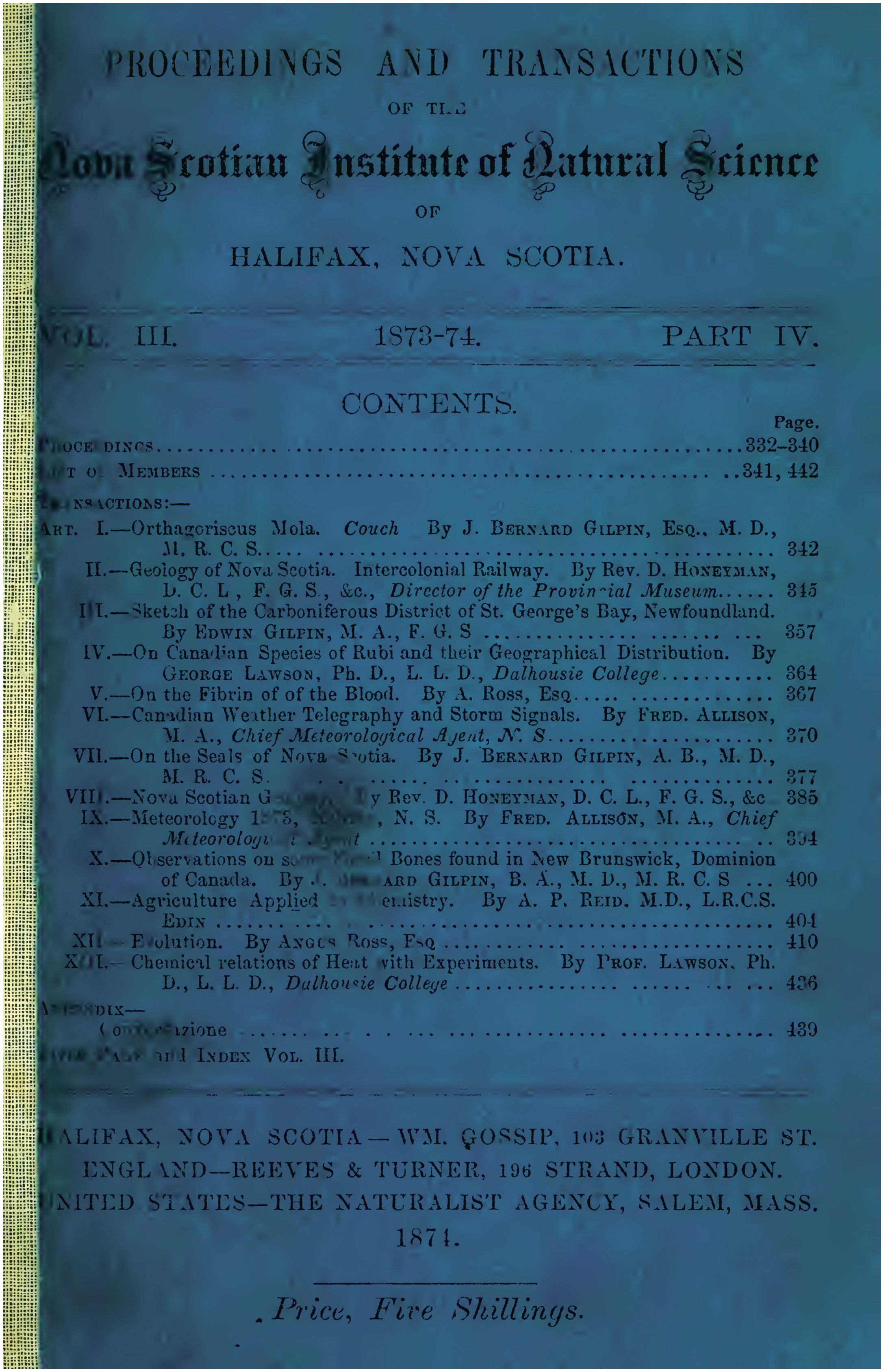
Natural history as practised in Britain and British North America in the first half of the nineteenth century was strongly influenced by natural theology. While utilitarian commercial interests provided a significant stimulus for engaging in what Suzanne Zeller has called the 'inventory sciences' in early Canada (geology, terrestrial magnetism, meteorology, botany), natural theology provided the activities of describing and classifying the flora, fauna, and natural resources of a colony like Nova Scotia with a more lofty and edifying purpose.[4] Darwin's theory of evolution evoked criticism and controversy for challenging natural theology's mission to provide empirical corroboration for the truths of Christianity as revealed in scripture and to be accepted on the basis of devout faith. Darwin's theory that humans share a common ancestry with all other extant species of animals and plants, a process driven not by intelligent

Figure 1. *Water-colour portrait of Charles Darwin, after his return from the voyage of the Beagle, by George Richmond, 1830s.*

providence but by blind material events and forces like natural selection was a competing 'world reading' with broad and alarming implications. In reaction, many impugned the method by which Darwin reached his conclusions as unscientific. As Henry Fawcett, the economist and Liberal politician, wrote to Darwin shortly after the publication of *The Origin of Species*: "It is easy for an antagonistic reviewer when he finds it difficult to answer your arguments to attempt to dispose of the whole matter by uttering some such commonplace, as "This is not a Baconian induction.""[5]

Baconian inductivism was frequently employed as a rhetorical device by which to criticize the scientific status of Darwin's theory of evolution. No other subject in science has cut so deeply to the core of traditional religious and philosophical beliefs about the nature of humanity and its ultimate place in the universe. The nineteenth century witnessed a shift in attitudes toward science, its value, purpose, and its standing with respect to other 'ways of knowing.' Those who promoted the theory of evolution insisted that science was no longer to be handmaid to theology. Naturalists of a younger generation, like T.H. Huxley (1825-1895) and John Tyndall (1820-1893), were comfortable with science's mission being the disinterested pursuit of knowledge and truth for their own sakes, no matter where its conclusions might lead; while representatives of the previous generation and those of a more conservative religious faith vigorously resisted. These debates played out across the globe, in scientific journals and newspapers, but also in the parlors of private residences and in more public spaces like lecture halls or wherever groups of the civic-minded and intellectually curious met to debate the important issues of the day.[6]

Here we discuss the reception of Darwinism in nineteenth-century Nova Scotia as evidenced in the printed records of the local scientific society of note, the *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* [**Fig. 2**]: what they reveal about attitudes toward the different ways of knowing and how these attitudes tended to vary between those engaged in natural history and those trained in the experimental techniques of the physical sciences. Suzanne Zeller has previously noted that the *Proceedings of the Nova Scotian Institute of Science* (its current title) provide very useful glimpses into the scientific topics discussed by the membership and how various theories have been received, and she concludes that "enticements continue to lurk in those 150 years of published papers, begging for historical and scientific follow-up."[7] We follow this lead and discuss a selection of some of the most pertinent articles and speeches from the published *Proceedings* between the years 1863-1879, the period during which there was frequent discussion of Darwin or ideas relevant to the theory of evolution and the origin of species.[8] These tended to be written by some of the earliest members of the Nova Scotian Institute of Natural Science who were supportive of the missions of natural theology and inventory science, many of whom could best be described as gentleman and amateur natural historians. In the years following (from the 1880s on) the published items reflect the



PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science

OF

HALIFAX, NOVA SCOTIA.

VOL. III. 1873-74. PART IV.

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ENGLAND—REEVES & TURNER, 196 STRAND, LONDON.

UNITED STATES—THE NATURALIST AGENCY, SALEM, MASS.

1874.

Price, Five Shillings.

Figure 2. *Proceedings and Transactions of the Nova Scotian Institute of Natural Science, 3 (1873-1874).*

increasing activity of individuals trained in the experimental techniques and theories of the current physical sciences, men who were employed as professors to teach these developments in the province's several universities, but who were also engaged in theoretical and experimental research and concerned with publishing their results to the scientific community outside of the province. James Gordon MacGregor (1852-1913), an experimental physicist trained in Edinburgh, Leipzig, and London and professor of physics at Dalhousie College from 1879 to 1901, signaled this change; as did the renaming of the organization to the Nova Scotian Institute of Science under MacGregor's presidency in 1890, a change resisted by several of the older members.[9] While there is evidence of an increasing acceptance of the use of hypothesis in scientific practice among the institution's members, there was also a distinct decline in the discussion of Darwinism and its implications for religion and 'man's place in nature.' Why this occurred is unclear. Perhaps these topics came to be considered too philosophical or theological—too much concerned with what Pickstone called 'world-reading'—and so insufficiently professional, technical, or properly 'scientific' by the standards of a new class of university-based specialists working in a different kind of reward system in which publication acquired a new significance. These individuals were eager to shed the organization's reputation as an amateur natural history society so that publication in its official organ would be regarded with greater credibility within a non-local community of professional scientific researchers.[10] Or perhaps due to the call of duties or opportunities elsewhere, those few individuals most interested in discussing these more general topics were lured away from the province, making further contribution to the *Transactions* for them unviable. Alternatively, it may be that by the end of the century many people had found a way to reconcile the idea of evolution with their religious faith, so that the topic was no longer worthy of comment.[11] Of course, some combination of all three may have been at work.

Papers in the Proceedings and Transactions of the Nova Scotian Institute of Natural Science

The Nova Scotian Institute of Natural Science (NSINS) was founded in 1862.[12] Its original membership consisted of 51 regular, 4 associate, and 2 corresponding members. Most were amateur enthusiasts, with a handful of mining engineers, military men, physicians, and two professional 'scientists': Henry How, Professor of Chemistry and Natural History at King's College (then in Windsor, Nova Scotia), and George Lawson, Professor of Chemistry and Mineralogy at Dalhousie College in Halifax.[13] The colony's most famous home-grown scientist, the geologist and paleontologist, Sir John William Dawson (1820-1899), had left Nova Scotia for Montreal in 1855, prior to the founding of the NSINS, to become principal of McGill College, and was never a member.[14] Dawson's influence over the organization, nevertheless, could be felt from afar, as we discuss below.

While the NSINS held regular meetings and, starting in 1867, published regular proceedings and transactions, it struggled to grow its membership significantly or to expand its list of contributing lecturers and authors beyond a relatively small subset of regulars.[15] Its focus throughout its early period from 1863 to 1880 was the main topics of natural history, geology (especially as related to coal, gold, and other commercially important minerals), botany, zoology (of fish and other marine organisms especially), meteorology, in addition to the occasional piece dealing with the ethnography of the local indigenous Mi'kmaq people, and curiosities of animal behaviour and anatomy.[16]

In the period from 1863-1879 there were also a number of items notable for their discussion of the theory of evolution, the age of the earth and of humanity, the implications for traditional religious accounts of human origins, and of the legitimacy of Darwin's and his compatriots' reliance upon hypothesis in arriving at their conclusions. After 1879, however, discussions of such broad philosophical nature are absent, replaced by technical reports dealing with specialized topics in experimental physics and chemistry by the likes of MacGregor and other professional scientists who had found wider employment within the province's universities.[17]

We now discuss several of these articles and Presidential Addresses published in the *Proceedings and Transactions of the NSINS* in the period from 1863-1879 that illustrate reactions to Darwin's ideas as well as the authors' opinions about proper scientific method or 'ways of knowing.'

P.C. Hill's "Inaugural Address" (delivered 1863; published 1867)[18]

In 1863 the lawyer and politician Philip Carteret Hill (1821-1894) gave his Inaugural Speech as the first president of the NSINS, in which he made clear that, at least in his estimation, the Institute's purpose was to conduct natural history in the service of natural theology.[19]

Hill opened by noting that the progress of science requires communication, "every laborer in the field casting his contribution into a common receptacle whence all can freely draw"[20], thus evoking Bacon's trope of the ant as symbolic of science as a mere aggregative stock-piling of facts (whereas the bee, in contrast, collects and processes its raw material to produce a sweeter and more valuable product). Hill stressed the importance of "facts verified *in situ*"[21], since all and any facts secured by the workers in Natural History cannot help but be relevant for the pressing question whether species have been separately and distinctly "created" in local centres or originally in one centre in Central Asia from whence they have emanated after the "deluge". In that regard "our own country presents in many aspects a new and untrodden field for research."[22]

Of greater interest are his remarks on the proper attitude and reward for engaging in the study of natural history. "The love of knowledge itself…," he said "must be the great motive animating all our efforts. And rightly viewed, what higher incentive could be presented to any intelligent mind? The works of nature are but the manifestations and exponents of the Creator's skill."[23] Touching again on the question of species he reminded his audience that:

> To have lifted the veil from some portions of this wonderful order and design; to have learned something of the true system in which the Creator has arranged His works, form the glories of modern science. Classification, which simply, in one word, embodies this idea, is now the great object of attention; thus, the orders into which the animal kingdom is divided are based on the essential and immutable diversities which modern research has revealed, and the transfers which sometimes take place of species, or even a genus, from one place to another, in the general system, are merely the result of a further insight obtained by pains-taking laborers into this universal plan of creation.[24]

And "he who, in earnest sincerity of purpose, devotes his attention to any one branch, however special and circumscribed it may appear, cannot fail to see new and hitherto unknown evidences of the skill and wisdom of the Great Architect, the contemplation of which will not only confer on himself the most exalted pleasure, but will add to the general stock of human knowledge." Hill concluded his talk by holding up Dawson, Darwin's staunch critic, as a model: "The object of this Institution," he said, "is to stimulate the effort to follow so bright an example."[25]

Thomas Belt "Recent movements of earth's surface" (delivered 1863)

Belt (1832-1878) was a geologist born in Newcastle upon Tyne, who moved to Nova Scotia sometime around 1862-63 as superintendent of the Nova Scotian Gold Company's mines. He stayed for a couple of years before moving on to Nicaragua.[26] One of the founding members of the Institute, he read a paper on February 1, 1863 titled "Recent movements of the earth's surface."

In his talk Belt mentioned "the celebrated naturalist, Darwin" on the formation of coral reefs and atolls, and also Lyell on the uniformitarian theory in geology and the implications for the great age of the earth, which would need to be measured in "millions of years" rather than the thousands favoured by more traditional catastrophist and biblical accounts. Noting that some were concerned the new science would "tend to sap the foundations of religion,"[27] Belt concluded with a parable of an island whose inhabitants erected wooden bulwarks to buttress its shores against the erosive actions of the waves and winds, only to discover that, after a particularly severe storm swept all the artificial constructs away, the island was revealed to rest on a bed of solid granite. "And is it not so with religion?" Belt asked, "have we not reared bulwarks and buttresses, which we, puny mortals, think are necessary for its support? The sea of knowledge ever spreading, sweeps them away, but exposes the eternal rock of truth on which religion is built."[28] But while Belt believed science and religion could be reconciled, not all members of the Institute believed this was possible on the question of the earth's age, as we will see presently.

George Lawson "On the flora of Canada" (delivered March 7, 1864) and "Notice of the occurrence of Heather (Calluna vulgaris) at St. Ann's Bay, Cape Breton Island" (delivered Dec. 5, 1864)

Lawson (1827-1895) was a Scottish botanist educated at the University of Edinburgh and the University of Giessen, Germany where he attained a D.

Phil. He was Professor of chemistry and natural history at Queens College in Kingston, Upper Canada from 1858 until 1863, when he moved to Halifax where he spent the rest of his life teaching at Dalhousie College. Lawson was sympathetic to Joseph Dalton Hooker's theory of plant species distribution and variation by gradual spread under naturally occurring climatic changes, a uniformitarian view in the fashion of Lyell and Darwin. The article attributed to Lawson on the distribution of Canadian Flora (i.e. upper and lower Canada) would appear to be a report written by someone in attendance of a talk Lawson gave in 1864.[29] Lawson is said to have discussed the views of Hooker, Lyell, Dawson, and Darwin in application to the question of the distribution of plant species in North America, and most notably, that he had found Darwin's theory of the origin of species "insufficient to meet the wants of the case."[30] Later that same year Lawson gave another talk concerning the discovery of a patch of heather on Cape Breton Island. This was "a matter of great interest in a strictly scientific point of view," he explained, "for it has important bearings on the questions of distribution, age and origin of species."[31] Lawson chose to believe that this and other disjointed patches of heather were remnants of more robust populations that had slowly worked their way from the far north down the east coast of North America in advance of periods of glaciation, in opposition to those who suggested the plant had been introduced into the new world by Scottish immigrants.[32]

William Gossip "Enquiry into the antiquity of man" (1865)

William Gossip (born 1809 in Plymouth, England, died 1889 in Halifax), moved to Nova Scotia with his parents in the early 1820s and became a prominent publisher, bookseller and journalist in Halifax. A member of the NSINS since 1863, Gossip was the first editor of its *Proceedings and Transactions* and its president from 1878-1880. An Anglican and a conservative with an interest in anthropology and geology, he contributed several papers including two anniversary addresses (1876, 1879), about which more below. On March 6, 1865 he delivered what was essentially a critical response to Sir Charles Lyell's 1863 book *Geological Evidences of the Antiquity of Man* in which Lyell came out in support of a much greater age for the human species, the existence of recurrent ice ages, and, albeit less enthusiastically, Darwin's theory of descent by means of natural selection. Gossip set out to salvage the Biblical account of creation and the chronology of human history from such attempts to push back the antiquity of man far into pre-historical time. Lyell's book, he objected, was skewed by "bias" and "speculation" calculated to invoke scepticism about the "truth of the sacred record."[33] We quote at length one key passage:

> One great cause of scepticism is the readiness with which mankind yield their belief to theories put forth with show of reason, by those whom they regard as superior intelligences, and in whom they repose implicit confidence. Let a man do some great thing which will bear the test of enquiry in every possible shape, and become famous thereby, and he may afterwards commit a thousand vagaries, and find multitudes to

> uphold him. A Lyell, a Darwin, or a Huxley, may go a long way in the path of human knowledge, make important discoveries, and satisfy the world that all they do is right and just and proper—and that therefore their theories, equally with their facts, may be received with faith equal to that which should follow plain demonstration. But there is no reason why we should respect their speculations as we do their truths, seeing that, although in their own hands, they lead to nothing, and are nothing. Such an impotent conclusion has met Lyell… Such also has met Darwin, who has let go his belief in creation, and adopts variation of species instead; and such also meets Huxley, who traces back organized being to molecules…We must, therefore, be careful while giving due credit for the truths that such men teach, not to be led away by speculation which is not truth, and to which the test of truth cannot be applied in any satisfactory results.[34]

Gossip concluded with a reminder to his audience to keep their priorities in proper perspective, stating that "the exploration of the earth for the past history of man is of little consequence as it concerns his present happiness, to say nothing of the future, while it only tends to perplex his ideas and unsettle his reason."[35]

In 1873 Gossip also published in the *Transactions* a lecture on "The affinity of races."[36] In what was most likely a response to Louis Agassiz's polygenist division of the various races of humankind into separate species, Gossip appealed to evidence of ethnological and linguistic similarities between the Caribs of the West Indies and the peoples of the biblical lands to argue for the unity of all humans. Gossip also offered the speculative hypothesis that the lost continent of Atlantis—situated midway in the Atlantic Ocean between the Western and Eastern hemispheres—might have been the location of the original garden of Eden, and from whence all the diverse races of humankind spread out to conquer the globe.

Thomas Frederic Knight "Natural History and its place in the sciences" (1869)

Knight (1828-1902) is listed in the *Proceedings* as having joined the NSINS on January 7, 1867, with "Receiver General's House, Halifax" given as his address. He wrote several important reports on the fish and fisheries of Atlantic Canada.[37]

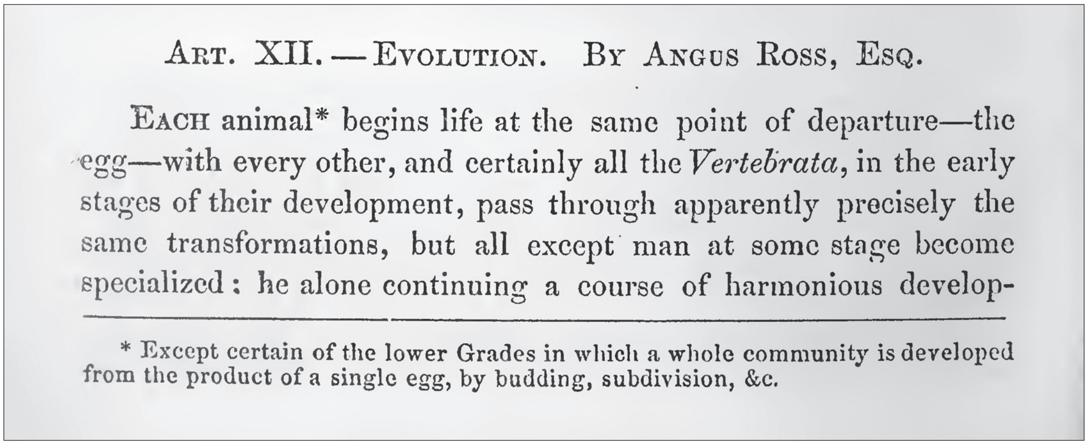
Knight's paper on the historical development of Natural History into a proper science is the most methodological of the papers discussed here, and it treats most closely the subject of different "ways of knowing" (though without using those terms). At the center of his discussion is the antagonism between the Artificial and Natural methods of classification and the role of 'the inductive philosophy' in the creation of a truly scientific arrangement of organic and inorganic bodies.[38] The ancients, according to Knight, failed to apply the 'process of induction or experiment' in their attempts to provide adequate terminology and to systematize nature. Linnaeus, "the greatest naturalist…of any age,"[39] he credits with inventing the Artificial method in classification, as Cuvier expounded the Natural method. "The Artificial method is allowed to be Natural as to the narrowest members of the system, viz. – species and genera; but it is called artificial as respects the wider groups."[40] A natural method he explains, "is an attempt to provide positive and distinct characters for the *wider* as well for the natural groups" whereas an artificial system is "intended for ready identification of allied genera, but obscures close relations or affinities beyond genera."[41] Cuvier's natural system (consisting of the four great divisions: vertebrata, mollusca, articulata, radiata) was based on internal characters rather than external ones alone, and Knight claims as "a signal proof of the excellence of natural arrangement that being founded on internal structure it must be permanent."[42]

In consideration of the rationale of classification, Knight takes "a thoroughly philosophical standpoint,"[43] which leads him to identify three grand instruments or *organa* by which the human mind arranges sensory observations or phenomena in its pursuit of knowledge and truth. These are: Language (for the acquisition and communication of ideas), Mathematics (for the determination of number and quantity), and Experiment or induction (composed of the dual operations of analysis and synthesis).[44] While Analysis consists of the observation, comparison, and separation of ideas, Synthesis involves their combination and re-organization. Through the processes of induction general laws are established and true classification begins. Following the lead of Whewell and Herschel, he writes that Natural History achieves the level of a science when it moves beyond the mere cataloguing of facts and begins to discover general laws.[45] The explorer and naturalist Alexander von Humboldt he identifies as the first to employ "wonderful powers of generalization in comprehending the vastness and oneness of nature."[46] Speaking of the positive benefits secured by the study of natural science, Knight noted that it "suggests to the human mind the idea of a great first cause or intelligent artificer of nature; and under this head might be discussed the doctrine of *final causes*." It moreover "enlarges and strengthens the intellect", in addition to the economic utility it provides in the pursuit of art and industry.[47]

Knight concluded by saying that "if we fully comprehend the sphere of natural science, we shall not restrict ourselves to contemplation only of the earth beneath our feet with its wealth of life and wonder and beauty; but *we shall assert the dignity of our origin*, and lift our gaze to the atmosphere that envelopes us, and even penetrate with the aid of its cunning implements the mysterious depths of the illimitable space" [italics added].[48] In this way, without ever explicitly mentioning Darwin and his ground-shaking ideas, Knight counseled his audience of the congruity of the progress of natural science and its particular ways of knowing with what Pickstone called the more ancient hermeneutic activity of "world-reading" and the framework of Natural Theology with which it was so strongly associated.

Angus Ross "Evolution" (1874)

George Angus Ross (1854-1889) was a lawyer and a Liberal member of the provincial parliament from Lunenberg, Nova Scotia who campaigned for the repeal of Nova Scotia's membership in Confederation in 1886. It is striking



ART. XII.—EVOLUTION. BY ANGUS ROSS, ESQ.

EACH animal* begins life at the same point of departure—the egg—with every other, and certainly all the *Vertebrata*, in the early stages of their development, pass through apparently precisely the same transformations, but all except man at some stage become specialized: he alone continuing a course of harmonious develop-

* Except certain of the lower Grades in which a whole community is developed from the product of a single egg, by budding, subdivision, &c.

Figure 3. *Angus Ross, "Evolution," Proceedings and Transactions of the Nova Scotian Institute of Natural Science 3, 4 (1874): 410-435.*

that in an essay specifically titled "Evolution" [**Fig. 3**] Ross could write 25 pages of detailed discussion about the evidence for the evolution of species without once mentioning Darwin.[49] Perhaps by 1874 to have done so would have been unnecessary, so closely associated had the two become. Or perhaps, though he found Darwin's hypothesis of the community of descent of species compelling, he was less convinced of Darwin's explanatory hypothesis of natural selection as its mechanism.[50] Ross summarizes the multiple lines of evidence from within the Animal Kingdom, noting in particular: comparative vertebrate anatomy, embryological homologies, vestigial structures, the fossil record (which he mentions, following Darwin's lead, one would expect to be imperfect and full of gaps), biogeographic distribution patterns of closely related species, the inherent difficulty of drawing firm and clear species boundaries between many real populations of organisms, and evidence for the creation of new species from cross-species hybrids. His discussion of the relationship between single-celled protozoa and the tissue-forming metazoa and the doctrine of recapitulation (i.e. that ontogeny recapitulates phylogeny), strongly suggests that Ross had also been reading the popular accounts of Darwin's German colleague, the militant evolutionist and materialist Ernst Haeckel who wrote extensively on these topics.[51] Yet in contrast to Haeckel's materialism Ross advocates for a version of theistic evolution whereby God has no need to specially create each species but rather allows them to unfold "by the operation of His Laws from a single protoplasmic primordial Type".[52]

One of the most interesting aspects of Ross's article is his critical response to the Harvard biologist Louis Agassiz's opposition to the theory of evolution and his defense of polygenism, the thesis that the various human races are of independent origin and equivalent to separate species. Agassiz, who had studied with Cuvier in Paris and had made his reputation as an authority on fossil fishes and the theory of past ice ages, became an influential source of scientific racism after moving from Europe to the United States in the 1840s. Originally a Biblical monogenist, soon after meeting black people for the first time in the States Agassiz adopted the opinion that the differences between human races were as great as the differences between different species of monkeys or even as great as the differences between the monkeys and humans.[53] What he called "The appalling feature of the subject [of Darwin's theory of the community of descent]" was this: that if one accepts that all races of human have a common origin, then one must accept also that all species of monkey likewise have a common origin and so too humans and monkeys.[54] Since we cannot accept that monkeys and humans have a common origin, Agassiz reasoned, we cannot accept that the different races of humankind have a common origin. To this Ross responded:

> Now, I need not say that a disbelief of the original unity of Man is irreconcilable with Christianity, so that if as Agassiz affirms, a common origin for the races of Mankind necessarily implies a common origin for the various species of each Genera of Monkeys, and for each of these Genera and Man, then, from a theological point of view, we would be driven to accept the view which assigns a common origin to Man and Monkeys, and if to these then to all Vertebrates, and ultimately to all organic Types.[55]

A clearer example of the adage that one person's *modus tollens* is another's *modus ponens* could not be wished for. It is worth noting how Ross here appeals to the "way of knowing" Pickstone called "world reading" to challenge Agassiz's own bit of hermeneutics. But like Thomas Knight (see above) Ross insisted on the compatibility of natural science and Christianity and concluded with the words: "I have thus endeavoured, in intervals snatched from professional study and daily avocations, to sketch in outline this great subject, in undoubting faith that fidelity to truth is the only true fidelity to Religion and to God."[56] But as our next writer illustrates, not all contributors to the *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* were so insistent on reconciling faith and science.

Andrew Dewar "Spontaneous generation, or predestinated generation" (1875)

Andrew Dewar (1846-1932) was a Scottish-born architect who came to Halifax in 1869 and spent just over 12 years in the Atlantic provinces before returning to Edinburgh in 1881 and finally settling in 1903 in Johannesburg, South Africa. Dewar was evidently less of a natural historian following a cautious Baconian empirical method than an enthusiastic amateur philosopher intent on drawing the most wide-ranging universal principles with which to create a cosmic system. In short, Dewar advocated for a deistic version of ancient Greek atomism updated with modern ideas of evolution and his own speculations about magnetism as the ultimate physical force driving the entire cosmos. In this respect his was just one of many such projects popular in the nineteenth century, one of the best known perhaps being Herbert Spencer's 'Synthetic Philosophy.'[57] But where Spencer proposed that the entire universe was being driven ever onward to more progressive and complicated evolution as a result of the law of the conservation of energy, Dewar believed that the motive force could be traced to his hypothesis that each atom is a magnet with a dipole force of attraction and repulsion. Dewar referred to this as his 'ato-magnetic theory of life'.

Dewar's first publication in the *Transactions* of the NSINS was based on a talk he gave on April 12, 1875 on the topic of spontaneous generation of life. Dewar began with a concession to his audience that the topic was a "dangerous" one, but "knowing well that we are addressing a Scientific Society who look at and discuss the subjects brought before them from no other than a scientific point of view" he begged their indulgence for a short time.[58] Dewar also admitted that he had no new experimental evidence to offer on the question whether living organisms are always produced from the seeds or eggs of previously existing organisms or whether life can spring forth from inorganic matter; but, in any case, he remarked "no one would put faith in experiments performed in such a benighted country as Nova Scotia."[59]

Dewar announced his belief in the evolution theory, i.e. that new species of life have emerged from previous organic forms, but faulted Darwin and his colleagues (he mentions Tyndall and Huxley) for providing no account of the very first form of life. His own solution, which he preferred to call "predestinated generation" over "spontaneous generation", proposed that life was created not just once but continually as the pre-ordained result of a law "implanted in matter in the beginning."[60] To motivate acceptance of the spontaneous generation of life from inorganic matter Dewar offered that what we typically regard as dead or inert matter is not really entirely lifeless, if we recognize that all matter is constantly in motion as a result of physical laws such as magnetism. If we are willing to regard magnetism as a 'lower' form of life, he suggested, then we can begin to recognize analogies between supposedly inorganic matter and living organisms. For instance, every magnet possesses attractive and repulsive polarity, just as plants and animals typically display anterior-posterior polarity (branches-roots; head-tail). Plants and animals also grow outward from a central point in the seed or egg in analogy with a magnet. Cutting a zoophyte into pieces, as the Swiss naturalist Abraham Trembley (1710-1784) did with fresh water polyps (hydra), produces two smaller organisms each with two poles, in further analogy with the division of a magnet resulting in two smaller magnets each with its own positive and negative poles.

Dewar reasoned further—using the hypothetical method—that if each magnet divided results in a smaller magnet, then by extension each atom is itself a magnet with attractive and repulsive poles. "If we can prove," Dewar said, "that the life which forms crystals and rocks and moves the compass needle, is the same as that which grows trees and moves our bodies, then we may consider our premises proved, for as all organic beings are composed of so-called inorganic matter, and if the same life pervades both, what should prevent the life force from gathering several inorganic atoms, and growing them into an organic animal?"[61] This was a big 'if' indeed, but Dewar's proposal was essentially that of earlier philosophers and naturalists who had been struck by the analogy between the 'growth' of crystals and the development of organic beings.[62] As for the properties of mind, a feature exclusively enjoyed by 'man', Dewar conceded that only the "special interposition" of the Deity could be responsible for such an extraordinary faculty. But aside from this one act of special creation Dewar insisted that the hypothesis of predestinated generation was preferable to the supposition of many such acts, for "A God which endowed matter from the beginning with new properties which enabled it when in a certain condition to form new life, is certainly greater than one who had to interpose in every new creation."[63]

Despite this attempt to reassure his audience of the moral rectitude of his proposal, a report on the minutes of the Institute recorded that, "This paper elicited considerable discussion, and a majority of those presented expressed themselves as opposed to the theory advanced; but the Publishing Committee, not wishing to constitute themselves rigid judges, have decided upon giving it a place in the *Transactions*, leaving it open to the public for scientific criticism."[64] It is also mentioned in William Gossip's Anniversary Address of 1876 that Dewar's paper received critical attention in an unnamed Halifax "periodical".[65]

Regardless, the Institute displayed its open-minded and 'scientific' attitude by continuing to permit Dewar to present several more talks over the next few years. According to the *Proceedings of the NSINS*, at an ordinary meeting on February 14, 1876, Dewar read a paper "On the Atomic philosophy—its past and present," and at an ordinary meeting on December 11, 1876, a paper entitled "A New Theory of the Descent of Man," after which a discussion is said to have taken place in which the President J. B. Gilpin, Dr. Reid, Dr. Sommers, the Honourable L.G. Power, and Dr. J.G. McGregor, took part.[66] Neither of these talks were published in the *Proceedings*; however, they likely included ideas Dewar published two years earlier in a book with his co-author, Thomas Roderick Fraser, M.D. titled *The Origin of Creation, or The Science of Matter and Force. A New System of Natural Philosophy*.[67] Dewar did publish in the *Proceedings* a second account of his atom-magnetism speculations in "Magnetism, the life of the world"[68] but it included little new worth mentioning here.

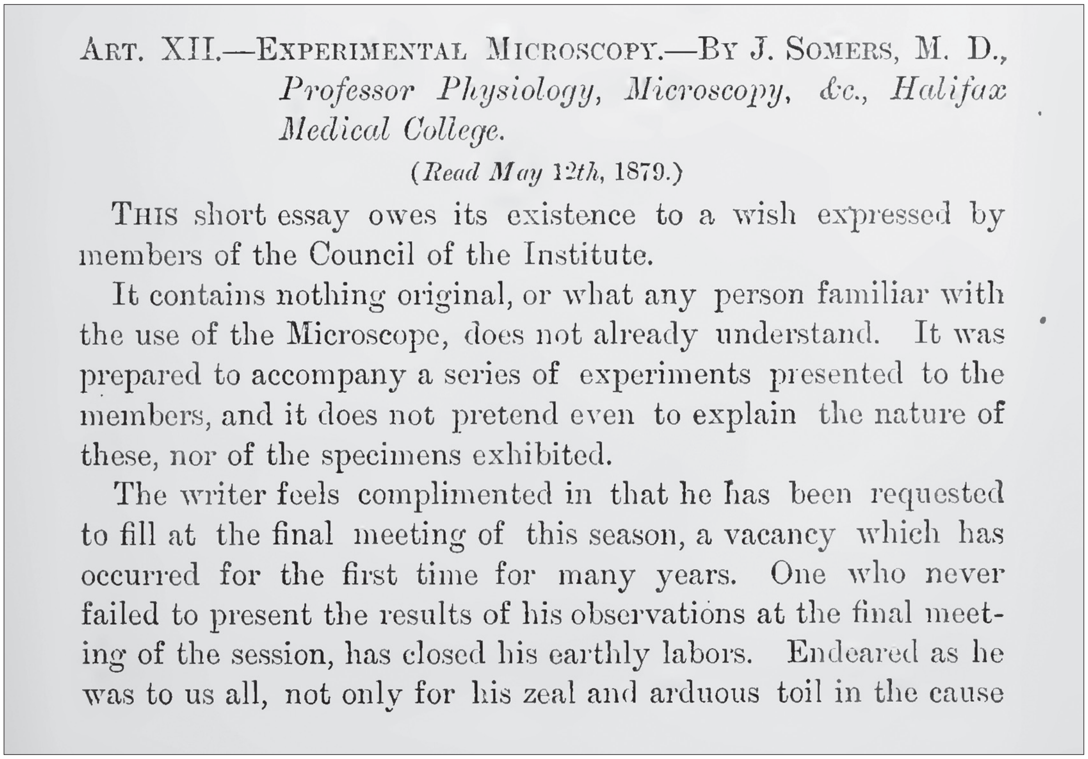
Surprisingly, given the scathing criticism Dewar's speculations received from the scientific community elsewhere, the NSINS proved more sympathetic. For instance, none other than William Gossip in his presidential Anniversary Address of 1879 made favourable remarks about Fraser and Dewar's "atomagnetic theory", referring to their "plausible theory of the magnetic polarity of atoms."[69] Their ideas about atoms he thought had been given some validity by Norman Lockyer's experiments in stellar and solar spectroscopy to arrive at the conclusion that hydrogen is the fundamental element. Gossip spoke approvingly of Lockyer's employment of what is now called the hypothetico-deductive method, wherein "[Lockyer] has started an hypothesis, and justified it by experiment."[70] Gossip also mentioned Sir George John Allman's 1879 British Association for the Advancement of Science (BAAS) lecture on protoplasm as the material basis of life; but here he *was* critical of the protoplasmic theory of spontaneous origins of life,[71] citing the failure of scientists to create a living cell or protoplasm in the lab, "a reason for which I think is satisfactorily given in the Book of Genesis, chap.3, v. 22 to 24."[72] Gossip was here referring to the story of the expulsion from Eden, which he believed foretold of safeguarding "the Tree of Life" (the purported source of life or souls) and the immortality of the soul. Gossip believed that while science has required many changes in empirical beliefs it has placed revealed religion "upon a surer basis,"[73] and that "Science and religion ought to dwell in perfect harmony. True science can do no more than accommodate each to each by the operation of the laws of eternal truth."[74]

Gossip concluded his address on a frustrated note, however, lamenting that the Institute had failed to inspire much interest in science among the broader public: "we must, I suppose, rest content with being the pioneers of science in Nova Scotia, and leave it to future generations to enter into and profit by our gratuitous and disinterested labors."[75]

John Somers "Experimental microscopy" (1879)

Just slightly earlier that year, on May 12 (Gossip's Anniversary Address occurred in October), the physician John Somers (examiner in physiology and histology in the Dalhousie College of Medicine and twice NSINS president 1880-1883 and 1885-1888) gave a talk before the NSINS on the significance of microscopy for several topics of debate in the life sciences [**Fig. 4**]. Somers mentioned how the microscope had opened up the world of the 'infusoriae', the unicellular microbes that proved so difficult to assign to either the animal or vegetable kingdoms. "Here," he wrote, "we find the battle ground where Vitalist, Evolutionist and Panspermatist can wage intellectual warfare."[76] The microscope, he explained had been vital to "exploding false ideas and crude theories" such as the spontaneous generation of living organisms from non-living matter. When Somers writes of Athanasius Kircher (1601-1680) that, "If one of the ablest men of his time, which Kercher [sic] undoubtedly was, will to us appear at a disadvantage, because he too readily accepted a false theory, how careful we should be lest our successors a century or so hence may be in a position to subject our theories and experiments to the criticism of ridicule", one can only wonder whether he is making an oblique reference to the theory of evolution.[77]

These 1879 contributions by Somers and Gossip appear to be the last time topics of such a broad nature were discussed in the *Transactions* in that century. Why then this cessation of discussion about Darwin and evolution? One possibility is that the institute's leadership made a decision to focus publication on more strictly scientific topics and to leave discussion of more religious and philosophical topics for other venues.[78] Alternatively, as Jerry Pittman has documented, by the late 1870s and early 1880s newspapers produced by religious groups in the province "began to inform readers that evolution could be reconciled favorably with Christianity,"[79] which could help explain why



ART. XII.—EXPERIMENTAL MICROSCOPY.—BY J. SOMERS, M. D., *Professor Physiology, Microscopy, &c., Halifax Medical College.*

(*Read May 12th*, 1879.)

THIS short essay owes its existence to a wish expressed by members of the Council of the Institute.

It contains nothing original, or what any person familiar with the use of the Microscope, does not already understand. It was prepared to accompany a series of experiments presented to the members, and it does not pretend even to explain the nature of these, nor of the specimens exhibited.

The writer feels complimented in that he has been requested to fill at the final meeting of this season, a vacancy which has occurred for the first time for many years. One who never failed to present the results of his observations at the final meeting of the session, has closed his earthly labors. Endeared as he was to us all, not only for his zeal and arduous toil in the cause

Figure 4. *John Somers, "Experimental microscopy," Proceedings and Transactions of the Nova Scotian Institute of Natural Science 5, 1 (1879): 81-87.*

discussion of Darwinism and evolution in the *Transactions* of the NSINS ceased. Yet another possibility arises from noting that the *Transactions* had always drawn on a small pool of contributors to begin with, and the number showing an interest in these particular topics was fewer still. Of those we have discussed, Thomas Belt moved away sometime in the mid 1860s as did Andrew Dewar in 1881. Hill, Knight, and Ross each contributed no more than one, two, and three articles respectively. That leaves Somers (who contributed 14, almost all dealing with mosses or other botanical topics), Lawson (with 18), and Gossip (10 in total). But why none of these men said anything more on the topic of evolution or Darwinism in this venue remains unclear.

The Mechanics Institutes

Another site of interest for gauging how these kinds of debates played out is the local Mechanics Institutes, which were created with the mission of educating the public (working class) about developments in science, culture, history, and philosophy.[80] Due to considerations of space we conclude here with only a brief discussion of one such example.

Second only to the founding of a Mechanics Institute in Halifax in 1831, the port town of Sydney, Nova Scotia, situated on the north-eastern coast of Cape Breton Island, established a Mechanics Institute in 1847.[81] In his diary, the Clerk and High Sheriff of Sydney, John L. Hill recorded the events of a lecture of the Mechanics Institute held on February 26, 1872. Hill wrote in his diary:

> Mr. R. Martin lectured on The Mind. Self opened the discussion. Rev. Mr. Chipman spoke. Murray Dodd. Mr. Pipes [later Premier of Nova Scotia] (with much truth and sound argument. Mr. Wiley and Mr. Grant. Dodd thought Bible & Geology differed and seemed disposed in favour of Geology. Pipes thought Geology & Bible will agree. Better that the apparent differences would end by & by—instanced Galileo & Copernicus. Self denied progress in development. Monkey Ape Gibbon or Gorilla never could become man—human species sixteen teeth upper and lower jaw. Wolf can never be a dog. Horse never become an ass. Dodd instanced Chrysalis becoming Butterfly. Tadpole becoming frog as instances of Progressive development—poor examples—an egg producing a hen would be as good, unless it were a Goose's.[82]

Hill evokes what were at the time common objections to the evolution hypothesis, but it is notable that his reasons for skepticism are not theological but empirically grounded, citing a lack of evidence for the emergence of a new species from one previously existing. Dodd, on the other hand appeals to analogies of development in butterflies and tadpoles, as Darwin and many other defenders of the 'development hypothesis' did. In doing so they displayed greater willingness to employ a hypothetical mode of reasoning beyond directly observable phenomena, so long as the hypothesis in question provided a reasonable explanation of the phenomena and helped to provide what Whewell had called a 'consilience of inductions.'

Conclusion

As Darwin recognized in the mid-19th century, progress in science requires a willingness to move beyond cautious observation and cataloguing of facts as promoted by the adherents of a strict Baconian inductivist methodology. Natural history was supplemented by the experimental and hypothetical methods of the modern physical and life sciences, which were largely taken up by the later generation of research scientists who were employed in academic institutions like Dalhousie University. This change in attitude and procedure is reflected in the later issues of the *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* from the 1880s on.[83] Professional scientists trained in the most recent experimental ways of knowing and theories increasingly came to replace amateur naturalists as the primary authorities on topics about the natural world, if not about their ultimate significance and meaning for humanity's place in the universe.

Those who were devoted to the study of natural history in Nova Scotia and other colonies of British North America (from 1867 on the Dominion of Canada) worked under the perceived mission of inventorying its natural resources and recording useful facts about the local flora, fauna, geology, and meteorology. By and large those who published in the *Proceedings and Transactions* initially displayed a humble and even self-denigrating attitude. Its earliest members for the most part understood their mission to be restricted to carefully cataloguing and describing the local facts of natural history *in situ*, and that the tasks of systematic classification and interpretation were to be left to the leaders of science in the metropole (London and Edinburgh). But this division of intellectual labour did not mean that the scientific upper class was beyond criticism if they were perceived to stray from what was considered proper Baconian inductive method, and their hypotheses and speculations threatened to unsettle the bedrock of natural theology on which the traditional Christian readings of the world-order were affixed. Only the boldest and least reliant on local opinion for their livelihood it seems—like the itinerant architect and amateur philosopher Andrew Dewar—dared to openly endorse the anti-establishment religious views of radical figures like T.H. Huxley, John Tyndall, or Ernst Haeckel, and then only after moving elsewhere. As support for the newer methods of science was created in the province's universities, and professionals trained in the techniques of experimental and theoretical science were hired to teach in them, the contents of the *Proceedings and Transactions of the Nova Scotian Institute of Science* came to reflect this new class of members and their efforts to align the society with their own standards of research and publication. This seems also to have contributed to a decline in the sort of philosophical discussion about the implications of Darwinism and evolution that had once been common in its pages. Whether this was the result of a conscious editorial decision, diminished interest, or concern with the topics is unclear.

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Andrew Reynolds is Professor of Philosophy at Cape Breton University. His research is in the history and philosophy of science with special focus on biology and evolution. He is the author of The Third Lens: Metaphor and the Creation of Modern Cell Biology (University of Chicago Press, 2018).

Christie MacNeil was the Digital Archivist at the Beaton Institute, Cape Breton University from 2009-2018, working with archival photographic, sound, and moving image media. She has a BA (Hons) in Fine Arts Cultural Studies (York University), BSc Biology (CBU), and MA in History and Philosophy of Science and Technology (Toronto).

Mitchell Jabalee graduated with a BA (Hons) in History from Cape Breton University in 2018. He graudated from the Master in Library and Information Studies program at Dalhousie University in 2020.

Endtnotes

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6 Ronald L. Numbers and John Stenhouse eds., *Disseminating Darwinism: The Role of Place, Race, Religion, and Gender* (Cambridge: Cambridge University Press, 1999).

7 Suzanne Zeller, "Reflections on Time and Place: The Nova Scotian Institute of Science in its First 150 Years," *Proceedings of the Nova Scotian Institute of Science* 48, 1 (2015), 49.

8 Zeller has briefly discussed two of the authors covered here (Angus Ross and Andrew Dewar), in Suzanne Zeller, "Environment, Culture, and the Reception of Darwin in Canada, 1859-1909," in *Disseminating Darwinism: The Role of Place, Race, Religion, and Gender*, eds. Ronald L. Numbers and John Stenhouse (Cambridge: Cambridge University Press, 1999), 91-122, as well as the botanist George Lawson in Zeller, "George Lawson: Victorian Botany, the Origin of Species and the Case of Nova Scotian Heather" in Paul Bogaard ed., *Profiles of Science and Society in the Maritimes prior to 1914* (Sackville, NB: Acadiensis Press, 1990), 51-62.

9 See Harry Piers, "A Brief Historical Account of the Nova Scotian Institute of Science, and the events leading up to its Formation; with Biographical Sketches of its Deceased Presidents and other Prominent Members," *Proceedings and Transactions of the Nova Scotian Institute of Science* 13, 3(1913): liii-cxii, lxxii. In Zeller's words: "MacGregor showed himself a force of nature who reconfigured the NSIS in his own image of Analytical science as the path to progress in the modern world", Zeller, "Reflections on Time and Place," 12.

10 See Zeller, "Reflections on Time and Place," 13.

11 See Jerry N. Pittman, "Darwinism and Evolution: Three Nova Scotia Religious Newspapers Respond, 1860-1900," *Acadiensis* 22, 2 (1993): 40-60.

12 Zeller, "Reflections on Time and Place," 9.

13 By 'professional scientist' we intend those with scientific training and engaged in scientific activity as their primary means of employment, in contrast to so-called 'amateurs', who may have acquired significant expertise in a scientific topic, but did not rely upon this activity for their profession. On the nuanced nature of the concept of 'professional scientist' during this time see Paul Lucier, "The Professional and the Scientist in Nineteenth-Century America," *Isis* 100, 4 (2009): 699-732.

14 Born in Pictou, Dawson studied at the University of Edinburgh in 1840-1841 and 1847, taught natural history and practical mineralogy at the Pictou Academy (1848) and at Dalhousie College (1850). Dawson escorted Sir Charles Lyell during his visits to Nova Scotia in 1841 and 1852 to the Joggins fossil cliffs. He was elected a fellow of the Geological Society of London in 1854 and the Royal Society of London in 1862 (with sponsorship from Darwin and Lyell), published *Acadian Geology* (1855) and many other books, and was Knighted in 1884. Like his fellow paleontologist at Harvard College Louis Agassiz (1807-1873), Dawson was a vocal opponent of Darwinism in North America, and authored one of the first, and very critical, reviews of the *Origin of Species* in North

America. See John William Dawson, "Review of Darwin on the Origin of Species by means of Natural Selection," *The Canadian Naturalist and Geologist* V, 2 (April 1860): 100-120. For Dawson's early years in Nova Scotia see Susan Sheets-Pyenson "Sir William Dawson: the Nova Scotia Roots of a Geologist's Worldview" in Bogaard ed., *Profiles of Science*, 83-99.

15 Zeller, "Reflections on Time and Place", 32.

16 The by-laws dictated that the Institute was to "undertake the publication of lists of the various natural productions of the province, with such observations as their respective authors may deem necessary," Piers, "A Brief Historical Account of the Nova Scotian Institute of Science," lxiv.

17 Reports on local geology and natural resources (principally coal but other valuable minerals as well) also continued to be common features in the published *Proceedings and Transactions*.

18 The *Proceedings and Transactions* for the years 1863-1866 were first published together in 1867.

19 Hill was mayor of Halifax at the time and it seems attended just this one meeting of the Institute. See Piers, "A Brief Historical Account," lxvi. He was premier of Nova Scotia from 1875-1878. The following assessment of Hill is relevant: "By the late 1850s he had clearly demonstrated the tenets of a conservative creed in an address to the Young Men's Christian Association of Halifax following an extended visit to the United States. Dismissing the uninhibited expectations of young Americans, he told rank-and-file Nova Scotians to imitate the Englishman who, cast in a subordinate role, performed his duties conscientiously and uncomplainingly." J. Murray Beck, "HILL, PHILIP CARTERET," in *Dictionary of Canadian Biography*, vol. 12, (Toronto and Laval: University of Toronto/Université Laval, 2003), accessed April 23 2018, http://www.biographia.ca/en/bio/hill_philip_carteret12E.html.

20 Philip Carteret Hill, "Inaugural Address," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 1, 1 (1867), 1. The first volume of the Proceedings and Transactions (covering the first four years of activity) was published in 1867, as explained in Piers, "A Brief Historical Account," lxviii.

21 Hill, "Inaugural Address," 2.

22 Ibid.

23 Ibid., 2-3.

24 Ibid., 3.

25 Ibid.

26 Belt corresponded with Darwin on the dispersal of seeds by animals, geology, the theory of ice-ages, and climate (see 12 Jan. 1867, "Letter no. 5359," Darwin Correspondence Project). His memoir *The Naturalist in Nicaragua: A narrative of residence at the gold mines of Chontales; journeys in the savannahs and forests; with observations on animals and plants in reference to the theory of evolution of living forms* (London: John Murray, 1874) was praised by Darwin as "the best Nat. Hist. book of travels ever published." See letter to Fritz Müller 1 Jan. 1874, "Letter no. 9223," and to J.D. Hooker 25 March 1874, "Letter no. 9372," Darwin Correspondence Project.

27 Thomas Belt, "Some recent movements of the earth's surface," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 1, 1 (1867), 29.

28 Ibid., 30.

29 Perhaps the proceeding's editor William Gossip (see below).

30 George Lawson, "On the flora of Canada," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 1, 2 (1867), 75.

31 George Lawson, "Notice of the occurrence of Heather (*Calluna vulgaris*) at St. Ann's Bay, Cape Breton Island," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 1, 3 (1867): 31.

32 For a fuller discussion see Zeller, "George Lawson: Victorian Botany."

33 William Gossip, "Enquiry into the antiquity of Man," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 1, 3 (1867): 81.

34 Ibid., 100-101.

35 Ibid., 101.

36 William Gossip, "The affinity of races," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 3, 3 (1873): 288-315.

37 We have been unable to learn much more about his education or occupation.

38 Thomas Frederic Knight, "Natural history, and its place in the sciences," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 2, 3 (1869), 88.

39 Ibid., 91.

40 Ibid.

41 Ibid., 92.

42 Ibid.

43 Ibid.

44 Ibid., 93.

45 Ibid., 97.

46 Ibid., 98.

47 Ibid., 99.

48 Ibid., 100.

49 Angus Ross, "Evolution," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 3, 4 (1874): 410-435.

50 What is distinctly odd is that there appears to be no mention in the *Proceedings and Transactions* of Darwin's explicit application of evolutionary theory to human origins in his 1871 book *The Descent of Man, and Selection in Relation to Sex* (London: John Murray). A North American edition was published by Appleton in New York the same year.

51 By 1874, Haeckel's popular university lectures on evolution (*Natürliche Schöpfungsgeschichte* Berlin: Georg Reimer) were in their third edition and would be translated into English two years later.

52 Ross, "Evolution," 432.

53 Louis Menand, *The Metaphysical Club: A Story of Ideas in America* (New York: Farrar, Straus and Giroux, 2001), 103-106.

54 Ross quotes from an unnamed source which appears to be Agassiz's lecture to the Cooper Institute in New York, February 26, 1867 on "The Monkeys and Native Inhabitants of South America". See *The Round Table* V, (April 6 1867): 213. https://books.google.ca/books?id=8uBQAQAAMAAJ&pg=PA213&lpg=PA213&dq=%22the+monkeys+and+native+inhabitants+of+south+america%22&source=bl&ots=p_xVDqW0_p&sig=Z8iBWlX24yVo9uVg8bN-WA2xMbo&hl=en&sa=X&ved=0ahUKEwiEicPIoKTcAhVSON8KHUZJAR0Q6AEIKTAB#v=onepage&q=%22the%20monkeys%20and%20native%20inhabitants%20of%20south%20america%22&f=false.

55 Ross "Evolution," 434.

56 Ibid.

57 Herbert Spencer, *First Principles* (London: Williams and Norgate, 1862).

58 Andrew Dewar, "Spontaneous generation, or predestinated generation," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 4, 1 (1875): 35.

59 Ibid. One wonders how that assessment was received by his audience.

60 Ibid.

61 Ibid., 38.

62 James E. Strick, *Sparks of Life: Darwinism and the Victorian Debates Over Spontaneous Generation* (Cambridge, MA: Harvard University Press, 2000), 42; Donna Haraway, *Crystals, Fabrics and Fields: Metaphors that Shape Embryos* (Berkeley, CA: North Atlantic Books, 2004).

63 Ibid., 37.

64 *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 5, 1 (1875): 444. It may be relevant to note that 1874 saw one of the lowest submission rates, see Piers, "A Brief Historical Account," lxxi-lxxii.

65 William Gossip, "Anniversary Address," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 4, 2 (1876): 229.

66 *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 4, 3 (1876): 234.

67 The authors self-published a North American edition in Halifax in 1876 with Longmans, Green, Reader, and Dyer of London. To quote the review in *The Chemical News*, Jan. 22 1875 [sic]: "What we have to protest against in this book is not merely the abundance of gross errors, but the total absence of scientific method and of the scientific spirit. Almost every page bears evidence of vague habits of thought, of inaccurate observation, and of hasty generalisation. Of what is required to establish a theory, the authors seem to have but a very dim conception. That such a book should be produced in Britain, and in the latter part of the nineteenth century, is truly humiliating" (39). https://books.google.ca/books?id=v2sfCwFk28AC&pg=PA38&lpg=PA38&dq=tr+fraser+%22the+origin+of+creation%22&source=bl&ots=lVbaFeXXkP&sig=mqgnea_srIz2YOI_gvSC-np-08A&hl=en&sa=X&ved=0ahUKEwjVk-605YXcAhXEtlMKHWVeDao4ChDoAQgxMAA#v=onepage&q=tr%20fraser%20%22the%20origin%20of%20creation%22&f=false. *The Popular Science Review* was no kinder: "It is the most extravagant piece of composition we have almost ever seen written on a scientific subject…by men whose knowledge even of the rudiments of science is absurdly small, or we might better say absolutely *nil*" Vol. 14, p. 80. https://books.google.ca/books?id=h8AWAQAAIAAJ&pg=PA80&lpg=PA80&dq=tr+fraser+%22the+origin+of+creation%22&source=bl&ots=WbYcD9j7K-&sig=duTRvFjiPfYB9wx6MpskwAJutw8&hl=en&sa=X&ved=0ahUKEwipyK715IXcAhVCt1MKHcT8BeUQ6AEIXDAP#v=onepage&q=tr%20fraser%20%22the%20origin%20of%20creation%22&f=false. Given these scathing criticisms of the book in scientific periodicals it must be noted that Dewar's co-author, Thomas Roderick Fraser, is not the celebrated experimental pharmacologist Dr. Thomas *Frederic* Fraser, FRS and professor of medicine at the University of Edinburgh.

68 Andrew Dewar, "Magnetism, the life of the world," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 5, 1 (1879): 58-64.

69 William Gossip, "Anniversary Address," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 5, 1(1879): 101.

70 Ibid., 100.

71 Ibid., 105-106.

72 Ibid., 105.

73 Ibid.

74 Ibid., 106. Dewar continued to publish his ideas on ato-magnetism after leaving Canada for South Africa. In 1898 he published, under the name Andrew Redcote Dewar, the book *From Matter to Man, a new theory of the universe* (London: Chapman & Hall, 1898). By this time he had moved beyond deism to a full-blown atheism, espousing what he called 'the New Materialism.' All nature, living and inanimate, he maintained, followed the blind laws of magnetism and electricity that animate the eternal atoms, the entire cosmos (itself eternal and so without need of a first cause) evolving without plan or providence to greater complexity. Ideas from thinkers such as Haeckel, Huxley, Spencer, and E. Ray Lankester are notable throughout. The book was reviewed in *Nature* by the British chemist and entomologist Raphael Meldola (1849-1915) who concluded: "We do not recommend this work to the serious attention of our readers, but as a study in word-stringing it is not devoid of interest." See Raphael Medola "Review of *From Matter to Man, a new theory of the universe*" *Nature* 62 (1900): 493-494.

75 Gossip, "Anniversary Address," 111.

76 John Somers, "Experimental microscopy," *Proceedings and Transactions of the Nova Scotian Institute of Natural Science* 5, 1 (1879): 83.

77 Somers was a 'traditionalist' on medical issues of disease etiology and treatment. He rejected the germ theory of disease as resting on insufficient evidence. See Colin Howell and Michael Smith, "Orthodox Medicine and the Health Reform Movement in the Maritimes, 1850-1885," *Acadiensis* 18, 2 (1989): 55-72. Somers was also opposed to the name change of the NSINS pushed by MacGregor, see Zeller, "Reflections" 15, n. 10.

78 Verification or refutation of this hypothesis would require inspection of relevant archives of the NSINS or correspondence of MacGregor and others in positions of editorial influence. We unfortunately have not had time to follow this up.

79 Pittman, "Darwinism and Evolution: Three Nova Scotia Religious Newspapers Respond, 1860-1900," 51.

80 C.B. Ferguson, "The Nova Scotian Institute of Science, Early Organization," *Proceedings of the Nova Scotian Institute of Science* 25, 4, (1964): 222-223; Martin Hewitt, "Science, Popular Culture, and the Producer Alliance in Saint John, N.B.," in Bogaard, *Profiles of Science*, 244.

81 Robert Morgan, "Glimpses into the intellectual life of early Cape Bretoners," (Talk, Nova Scotia Librarians meeting in Sydney, NS, Beaton Institute of Cape Breton University, Oct. 5, 1978).

82 John L. Hill Diary, MG 2.2, Beaton Institute, Cape Breton University. Bob Morgan, the historian long associated with Cape Breton University, hinted at the existence of this document when one of us (AR) gave an earlier version of this paper in a talk to a joint meeting of the Cape Breton Naturalists Society and the Old Sydney Society during the Darwin bicentennial and Origin sesquicentennial year in 2009. CM eventually tracked down the document in the Beaton Institute Archives at CBU in the summer of 2017. We are very pleased to express our gratitude to Bob, who passed away in 2011, but whose positive impact continues to be felt on his colleagues and students to come. Bob also mentioned this diary passage in Morgan "Glimpses into the intellectual life". We thank Anna MacNeil for assistance in reading Hill's cursive writing.

83 Zeller, "Environment, Culture, and the Reception of Darwin," and Zeller, "Reflections on Time and Place."

Mayflowers and Sleeping Johnnies: Nature-Study, Local Knowledge, and A. H. MacKay's Phenological Research in Rural Nova Scotia, 1892-1925

Sara Spike

Abstract: *This article explores the social context of a crowd-sourced science experiment to record phenological data in early twentieth-century rural Nova Scotia, run through the provincial school system. It focuses in particular on the interaction between the project administrators and the rural people who participated, bringing non-traditional actors—young rural women and children—to the foreground of the history of science in Canada. These ongoing interactions reveal early twentieth-century efforts to consolidate scientific authority alongside efforts to standardize rural engagements with the natural world. However, participants challenged the project's scientific ideals, asserting the relevance of local, place-based knowledge in rural Nova Scotia.*

Résumé : *Cet article explore le contexte social entourant une expérience unique de science participative au début du XXe siècle et dont l'objectif résidait dans l'enregistrement de données phénologiques dans les régions rurales de la Nouvelle-Écosse. Il porte plus particulièrement sur l'interaction entre les administrateurs du projet et les populations rurales qui y ont participé, amenant ainsi des acteurs non traditionnels – des jeunes femmes et des enfants de zones rurales – à l'avant-plan de l'histoire des sciences au Canada. Ces interactions continues ont révélé les efforts déployés au début du XXe siècle pour consolider l'autorité scientifique parallèlement à ceux visant à normaliser la mobilisation des collectivités rurales par rapport au monde naturel. Toutefois, les participants ont mis en doute les idéaux scientifiques du projet, affirmant la pertinence des connaissances locales et propres aux milieux ruraux de Nouvelle-Écosse.*

Keywords: history of education, nature-study movement, phenology, crowd-sourced science, Nova Scotia

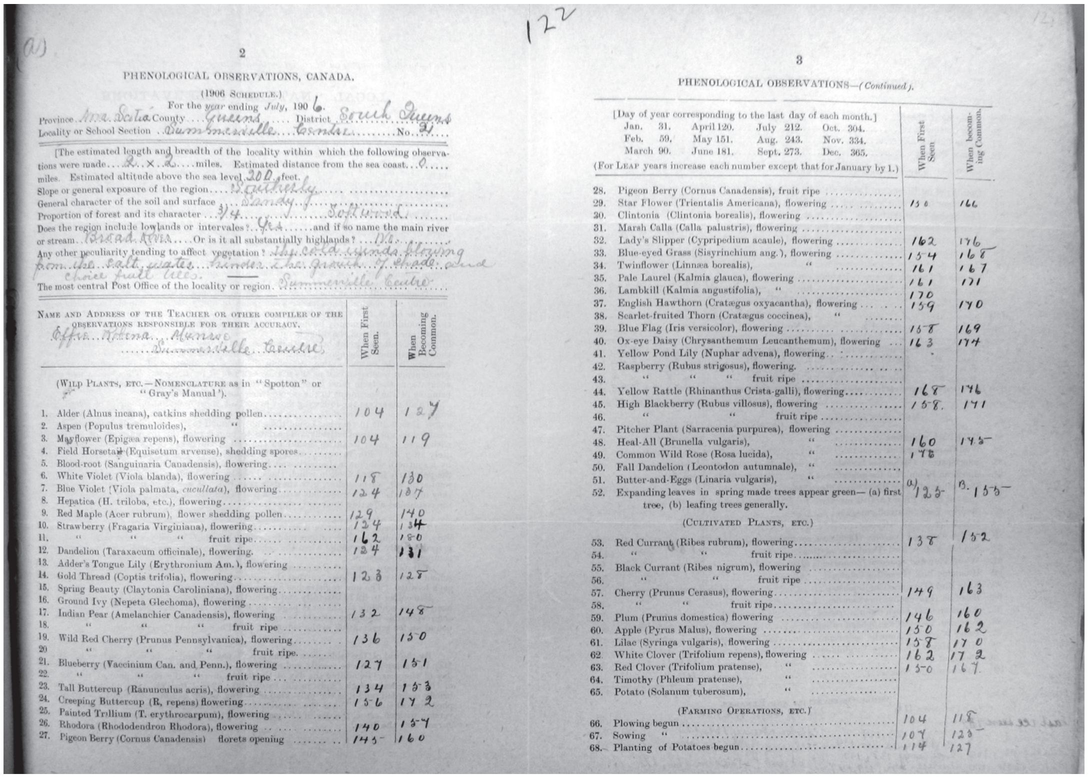
Always a watched-for sign of spring, the annual blooming of mayflowers was regularly reported in newspapers across Nova Scotia in the late nineteenth century [**Fig. 1**, next page]. The province's official floral emblem since 1901 and closely associated with the province long before, these "fragrant little harbingers of Spring" are tiny, sweet-smelling, pink and white forest ephemerals. They grow along the edges of the woods, where the rays of the sun find their earliest purchase in the frozen earth, and often "bloom amid the snow." From late March through early May, local newspapers could report simply that "Mayflowers have made their appearance" to invoke the whole range of emotions and sensory longings that accompanied the changing seasons. As the spring progressed, a walk in the woods might also reveal a number of other early wildflowers—violets, bluets, goldthread—but these plants rarely made the papers.[1]

 Sara Spike, "Mayflowers and Sleeping Johnnies: Nature-Study, Local Knowledge, and A. H. MacKay's Phenological Research in Rural Nova Scotia, 1892-1925," *Scientia Canadensis* 42, 1 (2020): 29-53.

Figure 1. *Mayflowers in bloom. Photo by Sara Spike.*

In 1901, Ella Gaetz and her students in the coastal village of West Petpeswick, Halifax County, found their first mayflowers on March 24, among the earliest in the province that year. In the Acadian community of Meteghan, Digby County, Sister Mary Alexius and her students found mayflowers on April 15. For Christina Baillie's students in Loganville, Pictou County, it was April 20.[2] More than the seasonal observations of their neighbours, these sightings were recorded as part of an ambitious crowd-sourced science project run through the provincial school system. Beginning in the late 1890s and continuing through the first quarter of the twentieth century, teachers and students across rural Nova Scotia recorded thousands of phenological observations in their communities. Phenology charts the timing of seasonal life cycles. In addition to an extensive list of wildflowers, participants noted events such as the first alder catkins shedding pollen and the first frogs peeping in the spring, the first ripe wild strawberries in early summer, the first geese migrating in the fall, the opening and closing of rivers, the planting and harvesting of potatoes, and so on. The project encouraged teachers to record more than one hundred natural and agricultural phenomena.

Phenology was the pet project of Alexander H. MacKay, Nova Scotia's provincial Superintendent of Education from 1891 to 1926, who insisted on its inclusion in the rural school curriculum during his tenure. Teachers were requested to submit detailed schedules at the end of each school year, using elaborate forms printed into their official school registers.[3] [**Fig. 2**] MacKay



PHENOLOGICAL OBSERVATIONS, CANADA.

(1906 SCHEDULE.)

For the year ending July, 1906.

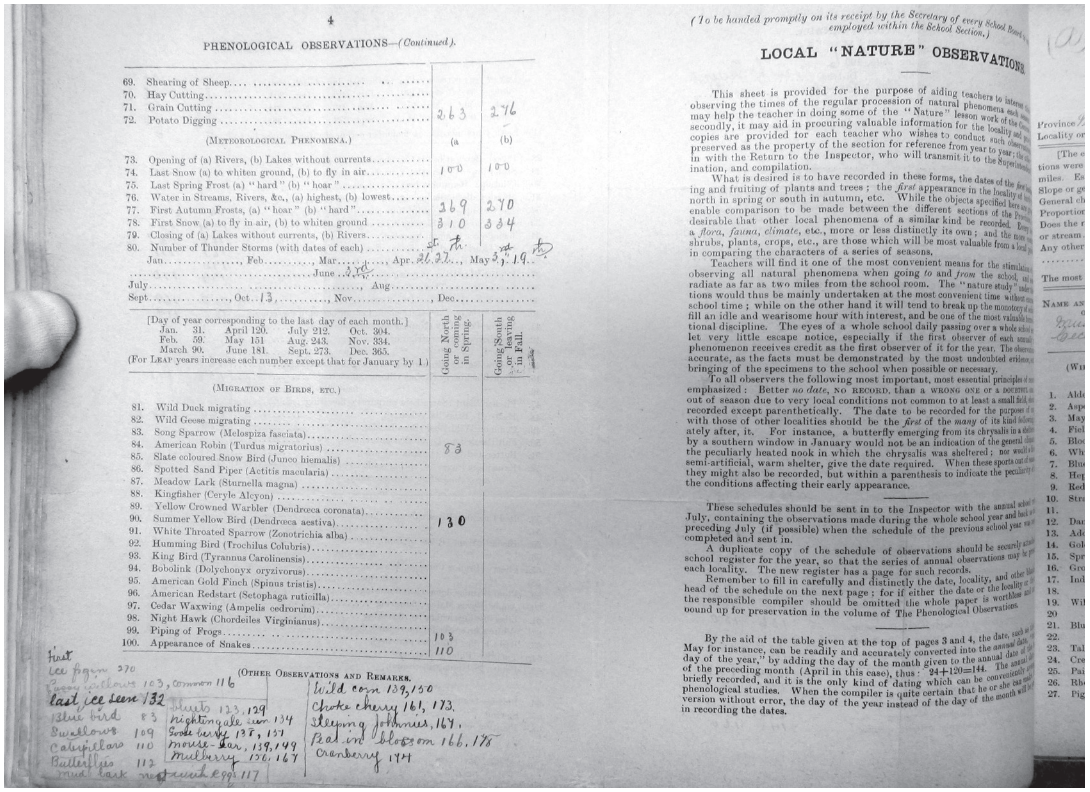
Province Nova Scotia County Queens District South Queens

Locality or School Section Summerville Centre No. 31

	When First Seen.	When Becoming Common.
1. Alder (Alnus incana), catkins shedding pollen	104	127
2. Aspen (Populus tremuloides), "		
3. Mayflower (Epigæa repens), flowering	104	119
4. Field Horsetail (Equisetum arvense), shedding spores		
5. Blood-root (Sanguinaria Canadensis), flowering		
6. White Violet (Viola blanda), flowering	118	130
7. Blue Violet (Viola palmata, cucullata), flowering	124	137
8. Hepatica (H. triloba, etc.), flowering		
9. Red Maple (Acer rubrum), flower shedding pollen	129	140
10. Strawberry (Fragaria Virginiana), flowering	124	134
11. " " " fruit ripe	162	180
12. Dandelion (Taraxacum officinale), flowering	124	131
13. Adder's Tongue Lily (Erythronium Am.), flowering		
14. Gold Thread (Coptis trifolia), flowering	123	128
15. Spring Beauty (Claytonia Caroliniana), flowering		
16. Ground Ivy (Nepeta Glechoma), flowering		
17. Indian Pear (Amelanchier Canadensis), flowering	132	148
18. " " " fruit ripe		
19. Wild Red Cherry (Prunus Pennsylvanica), flowering	136	150
20. " " " fruit ripe		
21. Blueberry (Vaccinium Can. and Penn.), flowering	127	151
22. " " " fruit ripe		
23. Tall Buttercup (Ranunculus acris), flowering	134	153
24. Creeping Buttercup (R. repens) flowering	156	172
25. Painted Trillium (T. erythrocarpum), flowering		
26. Rhodora (Rhododendron Rhodora), flowering	140	157
27. Pigeon Berry (Cornus Canadensis) florets opening	145	160

PHENOLOGICAL OBSERVATIONS—(Continued).

	When First Seen.	When becoming Common.
28. Pigeon Berry (Cornus Canadensis), fruit ripe		
29. Star Flower (Trientalis Americana), flowering	150	166
30. Clintonia (Clintonia borealis), flowering		
31. Marsh Calla (Calla palustris), flowering		
32. Lady's Slipper (Cypripedium acaule), flowering	162	176
33. Blue-eyed Grass (Sisyrinchium ang.), flowering	154	168
34. Twinflower (Linnæa borealis), "	161	167
35. Pale Laurel (Kalmia glauca), flowering	161	171
36. Lambkill (Kalmia angustifolia), "	170	
37. English Hawthorn (Cratægus oxyacantha), flowering	159	170
38. Scarlet-fruited Thorn (Cratægus coccinea), "		
39. Blue Flag (Iris versicolor), flowering	158	169
40. Ox-eye Daisy (Chrysanthemum Leucanthemum), flowering	163	174
41. Yellow Pond Lily (Nuphar advena), flowering		
42. Raspberry (Rubus strigosus), flowering		
43. " " fruit ripe		
44. Yellow Rattle (Rhinanthus Crista-galli), flowering	168	176
45. High Blackberry (Rubus villosus), flowering	158	171
46. " " fruit ripe		
47. Pitcher Plant (Sarracenia purpurea), flowering		
48. Heal-All (Brunella vulgaris), "	160	175
49. Common Wild Rose (Rosa lucida), "	178	
50. Fall Dandelion (Leontodon autumnale), "		
51. Butter-and-Eggs (Linaria vulgaris), "		
52. Expanding leaves in spring made trees appear green—(a) first tree, (b) leafing trees generally.	a) 125	B. 155
53. Red Currant (Ribes rubrum), flowering	138	152
57. Cherry (Prunus Cerasus), flowering	149	163
59. Plum (Prunus domestica) flowering	146	160
60. Apple (Pyrus Malus), flowering	150	162
61. Lilac (Syringa vulgaris), flowering	158	170
62. White Clover (Trifolium repens), flowering	162	172
63. Red Clover (Trifolium pratense), "	150	167
66. Plowing begun	104	118
67. Sowing "	107	120
68. Planting of Potatoes begun	114	127



PHENOLOGICAL OBSERVATIONS—(Continued).

71. Grain Cutting	263	276
74. Last Snow (a) to whiten ground, (b) to fly in air	100	100
77. First Autumn Frosts, (a) "hoar" (b) "hard"	269	270
78. First Snow (a) to fly in air, (b) to whiten ground	310	334
84. American Robin (Turdus migratorius)	83	
90. Summer Yellow Bird (Dendroeca aestiva)	130	
99. Piping of Frogs	103	
100. Appearance of Snakes	110	

LOCAL "NATURE" OBSERVATIONS

Figure 2. *Effie Robena Munroe's completed schedule for the year ending July 1906, Summerville Centre, Queen's County. A. H. MacKay Ledger Collection, Nova Scotia Museum Library, Halifax.*

kept extensive ledgers of the collected data, attempting to produce a scientific picture of the province's natural life cycles. Although phenological reporting was a common hobby of naturalists at the time, MacKay has the unique distinction of having mandated thousands of rural teachers and schoolchildren to feed his statistics. Nothing on a similar scale was implemented anywhere in North America at the time and MacKay's assertion in 1903 that "the Nova Scotian Phenological Observations are the most complete … observations of the kind conducted in any country" appears to have been true.[4]

This article explores the cultural history of MacKay's phenology project in rural communities across Nova Scotia. It introduces and provides historical context for the project and then focuses in particular on the interaction between the project administrators and the rural people who participated, bringing non-traditional actors—young rural women and children—to the foreground of the history of science in Canada. Over the course of a quarter century, thousands of rural teachers and many thousands of their students participated in MacKay's project, often with great enthusiasm. But they did so on their own terms, in ways that consistently defied and challenged MacKay and his colleagues. Participants were regularly chastised for their inappropriate and incomplete submissions. But rather than simply taking at face value the alleged failure of rural participants to adhere to the demands of this elaborate science experiment, a broader interpretation reveals a self-aware, ambivalent community response to the project. Embedded in the provincial education system, MacKay's phenology project was part of a larger reform movement to modernize rural communities. Its ongoing interactions reveal early twentieth-century efforts to consolidate scientific expertise and authority alongside efforts to standardize rural engagements with the natural world. However, in the locally-situated, idiosyncratic nature of their participation, generations of rural teachers pushed back against the narrow purview of the project and made a claim for the legitimacy of their local knowledge.

Lessons from Nature

Across North America and Europe, a variety of nature-study lessons—object-based precursors to elementary school science classes—were integrated into the curricula of rural and urban schools through the late nineteenth and early twentieth centuries.[5] In rural areas, these initiatives coincided with larger education-centred reform movements intended to overcome the "rural problem" of depopulation, specifically of young people leaving agriculture for work and life in urban areas.[6] Nature-study programs were also consistent with the philosophy of the progressive New Education movement, moving away from rote memorization toward a new emphasis on practical skills by training and refining the nascent senses of children through student-centred object lessons.[7] Although in practice it was frequently combined with vocational agricultural training and school gardens, nature-study as an educational philosophy was distinct from either of these. In general, nature-study prioritized children's direct observation of the natural world in a way that encouraged curiosity, imagination, and individual learning. Lessons were to be drawn from the local environment through excursions and the collection of specimens, rather than from books. A 1901 article in the *Nova Scotia Journal of Education* titled "False Nature Lesson Teaching" chastised teachers who gave nature lessons through traditional methods: for instance, "a short essay on the 'potato bug'" written on the blackboard "*for the children to copy and learn to recite parrot fashion on the morrow*." The author insisted, using frequent italics for emphasis, that "*pupils should not be required to memorize notes and facts which they have not, at least, to some extent actually observed or verified for themselves. … Such memorizing is pure cram, injurious instead of being useful. … The lesson must be direct from nature itself*."[8] On the question of where sources for nature-study lessons might be found, another author in the *Journal* advised, "Every hill has its history. Every brook tells a dozen stories. Every plain is a museum of wonders."[9]

A. H. MacKay was an accomplished and respected amateur naturalist who served as president of the Nova Scotian Institute of Science from 1899 to 1902 and communicated regularly with the Royal Society of Canada on a variety of topics. He was also a motivated and influential educator and an early and enthusiastic promoter of nature-study and other aspects of progressive education.[10] In 1887, he was a founding editor of the *Educational Review,* a professional journal for educators in the Maritime provinces, and was the author of the monthly "Ferndale School" series, offering local nature lesson ideas for teachers. MacKay was well connected, serving as president of the Dominion Education Association from 1895 to 1898, and his phenology project received national and international attention. Amid the avalanche of prescriptive literature on nature-study and rural education reform, the project was recommended in pamphlets from the Ontario Agricultural College, the UK Board of Education, and the US Bureau of Education, all of which included modified versions of MacKay's observation schedule for teachers to use in their schools.[11] The emphasis in all these recommendations was on the pedagogical value for children: phenological observations as the basis for hands-on nature-study lessons. It was never suggested that other jurisdictions should follow the lead of MacKay's larger project of collecting and analyzing the data en masse.

In fact, the project did not originate within the education system. It emerged in 1891 when distinguished botanist George Lawson organized a national Botanical Club under the auspices of the Royal Society of Canada and MacKay became its first secretary. Lawson imagined a friendly and informal "band of gleaners" and proposed "the publication of every season's botanical field observations throughout Canada."[12] Efforts to encourage nature observation by non-specialists, particularly college students and science teachers, also had the support of the Nova Scotian Institute of Science.[13] Beginning with observations from 1892, MacKay presented yearly findings of the phenology project to the Institute.[14] In the first year, ten associates across mainland Nova Scotia observed twenty-eight natural phenomena. These were amateur naturalists like

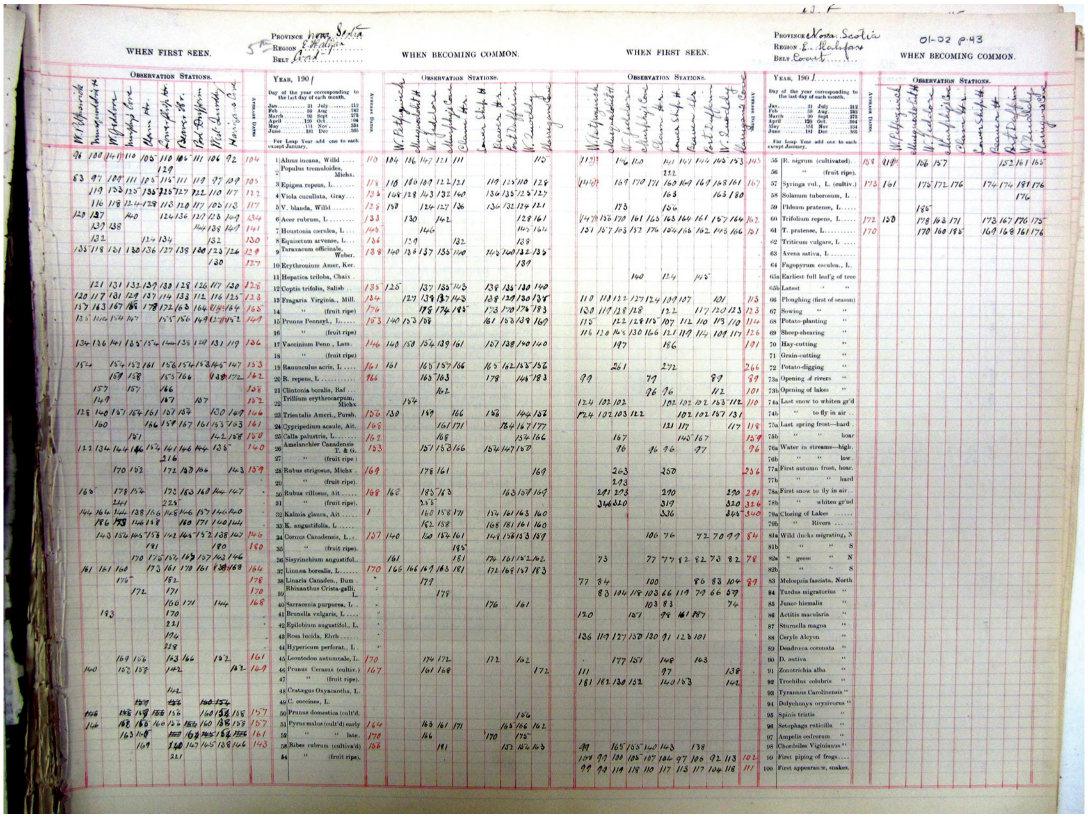


Figure 3. *Completed ledger of phenological observations for Eastern Halifax, coast belt, 1901. A. H. MacKay Ledger Collection, Nova Scotia Museum Library, Halifax.*

MacKay, many of them educators, both women and men. Over the next several years they expanded their provincial network and also included scattered observers in locations across Canada: a few in New Brunswick, Charlottetown, Muskoka, ON, Blackfalds, AB, Vancouver, and others. However, any notion of a real national survey was illusory. Nova Scotia was the only province with meaningful coverage, particularly after 1897 when MacKay used his position as Superintendent of Education to begin phasing the project formally into the provincial curriculum. Noting that the province's rural schoolchildren could easily cover more ground than a small group of naturalists, he wrote with pride that "the eyes of a whole school daily passing over a whole school section will let very little escape notice."[15]

Selecting carefully from among the completed schedules sent in by teachers, MacKay and his colleagues amassed detailed ledgers of the collected phenological data, tabulating and averaging dates to develop a picture of the natural life cycles of the province. [**Fig. 3**] These completed forms and ledgers are held by the Nova Scotia Museum and MacKay would be delighted to know that since the late twentieth century his botanical data have been used by climate scientists to analyze historical climate change.[16] Although today's scientists use different methods, the basic science of phenology—documenting the annual appearance of natural phenomena as an indicator of local climate—has not changed. For his part, MacKay called his calculated averages *phenocrons* (each phenomenon had its phenocron, or average first date of appearance). He saw the province as divided into twelve distinct regions, which he called *slopes*, each with three *belts*: coast, low inlands, and highlands. "Every locality has a *flora*, *fauna*, *climate*, etc., more or less distinctly its own," he wrote in his instructions to observers.[17] MacKay even saw these environmental micro-regions as pitted against each other in a friendly bit of climatic rivalry. Reporting on his 1895 findings, just before the project began to include schoolchildren, he felt compelled to reassure the Institute of Science about the objectivity of his project. Noting that the averages for some phenomena in northern Nova Scotia had advanced considerably over those of the previous year, MacKay suggested that perhaps the observers there were compelled to "be more constantly watchful than usual" so as not to be outdone by their southern counterparts. He explained, "they may have made a greater effort to get the exact facts, which would tend to bring phenomena more promptly to their notice," but insisted that "there need not be the slightest suspicion that any of the observers, who are well known to me, put a single figure down in the 'interest of any particular climate.'"[18] In later years, observers were reminded that the figures "must be as accurate as possible …. Very early dates … do not prejudice the compiler in favour of the observers, but very much the reverse."[19] Nevertheless, the subjective character of the project was already evident.

From one perspective, MacKay's project may be seen as a sympathetic collaboration with rural communities, drawing on and privileging local knowledge. Positioned along with more recent crowd-sourced science, we can read MacKay's project as one that took the knowledge of rural observers seriously, celebrating and formalizing the long-standing observational activity of farmers, sailors, and other rural people who had long been watching the weather and keeping track of environmental changes around them. However, it is also important to contextualize the project in relation to widespread rural reform movements in the period. MacKay was a fervent advocate for rural modernization and he, like many others, saw education as key to this transformation. MacKay was confident about the positive influence his project would have on students. He insisted that participating in compulsory observations on the walk to school would "fill an idle and wearisome hour with interest, and be one of the most valuable forms of educational discipline."[20] When the phenology project was underway he remarked that "it was good to see that so much of the leisure time often given to unproductive recreation is now being directed to research. It is a good thing to feel that the search for more truth is in the air."[21] MacKay was also confident about the results of this discipline, writing that his program of phenological observations was "no doubt, starting a very many young pupils on the beginning of an observant course which will make them specially useful citizens."[22] Elsewhere, with more characteristically gendered language, he added that the program starts pupils "thinking in the way of the men who have done something in the world," and "such exercises have special power in developing the habit of accurate observation (which is the soundest basis for any career ranging from that of the poet and professional man to the tiller and lord of the soil, the tradesman, the manufacturer and inventor)."[23] Training rural children and teachers in scientific observation was part of a broader effort intended to transform rural lives and to produce productive, morally upstanding citizens who would modernize rural places and fulfill the demands of the liberal state.

At the heart of such notions and the reform initiatives they underwrote was a belief in the potential of these people to "be modernized"—and a belief that their ongoing place on the land was appropriate and desirable.[24] In the case of the phenology project, there is also the inherent implication that these rural people had knowledge of the natural world that was valuable and legitimate. This stands at odds with the cultural genocide and devaluation of knowledge experienced by the Mi'kmaq, upon whose unceded lands those settlers made their lives.[25] Efforts to remake and modernize rural communities were always part of larger processes to rationalize rural spaces and to consolidate and formalize settler authority over Indigenous lands. By drawing on and then overwriting Mi'kmaw environmental knowledge, European observers had long since begun to make the flora and fauna of the province legible to themselves, a process that was ongoing in the late nineteenth century.[26] MacKay's project offers an opportunity to think through the ways that the logic and practices of science worked in tandem with the settler colonial state in contexts well beyond imperial narratives of so-called discovery.[27]

Observers in Training

MacKay's annual reports as Superintendent include his running commentary on the phenology project, much of it laced with concern about the actual reach of his authority into rural places. The mandatory status of the project did not mean that it was universally followed by rural teachers. Participation and administrative support for the program ebbed and flowed, and even at its height in the first decade of the twentieth century, fewer than ten percent of the province's 1700 schools ever submitted reports in a single year. Nevertheless, MacKay took the project very seriously and continued to cajole and admonish teachers to participate. He even threatened to revoke the teaching license of anyone caught forging data.[28] It is important to note that it was teachers, rather than children, who were expected to be the main participants of the project, the vast majority of whom were young rural women with very little, if any, formal training as educators. Although initiatives such as a Summer School of Science were intended to help teachers upgrade their qualifications, the vast majority of rural teachers never accessed these resources. They were paid among the lowest wages in Canada, typically worked for only a few years, and frequently switched schools from year to year, conditions that mitigated efforts to modernize and standardize education across the province.[29]

Rural elementary school students and their young, typically female teachers, were considered to be "observers in training" by MacKay and his colleagues.[30] This analysis shares its focus with the work of Lianne McTavish on efforts by the New Brunswick Natural History Society to train the visual practices of New Brunswickers through nature observation, encouraging a kind of "geographical citizenship" and pride in the province. McTavish wrote about the aims of the Society, but noted the records to which she had access did not reveal "whether or not the 'students' they targeted actually adopted the desired visual practices."[31] The substantial existing evidence of MacKay's project reveals that the rural people who participated in fact challenged his ideals of scientific practice and collective empiricism. And their refusal to adhere to appropriately scientific modes of observation was a constant frustration to the aims of the phenology project.

The collected data were compiled by the men and women MacKay called his "staff of phenologists," a group of fellow educators and naturalists, mostly science teachers and principals at the county academies. The group was made up of people like the young Loran DeWolfe, who would later become the first provincial Director of Rural Science, and others who shared, at least to some extent, MacKay's passion for nature and its pedagogical potential.[32] Compilers were assigned the completed schedules of one or more regions and were requested to tabulate and average the data received. They published yearly remarks on their work in the *Journal of Education*, often editorializing as they did so. Writing in 1904, DeWolfe shared his worries and his hopes: "I fear too many teachers have never learned what pleasure it is each night after school to go for a long walk through the woods and fields, by the brook or the lakeside, and observe for themselves the advance of vegetation and the appearance of the birds," adding, "a short talk about this trip next day in school may stimulate a few of the pupils to go on similar excursions, until at last the whole school would be a band of enthusiastic observers."[33] There is no doubt MacKay, DeWolfe, and their colleagues were sincere in their desire for Nova Scotian children and teachers to engage with the world around them, to become enthusiastic nature lovers, and in their faith in the benefits this would bring.

But the phenology project was no childish diversion; it was a real scientific investigation of regional plants and birds that many people today would struggle to identify. The completed schedules demonstrate an astonishing breadth of engagement and knowledge of the natural world by many young rural women who chose to dedicate their time to its study. However, this was not universally the case. Over several pages annually, the compilers' remarks were typically filled with sarcastic admonitions about the inability of teachers to recognize even common birds and flowers and their propensity for confusing those of similar species. The compilers complained of the "great confusion," the "many irregularities and errors," and the "manifest absurdities" that allegedly appeared in the reports before them.[34] Although some teachers were celebrated as "enthusiastic botanists" and "good observers," and compilers often noted that the best schedules came from small, ungraded "country" schools,[35] on the whole, the remarks reveal a perceived widespread inattention to detail and general failure across two decades to adhere to the kind of precision demanded by this scientific experiment. Surely this was an indictment of the education system rather than the fault of individual under-resourced teachers, but this was not apparent in the compilers' commentary. Teachers were regularly called "careless," or accused of "carelessness." Misidentifying the arrival of mayflowers was seen as particularly egregious, one compiler writing, "as usual, some mistakes occur, which in the case of the rarer plants can readily be excused, but in the case of such common plants as Viola blanda [sweet white violet] and Epigaea repens [mayflower], carelessness is the only cause one can ascribe."[36]

Among the common complaints, Goldthread and Starflower, two small white star-shaped blooms of late spring, were regularly mistaken. The relatively rare Adder's Tongue Lily was often entered in place of the more common yellow forest lily Clintonia. Buttercup species were routinely confused. One particular thorn in the side of the compilers over the entire life of the project was the persistent confusion between Pale Laurel, Lambkill, and Rhodora, three showy purple flowers that all grow in or near bogs. [**Fig. 4**] One exasperated compiler was already insisting in 1903 that the three plants were "so generally taken one for the other, that any average of observations is useless."[37] In response to such complaints, MacKay himself made a rare intervention in the *Journal* to chastise teachers, suggesting that these plants "can be mistaken only by observers who are shamefully ignorant of botany, for nothing can be easier than to distinguish them apart. It is hoped that the blunder will not occur again."[38] Nevertheless, misidentifications were reported by compilers every year through to the 1920s. "Our boys and girls doubtless hear the Rhodora called 'Lamb-kill' [in their communities] and the name sticks," wrote one. Compilers regularly called for these and other plants to be removed from the list, or replaced with species that were more widely known and less easily confused. This was never done.[39]

Birds posed a unique challenge. Compilers complained that of the eighteen birds on the list, few of them were widely known—"the song sparrow, robin, and humming bird are the only ones everybody knows," according to the compiler for central Nova Scotia in 1903. The compiler for Shelburne County the same year was more incredulous, claiming "the Peabody bird, though known to few by sight, must be known to every teacher by its song" and "there is no reason why the Kingbird should not be reported, for I am sure that it is quite widely known in this County by the name of Martin bird." A third compiler was more sympathetic, asking: "Would it not be advisable to publish short descriptions of the birds mentioned in the schedule, as the books of reference recommended in the Journal of Education are too expensive for most teachers?"[40] Moreover, compilers routinely pointed out that the method of averaging dates of appearance was in fact inappropriate for most of the birds on the list. When the migration of wild geese was recorded a month apart in adjoining school districts in 1909, the compiler for Halifax County suggested "again the propriety of taking the date of one reliable observer from each belt"

Figure 4. *(Top to bottom) Pale Laurel, Lambkill, and Rhodora in bloom. Photos by Sara Spike.*

rather than averaging the dates. "I believe both observers honest, but I have no doubt that the early flock flew over the late observer, without attracting attention. One teacher is on the watch for the Song Sparrow, and hears its note ten days before her neighbour, who only hears it when brought suddenly into such close proximity to the song that it cannot escape the attention of the most careless."[41]

These troubles with birds along with frequent confusion among wildflowers also signalled broader weaknesses with the project as a whole—namely its inflexibility and overall inaccessibility—which compilers pointed out to MacKay in their correspondence year after year, duly printed in the *Journal of Education* and soundly ignored. It is also clear that participants did not understand where their data were going, or to what end. As late as 1917, one compiler complained of the small number of schedules submitted and suggested "no doubt most teachers have an idea that these are never used and pile up 'Somewhere.'"[42] Two years later, and more than twenty years after the project began, a short piece on the utility of the phenological observations for the timing of crops attempted to answer its own rhetorical question: "Are the Phenological Observations, then, that we are asked to keep, after all, useless? Apparently not."[43] By 1920, a new generation of compilers was publishing remarks identical to those of their predecessors, still noting that "the Observation schedules had mistakes similar to other years" and exhorting: "Let us all try to improve our Phenological returns. This can be accomplished by keener observation."[44]

Harry Piers, long-time curator of the Nova Scotia Provincial Museum, and a colleague and friend of A. H. MacKay, was certainly a keen observer and he provides an evocative phrase to describe the aim of all natural history pursuits. Namely, he extolled the virtues of his "very pleasant duty of keeping Nature under police surveillance."[45] Extending Piers's metaphor, it might seem that MacKay had deputized rural teachers and schoolchildren in a province-wide stakeout of buttercups and robins. But in this particular arrangement, rural people were not necessarily on the side of the law. Rather, they were more often than not treated as unreliable eyewitnesses in the court of capital-S-Science, where their colloquial, undisciplined ways of interacting with the world were put on trial. And indeed, this project placed rural people themselves under scrutiny as much as the plants and animals it purported to study. Teachers were publicly congratulated for their excellent submissions, and the names of all teachers who sent in schedules were published in the *Journal of Education* each fall with the number of their observations. At the same time, however, even as they were assured that recording observations was "entirely voluntary," teachers were reminded that "our Inspectors are observing the differences between the schools in which they are made and those in which they are not, in order to form judgements on the effect of such scientific amusements."[46] It was suggested that "the character of the schedule should be an index of teaching" and a poor quality schedule could put into question a teacher's "fitness to hold even a permissive license."[47] The disciplinary function of the phenology project was manifold. Not only did it train young minds in civic virtue, it also functioned as an additional surface for the surveillance of rural teachers both in and out of school.

Unlike his naturalist colleagues, whose objectivity and impartial enthusiasm could be counted on in the early years of the project, it is significant to note the lack of trust that MacKay and the compilers clearly had in the rural teachers they were compelling to participate. MacKay repeatedly declared with pride that the Nova Scotia observations were "more accurate in the great majority of cases than the observations made by individuals of the scientific societies, who often were able to make their observations only once or twice a week, and then only over a comparatively circumscribed ground."[48] Nevertheless, the compilers were always considered the reliable authorities in the frequent cases of discrepancy. Year after year teachers were told that their observations were inaccurate or outright wrong because the compilers assessed the value of the submitted reports against historical data. Only the "most accurate"—those that conformed to the compilers' expectations—were included in the final rendering of the data. Each year, teachers were singled out and congratulated for having submitted "correct" and "accurate" observations while those who fell outside the acceptable dates were admonished. The words *accurate* and *inaccurate*, *correct* and *incorrect*, *too early* and *too late* recur persistently throughout the compilers' remarks. Only the ten "most accurate" schedules for each of MacKay's thirty-six regions were compiled and averaged.

The logic of drawing parameters around the acceptable dates for observations is clear if considered as a complement to boundaries around the known localities for particular plants or animals. Observations outside these boundaries would rightly be received with skepticism and require additional support. The accuracy of the phenological observations certainly mattered, and it was appropriate for project administrators to question and scrutinize the data supplied by teachers. However, following Tina Loo, it is also important to consider the conditions within which notions of accuracy, reliability, and relevance were determined—how some knowledge came to be labelled as local and other knowledge as expert and universal.[49] Compilers were forthcoming that they relied heavily on their own personal knowledge of the teachers when selecting which schedules to include in their averages. From the earliest years of the project distinctions were made between those known to be "enthusiastic botanists" and the remaining "average observers."[50] The compiler for Halifax County in 1901 admitted he was very skeptical of the dates given for black currant, lilac, and white clover by teacher Ella Gaetz in West Petpeswick, whose mayflowers opened this article, but added that because "Rev. Mr. Rosborough is there and instructs the teachers often in Botany, I accepted them."[51] Rosborough was a friend of MacKay's and one of the original phenologists in the earliest years of the project.[52] The very same data coming from Gaetz alone would have held no authority and would have been rejected out of hand. Compiler and vice-principal Antoinette Forbes added that she also considered the "sex and temperament of the observer" when selecting which schedules to average.[53] This comment may explain the note she wrote on the 1901 schedule of fifty-nine-year-old Mary Hilton, teacher in Rockville, Yarmouth County: "[teacher] born in section, yet sheet of little value." Hilton's return provides a rare example of a teacher recording the name of the student who made each observation.[54] While she clearly used the phenology project as directed—as an opportunity to encourage the study of nature among her students—Forbes's doubts about the value of Hilton's schedule point to the fact that the project was not to be taken lightly or treated simply as a game for the children.

The artificiality and disciplinary function of the pre-determined averages and norms was most apparent when it came to recording the timing of agricultural activities. Crop timing is an important undertaking, certainly worthy of study, but it is not clear that this was always the aim of MacKay's project. The case of spring plowing and potato planting points to the ways that norms were established and shaped by boundary-making and exclusions. In a rare occasion of personal commentary from a teacher, Louise Freeman in West Middle Sable, a fishing village in Shelburne County, added a note to her 1910 schedule to specify and apologize that in her community, plowing, sowing, and potato planting "probably commenced earlier than in some sections on account of the men going away to the 'Banks'"—a reference to local fishermen leaving for the first offshore schooner trip of the season.[55] She recorded these activities as underway by early April, a full month ahead of the same in dedicated farming districts such as the Annapolis Valley. This is supported by the Shelburne County compiler's remarks from 1903, which indicate that in fishing settlements along the coast, potato planting was noticeably earlier than in the inland communities.[56] Likewise, a news column from nearby Wood's Harbour in the *Yarmouth Herald* noted that with the early opening of spring in 1892, by the last week of April "some [had] already finished planting, while a large number will have none planted, having left so early on their fishing voyages."[57] This suggests the dates for potato planting in that community were in fact widely divergent—both very early and very late according to MacKay's standards—but this information would not have been conveyed by recording simply the date on which the activity began or was judged to have become common. These comments point to the locally-specific variations in dates that were obscured by MacKay's project. Rather than acknowledging that potatoes might successfully (if not ideally) be planted on a wider range of dates, these coastal communities were positioned as outliers and left out of the averages in favour of the dates for "normal" communities that did not engage in such apparently disruptive occupational pluralism.[58]

In the case of sheep shearing, the compilers complained that the idiosyncrasies of rural practice meant that no average was even possible, that the timing of sheep shearing depended as much as anything "on prejudice, or custom, or … even on superstition." One compiler grumbled that "adjoining sections differ by a month or three weeks, because one waits for mild weather, and the other shears 'in the light of the moon,' for shearing in the 'dark of the moon' will cause deterioration next year in the quality of the cut."[59] The arbitrariness of the phenomena MacKay included in his study—some despite their ill fit for the task at hand—the rigidity with which he excluded outlying data, and the commentary that emerged in relation to these categories suggests that in some cases establishing norms or averages for agricultural activities was an aspirational or disciplinary endeavour, an effort to formalize normative behaviours and extend the logic of the modern state and of science into rural areas.

Local Names

Natural history observation has always been a collective, cumulative process, but positioning MacKay's project in relation to histories of scientific observation is complicated by the coerced involvement of thousands of rural observers. Daniela Bleichmar's comments about the eighteenth century are also relevant to the communities of amateur naturalists practicing in the early twentieth century. She writes that botanists and other naturalists have often been represented as solitary workers, but in fact they participated in broad networks of exchange across time and space: "Natural history observation did not occur in a single session or location, but rather over extended periods of time, sequentially, and in various settings. It implied a series of comparisons and conversations, as naturalists attempted to see something that had not been seen before, to correct what someone else had seen, and to describe so that others could see what they had."[60] Characterized as a conversation, these interactions between naturalists were dependent on shared standards and on mutual faith in the commensurability of their observations—what Lorraine Daston calls "the reciprocal calibration of observers."[61] The ideals of collective empiricism did not always hold up, leading to confusion and disputes, but the guiding presumption was that these "comparisons and conversations" were taking place between peers qualified (or at least aspiring) to the standards of the day.

With his accumulated data in hand, MacKay was in conversation with other naturalists across the province, the country, and internationally. And his "staff of phenologists" were enthusiastic observers interested in the mutual exchange of botanical information as well. It is less clear where the majority of MacKay's rural participants fit into this conversation. While certainly not voiceless, it would be inappropriate to suggest they were considered peers in the project. Contemporary crowd-sourced science projects are generally voluntary, undertaken by "people who have chosen to use their free time to engage in the scientific process" and who tend to become involved for altruistic reasons (such as concern for the environment), or to gain knowledge for their own hobbies and interests. While some scientists continue to perceive the public with a "deficit view" of their potential for scientific understanding, the combination of compulsion and criticism in MacKay's project seems to put it at odds with other crowd-sourced efforts, recent and past.[62]

Lorraine Daston writes that in scientific training, "convergence is indispensable. Novices must be taught to see things and to see the *same* things, a world held in common. But it is not the common world that they learn to see."[63] The cultivation of a scientific self, through training and experience, means learning to see not as an individual but as a member of a community. A. H. MacKay and his colleagues were eager to create such a community in rural Nova Scotia, but they offered little beyond criticism to help bring their potential adherents into form. Instead, the rural people who participated in MacKay's project challenged his scientific ideals, revealing the persistent relevance of local, place-based knowledge in rural Nova Scotia. Daston writes that since the sixteenth century, the work of botanical description and illustration has been characterized by "concerted attempts to represent a universal, not a particular." This "atlas image of record," which becomes a figure of authority, pits "the universalized plants of scientific ontology" against the "the particular plants of everyday experience."[64] In response to the attempted imposition of a standardized scientific view of the natural world in rural Nova Scotia, participants pushed back, asserting the legitimacy and value of the "particulars" of their local knowledge.

A common grievance of the phenological staff was the use of colloquial or regional names for plants and birds. For instance, the teachers who interchanged the names of Lambkill and Rhodora were following a naming convention common throughout the province. The persistence and use of colloquial names was most obvious when teachers added additional notes to the end of their forms, as many did. These extra entries were encouraged by the administrators for the sake of general interest, but they were not averaged or tabulated. Nevertheless, it was expected that they would adhere to scientific method and nomenclature. A compiler in 1910 repeated a common refrain when he asked that teachers, when "reporting additional observations, give the scientific name in preference to some local name, such as 'Bird's Eye Primrose.'"[65] Most teachers included just a handful of extra entries. Ella Gaetz in West Petpeswick, whose reliability was questioned save for her relationship with Rev. Rosborough, added seven items that year: Daisy, Butterfly, Swallows, Elder flowering, Robin's nest seen, Peas planted, and peas blooming. Mary Hilton of Rockville, whose schedule was rejected as "of little value" by the compiler, added twenty-five.[66] It is common to find dozens of additional items, and occasionally more than one hundred, either scribbled into the margins of a schedule or listed in tidy handwriting on extra sheets of paper attached to it. [**Fig. 5**] These submissions demonstrate a remarkable engagement with local environments and often an impressive scientific vocabulary and knowledge, sometimes combined with the use of colloquial naming.

MacKay and many of his colleagues believed that the use of colloquial names led to inaccurate and incomplete data. As teachers only knew the local names of plants and birds, they did not recognize the "correct" names listed on their forms, and consequently they left many entries blank, or mistook certain species

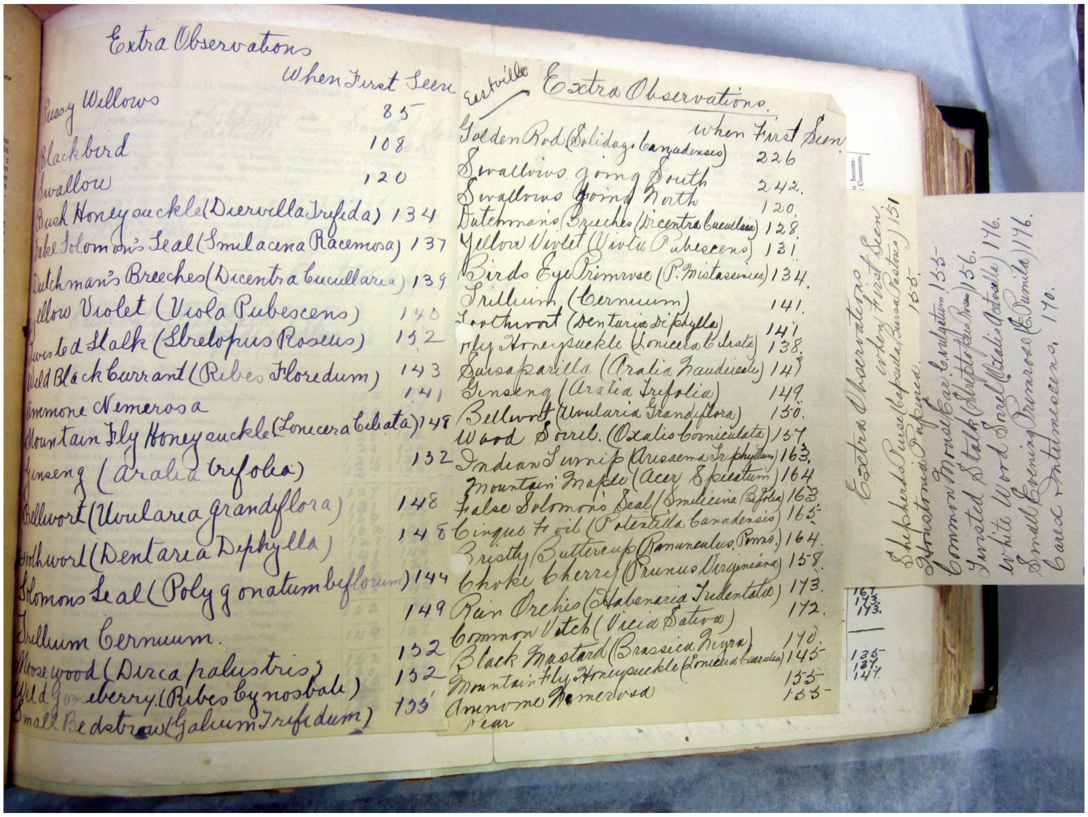


Figure 5. Extra entries provided by Olive Lyle Archibald for the year ending July 1906, Eastville Upper Stewiacke, Colchester County. A. H. MacKay Ledger Collection, Nova Scotia Museum Library, Halifax.

for others. Proper scientific observation in MacKay's project as elsewhere was not only the bodily act of purposeful, attentive looking. It was an intellectual process that included the ability to effectively connect received sensory information with a relevant body of scientific knowledge. It was participation in a collective endeavour, of which all members connected "the same words to the same things."[67] Moreover, underlying the insistence on the use of scientific vocabulary was a broader implication that its absence denoted an immature relationship with the natural world. One compiler unintentionally made this explicit when he helpfully offered a list of local names for his region, noting, "this was my own boyish nomenclature, so it may prevail in many parts of the country still." But these colloquial names were not simply made up by children. They were locally meaningful, passed through generations, and often denoted a unique relationship to the places where they were used. Nevertheless, in the commentary on the phenology project, all names not common to science were lumped together as "local or childhood names."[68]

It is notable, however, that the compilers frequently acknowledged they were familiar with the colloquial names of plants and birds, and therefore their work was often not hindered by their use. Some compilers asked MacKay for local names to be provided directly on the schedule, a suggestion that was never implemented. Instead many included local names in their comments in the *Journal*. Loran DeWolfe found in his own school in North Sydney "that Gold Thread was locally known as 'Morning Star,' and Star Flower as 'Evening Star.'"[69] A compiler for Shelburne County offered local names for Rhodora (Rosebay, Azalea) and Lambkill (Sheep Laurel).[70] A notable example was a compiler in Cape Breton who included some Gaelic names for plants and birds in his report: Spring Beauty (*Ditheanan Cnothan nam Muc*), Nighthawk (*Clamhan nan Chuileag*), and Snipe, which had four local names (*Gobhar-athair*, *Gobhar-oidche*, *Ianrag*, and *Ian-ghobhrag*).[71] It is clear that some compilers chose to act as facilitators or interpreters between local communities and the world of science. Many of them were enthusiastic observers who shared a vocabulary with the teachers in their counties and acknowledged that colloquial names were not in fact the opposite of scientific objectivity, but could coexist with it. This was not, however, the policy of the project.

Particularly when they are few, the extra entries added to schedules were often quite sweet—such as noticing the first butterflies, bees, and pussy willows, very common entries that certainly seem to reflect what may have been of interest to young children. A compiler in 1906 suggested that swallows, butterflies, fireflies, and bees were the most common additions and "should find a place on the [official schedule] as they are watched for by parents and pupils."[72] Swallows were eagerly observed returning to Nova Scotia each spring, and their absence from the official list was an unusual omission. The inclusion of extra entries reveals that many rural teachers embraced MacKay's project, but they did so in ways that broadened and complicated the boundaries of his scientific agenda, bringing the local priorities and preferences of their communities and classrooms into the conversation.

These extra entries not only broadened the parameters of MacKay's project, but also challenged the imperative of focused, circumscribed observation. Rural Nova Scotians instead approached their environment with a roving, promiscuous, inclusive gaze. Many of the extra observations and notes fell well beyond the boundaries of MacKay's project, making reference to meaningful events of significance to particular communities. On December 5, 1900, Florence Fultz in Lower Ship Harbour, Halifax County, noted what she called the "highest tide for years." The following spring, seventeen-year-old John Millar, schoolteacher in Pleasant Lake, Yarmouth County, noted the arrival of the herring in the Tusket River on April 3. Aspects of local economies were also made apparent in these notes, for example, Louise Freeman's note about the relationship between potato planting and the local fishery. And in 1908, A. McPherson in Charlo's Cove, Guysborough County, recorded the dates for the first local catches of lobster, mackerel, haddock, and herring. Myra Ross in Brule, Colchester County, noted the day that the harbour froze one winter (December 12, 1905) and the day that it was first crossed on foot (January 8, 1906), while Olive Lewis in Upper Economy, Colchester County, noted the first lighting of the Burntcoat lighthouse on March 15, 1924, the same day the first vessel came into the bay that spring.[73] It is no coincidence that all of these examples make reference to a close relationship with the ocean, something MacKay's list did not call for. These extra notes are similar to the observations that rural people were making in private, affirming the public relevance of knowledge that would otherwise have been tucked away in daybooks and diaries. As much as they illustrate the keen interest and enthusiasm that many teachers had for MacKay's project, the extra notes are also an assertion of the continuing value of local knowledge and rural ways of making sense of place.

MacKay and his staff certainly acknowledged that rural people had specialized knowledge and access to the natural world around them. Indeed, this is why they were sought out. But the idiosyncratic and variable character of their experience was often a direct challenge to the "calibration of observers" demanded by scientific objectivity. A compiler for Queens County in 1907 offered the kind of backhanded encouragement common to the project when she wrote: "Many show the deep interest they take in this work by making a number of additional observations. May I suggest that, in reporting these, they use the scientific names of the plants, or the common ones recognized by botanists. Such names as 'wild corn,' 'tame gooseberries,' 'garden lilies,' 'water-berries,' 'sleeping Johnnies,' etc., while intelligible in their own districts, are rather out of place in scientific records."[74] These five colloquial names were submitted by three young women in well-filled schedules that each demonstrate an extraordinary knowledge of local flora. Teacher Myra Matthews in Port Joli submitted an extremely tidy schedule with twenty additional entries where colloquially named water-berry, garden lily, June roses, and wood daisy appear alongside the more familiar-to-science bluets, cinquefoil, chickweed, and harebells. Effie Munroe in Summerville Centre included twenty-six additional entries, including sleeping johnnies and wild corn, alongside cranberry and chokecherry blossoms [**Fig. 2**, page 27]. Buelah Gross in St. Catherine's River added eleven entries, wild corn and tame gooseberries among them, along with Labrador tea and wood sorrel. All three women added pussy willows, swallows, and butterflies.[75]

While the administrators of the project continued to believe in the power of science to create a consistent and coherent picture of the world, these young rural women knew otherwise. By asserting these local variants rural teachers may have been demonstrating their ignorance of scientific language and practices, and they were certainly declaring their ambivalence for the rules of MacKay's project, but year after year for more than twenty-five years, generations of rural teachers were also affirming locally-meaningful knowledge, and arguing for the legitimacy of this knowledge—arguing that it was in fact *not* out of place in official records. These extra notes express a desire for their local observations and experiences to be recorded, in spite of repeated efforts to overwrite them.

A. H. MacKay's collected Nova Scotia phenological observations are an incredible achievement. Another version of the project, one which embraced the idiosyncrasies of local knowledge, might have held even greater historical

Figure 6. *Foxberries. Photo by Sara Spike.*

significance. Local names for some wild plants persist and are often embraced as part of regional identities: for instance the plant known in English as foxberry in mainland Nova Scotia is known in Newfoundland as partridgeberry, in northern Canada as low-bush cranberry, and in Europe as lingonberry (*Vaccinium vitis-idaea*) [**Fig. 6**]. But it is clear that many more local names were once known and understood within communities, counties, or regions. By connecting local names to their common names, some compilers of the phenological data hinted at the possibility for an ethnography of rural Nova Scotia that might have preserved locally meaningful naming that has long since been lost through the modernization (and depopulation) of rural communities.[76] The handwritten schedules submitted by teachers across the province contain many local names that were simply scorned and overlooked rather than engaged and translated. Dwelling on the loss of these situated rural meanings only highlights the even greater loss of the Mi'kmaw knowledge and naming practices that were forcibly displaced by rural settlement. Like the ideal botanical illustration that sought to depict a universal specimen over the particulars of everyday plants, the aim of scientific inquiry has historically tended to calibration rather than eccentricity, a so-called universal language to the detriment of other ways of knowing. Local knowledge (whether Indigenous knowledge or from rural settler communities) can be messy—it does not always fit into tidy columns; it is difficult to crunch or average.[77] The young rural women who chose to participate in MacKay's remarkable phenology project did not know why their observations were being collected, but they knew what was important to their communities and they documented the world around them to the best of their abilities with thoughtfulness and care.

Sara Spike is a SSHRC Postdoctoral Fellow in the Department of History at the University of New Brunswick, Fredericton. She is a cultural historian of rural and coastal communities in Atlantic Canada. She received her PhD in 2016 from Carleton University and works as a university instructor and an advisor to museums and community groups in Nova Scotia.

Endnotes

1 *Truro Daily News*, May 2, 1899; *Yarmouth Herald*, April 23, 1890; *Digby Courier*, April 24, 1885. This research was supported by the Social Sciences and Humanities Research Council of Canada. My thanks to David Banoub, Jessica Dunkin, and James Opp for feedback on earlier versions of this work.

2 A. H. MacKay Ledger Collection, Nova Scotia Museum Library, Halifax, Nova Scotia, Collected Returns, year ending July 1901, West Petpeswick, Meteghan, Loganville.

3 The blank "Local 'Nature' Observations" form was printed in each issue of the *Nova Scotia Journal of Education*, circulated as a loose sheet, and printed at the back of the school registers kept in each school.

4 *Nova Scotia Journal of Education*, October 1903, 137. (Hereafter *NSJE*.)

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14 A. H. MacKay, "Natural History Observations, Made at Several Stations in Canada during the Year 1892," *Proceedings and Transactions of the Nova Scotian Institute of Science* 8, pt. 3 (1893): 378–79.

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17 "Local 'Nature' Observations," blank form. Italics in the original.

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34 *NSJE*, April 1907, 83.

35 *NSJE*, April 1905, 78, 79, 80; *NSJE*, April 1906, 60.

36 *NSJE*, April 1905, 82.

37 *NSJE*, April 1903, 97.

38 *NSJE*, April 1903, 98.

39 The list changed substantially only once, in 1902, when the future vexing Rhodora was actually added along with a handful of other plants. A few plants and agricultural activities were also removed. *NSJE*, October 1902, 143–156.

40 *NSJE*, April 1903, 98, 96. Kirsten Greer and Laura Cameron have noted that while birdwatching was becoming a common hobby in the period, it was dominated by urban participants. Kirsten Greer and Laura Cameron, "'Swee-Ee-et Cán-a-Da, Cán-a-Da, Cán-a-Da': Sensuous Landscapes of

Birdwatching in the Eastern Provinces, 1900–1939," *Material Culture Review* 62 (Fall 2005): 37. See also their discussion of the Peabody bird (White-throated Sparrow) and the reinterpretation of its call from I-I-Peabody-Peabody for American ears to their titular Sweet Canada for Canadian bird lovers (42).

41 *NSJE*, April 1909, 96.

42 *NSJE*, April 1917, 75.

43 *NSJE*, October 1919, 239.

44 *NSJE*, April 1920, 94.

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49 Tina Loo, "High Modernism, Conflict, and the Nature of Change in Canada: A Look at *Seeing Like a State*," *Canadian Historical Review* 97, 1 (2016): 34–58.

50 *NSJE*, October 1899, 143.

51 *NSJE*, April 1902, 62.

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54 Collected Returns, year ending July 1901, Rockville.

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63 Daston, "On Scientific Observation," 107.

64 Daston, 103.

65 *NSJE*, April 1910, 92.

66 Collected Returns, year ending July 1901, West Petpeswick, Rockville.

67 Daston, "On Scientific Observation," 107, 104.

68 *NSJE*, April 1904, 78; *NSJE*, April 1906, 62.

69 *NSJE*, April 1904, 80.

70 *NSJE*, April 1917, 67.

71 *NSJE*, October 1921, 152–53.

72 *NSJE*, April 1906, 64.

73 Collected Returns, year ending July 1901, Lower Ship Harbour, Pleasant Lake; year ending July 1908, Charlo's Cove; year ending July 1906, Point Brule; year ending July 1910, West Middle Sable; NSA, RG 14, vol. 111, school papers, Colchester County 1895–1960, file: Upper Economy.

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Michael W. Burke-Gaffney and the UFO Debate in Atlantic Canada, 1947-1969

Matthew Hayes and Noah Morritt

Abstract: *This article offers a history of UFOs in postwar Atlantic Canada, as experienced by St. Mary's University astronomer Michael W. Burke-Gaffney, an academic who engaged with UFOs and the interested public at a time when the standard response from his colleagues was to deny and debunk the phenomenon. The article argues that Burke-Gaffney's efforts to explore UFOs with an open mind fit comfortably within Jennifer Hubbard's framework of an "ideal of service." However, by the end of his life and career, members of the public no longer admired Burke-Gaffney's commitment to public education and service, coming to see him instead as yet another intellectual who aimed to ridicule and dismiss claims of UFO sightings as nothing other than misidentified natural phenomena. Burke-Gaffney's work is important because it provides a means of tracking changes in the public's perception of and deference to scientific authority and expertise in Atlantic Canada during the postwar period.*

Résumé : *Cet article présente l'histoire des ovnis dans le Canada atlantique d'après-guerre, telle que vécue par Michael W. Burke-Gaffney, un astronome de l'Université St. Mary's. À une époque où la réaction générale de ses collègues était de nier et de réfuter le phénomène, ce dernier s'est intéressé à ces objets volants ainsi qu'au public interpellé par ces manifestations. L'article soutient que les efforts déployés par M. Burke-Gaffney pour traiter de la question des ovnis dans un esprit d'ouverture cadrent dans un « idéal de service », concept développé par Jennifer Hubbard. Toutefois, à la fin de la vie et de la carrière de l'astronome, le public n'admirait plus le dévouement de ce dernier dans les domaines de l'éducation et du service public, le considérant plutôt comme un autre intellectuel cherchant à ridiculiser et à rejeter les signalements d'ovnis, alors considérés comme n'étant rien d'autre que des phénomènes naturels mal identifiés. Le travail de Michael W. Burke-Gaffney est important, car il permet de suivre l'évolution de la perception et de la reconnaissance du public en ce qui concerne l'autorité et l'expertise des scientifiques dans les provinces de l'Atlantique d'après-guerre.*

Keywords: UFO; Atlantic Canada; extraterrestrial hypothesis; ideal of service; skepticism

"TWO WHIRLING RED-AND-WHITE DISCS, trailing a tail of fire which 'seemed to light up the whole sky' whizzed low over the housetops in the South End before passing out to sea last night," reported the *Halifax Chronicle-Herald* on 21 September 1950.[1] Telephone calls from multiple witnesses claimed the two flying, saucer-shaped discs were visible for approximately two minutes, and for up to two miles, before disappearing into the water. These mysterious flying discs were the latest in a series of unusual sightings near Halifax, Nova Scotia, that were quickly becoming a topic of serious local and international attention. A month earlier, fifteen children playing baseball in a vacant lot spotted a similar disc-

 Matthew Hayes and Noah Morritt, "Michael W. Burke-Gaffney and the UFO Debate in Atlantic Canada, 1947-1969" *Scientia Canadensis* 42, 1 (2020): 54-74.

shaped object hovering in the sky above them.[2] The disc remained motionless for nearly three minutes before tilting upward and flying off over the Eastern Passage. To corroborate what the children reported, the *Chronicle-Herald* solicited information from the Royal Canadian Air Force, Halifax police, airline officials, and the RCMP. Their answers were the same: "no report had been received of the sighting of the disc last night."[3]

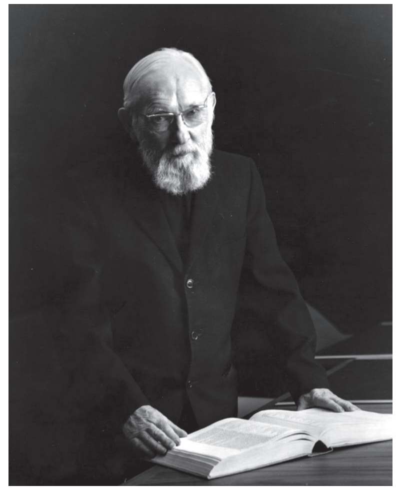

Figure 1. *Portrait of Reverend M.W. Burke-Gaffney, ca. 1970, photographer unknown. Photo courtesy of St. Mary's University Archives (Halifax, Nova Scotia).*

Despite reports from multiple witnesses, the newspaper was at a loss to explain the mysterious saucers. It turned instead to Father Michael W. Burke-Gaffney, an astronomer and Dean of Engineering at St. Mary's University in Halifax. [**Fig. 1**] When asked about the sightings of the two saucer-shaped discs, Burke-Gaffney was puzzled: "Queried last night, he said nothing in the astronomical world explains them. 'There seems to be no connection between them and the Heavens,' he said. 'I can only hazard a guess that they are something purely military.'"[4] He did, however, state what the objects were *not*: "he laughed off the suggestion that the low-flying, colored, revolving discs might have been directed toward Earth from another planet."[5] Whatever the objects were, he concluded, they would remain a mystery until scientists could obtain further information.

From 1947 until his death in 1979, Burke-Gaffney was regularly sought out by newspapers, local organizations and fraternal societies, as well as individuals, to provide expertise on a number of astronomy-related topics and issues, such as meteorite sightings or other, more unusual, encounters. Born in Dublin, Ireland on 17 December 1896, Burke-Gaffney completed an undergraduate degree in engineering at the National University in Dublin in 1917, as well as theological studies in Ireland, France, and Canada, joining the Society of Jesus in 1920. He completed his graduate studies in astronomy at Georgetown University, earning his doctorate in 1935.[6]

As both a Jesuit priest and university professor, Father Burke-Gaffney used media opportunities to educate the public about current findings and advances in astronomy, and in some instances, to clarify or correct what he perceived as errors of fact or interpretation. This included reports of flying saucers, later known as unidentified flying objects or simply UFOs. Burke-Gaffney was thus involved in the public discussion surrounding UFOs from the very beginning of what is now referred to as the "modern era of UFOs,"[7] and his public persona became increasingly connected to the debate surrounding the extraterrestrial hypothesis (ETH) that came to dominate discussion of UFOs and extraterrestrial life during the 1960s. However, UFOs were not one of his major research interests, and as he became associated with the phenomena he also became uncomfortable and impatient with the insistence of many UFO researchers and enthusiasts, as well as the public more generally, that UFOs were extraterrestrial in origin.

Burke-Gaffney's efforts to educate the public about astronomy, and to willingly engage in the debate about UFOs, were unique. Throughout the history of Canada's involvement in the UFO phenomenon, no other academic took on such a prominent role. This article argues that Burke-Gaffney's work was an example of what Jennifer Hubbarb calls the "ideal of service." Unique to Atlantic Canada, the origins of this ideal are found in turn of the 20th century fisheries science, which played a significant role in Canada's "emergence as a scientifically based industrial society."[8] The idea that scientific work should benefit the public guided fisheries scientists, helping to establish a tradition of scientific service and education in the region. Burke-Gaffney's own work, in his case with the emerging discipline of astronomy and the public's interest in UFOs by extension, [9] comfortably sits within this framework. The particular conditions shaping the relationship between science and the public in Atlantic Canada significantly influenced Burke-Gaffney's public commentary about UFOs, and helps explain why he at all felt the need to publicly discuss UFOs, when few of his colleagues were willing to do so.

This article uses Burke-Gaffney's work as a way of tracking changes in the public perception of scientific authority in the region. In the early 1950s, Burke-Gaffney was cautious yet open-minded about the UFO phenomenon, advocating for patience at a time when many of his colleagues showed no scruples in debunking it. While he was fairly convinced that UFOs were not instances of extraterrestrial visitation, he nevertheless argued that it was impossible to know anything about them with certainty. Over time, however, Burke-Gaffney's views on the subject hardened and came more in line with the mainstream scientific opinion that UFOs were nothing other than misidentified natural phenomena. By the mid-1960s, despite his respected reputation and commitment to an "ideal of service," an emerging subculture of UFO enthusiasts, investigators, and witnesses interpreted this approach differently, as closedmindedness. Burke-Gaffney thus found himself in the midst of a public debate on the UFO phenomenon that we argue was indicative of broader social and cultural changes during this period. In his exchanges with the public, Burke-Gaffney exemplified the "ideal of service," diligently investigating sightings and communicating his findings. With UFO investigators and enthusiasts, however, he grew increasingly frustrated and confrontational. His patience, it turns out, had limits, and in the proponents of the ETH he perceived a potential threat not just to his own authority, but to that of science itself.

Flying Saucers and the Rhetoric of Patience, 1947-1960

"It has always been my case not to trespass on the fields of others,"[10] wrote Burke-Gaffney in a handwritten note from October 1957. Here he reflected on his opinion about UFOs and the position he often expressed to the media: that the study of UFOs and UFO sightings did not belong to the science of astronomy. At the same time, given his belief in public education, Burke-Gaffney could not help but engage with the issue. Charles Harnett, a UFO researcher based in Springfield, Illinois, wrote to Burke-Gaffney as part of the research for a book he was preparing called "Science and the Flying Saucer." Harnett was looking to include comments from scientists, and the book, he claimed, would be "designed to present a case for the existence of UFOs, but on a semi-technical, scholarly basis, written in popular science style."[11]

In his response to Harnett, Burke-Gaffney claimed that most UFO sightings had already been identified as known phenomena, and as such, "A few, a very few, remained unidentified and unexplained— these are the so-called UFOs."[12] Turning to the issue of identification and classification, he took issue with both the terms "flying saucer" and "UFO" and proposed his own: *UPOFO* — unexplained phenomena or flying objects. He explained, "I would classify as a UPOFO the seeing of an object traveling at supersonic speed, suddenly reversing its direction. It has been reported that such objects were seen, and neither optics nor any other branch of physical science has come forward with an adequate explanation."[13] This, however, did not mean that an explanation was impossible or beyond scientific understanding. This was precisely why the terms "flying saucer" and "UFO" were problematic: "They have engendered the notion that UPOFO are objects and that they are objects totally different from any of which we have knowledge. Then, persons impatient to have explanation of these UPOFO have jumped to the conclusion that there must be space mice or men from Mars or beings from unseen planets."[14] From Burke-Gaffney's perspective, the public failed to heed William of Occam's dictum in their readiness to accept the extraterrestrial hypothesis. Patience, he argued, was essential: "I believe that there are UPOFOs. I do not know their explanation. They are unexplained phenomena or flying objects. They are at present unexplained; they are not necessarily unexplainable. We must have patience."[15]

Burke-Gaffney's unwillingness to provide an answer one way or the other was unusual. His colleagues in Canada— other astronomers working for the federal government in Ottawa, for instance—rarely displayed such patience and open-mindedness. The mainstream scientific view was simply that UFOs were either misidentified natural phenomena, such as meteorites or the planet Venus, or the products of delusional minds. In fact, it is at this same conclusion that Canada's official UFO investigation arrived. From 1952-1954, the Defence Research Board (DRB), Canada's post-war military science agency, ran Project Second Storey (PSS). A fellow astronomer, head of the Dominion Observatory Peter Millman, served as the Chairman of PSS, which also included another half-dozen members from various military bodies. The committee's goal was to research the UFO phenomenon and provide a clear answer to its mystery.

Millman firmly disbelieved the extraterrestrial hypothesis. In a letter to a colleague years after PSS was terminated, Millman expressed one aspect of his continued disbelief: "I am afraid that the more I study this field, the more I realize how much hoaxing has occurred on the part of pranksters and publicity seekers."[16] Millman's attitude permeated the discussion in PSS meetings, six of which the DRB held over the project's two-year life. The committee concluded that UFOs simply did "not lend themselves to a scientific method of investigation," a conclusion that also echoed the views of their American counterparts. Thus, it was not unusual that a Canadian scientist would take an interest in UFOs during the 1950s. It *was* unusual, however, to depart from the "orthodox" line, as many ufologists would come to call it. By the mid-1950s, the expected attitude toward UFOs within the scientific community was at the very least a strong skepticism, if not outright hostility to the whole subject.

Burke-Gaffney broke this mold by maintaining an open mind about the possibility of origins other than misidentified natural phenomena, something he was able to do possibly because of his academic position within the university. Many of his colleagues worked with the federal government and so may not have had as much freedom to express their thoughts on the subject. Even though Burke-Gaffney did very much doubt the ETH, and thought that UFOs must be outside the realm of conventional astronomy, he nevertheless demonstrated a reticence toward a definite answer. Science did not, in fact, have the power to explain everything, and sometimes it was necessary to simply wait and see what would happen. A particular "rhetoric of patience," we argue, infused Burke-Gaffney's commentary on UFOs during his first decade of interest in them. He continually insisted that the appropriate scientific personnel must carry out a sober and careful examination of the available evidence on UFOs before arriving at any conclusion. This insistence, of course, was simply good scientific practice.

Burke-Gaffney first articulated his position on UFOs in July 1947 in response to a series of local UFO reports from Prince Edward Island during the weeks following the now famous Kenneth Arnold sighting. The term "flying saucer" entered popular parlance after Arnold reported seeing what he described as nine flat, reflective, saucer-like objects flying at high speed over Mount Rainier, Washington. Burke-Gaffney found himself inundated with calls from wire services in both Ottawa and Washington— including the Associated Press, United Press, Reuters, and the Canadian Press— asking about a similar flying saucer sighting in Prince Edward Island a few days after Arnold's.[17] The Sydney, Australia-based *Sun* quoted him as saying the objects were "outside the realm of astronomy," whereas the London *Evening Standard* incorrectly reported that Burke-Gaffney had himself seen one of these alleged flying saucers.[18] In a tongue-in-cheek letter to the editor published by the *Evening Standard*, he set the record straight:

> I never saw a flying saucer.
> I never hope to see one.
> There's one thing, note it, please sir.
> I'd rather see one than be one.[19]

However, if UFOs were not astronomical phenomena, what were they? Burke-Gaffney resisted attempts by reporters to nail down an origin, but they, however, demanded some kind of concrete answer to the mystery. His reluctance to oblige appears to have wavered in September 1950, when he told a reporter for the *Chronicle-Herald* that he "could only hazard a guess" that UFOs might be military in origin.[20] It was three years after the first major sightings in 1947, and so the persistence of the phenomenon may have convinced Burke-Gaffney that it warranted further consideration.[21] Whereas previously he brushed off the issue and advocated for patience, he now considered it more attentively. In his notes he constructed a hierarchical list of potential explanations.[22] These included balloons, flares, high-flying planes, kites, passing clouds, reflections from planes, and hoaxes. Initially, balloons and flares were his top two choices, but upon further consideration he moved "kite" from seventh to second position and moved up "reflection from plane" to make "hoax" the final, and least likely, option (in contrast to Millman's view). Faintly, in pencil, he also noted that the Korean War was ongoing at the time of the September 1950 sighting, perhaps indicating that the military explanation was indeed worth further consideration. Notably absent from his list of potential explanations was the possibility that the objects were extraterrestrial. As the reporter for the *Chronicle-Herald* stated, Burke-Gaffney "laughed off" the suggestion that the alleged flying saucers were anything other than natural or terrestrial. If flying saucers were indeed some kind of secret military aircraft or project, then they were still a non-astronomical phenomenon. Nevertheless, the press continued calling upon Burke-Gaffney because he was willing to talk about the possibilities without immediately shutting the topic down.[23]

On the evening of 25 May 1952, witnesses saw a bright flash in the sky near Halifax between ten thirty and ten forty-five. Frank Johnston of Spryfield, NS, who was in his car with three other men, stated: "I turned on the headlights of my car outside the house and just then I see this 'blue ball' rushing through the sky. It came out of the south and went straight north… it lit things up like a full moon. I thought it was a short circuit in my headlights at first. But that's what it looked like, a great big blue ball."[24] Johnston was just one of several witnesses who called the newsrooms of both the *Chronicle-Herald* and *Mail-Star* that evening, the majority of whom believed the object was a flying saucer.[25] According to the *Mail-Star*, an official at the Dominion Weather Office was unable to explain the sightings. Nevertheless, due to heavy cloud cover at the time of the sighting, the official discounted the possibility that the object was a meteorite and instead concluded that it was likely "man-made." The next day the *Mail-Star* ran another story about the sightings, adding Burke-Gaffney's candid comments to the mix: "Admittedly when a meteor falls, it some times [sic] shows a variety of colours, but I don't think this was a meteor, for the description doesn't fit."[26] Burke-Gaffney did speculate that there was a possible terrestrial explanation: "All I can say is that it may have been some giant rockets bought by someone in this area and left over from Victoria Day celebrations."[27]

Figure 2. *Reverend M.W. Burke-Gaffney with telescope on the roof of the McNally Building, St. Mary's University, July 1957, photographer unknown. Photo courtesy of St. Mary's University Archives (Halifax, Nova Scotia).*

However, it appears that Burke-Gaffney was not entirely satisfied with his response to reporters. Several days later, he offered another opinion on the sightings, this time claiming the object was likely a bolide, a meteorite that had exploded in the atmosphere at a height of 40,000 feet:[28]

> All meteors are small pieces of matter which come into the earth's gravitational field from outer space. They ignite from the intense friction of the earth's atmosphere. Usually they burn themselves out before reaching the ground. If they burn out while still very high, and looking small, they are called shooting stars. If they come low and look big, they are called fire-balls. Bolides are fire-balls that end their career with a bang.[29]

Providing readers with a simple, concise, and clear outline of the different kinds of meteors that Nova Scotians could expect to see in the sky, Burke-Gaffney took the sightings as an opportunity to educate the public. By explaining how he arrived at his conclusion that a bolide had caused the sightings, he demonstrated for readers the efficacy of a scientific approach. Speculation and unfounded theorizing were unnecessary. As long as the public remained patient and provided accurate data, experts would arrive at a sound conclusion.

Over the next few years, Burke-Gaffney solidified his position as an expert astronomer [**Fig. 2**] whom the public could trust. He did so through regular media interviews, and by making two more identifications of meteors on 24 February 1955 and 9 December 1959.[30] However, to his chagrin and despite his best efforts to provide what he believed were sound, reasonable, and accurate explanations of otherwise mysterious sightings, Nova Scotians continued to report flying saucers. They also continued to consult Burke-Gaffney, expecting he would assess their reports with a reasonably open-mind. Of course, Burke-Gaffney was clear about his position on the ETH, but given that no other intellectual or government official was willing to express any doubt on record, he became the local media's favourite expert.[31]

Things were changing by the late 1950s. When Charles Harnett wrote to him in September 1957 requesting his opinion of UFOs, Burke-Gaffney's response to the letter indicates that his perspective, as well as his willingness to consider various explanations, was beginning to harden. He identified "impatience" as one of the underlying causes of the controversy and suggested that "persons impatient to have an explanation" readily jumped to the extraterrestrial hypothesis, undermining the scientific process. By the late-1950s growing public and media interest in UFOs now attracted attention to the deepening rift between sceptical scientists and proponents of the ETH. Popular UFO writers such as George Adamski and Donald Keyhoe did little to help. As astronomer and historian Steven Dick argues, their claims brought "new scientific disrepute" to UFOs, discouraging study of potentially credible sightings and strengthening the position of sceptics.[32] Burke-Gaffney's appeal to patience was no doubt a response to this increasingly polarized debate, as well as to the threat posed by UFO writers and investigators like Harnett to scientific authority. He admitted to Harnett that a satisfactory explanation had not yet been reached, but cautioned, "not all that is unexplained is unexplainable." If the public would be patient, scientists would reach an acceptable conclusion in time. As he explained, "Not all that defies the explanation of one generation defies the explanation of the next generation." The development of new technology and the continued advancement of scientific knowledge would, from his perspective, likely lead to an answer. The problem, Burke-Gaffney noted, was that the evidence simply did not exist to justify anything other than a prosaic explanation: "In 1947, I took the stand that the flying saucers seen in June and July 1947 were not extraterrestrial and therefore none of my business. But as each sighting was reported, I judged it on its merits. By 1950, I had not heard of any that gave evidence of being extraterrestrial."[33] It appears at first blush that Burke-Gaffney, given his insistence on patience and his trust in the scientific process, may have been willing to consider the possibility of extraterrestrial visitation via UFOs if supported by the available evidence. However, this is also unlikely, given that he was convinced that claims of UFO sightings simply lacked the necessary detail to make a proper scientific study of them. It is more likely that Burke-Gaffney, like many of his colleagues, simply believed that the phenomenon needed more time to resolve into focus.

This makes it even more interesting that by 1960 Burke-Gaffney began embracing the idea that life exists on other planets, a theory that at the time had arguably no more evidentiary proof than UFO visitation. With more than a decade of research on the topic, Burke-Gaffney outlined his perspective on the possibility of extraterrestrial life in the *Halifax Gazette* in April 1960.[34] He advised his readers "space travel is just around the corner," and contemplated what humans should expect to find upon reaching the moon, and even Mars. Conditions elsewhere in the solar system, he argued, did not favour life. However, this might not be the case in distant solar systems. "It would be rash, even presumptuous to deny the possibility. The simple fact is that we do not know." Radio astronomy seemed to present new possibilities for discovery, but astronomers listening for alien radio signals seemed "far-fetched." Progress, however, was inevitable. New technology, new perspectives, and new ambitions would push the boundaries of astronomy, but it would require careful analysis and need to harness the full potential of the scientific knowledge currently available. He explained to his readers that there was both cause for excitement and a need for patience as new discoveries followed new advances in technology:

> Preceding from such dreams, and confining ourselves to what now seems possible, we see exciting prospects opening before us. Our horizons are to be widened. Our knowledge of the stars comes from the light and other radiations that we receive from them. These radiations come to us through a thick atmosphere, which is sometimes turbulent. The view which we get of the stars is somewhat like the view which a fish at the bottom of the ocean gets of a gull flying over the sea. This view is being improved upon. Already photographs have been taken from rockets high in our ionosphere, and from balloons high in the stratosphere. They show the sun as we have never seen it. When observations can be made from the moon, we shall delve more deeply into the mysteries of the universe.

Burke-Gaffney's words indicate his maturing attitudes toward UFOs and the ETH. In the late 1940s, he was adamant that UFOs were not extraterrestrial, but remained open-minded about possible origins and advocated patience until science could make sense of it. By 1960, advances in scientific technology had convinced him that life in outer space was, at least, possible, even if UFOs were still bunk.

Scientific curiosity and the thrill of discovery, however, could not alone fully uncover the wonder of the cosmos. As he explained in the same article, "The Lord God, who has planted in the heart of man an insatiable thirst for knowledge…. has entrusted to man the whole creation in order that he may penetrate it and come to understand, even more and more, the infinite intelligence and greatness of his Creator."[35] The commentary he first offered to reporters back in 1947, and throughout the 1950s, lacked any kind of explicit religious tone or theological perspective. His religious position as a member of the clergy would have been clear to readers as most news reports introduced him as "Rev. M.W. Burke-Gaffney," but in his public statements related to UFOs, he had never before felt it necessary or appropriate to address reports from a religious perspective. Why then did Burke-Gaffney choose to conclude this latest article on the possibility of extraterrestrial life with explicitly religious comments? It seems to suggest that he saw the UFO phenomenon and the possibility of extraterrestrial life as separate concerns, each with its own scientific and intellectual merits. In the possibility of extraterrestrial life, he explained, "It seems that [humanity] is now offered the chance to breach the barrier, and to attain to new truths and to new knowledge of the things that God has spread in such profusion throughout the Universe." The possibility of extraterrestrial life appealed to his scientific and theological curiosity, connecting both his research interests and his religious vocation. UFOs and the ETH, however, he claimed to reporters, and again to Harnett in 1957, were not astronomical phenomena and thus "none of my business." This, it turns out, was not entirely true. Burke-Gaffney's involvement in the study of UFOs continued into the 1960s, and his involvement cannot be explained simply as the fault of reporters.

The Associate Committee on Meteorites and Waning Public Trust, 1960–1969

In the early 1960s, Burke-Gaffney's involvement in the federal government's UFO investigation formalized. Although Project Second Storey had run only from 1952 to 1954, various departments continued to take an interest, however weakly, in UFOs. There was never any central communication or instructions regarding the objects, leaving individual departments and agencies to construct their own policies around sighting reports, usually corresponding to their specific motivations or mandates. For example, various sections within the National Research Council (NRC), headquartered in Ottawa, maintained an interest in the tracking of meteorites and fireballs, although during the early post-war period there was no formal procedure in place to guide this task. This changed as the result of the fall and recovery of meteorite fragments north of Bruderheim, Alberta on 4 March 1960. This event catalyzed the formation of the NRC's Associate Committee on Meteorites (ACOM), a body comprising scientists representing each province and territory. While in operation, NRC's various associate committees served "as instruments to provide the opportunity to bring together experts for the study, coordination, and promotion of research on problems of national significance. When an associate committee studied a particular problem, it collected and collated pertinent information, delegated research problems, coordinated research, and suggested new avenues of research."[36] The NRC tasked ACOM with establishing a reporting procedure for meteorites in case its members could recover pieces from a future landing. The membership of this committee fluctuated over the years until its termination in the early 1990s, due to a shortage of personnel.[37]

In addition to chairing Project Second Storey, astronomer Peter Millman also became the chair of ACOM. While the purpose of ACOM was specifically meteorites and fireballs, not surprisingly the public also submitted UFO reports to the committee. In his role as chairman, Millman made it clear that the committee's primary interest was in the scientific study of the nature of meteoritic objects and their rapid recovery when found. UFO reports might be useful under this umbrella as a contribution to tracking meteorites and fireballs, but "all sighting reports that do not seem to refer to fireballs or meteors will be placed on the non-meteoritic sighting file which will be unclassified, as in general we do not deal with classified material in our research program."[38] Millman was referring to a separate file that the NRC eventually established for the collection of UFO reports to keep them from intruding into the real business of the committee.

In practice, however, keeping meteorite and UFO reports separate was difficult. On and off for about fifteen years, Burke-Gaffney served as the ACOM representative for Atlantic Canada, and so was at the front line of reports of unusual things seen in the sky. In a letter to Millman on 12 April 1962, Burke-Gaffney provided an update on the status of his work and of the program in general. He informed Millman that a recent report of a "green falling star" by a woman in Purcell's Cove, NS might interest the committee. The woman in question contacted Burke-Gaffney's office and he duly investigated the sighting, looking for additional reports as well as data that might shed light on its trajectory and the likelihood of obtaining a sample. The RCMP confirmed that no report matching the date and time of the sighting existed. However, Burke-Gaffney did receive three newspaper clippings from the *Moncton Transcript*, as well as a Canadian Press dispatch, that he enclosed with his letter. Based on one witnesses' observation that the object was "as bright as the sun," and another's report that it was small, Burke-Gaffney concluded that the object likely broke up as it moved through the atmosphere. In addition to his evaluation of the meteor sighting, he also included a brief comment on the cooperation of the RCMP, RCAF, Army, and Navy with the committee's meteorite reporting program. "Of the program in general," he reported,

> From January 29 to March 27, I have received half a dozen reports from the RCAF, who are to be commended on showing a spirit of cooperation. (I presume you received copies of these reports.) I received one report from the RCMP (that dated April 5). I have received none from the Army and Navy.[39]

As a recommendation, perhaps to help increase the number of reports available for evaluation or to secure a more direct route to witnesses, Burke-Gaffney asked if it was possible to enlist the assistance of the press more directly. In his response, Millman thanked him for the forwarded information and noted that the committee would consider his recommendation at its next meeting.[40]

In his capacity as a regional representative of the ACOM, Burke-Gaffney conducted his research methodically, following up with both the police and the public when they submitted reports. In August 1962, he received a report from the RCMP about a potential meteorite sighting made by Aurele Doucet near his home in West Bathurst, New Brunswick. [41] Doucet told the police that he watched the object fly overhead and fall somewhere in the forest approximately one mile from his house. Intrigued, Burke-Gaffney wrote to Doucet for more information, asking if the object was located or if locating it would be possible.[42] Doucet's response included a newspaper clipping explaining that a parachute flare released by local youth caused the sighting.[43] In another such incident in November 1965, Burke-Gaffney received a letter from Gordon Beattie of Pictou, NS in response to a newspaper report about a recent sighting on which Burke-Gaffney had commented.[44] Beattie had witnessed a bright flash of blue light broaden into a string of white lights or balls for approximately two to three minutes before they faded from view. He explained that he was not looking for publicity and, because of discussing the sighting openly, had become the subject of ridicule. Perplexed by the report, Burke-Gaffney began an investigation, appealing to the Smithsonian Institution Astrophysical Observatory for help. The Smithsonian confirmed that it was possible an object entering Earth's atmosphere caused the sighting.[45] In his response to Beattie, Burke-Gaffney confirmed that the Air Force had no planes near the location of the sighting and concluded that the cause was neither a meteor nor satellite re-entering the atmosphere.[46] Without a positive identification to offer, he thanked Beattie for his report: "I have no doubt that you saw what you have described, and I would like to assure you, that I am grateful to you for reporting your observations. Such reports can be of great assistance." He concluded by acknowledging the "kidding" Beattie suffered by reporting the sighting, noting that he too had suffered similar ridicule after seeing the Northern Lights for the first time while working as an engineer in Manitoba.

Burke-Gaffney was willing to cooperate with law enforcement and military personnel, and was responsive to the experiences and concerns of the public, fulfilling his ACOM role in a way no other representative in the country was able or willing to do.[47] In fact, his correspondence with Beattie demonstrates that he investigated reports from the public in a serious and professional manner, sharing with them the results of his investigations. It also shows that he was aware of the risks of reporting unusual sightings and sympathized with witnesses who suffered ridicule by speaking openly about them. It was because of this kind of candidness in his correspondence with others and in the media that the community had come to trust Burke-Gaffney and his opinions. Burke-Gaffney's efforts were unique among other academics, like Peter Millman and the Project Second Storey committee, who almost uniformly dismissed reports and refused to investigate.[48]

The attitude of Millman and other scientists like him reflected broader changes in the UFO debate and the public's attitudes toward expertise in the mid-1960s, exemplified by the Condon Committee. In October 1966, the University of Colorado accepted a contract from the United States Air Force to conduct a scientific study of the UFO phenomenon headed by respected American physicist Edward U. Condon. The committee worked through thousands of UFO reports, only to conclude in 1969 that all efforts toward solving the UFO mystery had been a waste of time. Historian David M. Jacobs argues that the beginning of the University of Colorado study marked a turning point in the

UFO controversy in the United States as the press, government officials, the public, and the scientific community renewed their interest in UFOs.[49] After the initial excitement of the late-1940s and early 1950s, public interest waned and the debate moved out of public view. Civilian UFO research groups such as the National Investigations Committee on Aerial Phenomena (NICAP), the Aerial Phenomena Research Organization (APRO), and, later, the Mutual UFO Network (MUFON), all of which were unhappy with the air force's near-monopoly over UFO data, became an important vehicle of the ongoing debate. This changed in 1966 as press coverage of UFOs increased and public debate resurfaced.

After the Condon Committee released its report in 1969 the debate intensified.[50] Civilian UFO investigators criticized Condon for his lack of neutrality and his skepticism of scientists who attempted to take the matter seriously. Despite Condon's efforts to finally debunk the matter, UFO sighting reports increased. As Jacobs notes, the United States Air Force received nearly 3000 UFO reports between 1965 and 1967, an exponential increase.[51] Similarly, UFO reports in Canada jumped from 55 in 1966 to 167 in 1967. Not only did Condon fail to convince the public that UFOs were a waste of time, he actually spurred even more interest in them, and contributed to a growing sense that scientists and experts might not have the public's best interests in mind. Burke-Gaffney had secured a prominent position in the early UFO debates of the 1940s and 1950s, but this status was quickly coming under fire.

This changing attitude is most visible in an exchange of letters with Wayne Wright, a high-school student from Summerside, Prince Edward Island, who identified himself as the Canadian Director of the Thada UFO Research Society. From March 1965 to January 1966, Wright maintained a regular correspondence with Burke-Gaffney related to local UFO sightings. In his first letter he noted, "It is the first time I could actually speak with a true scientist about UFOs although I have written to many other saucer 'authorities.'" Looking to establish the Canadian branch of Thada as a serious UFO research organization, Wright wanted Burke-Gaffney's support and, most importantly, access to both his expertise and his UFO files. Burke-Gaffney's response was thorough and succinct. After answering a series of questions Wright had posed, Burke-Gaffney provided a summary of his scientific opinion on UFOs, refined from the early days:

> Of phenomena which I have seen in the sky since 1947, I have identified 99.9% - the other 0.1% await explanation. I would deem it unscientific to have recourse to beings outside our solar system until we have exhausted all possible explanations to be found from phenomena within our Solar System. To invent unknown objects as the cause (-instead of saying that the cause is unknown-) is a regression towards the Greeks who invented a new god or goddess to account for what they could not explain. It is a going back further than medieval times, when they gave a cause a name and then rested comfortably.[52]

Wright was undiscouraged by Burke-Gaffney's response. He acknowledged that many sightings were the result of known phenomena but insisted that "true" cases of "metallic discs" seen by reputable witnesses suggested there was more to the issue. He illustrated his point for Burke-Gaffney with a hand-drawn diagram of a flying saucer, labelled "These are not fireballs."[53] Wright's five-page letter defending the UFO phenomenon and the testimony of witnesses elicited little response, in itself an unusual change for Burke-Gaffney, who had always been willing to engage. Burke-Gaffney answered Wright's request for information related to sightings in Prince Edward Island by noting he indeed had a file that included the 1947 sightings but provided no further information. He did, however, enclose a copy of the Canadian Air Force's standard fireball reporting forms for Wright to use if he ever saw one. His short, two-paragraph letter made no further reference to Wright's comments.[54] Undeterred, Wright wrote back four days later, reiterating his interest in the file and asking Burke-Gaffney if he would consider examining reports collected by Thada and share information he obtained from his "sources."[55] There was no response.

Burke-Gaffney did not respond to Wright for another four months. Now frustrated, and convinced that Burke-Gaffney had no serious interest in UFOs after all, Wright wrote to him again. Significantly, Wright accused the astronomer of failing in his professional duties as a scientist: "I think that you could be of greater service to your profession if you devoted your time to the [UFO] research instead of inconsequential meteorites and other heavenly bodies."[56] Perhaps prompted by Wright's forcefulness or the claim that he had never clearly stated his position on UFOs, Burke-Gaffney finally wrote back. Longer than his previous letters, the response included examples of allegedly anomalous sightings later explained as natural or physical phenomena. He reaffirmed his earlier position, which he also often stated to the press: there was no evidence that UFOs were extraterrestrial.[57] Wright responded three days later, reaffirming his own opinion that there were too many reports from reputable and high profile witnesses to discount the ETH. Burke-Gaffney did not answer and they exchanged no further correspondence until the following year, when Wright wrote to him to request information about a sighting in Cape Breton. In his response, Burke-Gaffney discussed a recent conference he had attended and provided the information Wright requested, exclaiming, "it is a mental jolt to come down to your low flying planes!"[58]

Wright's last letter to Burke-Gaffney built upon similar points expressed in his previous correspondence. However, it also revealed his frustration with what he saw as Burke-Gaffney's inflexibility and lack of objectivity. Wright now interpreted the astronomer's attitude as symptomatic of scientists' treatment of UFOs more generally: "I might be speaking out of line but was any mention made of any recent 'saucer' sightings during the symposium? If not I doubt the reality of the so-called 'scientific mind.'" A student at university by this point, Wright further explained, "It may seem impertinent for a college student to speak so but if you believe what you say it is wrong to remain silent."[59] Something had clearly changed for Burke-Gaffney. Whereas before the astronomer was called upon as a respected source of authority, his correspondents now seemed to distrust his motivations.

In the ideologically charged climate of the UFO controversy of the mid-1960s, public interest and press coverage of UFOs in Nova Scotia followed a similar trajectory as it did in the United States. Burke-Gaffney's correspondence with Wright revealed the limits of his willingness to engage the controversy. As an ACOM representative, he was willing to elicit the public's help in identifying meteor sightings. He was even willing to investigate on behalf of witnesses and share his results, but collaboration with civilian or non-academic research efforts seemed out of the question. By invoking the history of science in his letters, he revealed that the proliferation of the UFO debate was a threat to normative science and human progress. However, he also indicated that he had not given up on his plea for patience either. As he told Wright, there are unidentified flying objects simply because there are objects that remain unidentified. Unfortunately, for Burke-Gaffney, the end of his correspondence with Wright did not end his involvement with the controversy. There was more yet to come.

On 4 October 1967, residents in the village of Shag Harbour, Nova Scotia watched a string of lights fly overhead before crashing into the Atlantic Ocean. When witnesses began telephoning the RCMP detachment in Barrington Passage to report a downed aircraft, a rescue party of local fishers went in search of survivors in the harbour. Three RCMP officers and at least a dozen residents watched the object disappear beneath the surface. The search party found no craft, no debris, and no survivors. There was, however, a patch of sulfurous-smelling yellow foam on the water's surface. A Canadian Coast Guard vessel stationed at nearby Clark's Harbour joined the search, as well as a navy dive team who took over operations and conducted an underwater search lasting three days. The events unfolding in Shag Harbour became front page news by the seventh of October when the *Chronicle-Herald* ran the headline "Could Be Something Concrete in Shag Harbour UFO – RCAF," quoting an air force squadron leader named William Bain. According to Bain, the air force was "very interested" in the crash and told the reporter, "We get hundreds of reports every week…but the Shag Harbour Incident is one of the few where we might get something concrete on it."[60] When the navy divers concluded their search on 8 October, they had nothing to report. According to Canadian Forces Maritime Command, the search turned up "Not a trace…not a clue…not a bit of anything."[61] Press coverage of the crash was extensive in newspapers across Atlantic Canada and included both of the main Halifax papers, as well as papers in Yarmouth and Moncton.

Unable to provide an explanation for the mysterious crash at Shag Harbour, the efforts of the RCMP and Canadian Forces to investigate and locate the allegedly downed craft appeared to lend legitimacy to the UFO phenomenon. Bill Fox, a reporter for *The Vanguard* based in Yarmouth, stated that local fishers, despite the exhaustive search conducted by the divers, intended to conduct their own search for the object that they believed was a UFO.[62] An editorial in the Dartmouth *Free Press* expressed a similar sentiment, arguing that the events in Shag Harbour posed a challenge to skeptics.[63] Around the same time, two research scientists, Rupert MacNeill of Acadia University and R.C. Tennyson of the University of Toronto, stated to reporters they believed the Shag Harbour UFO to be a "prototype supercraft" under development by the United States Department of Defence. In addition to MacNeill and Tennyson's support for the "military craft theory," the report also claimed (whether erroneously or not) that many members of the ACOM, of which MacNeill was a member, also believed that some UFO sightings were likely experimental military aircraft.[64]

Burke-Gaffney was not so sure. He advised the *Chronicle-Herald* that the Shag Harbour sighting was neither an extraterrestrial vehicle nor a military aircraft. He gave the statement following a lecture he delivered at St. Mary's University addressing recent interest in UFOs. The newspaper reported that "Father Burke-Gaffney thought saucer speculation by astronomers did not do the science much good," arguing that while life elsewhere in the universe seemed probable, there was no evidence extraterrestrials had visited Earth. The *St. Mary's Journal* further reported that Burke-Gaffney claimed 94% of sightings were explainable, citing marsh gas, mirages, and meteorites as frequent causes of UFO sightings.[65] It is unclear how his audience received the lecture, but in mid-December, a letter to the editor attacking Burke-Gaffney's remarks indicates that some members of the public were questioning the skeptical line maintained by scientists like Burke-Gaffney. In his letter, John O'Brien agreed that scientists might indeed identify many sightings as known phenomena, but certainly not all of them. As he wrote, "If it was the intention of Father Burke-Gaffney to pacify the masses, then he has failed," arguing that even if the objects were terrestrial, they represented a serious threat to public safety and security. However, their flight characteristics and ability to disrupt electrical systems indicated, O'Brien argued, an extraterrestrial origin. He concluded, "Why this letter? To show, that with some of us, while we have our feet solidly on the ground, our heads are not in the sand."[66]

In the late 1940s and throughout the 1950s, when other scholars openly mocked the subject, the public had welcomed Burke-Gaffney's open-minded views about UFOs. Even though he was also skeptical, his calls for patience and his commitment to public education in the region were what the press and the public wanted to hear. By the mid-1960s, Burke-Gaffney was out of his element. His views had not much changed, but public sentiment certainly had. The community no longer received Burke-Gaffney's thoughts on UFOs with such enthusiasm, seeing him no longer as a progressive influence within the scientific community, but instead as just another cynical scientist intent on debunking the subject.

The public's attitude toward UFOs at this time was a reflection of broader trends in Canadian society. During the 1960s, Canadians began to depart from a long tradition of deference to the state's authority.[67] As the baby boomer generation came of age, attitudes toward authority— and scientific authority and expertise specifically— started shifting. Previous generations had readily placed their trust in institutions like the state and the universities, assuming their benevolence and the power of their reason. But the experience of the Second World War and the technical rationality that underpinned its various horrors shook this belief in authority and expertise. This was especially evident, for instance, in the United States, where youth took to the streets to protest the Vietnam War and the ongoing threat of nuclear war with the Soviet Union. Whereas Burke-Gaffney was quick to express his faith in the progress of science and technology for humankind, others— such as Wayne Wright and John O'Brien— concluded that perhaps these institutions were not so benevolent after all.[68]

Conclusion

Burke-Gaffney's involvement in the UFO debate in Atlantic Canada waned after the 1960s ended. He had stepped into the spotlight almost immediately, only days after the infamous Kenneth Arnold sighting in 1947 that kick-started the modern era of UFOs. It was unusual for a university professor to speak so openly to the press about the phenomenon. When other scientists did so, they invariably strove to debunk the idea and attempted to assure the public that there was no mystery about it. Burke-Gaffney certainly shared part of this view, that UFOs were not extraterrestrial in origin. Yet, his ideas were more nuanced. He continually advocated for patience and trust in the scientific method, assuming that with time and more evidence, the answer to the UFO enigma would become clear. He was also willing to investigate credible sightings and give them their due diligence, in an attempt to provide clear evidence one way or the other. Burke-Gaffney's willingness to engage with the issue in a public forum, and through solid scientific investigation, endeared him to the community. Even if he would not admit the possibility of extraterrestrial visitation, at least he was discussing the topic. This article has argued that what historian Jennifer Hubbard calls an "ideal of service," something unique to Atlantic Canada, spurred Burke-Gaffney's public engagement.[69] The astronomer was committed to scientific education for the region, especially in Nova Scotia, given his position at St. Mary's University in Halifax. Even though he considered UFOs a strange departure from his normal work, he nevertheless thought they presented an opportunity to expand scientific literacy.

The respect that the media and the community had for Burke-Gaffney did not last. By the mid-1960s, understandings of the UFO phenomenon, and wider ideas about authority and expertise, had begun to change. Burke-Gaffney's personal views about UFOs remained mostly the same. He was always skeptical of the extraterrestrial hypothesis. Whereas his call for patience and his speculations about possible origins were welcome in previous years, by the time the U.S. military formed the Condon Committee the public found Burke-

Gaffney's views antiquated and just as stifling as they had always found those of his more conservative colleagues. In effect, the ideal of service to which Burke-Gaffney adhered became the very source of conflict in later years. At a time when deference to the benevolence of science and technology were waning, Burke-Gaffney continued to publicly engage with the issue and insist on patience, assuring the public of the power and scope of scientific knowledge. This put him at odds with UFO investigators and enthusiasts like Wayne Wright, who no longer thought that mainstream scientists had all the answers.

By the time of his death in 1979, the tenor of public opinion had changed, and the astronomer found himself at odds with the supporters of the ETH. This is ironic, considering Burke-Gaffney never wanted to study UFOs. In a sense, public interest forced him into the phenomenon in the first place. Yet, despite the changing reception his public statements received, and for all his skepticism and insistence on technical explanations of meteorological phenomena, he always maintained that what kept him interested in the topic was the never-ending mystery of the cosmos. As he said in April 1964, "In a deeper sense than ever before, the heavens declare to astronomers the Glory of God and the firmament proclaims to them the work of His hands."[70]

Matthew Hayes is a SSHRC Postdoctoral Fellow in the Department of History at the University of Western Ontario.

Noah Morritt is a doctoral candidate in the Department of Folklore at Memorial University.

Endnotes

1 "Mysterious 'Saucers' Seen Again," *Chronicle-Herald* (Halifax, NS), 21 September 1950.

2 "Children Report Seeing Flying Disc Over City," *Chronicle-Herald* (Halifax, NS), 25 August 1950.

3 Ibid.

4 Ibid.

5 "Mysterious 'Saucers' Seen Again."

6 "Teacher, Astronomer Dies at 82," *Chronicle-Herald* (Halifax, NS), 15 January 1979. The archival material used for this article is from the Burke-Gaffney fonds at the Saint Mary's University archives.

7 Many scholars identify antecedent themes, motifs, and descriptions of UFO-like phenomena prior to 1947. See, for example, Thomas E. Bullard, *The Myth and Mystery of UFOs* (Lawrence: University Press of Kansas, 2010), Jerome Clarke, "The Extraterrestrial Hypothesis in the Early UFO Age," in *UFOs and Abductions: Challenging the Borders of Knowledge*, ed. David M. Jacobs, 122-40 (Lawrence: University Press of Kansas, 2001), and David M. Jacobs, *The UFO Controversy in America* (Bloomington and London: Indiana University Press, 1975). However, many date the beginning of the UFO phenomenon to the Kenneth Arnold sighting on 24 June 1947. See Brenda Denzler, *The Lure of the Edge: Scientific Passions, Religious Beliefs, and the Pursuit of UFOs* (Berkley: University of California Press, 2001) and Steven J. Dick, *Life on Other Worlds: The 20th- Century Extraterrestrial Life Debate* (Cambridge and New York: Cambridge University Press, 1998).

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18 "On Origin of 'Flying Saucers,'" *The Sun* (Sydney, Australia), 4 July 1947.

19 Letter to the Editor, *Evening Standard* (London, UK), 22 July 1947.

20 "Mysterious 'Saucers' Seen Again," *Chronicle-Herald* (Halifax, NS), 21 September 1950.

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23 Other potential Canadian sources were not so generous. For instance, the Department of National Defence issued a decree forbidding its employees from speaking to the CBC about UFOs. See L.A. Bourgeois to DND Office of Information, 4 March 1965. Department of National Defence file on Unidentified Flying Objects. RG 24 vol. 17988, File HQC 940-105, Part 2, Microfilm Reel T-3291. Library and Archives Canada.

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25 "Fiery Object Over Halifax Area Still Not Explained," *Mail-Star* (Halifax, NS), 26 May 1952.

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27 Ibid.

28 "Believes Flash in Sky Was Bolide," *Chronicle-Herald*, 2 June 1952.

29 Ibid.

30 "Mysterious Light Said Stray Meteor," *Chronicle-Herald*, 25 February 1955; "Mystery 'Ball of Fire' Seen by Number Here," *Mail-Star*, 11 December 1959.

31 Like the DND's position, Peter Millman had earlier made it clear to the Project Second Storey committee that it was to make no contact with the press. See "Defence Research Board Project Second Storey, Minutes of the 2/52 Meeting," 19 May 1952. Department of Transport file on Sightings of Unidentified Aerial Objects." RG 97, Vol. 115, File 5010-4, Part 1. Library and Archives Canada.

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39 Burke-Gaffney to Millman, 12 April 1962, Burke-Gaffney Fonds, Academic Series, Astronomy Sub-Series, Fireballs File 3, 1999.17C.

40 Millman to Burke-Gaffney, 17 April 1962, Burke-Gaffney Fonds, Fireballs File 3.

41 RCMP Moncton Detachment to Halifax Division, 15 August 1962, Burke-Gaffney Fonds, Fireballs File 3.

42 Burke-Gaffney to L. Ducet, 15 August 1962, Burke-Gaffney Fonds, Fireballs File 3.

43 L. Doucet to Burke-Gaffney, 24 August 1962, Burke-Gaffney Fonds, Fireballs File 3.

44 G. Beattie to Burke-Gaffney, 18 November 1965, Burke-Gaffney Fonds, Academic Series, UFO Records Sub-Series, UFO File 5, 1999.17A.

45 C. Ready to Burke- Gaffney, 17 November 1965, Burke-Gaffney Fonds, UFO File 5.

46 It is unclear if he is referring to the Royal Canadian Airforce or the United States Airforce in his letter; Burke-Gaffney to G. Beattie, 23 November 1965, Burke-Gaffney Fonds, UFO File 5.

47 In a letter to Peter Millman, Edward Leith, another ACOM representative, mocked one witness: "At our last meeting of the Meteorite Committee you mentioned [a particular sighting]. When I got home from Ottawa I found the local paper had an article on the latest or most up to-date account (??) of it and thought you might like to have a copy for your files. You can see that it must be an authentic "saucer" because of the drawing made a the site!!!!" Leith to Millman, 11 April 1968. National Research Council Non-Meteoritic Sighting File. RG 77, Vol. 310, Microfilm Reel T-1744. Library and Archives Canada.

48 Indeed, during the late 1960s, the Department of National Defence transferred its responsibility for the UFO investigation to the National Research Council. The NRC grudgingly took it on, and even officials within DND noticed their reticence. See E.W. Greenwood to DGOps, 8 November 1967. Flying Saucers File. RG 24, Acc. 83-84/167, File 3800-10-1, Part 1. Library and Archives Canada.

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57 Burke-Gaffney to Wright, 12 July 1965, Burke-Gaffney Fonds, UFO 1965 March 29-July 13.

58 Burke-Gaffney to Wright, 13 January 1966, Burke-Gaffney Fonds, UFO 1966 January-February.

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64 The report, originally written by *Chronicle-Herald* staff writer David Bentley, was picked up by a number of local papers: "Shelburne's UFO: Secret 'War' Machine From U.S. – Scientists," *Chronicle-Herald*, 13 October 1967; "UFO New Supercraft Under Test, Scientists," *Moncton Daily Times*, 14 October 1967; "Shelburne's UFO: Secret War Machines from U.S. – Scientists," *Mail-Star*, 13 October 1967. A response from the Canadian Department of National Defence, published alongside MacNeill and Tennyson comments, claimed they had no knowledge of a secret aircraft over Nova Scotia at the time of the Shag Harbour Incident: "DND No Knowledge of Secret Project," *Chronicle-Herald*, 13 October 1967.

65 "U.F.O. Topic for 'Bear Pit,'" *St. Mary's Journal*, 27 October 1967.

66 John B. O'Brien, Letter the Editor, *Mail-Star* (Halifax, N.S.), 20 December 1967. O'Brien claimed to be speaking on behalf of a public audience that had become increasingly skeptical of scientific authority, however, the number of those interested enough in UFOs to actually engage with scholars always remained very small.

67 Neil Nevitte, *The Decline of Deference*: *Canadian Value Change in Cross National Perspective* (Peterborough, ON: Broadview Press, 1996); Chris Dummitt, *Unbuttoned: A History of Mackenzie King's Secret Life* (McGill-Queen's University Press, 2017).

68 Joseph Heath, *Enlightenment 2.0: Restoring Sanity to Our Politics, Our Economy, and Our Lives* (Toronto: HarperCollins, 2014), 217.

69 Hubbard, *A Science on the Scales*.

70 M.W. Burke-Gaffney, "The Heavens Declare the Glory of God, and the Firmament Proclaims the Work of His Hands," lecture given to the Cathedral Laymen's Association, 26 April 1964, Burke-Gaffney Fonds, Manuscripts Series, 1999.17G.

"Too Late For Action." A.G. Huntsman, M.L. Fernald and the Belle Isle Strait Expedition of 1923

Eric L. Mills[1]

Abstract: *A. G. Huntsman's Belle Isle Strait Expedition of 1923, the first oceanographic expedition organized by a Canadian, was modeled on the Canadian Fisheries Expedition of 1915, in which Huntsman had been a junior partner to the Norwegian fishery biologist Johan Hjort. Examination of Huntsman's documents shows that the 1923 expedition had more than one aim. For example, Huntsman hoped that one of the participants would be M.L. Fernald, a botanist from Harvard University. Although Fernald did not take part, his reason for interest in the expedition was to document his hypothesis that the flora of northeastern North America had spread along an emergent borderland after the last glaciation or had remained in unglaciated areas. Huntsman's aims were less transparent, but in addition to the oceanography they appear to be early steps in developing his concept of biapocrisis, the response of organisms as a whole to their individual environments, in which his collection of land plants during the expedition could play a part.*

Résumé : *L'expédition d'A. G. Huntsman dans le détroit de Belle Isle en 1923 constitue la première expédition océanographique organisée par un Canadien. Celle-ci s'inspire de l'Expédition canadienne de recherche sur les pêches de 1915, qui avait eu lieu alors que Huntsman était l'associé de Johan Hjort, un biologiste norvégien. L'examen des documents de Huntsman révèle que l'expédition de 1923 avait plusieurs objectifs. Huntsman espérait notamment que M. L. Fernald, un botaniste de l'Université Harvard, y participe. Bien que ce dernier n'ait pas pris part à l'expédition, il s'y est intéressé afin de documenter la trajectoire de la flore du nord-est de l'Amérique du Nord. Se serait-elle répandue le long d'une bande de terre ayant émergé après la dernière glaciation ou serait-elle demeurée dans des zones non englacées? Les objectifs de Huntsman étaient moins clairs; au-delà des travaux océanographiques, il en était aux premiers stades de l'élaboration du concept de biapocrisis, qualifiant la réaction des organismes dans leur ensemble à leurs environnements respectifs. Dans ce contexte, sa collection de plantes terrestres aurait pu appuyer ce travail durant l'expédition.*

Keywords: **Strait of Belle Isle, Newfoundland & Labrador, fisheries, botany, A.G. Huntsman, M.L. Fernald**

In 1926, the Harvard botanist Merritt Fernald wrote that "[i]n 1923, while I was in the mountains of Gaspé, the Biological Board of Canada undertook a survey of the Straits of Belle Isle and the invitation to join in this enterprise reached me too late for action. Consequently, the efficient Director of the Board[2], Dr. A.G. Huntsman, himself collected such land plants as came his way."[3] The "survey" was the Strait of Belle Isle Expedition of 1923, conceived and led by Huntsman under the aegis of the Biological Board of Canada, with the support of Huntsman's colleagues on the North American Council for

 Eric L. Mills, "Too Late for Action.": A.G. Huntsman, M.L. Fernald and the Belle Isle Strait Expedition of 1923" *Scientia Canadensis* 42, 1 (2020): 75-95.

Fishery Investigations, an advisory body made up of representatives from the USA, Canada, Newfoundland (in 1923 still a self-governing Dominion) and eventually France, all of whom were in one way or another involved in the Northwest Atlantic fishery.[4]

An expedition to the Strait of Belle Isle was not particularly unexpected, given the Strait's importance as a transportation route and as the northern entrance to the Gulf of St. Lawrence with its apparently huge fishery resources.[5] But Huntsman's invitation to a botanist to join an expedition ostensibly devoted to fisheries investigations was unusual not just for its time but for oceanographic and fishery expeditions in general, as was Huntsman's devoted effort to collect plants himself during the expedition. The invitation arose out of the special interests of Fernald in plant biogeography but also from Huntsman's emerging interest in the environmental relations of organisms. Fernald's interests are well known, but Huntsman's rationale for the 1923 expedition, and especially his interest in what land plants could add to his expedition and his approach to ecology, is not transparent, nor is it easy to untangle. This is the subject of this paper.

The Strait of Belle Isle

The Strait of Belle Isle figures in the early history of Canada as (probably) a Norse route into the Gulf of St. Lawrence, the highway for sixteenth-century fishermen to a fishing station on the present-day coast of Québec, and the path followed by Jacques Cartier into the Gulf and eventually the St. Lawrence River during the 1530s. Then and later it was a focus of European- and North American-based fisheries extending into the early 20th century.[6] But scientific knowledge of the Strait and the northern Gulf of St. Lawrence was very limited until late in the 19th century and later, despite their importance, and despite occasional interest in damming the Strait to "improve" the climate of the Gulf, based on the belief that there was major cooling by Labrador Current water entering by that route.[7]

The Superintendent of the Canadian Tidal and Current Survey, W. Bell Dawson (1854-1944) took an interest in the Strait at the turn of the 20th century:

> This strait is of the first importance to Canadian commerce: as a great circle from Montreal and Quebec to the middle of Great Britain passes through it. It thus forms the natural gateway for the St. Lawrence traffic, and is used as long as the season permits; as it affords a shorter route than through Cabot Strait and south of Newfoundland. The traffic through Belle Isle strait is consequently almost as great as on the St. Lawrence itself. …the importance of correct information regarding the currents in this strait is very evident, more especially as there is a considerable amount of fog in the early part of the season.[8]

Based on two summers investigation using tide gauges, Dawson concluded that although there was a lot of variation in currents in the Strait, and some evidence of inflow (westward) in the north and outflow (eastward) in the south,

Figure 1. *A.G. Huntsman in his laboratory in the Atlantic Biological Station, St. Andrews, New Brunswick, September 1920 (from University of Toronto Archives (UTARMS). Huntsman, Archibald Gowanlock, B2005-006, Series 10: Photographs).*

linked to weather systems, the net transfer of water was close to nil, making the utility of damming the Strait negligible.[9]

During the 1894 and 1906 tide surveys, Dawson's field workers had taken a series of water temperatures, showing, in general, cold water on the north (Labrador) side of the Strait and warmer water on the south (Newfoundland) side. These, he suggested might have broad and practical significance:

> [T]he influence of … temperatures on the movements of fish may be of importance …The coldness of the water, especially at the greater depths, in relation to other regions in the Gulf of St. Lawrence and around the coasts of Newfoundland as ascertained by this Survey may throw light on such questions. The temperatures may also help to explain the depths at which the fish are found as the season advances, and the change in their migrations from one season to another. The investigations of this Survey may thus afford information of practical value in such directions as these, apart from their direct bearing upon the behaviour of the currents.[10]

This statement captured the attention of A.G. Huntsman, the director of the Atlantic Biological Station in St. Andrews, New Brunswick, in the early 1920s as he began to think about the factors governing the distribution of East Coast Cod, the effect of temperature differences on the responses of organisms to their environments, and the circulation of the Strait.[11]

A.G. Huntsman: the Example of Johan Hjort and the Canadian Fisheries Expedition

Archibald Gowanlock Huntsman (1883-1973) [**Fig. 1**] became a dominating force in Canadian marine science, especially on the East Coast, from his position as Professor of Marine Biology in the University of Toronto, as Curator,

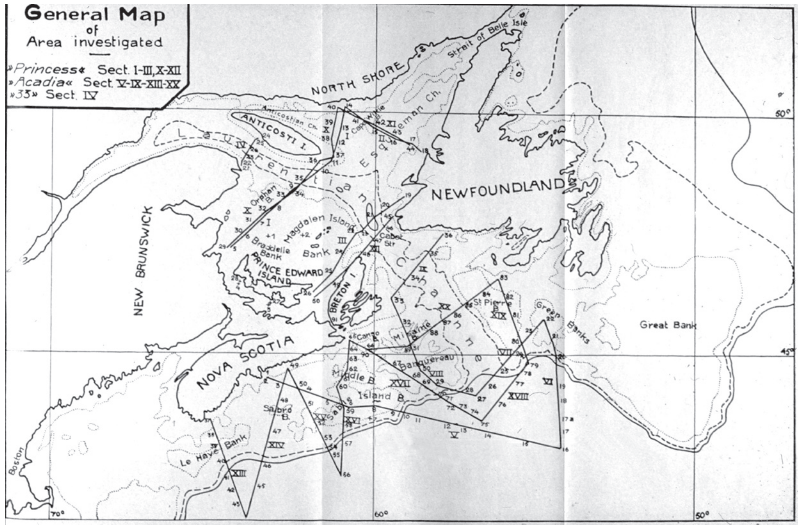


***Figure 2** (left). Johan Hjort about 1910 (from J. Murray and J. Hjort, The Depths of the Ocean: A General Account of the Modern Science of Oceanography Based Largely on the Scientific Researches of the Norwegian Steamer Michael Sars in the North Atlantic" (London: Macmillan, 1912), frontispiece). **Figure 3** (right). The route of the Canadian Fisheries Expedition of 1915 under the direction of Johan Hjort on the Scotian Shelf and in the Gulf of St. Lawrence (from Paul Bjerkan, "Results of the Hydrographical Observations Made by Dr. Johan Hjort in the Canadian Atlantic Waters During the Year 1915" in Canadian Fisheries Expedition, 1914-1915: Investigations in the Gulf. of St. Lawrence and Atlantic Waters of Canada, ed. Johan Hjort (Ottawa: Department of the Naval Service, 1919), Plate 1)*

then Director, of the Atlantic Biological Station in St. Andrews, New Brunswick (1911-1934), and in other capacities with the Biological Board of Canada and its successor, the Fisheries Research Board of Canada.[12] In his early career, he was greatly influenced by the then Norwegian Director of Fisheries, Johan Hjort (1869-1948)[13] [**Fig. 2**], who came to Canada late in 1914 and stayed through the summer of 1915 as the leader of the Canadian Fisheries Expedition [**Fig. 3**].[14] To the Canadian government, Hjort's mission was to locate new fish stocks, especially of herring, in the Gulf of St. Lawrence, while to Hjort the expedition was an attempt to provide New World evidence for the validity of his year-class hypothesis, as set forth in his 1914 monograph, *Fluctuations in the Great Fisheries of Northern Europe*[15] which made the case that fisheries were dominated by fish growing in especially favourable years.

Huntsman, as second-in-command to Hjort, had the opportunity in 1915 and during the write-up of the results to learn the most up-to-date European practices in oceanography, both at sea and in the laboratory. He set out thereafter to emulate Hjort and his methods in a series of yearly expeditions to East Coast locations as varied as the Miramichi estuary and the open Gulf of St. Lawrence off Cheticamp, Nova Scotia [**Fig. 4**]. The Belle Isle Strait Expedition was the last and most ambitious of the series, which was cut short after 1923 by Huntsman's appointment in 1924-1925 to direct a new Biological Board laboratory, a technological station devoted to fishing gear development and fish processing in Halifax.[16]

Figure 4. Expeditions involving A.G. Huntsman Expeditions after the Canadian Fisheries Expedition (CFE) of 1915, directed by Johan Hjort (in which Huntsman was a participant under Hjort), were organized by Huntsman on the general plan of the CFE.
1914 St Croix River & Passamaquoddy Bay Hydrography by J.W. Mavor & E.H. Craigie.
1915 Canadian Fisheries Expedition To the Gulf of St. Lawrence and Scotian Shelf. Oceanography and fisheries biology under Johan Hjort. Bay of Fundy dredging & hydrography by Mavor & Craigie.
1916 St. Mary's Bay & Annapolis Basin, NS/ Kennebecasis River, NB Hydrology and biology. Passamaquoddy Bay chemistry and hydrography by Alexandre Vachon.
1917 Cheticamp Expedition From the west coast of Cape Breton Island, Nova Scotia to the Magdalen Islands, Quebec. Hydrology and biology of the Western Gulf of St. Lawrence.
1918 Miramichi River & Bay, NB, Gulf of St. Lawrence Hydrology and biology.
1919 St. Mary's Bay & Annapolis Basin, NS/ Kennebecasis River, NB Hydrology and biology. Bay of Fundy & SW Nova Scotia drift bottle studies by J.W. Mavor.
1920 Hudson Bay Expedition For Biological Board by Frits Johansen.
1921 Shelburne Expedition SW Nova Scotia Fisheries & Hydrography based at Barrington Passage.
1923 Strait of Belle Isle Expedition Concentrating especially on the circulation of the Strait and on drift bottle studies of currents along the west and east coasts of Newfoundland in relation to fisheries.
1924 Halifax Harbour Hydrography by A.G. Huntsman.

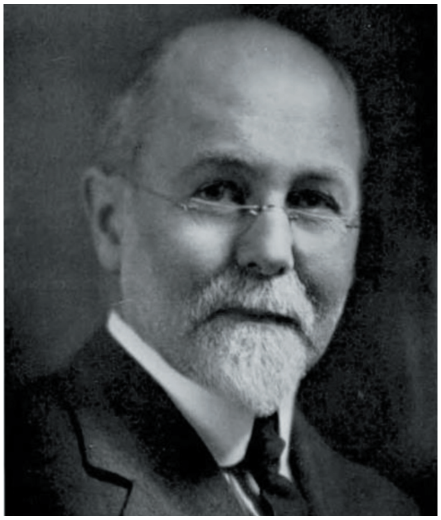


Figure 5a. *(Left) M.L. Fernald as a senior botanist in the Gray Herbarium, Harvard University (from E.D. Merrill, "Merritt Lyndon Fernald 1873-1950," National Academy of Sciences Memoir 28, frontispiece).* ***Figure 5b.*** (Right) *M.L. Fernald and Margaret H. Fernald cliff-climbing at Bic, near the base of the Gaspé Peninsula, Québec, summer 1907 (from M.L. Fernald, "Incidents of field-work with J. Franklin Collins," Rhodora 44, 520, plate 706).*

M.L. Fernald: Plant Biogeography, the Nunatak Hypothesis, and the Coastal Plain Flora

Merritt Fernald (1873-1950) [**Fig. 5a**]was the preeminent floristic botanist of his era. Born in Maine, he spent his entire scientific career at Harvard, rising through the ranks beginning in 1891 to become Fisher Professor of Natural History in 1915.[17] He was closely associated with *Rhodora*, the journal of the New England Botanical Society, as associate editor from 1899-1928 and as its editor from 1929-1950. Fernald made *Rhodora* his personal journal of record, including in his floristic and biogeographic studies personal accounts of his field work that are of great historical value but would never be permitted in present-day scientific journals.

Fernald came to Eastern Canada first in 1902 to explore parts of the Gaspé Peninsula and Cape Breton Island, returning for summer fieldwork mainly in the Gaspé region from 1904 through 1907 [**Fig. 5b**] and occasionally thereafter until 1931. He made his first trip to Newfoundland and Labrador in 1911. From early on, he was impressed by the presence of boreal, western ("Cordilleran"), and southwestern species in his collections, soon promoting the hypothesis that western and southwestern species had been able to survive the last Pleistocene glaciation in unglaciated refugia (nunataks) or that they had been able to recolonize glaciated eastern North America along a postglacial land bridge extending from south of Cape Cod to at least as far as western and northern Newfoundland.[18] His early publications on these hypotheses concentrated on the origins of the southwestern coastal plain flora:

> To summarize briefly, the indigenous flora of Newfoundland consists primarily of plants which occur to the north, in Labrador, or to the southwest, chiefly along the Atlantic seaboard or the Coastal Plain… the distance between Newfoundland and

> Labrador is not sufficiently great to prevent ready exchange of species across the Straits of Belle Isle, but the distance between Newfoundland and Cape Breton is so great that the plants of the latter region rarely if ever span it. Birds, ocean-currents, drifting logs and ice, and winds prove to be ineffective in carrying to Newfoundland the plants from the southwest, so that an ancient land-bridge is suggested… The amount of water withdrawn from the ocean to form the Pleistocene glaciers was apparently sufficient to leave exposed nearly if not all the old coastal plain… so that upon this now submerged plain, as the ice-front receded northward, the southwestern plants, most of which still occur on Cape Cod, Long Island or in the Pine Barrens of New Jersey, must have spread to Newfoundland, where they now form an isolated flora.[19]

By the early 1920s, Fernald had convinced himself that the presence of seemingly extralimital plant species required not only spread to the northeast along a now-submerged coastal borderland but also, in the case of western ("Cordilleran") species, their survival in unglaciated refugia (the nunataks) in many places, including the mountains of Gaspé, western and northern Newfoundland, and even the Torngat Mountains of Labrador. Bolstering his case with geological information on the last glaciation, he prepared to consolidate and summarize a theory of post-glacial plant geography.[20] Some of the last steps toward this goal appeared to lie in southwestern and northern Newfoundland. Planning to concentrate first on the southwest, he described how this changed:

> Before this plan could be carried out … another region of Newfoundland began to assume botanical importance – the south side of the Straits of Belle Isle… When she went to Flower Cove to take charge of the Grenfell hospital there, Miss Mary E. Priest most kindly offered to collect and send to me some plants of the region. These collections, made in Miss Priest's very rare moments of leisure in 1920 and 1921 and mostly from near the hospital, were indeed a revelation…These collections were thrilling, for Miss Priest was not a trained botanist, her duties at a mission-hospital on a rough coast were exacting and time-consuming and she had to spend such of both summers "on the Labrador"; and the long-dreamed-of plan that the next Newfoundland expedition should be for Atlantic European types near Cape Race, began to be confused by an equally urgent ambition to go directly to the Straits.[21]

Even with such a tantalizing goal, however, Fernald and his colleagues had already planned another botanical exploration in the Gaspé mountains [**Fig. 6**] so that, as he said, despite his intense interest in the area, the opportunity to go to the Strait of Belle Isle in summer 1923 came "too late for action."

A.G. Huntsman's Belle Isle Strait Expedition of 1923 and its Results

The main scientific aim of the 1923 expedition, as expressed later by Huntsman, was to examine the implications of Bell Dawson's conclusion that there was relatively little net inflow of water through the Strait of Belle Isle:

> Dr. Bell Dawson on the basis of extensive current measurements concluded that scarcely more water flowed in through Belle Isle strait than flowed out, and that therefore the influence of that Strait was negligible… If such movements are important for their secondary influence on the climate how much more important must they be in determining the valuable fisheries of the region. Such briefly has been the problem

Figure 6. *Field work during the summer of 1923. Left: A.G. Huntsman (left), A.C. Gardiner (center) and Lachlan Gilchrist (right) on the deck of the steamer Arleux during the Strait of Belle Isle Expedition (from A.G. Huntsman Papers, UTARMS B1978 – 0010/001). Right: M.L. Fernald's botanical field party on the slopes of Mont-Albert, Gaspé, Québec, at the same time (from http://www.botlib.huh.harvard.edu/libraries/fieldwork_exhibit/exploration_gaspe.htm).*

> that led the North American Committee on Fishery Investigations to recommend an expedition to Northern Newfoundland to study the waters and movements, particularly in relation to the cod fishery.[22]

Huntsman himself was convinced, on the basis of Dawson's temperature records showing cold, dense water on the north side of the strait and warmer, less dense water on the south, that there had to be a significant inflow of Labrador Current water westward and an outflow of Gulf of St. Lawrence water eastward through the Strait. More temperature and salinity measurements would be important to document the presumed currents, but best of all would be current measurements simultaneously on both sides of the Strait, which had been beyond the capabilities of the 1894 and 1906 tidal surveys. In a letter dated July 10, 1923, Huntsman described the programme he proposed for one of his vessels:

> The work that is contemplated … is briefly as follows: The main portion consists of the taking of temperatures and of samples of water from different depths at a series of stations from across the Gulf just east of Anticosti out through the Strait of Belle Isle. At the same time that we obtain these hydrographic data we will also with fine nets which will be towed to procure samples of the minute life which forms the basis for food in the water, and also consists in part of the eggs and fry of many of the fishes. … In addition to this it is proposed to make certain current measurements at one point only… Finally, it is proposed to visit certain ports to obtain information from the local fishermen and to try with fishing lines and perhaps a short set line or trawl line to obtain some of the local fishes.[23]

Information on the organization and progress of the expedition is not scanty but sometimes tantalizingly brief, based mainly on a few of Huntsman's letters,[24] 11 hand-written pages describing the expedition up to August 15,[25] a small black notebook in which he kept notes of the activities taking place between

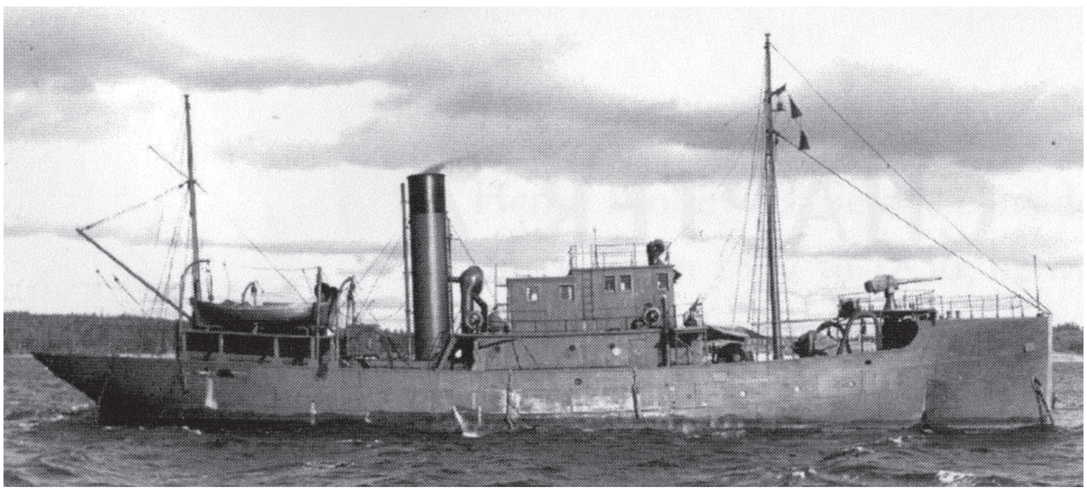


Figure 7*. (Above) The MV Prince at Red Bay Labrador during the Belle Isle Strait Expedition of 1923 (from A.G. Huntsman Papers, UTARMS B1978 – 0010/001). (Below) The FPS Arleux, which worked with Prince during the expedition (from C.D. Maginley and B. Collin, The Ships of Canada's Marine Services (St. Catharines, ON: Vanwell Publishing, 2001), 91).*

August 18 and September 14,[26] and a series of photographs he took during the expedition.[27] The group included as scientific staff Huntsman, his physicist colleague from the University of Toronto, Lachlan Gilchrist (1875-1962)[28], and an English marine biologist representing the Government of Newfoundland, Alan C. Gardiner[29] [**Fig. 6**]. The 60-foot MV *Prince* of the Biological Station at St. Andrews was pressed into service, and from the Department of Marine and Fisheries Huntsman was able to borrow the much larger Fisheries Protection Steamer *Arleux* [**Fig. 7**].[30]

Prince travelled alone with its crew from St. Andrews around Nova Scotia into the Gulf of St. Lawrence beginning on June 23,[31] while *Arleux* was provisioned and loaded at Halifax, where Huntsman and Gilchrist had joined the ship on August 3, departing the same day for Sydney. Gardiner joined the ship in

Sydney on August 4, when Huntsman had the opportunity to get some drift-bottle current information from his NACFI colleague Edouard Le Danois (1887-1968), the oceanographer in port aboard the French fisheries patrol vessel *Ville d'Ys*.[32]

Leaving Sydney on August 6, *Arleux* ran into bad weather and was only able to take the first three stations of the expedition while crossing Cabot Strait toward Newfoundland, intending from there to make a section northward toward Anticosti Island. Once again bad weather intervened, and the ship was taken into the shelter of Cape St. George, Newfoundland, on August 8, where Huntsman and his colleagues made the first current measurements, fished for cod, and made intertidal and land plant collections. Finally, on August 10 wind and sea conditions allowed the ship to head toward Anticosti, which they sighted on the 11th. By the early morning of the 12th they were close to the Québec North Shore, where they turned south to complete a section to Newfoundland's Bay of Islands [**Fig. 8,** next page]. During this transect, Gardiner improvised and used a Secchi Disk for the first time.[33]

By the morning of August 15 they had returned to the North Shore, where they first sighted icebergs and went ashore on an island off Cape Mecatina to collect intertidal organisms and land plants. During the next three days, the ship was directed northeastward to take a section across the Labrador Current seaward of Henley Harbour, Labrador, which was accomplished with some difficulty because of the ship's drift between August 18 and 20. With additional difficulty due to gear breakage, another goal of the expedition was accomplished between August 24 and 28 (the exact date is not clear) when the group was able to make a continuous 24-hour series of current measurements on the north and south sides of the Strait of Belle Isle, with *Arleux* off Red Bay, Labrador on the north and *Prince* off the Newfoundland shore to the south.

This was followed by an interval between about August 29 and September 4 on the Newfoundland coast, where *Arleux* was coaled in the mouth of the Humber River, returning to Red Bay, Labrador around September 5. From there, Huntsman and the vessels returned to Henley Harbour, visited Belle Isle (described by Huntsman as "a barren treeless place of granite"), then visited the northernmost tip of Newfoundland at Quirpon and St. Anthony from September 8 to 10. At Quirpon, Huntsman collected plants, in his notes recording "[f]lora somewhat sparse, but distinctly more southern than on Henley Id." And en route from Quirpon to St. Anthony, they noted a mixture of cold Labrador Current water interleaved with much warmer Gulf of St. Lawrence water, reinforcing Huntsman's belief that Gulf water found its way through the Strait onto the East Coast of Newfoundland.

A stop in St. Anthony on September 9 and 10 gave Huntsman the opportunity for more shore collecting and for a visit to the famed Grenfell Mission headquarters, which he photographed [**Fig. 9**] and where he apparently discussed the cod fishery with Wilfred Grenfell himself.[34] Finally, to bring the Strait of Belle Isle Expedition to a close, *Arleux* with Huntsman and Gardiner

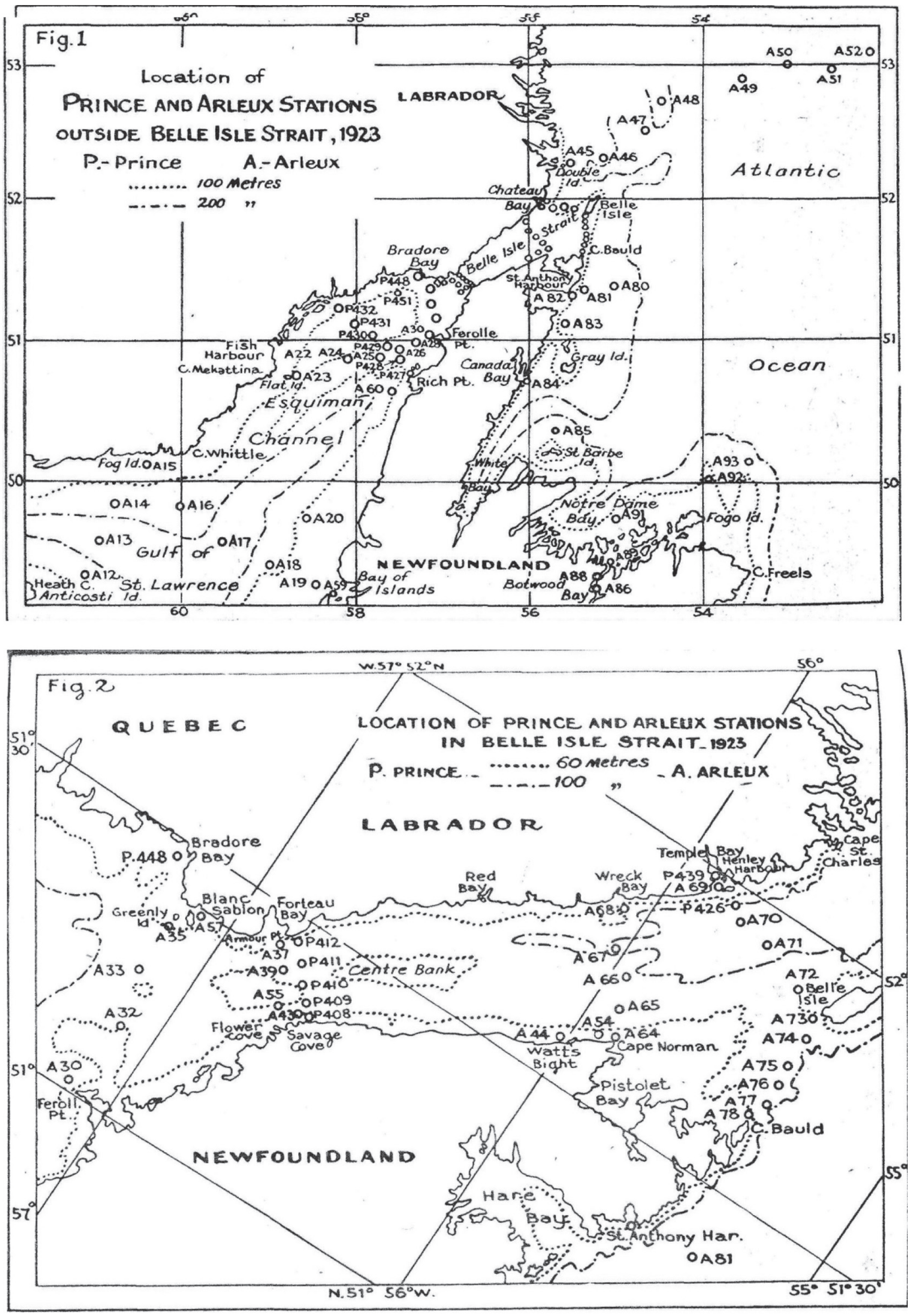


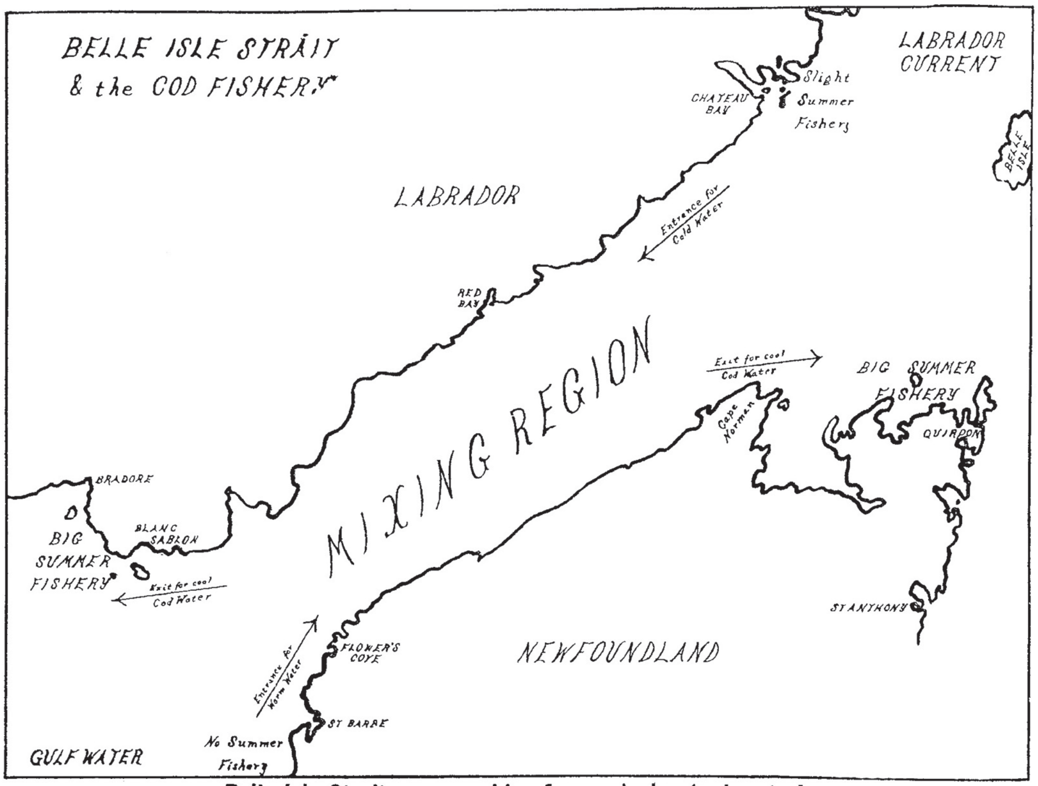
Figure 8. *Belle Isle Strait Expedition sampling stations in the northern Gulf of St. Lawrence and Strait of Belle Isle during the summer of 1923. Note that in the upper figure only stations outside the Strait are shown, while the lower figure shows mainly the sampling stations within the Strait. The two moored current meter stations within the Strait are not included. There were a few stations at the beginning of the expedition south of the areas shown here (from E.L. Bousfield, "Pelagic Amphipoda of the Belle Isle Strait region," Journal of the Fisheries Research Board of Canada 8, 3, (1951), 136, 137).*

Figure 9. *The Grenfell Mission hospital and headquarters in St. Anthony, Newfoundland, photographed by Huntsman on September 9, 1923 (from A.G. Huntsman Papers, UTARMS B1978 – 0010/001).*

(Gilchrist had gone home to Toronto from Newfoundland earlier) headed south along the East Coast of Newfoundland on September 11, taking plankton samples and temperature measurements all the way to St. John's, where they arrived about September 15. There Gardiner left for Newfoundland before Huntsman proceeded by sea on *Arleux* to St. Andrews.[35]

For the Biological Board, Huntsman summarized the results of the expedition as follows:[36]

> (1) It has been determined that water from the Labrador current (sic) passes along the north shore of the Strait of Belle Isle at the same time that the warm water of the Gulf passed out on the south side of the Strait. These two movements result in a very considerable loss in temperature to the Gulf, and have a most marked effect upon the character of the fishery on the north shore of that part of the Gulf for any season.
>
> (2) An eddy exists north of the bank extending from Meckattina (sic) on the Quebec shore to Ferolle on the Newfoundland shore, and this tends to limit the distribution of icebergs further in the Gulf, and also to determine the character of the water on the banks. The deep water north of these banks has been proved not to be connected with the deep water south.
>
> (3) The Labrador current has been found to be comparatively barren of proper food for fishes, containing chiefly jelly fishes. When, however, this water is mixed with more southern water and warmed up, it becomes remarkably productive, and is chiefly responsible for the richness of our fishing banks. This mixture with the other water has been taking place even before it reaches as far south as the Strait of Belle Isle.
>
> (4) Definite data have been obtained on the lower temperature relations of the cod, which should prove of considerable value in the use of the thermometer in locating cod along our coast.



Belle Isle Strait as a machine for producing 'cod water'.

Figure 10. *A.G. Huntsman's depiction of the locations where "cod water" was produced by mixing of the Labrador Current and Gulf of St. Lawrence water, resulting in summer fisheries (from A.G. Huntsman, "The Ocean around Newfoundland," Canadian Fisherman 12 (1925), 7).*

For a more general audience, Huntsman made many of the same points in his publication *The Ocean Around Newfoundland*, directed to the Newfoundland government and to fishermen, adding a sketch-map showing the "mixing region" of the Strait that produces water neither too cold nor too warm— "cod water" he called it— for cod to survive and thrive [**Fig. 10**].[37]

Huntsman's Strait of Belle Isle Expedition had paid off in terms of new knowledge of the currents of the Strait and in the development of a new hypothesis— mixing to produce "cod water" of just the right temperature range. But there was another aspect that Huntsman never addressed directly in the scientific results— his interest in the land plants, resulting in correspondence with Fernald and attention to the extensive plant collections that he made at nearly every stop during the expedition. Throwing light on this requires some detective work.

A.G. Huntsman and the Conditions of Existence

After 1923, A.G. Huntsman was not able to return in any substantive way to the results of the Belle Isle Strait expedition. With the opening in 1925 of a new Biological Board laboratory in Halifax, Huntsman was appointed its director while retaining his other positions. He relinquished the Halifax position due to overwork in 1928, which somewhat reduced his crushing administrative load but still left him chronically over-committed in St. Andrews, and Toronto. For several years beginning in 1927, he was deeply involved in scientific studies to evaluate the effect of a proposed tidal power dam across Passamaquoddy Bay,[38] and by the 1930s he had begun work on the study of Atlantic Salmon in Maritimes waters, becoming involved in a lengthy and sometimes rancorous debate about homing in salmon that lasted well after his retirement in the 1950s.[39] He had many other projects and responsibilities, including facing the consequences of a major fire at St. Andrews in 1932. Huntsman was constitutionally over-committed even without disasters and found great difficulty in finishing projects. The 1923 expedition was among the unfinished ones, except for a few student projects,[40] until he was able to take it up again in the 1950s with the assistance of two physical oceanographers, W.B. Bailey and H.B. Hachey.[41]

One of Huntsman's later publications is, at first glance, almost jarring in its lack of context, although it takes most of its examples from his work on salmon. Titled "Method in ecology – biapocrisis," it was published in 1948 in the journal *Ecology*. While it received no fanfare, and vanished virtually without trace from the canon of papers in ecology and fisheries[42], it requires attention here because it redirects us to Huntsman's plant collections.

Huntsman defined *biapocrisis* (based on the Greek nouns *bios*-"life" and *apócrisis* – "response") as "the response of an organism as a whole to what it faces where it lives," differentiating this approach from conventional physiological ecology because it involved the organism as a totality rather than isolated subsystems or processes. As he framed the approach in 1948: "[t]he problem is: Given a kind of organism in one or more places with the ability to multiply, where will the individuals live, grow and survive? The answer is to be found in the response of the organism as a whole in movement, growth and survival to what it faces." Moreover, "If there is to be scientific natural history, there must be knowledge of how each kind of life responds to what it faces where it lives in survival, movement, growth and reproduction. …How well can we predict what we can find in the sea at any given time? Again, this requires basic knowledge, not only of the kinds of life in the sea, but also of how each kind responds to what it faces. …Viewed objectively, the question is what does the environment do to the organism, that is, what is the latter's response?"[43] Summarizing: "In general, the procedure followed in biapocrisis is to discover and establish correlations between the behavior of the organism and the conditions in its environment, and then to test the significance of the correlations by appropriate experiments in nature or in the laboratory. The point should be emphasized that you start with nature, that is, with the organism in its environment."[44]

These statements take us back to some of Huntsman's statements, repeated frequently during the 1920s, but taking center stage in the late 1940s, around the time of "Method in ecology" and biapocrisis. Here his correspondence with Fernald in the 1920s gives us insight into aspects of Huntsman's early thought that would be easy to miss without the mirror of the biapocrisis paper. For example, writing to Fernald on July 23, 1923, before the expedition, Huntsman made it clear that he wanted to compare "the opposing shores of Newfoundland and Labrador not only as to the conditions in the water, but also those on the land for a short distance back from the water."[45] It seems that at this early date he was struggling with the relationship between organism response and the immediate environment experienced by the plants.

After the expedition, in October 1923, Huntsman wrote to Fernald that he had "expected that a marked contrast would be found between the two shores of the Strait, and the neighboring part of the Gulf, and such proved to be the case!," adding that "[i]t is to be expected that these differences will affect the land flora, but only close to the water." He asked if Fernald had "ever considered the matter of the contrast between the two sides of the Strait as shown in the flora" and that he (Huntsman), "[b]elieving that something might be made of this problem … took the opportunity to collect as many specimens of plants … as the nature of our cruise permitted."[46]

A few months later, responding to Fernald's suggestion that the nature of the substratum might be a governing factor in the distribution of the plants, Huntsman once again emphasized the importance of temperature: "[t]he problem in the Strait of Belle isle virtually resolves itself into an attempt to discover how the difference of temperature shown by the two sides of the Strait affects the character of the flora on these two sides" and claimed that Fernald's analysis of the flora would be "important in showing how small the climatic factor may or must be."[47] A week later, he wrote to Fernald that "[i]t is most encouraging to see an attempt to get away from the climatic zones which have dominated the literature, and to a considerable extent retarded progress…", suggesting that some gaps in plant distributions could be accounted for by temperature rather than substratum, based on his analysis of the temperature-governed distributions of marine organisms.[48] And early in 1925, after learning of Fernald's fieldwork in Newfoundland north to the Strait of Belle Isle in the summer of 1924,[49] he wrote that "the region is of extraordinary interest to me on land as well as on water because of the very evident differences in conditions within such short distances. How the various factors operate is the question, and whether or not the land conditions fit in with those found in the water, there should be very striking results."[50] And here the matter rested for two decades.

About the time of his biapocrisis paper in 1948, Huntsman once again took up the significance of his plant collections, which had just been identified by Fernald and sent to the herbarium of the National Museum of Canada[51] in Ottawa. In January 1949 he received from the Chief Botanist at the National Museum, A.E. Porsild (1901-1977),[52] a list of the Belle Isle Strait plants identified by Fernald. Huntsman wrote to Fernald that "[m]y object in making the collection and my continuing interest is a comparison of the plants occurring on the two sides of the Strait close to the shore. I don't know that anyone else would look at the matter in this way, and it may be that my collection is not adequate for such a comparison."[53] A few days later, he wrote to Porsild with reference to the plant list, that "[i]f on studying them, I see any indication of the effect of sea conditions on the adjacent land flora, I will consult you as to your views and as to additional records you may have that would test any conclusions reached."[54] Only a few days after that he wrote again to Porsild, asking his opinion on a short typescript titled "Water Influence on Shore Plants in Belle Isle Strait."[55]

The gist of "Water Influence" is that the biotic conditions in the Strait are governed by the contrast between the relatively warm Gulf water on the south side and much colder water on the north. This contrast, he wrote, "might well modify climatic conditions for land plants growing along the shore," and indeed there were very few plant species in common between locations in the coldest and warmest regions. The coldest region was dominated by arctic-alpine plants, whereas the warmest region was the stronghold of temperate-climate plants. He concluded that "[t]he striking difference between the two sides … clearly reflects not difference in latitude, but difference in local conditions,"[56] and shortly afterwards asked Porsild to indicate the "ecological relationships" (presumably the responses of the individual species to their microclimates) of the Belle Isle Strait plants.[57]

Porsild delegated this task to a senior botanist on his staff, Homer Scoggan (1911-1986),[58] who was an authority on the flora of the Gaspé region.[59] Scoggan undertook to relate the species collected by Huntsman to what he called "major geographical areas … by means of which a correlation between the climate and the flora of the areas might be revealed," claiming a northward increase of Arctic species and a decrease of Boreal species in the order Cape Breton Island – Newfoundland – Labrador as a result of "an increasing severity of climate from Cape Breton to Newfoundland and to Labrador." He added a cautionary note: "[i]t is emphasized that more must be known of the floras before and definite conclusions can be drawn for the area as whole, although such a correlation certainly exists in smaller areas such as alpine or inland valley habitats."[60] In short, by default or otherwise, it was a classic biogeographic classification of the species, and Huntsman was not shy in expressing his disappointment: "I hope you won't mind my saying that it fails to deal with my point… I understood you to say that you would give me some information concerning what is known about the habitats of some pertinent species as a basis for my consideration of the problem as I see it."[61]

What, then, was the problem as Huntsman saw it? It appears to have been to find evidence that, all other things being equal, ocean conditions on opposite sides of the Strait would affect the nature of the flora species by species or even plant by plant. Instead, he had been given geographical "range categories" that were not relevant to his hypothesis. But clarity in Huntsman's statements about what he was looking for — presumably oceanographic variables that would affect the responses of individual plants in small groups of them — is absent in his correspondence, just as in his biapocrisis paper, fresh off the press at the time of this correspondence, he was singularly vague about how the "response of the organism as a whole" was actually to be determined. Discouraged, and perhaps suffering from lack of clarity in his own mind, by the spring of 1951 he had given up on the problem and moved on to more tractable scientific work.[62]

A Confluence of Interests

The Strait of Belle Isle had something for both Fernald and Huntsman. Fernald wanted more information from northern Newfoundland and Labrador to buttress his nunatak and coastal plain hypotheses, subjects that became increasingly central to his analyses of Eastern North American floras during the early 1920s.[63] Even though he was unable to join the Belle Isle Strait expedition in 1923, he aggressively mounted field programmes that extended to southern Labrador based in part on the plants that Huntsman collected for him in 1923.

For Huntsman, Fernald's botanical work had the potential to fit into interests that almost certainly predated 1923 but that did not reach full expression until his publication in 1948, expressing the need for a new operational approach in ecology that he summarized in the word *biapócrisis*, focusing on responses of the entire organism rather than on subsystems. Because Huntsman himself was vague and probably uncertain about how such an approach could be put into practice, sorting out his thoughts on this matter is difficult. It is not aided by the fact that his 1948 publication was a one-off, leaving us to interpret what he had to say about environmental effects on individual organisms from brief and usually unfocussed mentions in his letters. Whatever Huntsman was trying to say to us, it never had an impact in ecology and remains problematic for the historian. Resurrecting the Belle Isle Strait Expedition of 1923 gives us worthwhile insight into a little-known episode in Canadian marine science, but leaves us with the interesting problem of its unresolved and perhaps unresolvable significance in the thought of A.G. Huntsman, one of Canada's most influential marine scientists.

Eric Mills is Professor Emeritus of History of Science in the Department of Oceanography, Dalhousie University, and Inglis Professor in the University of King's College, Halifax. He works on the history of the marine sciences, especially biological and physical oceanography, and on the history of marine sciences in Canada.

Endnotes

1 This paper owes a great deal to archivists, notably Harold Averill at the Universityof Toronto Archives (UTARMS), who curated the papers of A.G. Huntsman, and Lisa DeCesare, of the Botany Libraries, Harvard University Herbaria, for help locating and giving me access to the correspondence of M.L. Fernald.

2 Fernald was mistaken. Huntsman was the Director of the Atlantic Biological Station in St Andrews, NB, not the Director of the Biological Board of Canada.

3 M.L. Fernald, "Two summers of botanizing in Newfoundland," *Rhodora* 28, 328 (1926): 53.

4 On NACFI, see Jennifer Hubbard, *A Science on the Scales: The Rise of Canadian Atlantic Fisheries Biology, 1898-1939* (Toronto: University of Toronto Press, 2006), 163-172.

5 This was the rationale, at least in the minds of Canadian politicians, for the Canadian Fisheries Expedition of 1915 to the Gulf of St. Lawrence and Scotian Shelf (Ibid., Ch. 3).

6 Summarized in a fisheries context by George Rose, *Cod: the Ecological History of the North Atlantic Fisheries* (St. John's NL: Breakwater Books, 2007), 173-242.

7 An example typical of its generation is W.N. Burns, "Will a ten-mile dam change Canada's climate?," *Popular Science Monthly* 99, 2, (1921): 33-34.

8 W.B. Dawson, *The Currents in Belle Isle Strait. From the Investigations of the Tidal and Current Survey in the Seasons of 1894 and 1906* (Ottawa: Department of Marine and Fisheries, 1907), 38.

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12 Kenneth Johnstone, *The Aquatic Explorers: A History of the Fisheries Research Board of Canada* (Toronto: University of Toronto Press, 1977), 304-306; A.W.H. Needler, "Archibald Gowanlock Huntsman: 1883-1973," *Proceedings of the Royal Society of Canada,* Series IV, 13, 67-69.

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14 Canada. Department of the Naval Service, *Canadian Fisheries Expedition, 1914-1915: Investigations in the Gulf of St. Lawrence and Atlantic Waters of Canada Under the Direction of Dr. Johan Hjort, Head of the Expedition, Director of Fisheries for Norway* (Ottawa: King's Printer, 1919).

15 Johan Hjort, "Fluctuations in the great fisheries of northern Europe viewed in the light of biological research," *Conseil International pour l'Exploration de la Mer, Rapports et Procès-Verbaux* 20 (1914): 1-228.

16 J.E. Stewart and A. Safer, "A retrospective: three quarters of a century at the Halifax Fisheries Research Laboratory," *Proceedings of the Nova Scotian Institute of Science* 4,1, (2005): 19-44.

17 E.D. Merrill, "Merritt Lyndon Fernald (1873-1950)," *National Academy of Sciences Memoirs* 28 (1954): 45-98; R.L. Stuckey, "Fernald, Merritt Lyndon," *American National Biography Online* (http://www.anb.org/articles/13/13-00527.html), accessed December 10, 2009. An appreciation of the man and his work by five colleagues appeared in *Rhodora* in 1951, the most relevant of which are: L. Griscom, 1951,"Fernald in the field," *Rhodora* 53, 626 (1951): 61-65 and R.C. Rollins, "Fernald as a botanist," *Rhodora* 53, 626 (1951): 56-61. There are also recollections of Fernald in Anonymous, "The New England Botanical Club 800th meeting," *Rhodora* 88, 854 (1986): 157-228.

18 M.L. Fernald, "A botanical expedition to Newfoundland and southern Labrador." *Rhodora* 13, 151, (1911): 109-162.

19 Ibid., 162.

20 M.L. Fernald, "Persistence of plants in unglaciated areas of boreal America," *American Academy of Arts and Sciences Memoir* 15, 3, (1926): 239, 241-342.

21 M.L. Fernald, "Two summers of botanizing in Newfoundland," *Rhodora* 28, 328, (1926): 53-54.

22 A.G. Huntsman, *The Ocean Around Newfoundland* (St. John's: Newfoundland Ministry of Marine Fisheries, St. John's Fisheries Research Laboratory, 1924), 8-9; A.G. Huntsman, "The ocean around Newfoundland," *The Canadian Fisherman* 12, (1925): 6.

23 A.G. Huntsman to Ward Fisher, Chief Inspector of Fisheries in Halifax, July 10, 1923. A.G. Huntsman Papers, UTARMS B1978-0010 / 092 (15).

24 All in the A.G. Huntsman papers, University of Toronto Archive and Research Management services (UTARMS).

25 A.G. Huntsman Papers, UTARMS B1978 – 0010 / 93 (12).

26 A.G. Huntsman Papers, UTARMS B1978 – 0010 / 93 (5).

27 A.G. Huntsman Papers, UTARMS B1978 – 0010 / 001.

28 Biographical information in https://www.rasc.ca/lachlan-gilchrist. Accessed June 26, 2018.

29 Apparently a representative to Newfoundland of the English Ministry of Agriculture and Fisheries (M.Baker and S. Ryan, The Newfoundland Fishery Research Commission, 1930-1934" in *How Deep is the Ocean?*: *Historical Essays on Canada's Atlantic Fishery*, eds. J.E. Candow and C. Corbin (Sydney, NS: University College of Cape Breton Press, 1997), 163.)

30 C.D. Maginley and B. Collin, *The Ships of Canada's Marine Services* (St. Catharines, ON: Vanwell Publishing, 2001): 91.

31 Documented in Captain Arthur Calder's log of the voyage from St. Andrews and back, extending from June 23 to October 15 (A.G. Huntsman papers, UTARMS B1978 – 0010 / 93 (4)).

32 Le Danois was at the time assistant director of the French Office of Marine Fisheries. He was unique in France in understanding and using Scandinavian techniques of dynamic oceanography: see E.L. Mills, *The Fluid Envelope of Our Planet: How the Study of Ocean Currents Became a Science* (Toronto: University of Toronto Press, 2009), 188. The most complete summary of his life and science is https://fr.wikipedia.org/wiki/Édouard_Le_Danois (accessed 23 June 2018).

33 The Secchi Disk is a simple but effective device for measuring transparency of the water, usually involving a white or white-and-black plate that is lowered until it disappears from view. Apparently Gardiner was able to press a kitchen plate from the mess into service.

34 On Grenfell, see https://www.wikipedia.org/wiki/Wilfred_Grenfell (accessed 23 June 2018).

35 Based on a photograph of *Arleux* in the St. Croix River in Huntsman's photo record of the expedition (see Note 27).

36 A.G. Huntsman to W.A. Found, Director of Fisheries, Dept. of Marine and Fisheries, Ottawa, February 13, 1924. A.G. Huntsman Papers, UTARMS B1978 – 0010 /0092 (15) .

37 Huntsman, 1924, 1925, esp. 1925, 7.

38 Hubbard, 2006, 173-191.

39 Huntsman's career during this period and the debate over Atlantic Salmon migrations and homing are masterfully dealt with by Jennifer Hubbard, "Home sweet home? A.G. Huntsman and the homing behaviour of Canadian Atlantic Salmon," *Acadiensis* 19 (1990): 40-71.

40 V.M. Davidson, "The distribution of certain marine Ostracoda in the Canadian waters of the eastern coast," *Contributions to Canadian Biology and Fisheries* 2, 1, (1924): 295-306; K.F. Pinhey, "Entomostraca of the Belle Isle Strait Expedition, 1923, with notes on other planktonic species. Part I," *Contributions to Canadian Biology and Fisheries,* NS 3, 6, (1926): 179-233; K.F. Pinhey, "Entomostraca of the Belle Isle Strait Expedition, 1923, with notes on other planktonic species: Part II; and a record of other collections in the region," *Contributions to Canadian Biology and Fisheries* 3, 13, (1927): 331-346;C.J. Kerswill, "The distribution of Pteropods in the waters of eastern Canada and Newfoundland," *Journal of the Fisheries Research Board of Canada* 5, 1, (1940): 23-31; E.L. Bousfield, "Pelagic Amphipoda of the Belle Isle Strait region," *Journal of the Fisheries Research Board of Canada* 8, 3, (1951): 134-163; M.F. Udvardy, "Distribution of Appendicularians in relation to the Strait of Belle Isle," *Journal of the Fisheries Research Board of Canada* 11, 4, (1954): 431-448.

41 A.G. Huntsman, W.B. Bailey and H.B. Hachey, "The general oceanography of the Strait of Belle Isle," *Journal of the Fisheries Research Board of Canada* 11, 3, (1954): 198-260. Thereafter, there was more work on the Strait to sort out the effect of meteorology, and with the addition of new tide gauges, including W.B. Bailey, "On the dominant flow in the Strait of Belle Isle," *Journal of the Fisheries Research Board of Canada* 15 (1958), 1163-1174, and especially W.I. Farquharson and W.B. Bailey, *Oceanographic Study of Belle Isle Strait 1963* (Dartmouth, NS: Bedford Institute of Oceanography, BIO Report 66-9, 1966), 1-78. Only in the 1980s were modern methods of physical oceanography applied by researchers at Dalhousie University and the Bedford Institute of Oceanography to assess the circulation and its causation: C. Garrett and B. Petrie, "Dynamical aspects of the flow through the Strait of Belle Isle," *Journal of Physical Oceanography* 11, 3 (1981): 376-393; C. Garrett and B. Toulany, "Variability of flow through the Strait of Belle Isle," *Journal of Marine Research* 39, 1 (1981), 163-189; C. Garrett and B. Toulany, "Sea level variability due to meteorological forcing in the northeast Gulf of St. Lawrence," *Journal of Geophysical Research*87, C3 (1982), 1968-1978; B. Toulany, B. Petrie and C. Garrett, "The frequency-dependent structure and dynamics of flow through the Strait of Belle Isle," *Journal of Physical Oceanography* 17, 2 (1987), 185-196; and B. Petrie, B. Toulany and C. Garrett, "The transport of water, heat and salt through the Strait of Belle Isle," *Atmosphere-Ocean* 26, 2 (1988), 234-251.

42 A.G. Huntsman, "Method in ecology – biapocrisis," *Ecology*29, 1 (1948): 30-42. It may have suffered eclipse by a torrent of papers from G.E. Hutchinson and his students at Yale, culminating in Hutchinson's revolutionary recasting of the ecological niche in set-theoretic terms as an n-dimensional hypervolume: G.E. Hutchinson, "Concluding remarks," *Cold Spring Harbor Symposia in Quantitative Biology* 22, (1957): 413-427. Hubbard, 1990, 58-63 places Huntsman's thought in the context of his neo-Lamarckianism and hereditarian debates during the1920s-1940s.

43 These quotations from Huntsman, 1948, 31

44 Huntsman, 1948, 41.

45 A.G. Huntsman to M.L. Fernald, 21 July 1923. Harvard University Herbaria (HUH) General Correspondence, Huntsman file.

46 A.G. Huntsman to M.L. Fernald, 31 October 1923. HUH General Correspondence, Huntsman File.

47 A.G. Huntsman to M.L. Fernald, 18 February 1924. HUH General Correspondence, Huntsman File

48 A.G. Huntsman to M.L. Fernald, 25 February 1924. HUH General Correspondence, Huntsman File

49 Fernald, 1926, 49-63.

50 A.G. Huntsman to M.L Fernald, 17 February 1925. HUH General Correspondence, Huntsman File.

51 Now the Canadian Museum of Nature. The collections are now located in Gatineau, Québec.

52 W. Dathan, *The Reindeer Botanist: Alf Erling Porsild (1901-1977)* (Calgary, AB: University of Calgary Press, 2012).

53 A.G. Huntsman to M.L. Fernald, January 19, 1949. A.G. Huntsman Papers, UTARMS B1978 – 0010 / 94 (1).

54 A.G. Huntsman to A.E. Porsild, January 28, 1949. A.G. Huntsman Papers, UTARMS B1978 – 0010 /94 (01).

55 A.G. Huntsman, "Water Influence on Shore Plants in Belle Isle Strait," typescript (1949): 1-4.A.G. Huntsman Papers, UTARMS B1978 – 0010 / 94 (01).

56 Huntsman, Ibid, 4.

57 A.G. Huntsman to A.E. Porsild, February 14, 1949. A.G. Huntsman Papers, UTARMS B1978 – 0010 /94 (1).

58 M.J. Shchepanek, "A tribute to Homer John Scoggan, 1911-1986," *Canadian Field-Naturalist* 101, 2, (1987): 161-164.

59 H.J. Scoggan, "The flora of Bic and the Gaspé Peninsula, Québec," *National Museum of Canada Bulletin* 118 (1950): 1-339. Scoggan's work in the Gaspé region marshalled evidence against Fernald's nunatak hypothesis, summarizing updated geological and biological evidence against it (see Note 61).

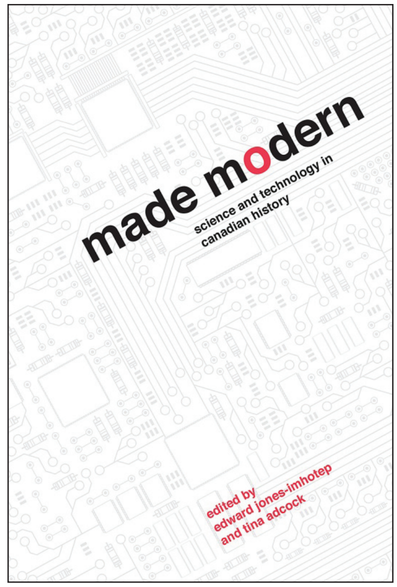
60 H.J. Scoggan, "Notes on plants collected by Dr. A.G. Huntsman in 1923…," A.G. Huntsman Papers, UTARMS B1978 – 0010 / 94 (1).

61 A.G. Huntsman to A.E. Porsild, March 9, 1949. A.G. Huntsman Papers, UTARMS B1978 – 0010 /94 (1).

62 A.G. Huntsman to A.E. Porsild, March 19, 1951. A.G. Huntsman Papers, UTARMS B1978 – 0010 / 94 (1). It was at this time that he began to work with Bailey and Hachey to summarize the oceanography of Belle Isle Strait based on his 1923 data.

63 Both came under attack in the following decades, late in Fernald's career and after his death. See especially V.C. Wynne-Edwards, "Isolated Arctic-alpine floras in Eastern North America: a discussion of their glacial and recent history," *Transactions of the Royal Society of Canada* Series III, 31, 5, (1937): 1-26; H.J. Scoggan, 1950, 3-14; and S.R. Clayden, M.C. Munro, S.C. Blaney and S.P. Van der Kloet, "Vascular flora of the Atlantic Maritime Ecozone: some perspectives," in *Assessment of Species Diversity in the Atlantic Maritime Ecozone*, eds. D.F. McAlpine and I.M. Smith (Otttawa: NRC Research Press, 2010), 197-213.. Based on updated geological information casting doubt on the existence of unglaciated area (nunataks), on the possibility of colonization from the west along the receding glaciers, and on the improbability of there being a continuous post-glacial borderland, Fernald's hypotheses are now not favored by biogeographers.

Made Modern: A Roundtable Review



Edward Jones-Imhotep & Tina Adcock, eds. *Made Modern: Science and Technology in Canadian History.* Vancouver: UBC Press, 2018. Xii+376 pp. $34.95. ISBN 9780774837248.

"We've always been modern"

Elsbeth Heaman

The editors of this splendid collection argue, in a sly nod to Bruno Latour, that "We've always been modern," or at least liked to describe ourselves as such. To identify as Canadian is to identify as a modernizer. Once it became obvious—during the second Industrial Revolution according to James Hull in this volume—that science and technology together yielded power and wealth, Canadian boosters avidly pursued them. Scientists and statesmen wanted standardization with European norms of modernity imposed on a land and polity seen as too wild and backwards. Science and technology seemed to offer a universalized modernity particularly useful for a "new" nation seeking to erase obstacles of geography, identity, and history. Perhaps the most spectacular exemplar of that high-modern erasure was the St Lawrence Seaway, described here by Daniel Macfarlane. But Macfarlane insists that it was a negotiated rather than an authoritarian modernity. Was this modernizing process, which produced so much wealth and power but also so much damage and despair, entered into knowingly? It depends, of course, on what you mean by knowledge and how you understand collective consent and national mandate, both of which get resoundingly debunked in this collection. The "rise" of science and technology in Canada rested as much on misunderstanding as on understanding, as much ignorance (or "agnatology") as knowledge.[1]

Arguments for scientific and technological modernization always played well in Canada. The case for a Eurocentric scientific project of knowledge and development for the Canadian Arctic was made by Richard King as early as the 1830s, Efram Sera-Shriar shows in the only paper on the colonial period. A ramped up and reconfigured version—less English, more transnational and Canadian-inflected—of the argument was more successfully made by the advocates of a big Arctic science expedition in the 1910s. They insisted, Andrew Stuhl shows, that such things shouldn't be left to trappers; that Canada must supplant local amateurs with internationally recognized and well-funded professionals. The Arctic Expedition and the St Lawrence Seaway were two of the most successful high modernist scientific projects aimed at asserting

 Elsbeth Heaman, Arn Keeling, Sverker Sörlin, "Made Modern: A Roundtable Review," *Scientia Canadensis* 42, 1 (2020): 96-111.

territorial sovereignty and control. But others were less successful. Tina Adcock's chapter on the Eastern Arctic expeditions of 1926-27 shows that their projector, George Palmer Putnam, really just wanted to go on a hunting expedition with his son and produce popular adventure books; science was an afterthought. But the hunting was illegal, a clear violation of protections for the wildlife that the expedition was supposed to be studying. Conservationists, appalled to see destruction and self-advertising passing itself off as science, stirred up international tensions around the incident. Edward Jones-Imhotep's chapter recounts similar ambiguities in the career of Gerald Bull. A scientific boy wonder, Bull wanted to build and fire off super big guns, and cobbled together Canadian-American support for their construction in Barbados, where they could be justified as warning off Cuba. Bull left Canada for better funding in the United States but was in over his head and was assassinated, supposedly by Mossad agents to punish a deal done with Iraq. We see in such stories not just the social turn in science and technology studies, but also a turn towards the "new political history." Both are superbly written pieces by impressively talented historians.

Other chapters in the collection show similar ambiguities in popular science: it too was at best commercialized and at worst fraudulent. An account of electrical medicine by Dorotea Gucciardo and an account of the science of the séance by Beth A. Robertson are two sobering reminders that science and technology gained public support as much through spurious claims as rigorous ones. Advertising also had its part in that process: Jan Hadlaw shows us the Bell Telephone Company teaching people how to use dial phones for themselves and Blair Stein shows us Air Canada persuading people to fly south for warm-weather holidays. Science and technology are here debunked not so much as not-true as not-disinterested. Business interests decked out self-interested promotional campaigns with the rhetoric of scientific and technological modernization.

Science and technology were always on the marketplace, a complex and heterogenous marketplace that was simultaneously popular and statist, plural and monopolistic. Another terrific chapter that brings such complex elements together is Eda Kranakis's account of a legal battle in 1998 over Montsanto's Roundup-Ready genetically modified canola. When the company sued a sixty-eight-year-old farmer, Percy Schmeiser, for breach of its patented canola, it had no viable patent on the grain that it had disseminated so promiscuously as to encroach on and affect nearby fields. This was a risky fight but one that Montsanto won, Kranakis argues, by blinding the judges with a slew of experts who glossed over the technical problems with the genetic and microbiological patenting process, as well as the problem of genetic drift. Kranakis quotes a contemporary description of the hapless, befuddled judges as "amateurish." That descriptor, also used to denounce local knowledge in the Eastern Arctic, resonates across the collection as it explores the borderlands of science and society. We may see a certain amateur quality in David Theodore's account

Ontario Hydro model in a warehouse at Islington, Ontario. One of the figures reproduced in Made Modern. © Ontario Power Generation.

of "small science" as quintessentially Canadian, as seen in a lonely computer scientist, trained in physics, working at the Montreal Neurological Institute. But he was hired to do service work for a larger scientific community very conscious of its collective identity and national prestige.

Why was there so much misunderstanding? One reason is that scientists are ordinary people who sometimes speculate wildly and sometimes lie. Sometimes those rash claims get hardwired into scientific and technological systems, policies, and funding programs. The Canadian government's hankering after modernity made it highly vulnerable to the most extravagant modernizing pitches. Even if they didn't lie outright, such pitches reflected a tendency towards "seeing like a state," as defined by James Scott and cited in this collection: a centralizing, simplifying vision imposed on the world that often wrought terrific havoc in the process of imposition.[2] But, as the editors and Stephen Bocking point out, science also began to provide empirical evidence of that terrific havoc, measured in the environmental and human costs, and to point towards better policies. Science isn't the best possible knowledge, but the ability to discard worse for better knowledge.

Bocking's dense and accomplished piece on "landscapes of science" is alone worth the price of admission. He surveys the shape of Canadian environmental knowledge, policies, technologies, administration, and challenges very broadly. In Canada, "natural systems tend towards extremes, unpredictable movements of fish and wildlife, countless local variations in forest productivity and seasonal water flow" (262). Here's a second explanation for so much misunderstanding: Canada is big and diverse and extreme. It continually tests knowledge and disproves it, doling out lessons in intellectual humility to would-be knowers and doers. Canada is a gigantic, perpetual falsification engine. Natural knowledge, Bocking argues, became "unavoidably uncertain" (268). Technology continually moved the goalposts on capturing "waste": from untapped resources to post industrial pollution and damage. But marketplace and research funding reward a specious certainty that comes to infuse public science, while "subjective ethical considerations become matters of the private sphere" (252). I hear in that remark echoes of Michael Bliss's famous lament for the privatization of history.[3]

The third explanation for misunderstanding is the amateur factor: the continual necessity for translation from one community to another in an irreducibly social world. Successful, mature science requires a certain community with shared standards for knowledge. Knowledge insiders like to talk to other knowledge insiders, engineers to other engineers. But the social, political, and economic payoff for knowing things requires wider conversations that are always a kind of translation, a thinking across different kinds of communities: between as well as amongst scientists and engineers, bureaucrats and politicians, capitalists and advertisers, lawyers and judges, and of course the wider public that was itself continually rearranging itself into specialized communities of workers or feminists or spiritualists or consumers and so forth. There's almost certainly an expert of one sort or another at one end of the story and an amateur at the other. Historians partake of a little of both identities, they are insiders and outsiders simultaneously, in ways that some authors problematize more openly than others.

So what can we reasonably know and what should we reasonably debunk as historians and as Canadians? Above all, we see an argument for diversity, pluralism, and local and situated knowledge in preference to the abstractions of high modernity. That's the kind of knowledge offered in this collection as well: "These chapters begin to locate the place of knowledge in Canada…. By establishing a handful of discrete data points, the authors contribute to the ongoing project of assembling a more coherent, if inevitably pointillist, history of these activities in modern Canada" (16).

That seems very sanguine. Knowledge that enjoins humility must, surely, do so humbly. Its authors, too, may misdiagnose their own certainties and the practical consequences of their work. I don't see that humility here: there's not much discussion of how history knows and what its knowledge owes to national priorities and opportunists. If we wish to scrutinize collective, professional standards of judgment, such scrutiny should, surely, extend to our own. It seems a little lopsided, for example, to see professional prizes listed in the biographies of the authors but never mentioned in the actual analyses of Canadian science.

Epistemological and political perplexities dovetail here. Consider an essay by historian Timothy Mitchell on area studies as applied to the Middle East. Mitchell notes that postwar modernization theory rested on broadly international social science and more place-based nation-state studies (largely modelled on the United States). But the social and political sciences "deterritorialized" themselves: they debunked area studies by arguing that globalization "transcended or cut at right angles" in a region like the Middle East, understood as a congeries of diverse places and peoples made more contingent by Edward Said's erasure of the difference between the things known and the people knowing them.[4] That's no less true of Canada, another such congeries of diverse places and peoples made more contingent by the settler-colonial paradigm which performs that same act of erasure. But, Mitchell argues, in debunking place-based scholarship, the social sciences debunked their own certainties, which had always rested on a presumed "nation-state" place of convergence for economy, culture, state, and society. His solution is a "provincialization" of the social sciences: the kind of local and situated knowledge seen in *Made Modern*.

But how to connect the pointillist dots without appeal to the large-scale institutional-cultural constructs — "science" and "Canada" — that the book debunks? Notions of "fact" and "place" rely on one another: they resemble arteries and veins, connected by capillaries that turn the one into the other. You don't get to posit the assembling of a "more coherent" picture without connective tissue, without appeal to something we *call* knowledge or community, "science" or "nation," and the one is constitutive of the other. History doesn't get a free pass as uniquely providing knowledge at once collective and objective. It's not enough to win pointillist battles and to lose the major institutional-political wars, that is, to lose the collective mandate for better knowledge and policy. That's why Bliss's privatization concern still resonates. Bliss came to the privatization debate from research on medicine and politics, natural knowledge and public policy, that tried to distinguish better from worse forms. He put his knowledge towards greater national unity and was smartly informed that good knowledge was too specific and local to prop up national mythologies. Three decades later, the nation still totters on, as do science and technology as policy. But if we've learned anything, it's that they are surprisingly vulnerable to concerted attacks by such interested parties as antivaxxers and major polluters, whose political victories that have driven the anthropologist Latour to apologetics and the political scientist Scott to anarchism.[5] David Edgerton's work on technology and the "rise and fall of the British nation" is instructive.[6] Jones-Imhotep and Adcock urge a "synoptic view [that] can enhance our ability to steward the nonhuman world wisely" (12), but that's not what *Made Modern* brings to the table. The fine scholars and illuminating essays gathered here might be the better for admitting that, if we want to use the word "we" for practical synoptic purposes, we are all, to some slight degree, become Michael Bliss.[7]

*Elsbeth Heaman teaches history in the Department of History and Classical Studies, McGill University. Her 2017 book, **Tax, Order, and Good Government**, won prizes from the Federation for the Humanities and Social Sciences and the Canadian Historical Association, including the Governor General's Prize for Scholarly History: The John A. Macdonald Prize.*

Endnotes

1 Robert N. Proctor and Londa Schiebinger, eds. *Agnotology: The Making and Unmaking of Ignorance* (Stanford: Stanford University Press, 2008).

2 James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1999).

3 Michael Bliss, "Privatizing the Mind: The Sundering of Canadian History, the Sundering of Canada," *Journal of Canadian Studies* 26, 4 (Winter 1991-2): 5-17.

4 Timothy Mitchell, "The Middle East in the Past and Future of Social Science," in *The Politics of Knowledge: Area Studies and the Disciplines*, David Szanton, ed. (Los Angeles: University of California Press, 2004): 74-118.

5 Bruno Latour, "Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern," *Critical Inquiry* 30, 2 (Winter 2004): 225-48; James C. Scott, *Against the Grain: A Deep History of the Earliest States* (New Haven: Yale University Press, 2017).

6 David Edgerton, *The Rise and Fall of the British Nation* (London: Penguin, 2018).

7 Thanks to Carmen Nielson for advice and the original prompt in regard to Michael Bliss: Carmen Nielson, "Canadian History Unsundered," *Canadian Historical Association Journal* (forthcoming 2020).

Space, made modern

Arn Keeling

1951 TCA Advertisement. Air Canada Collection, Canada Aviation and Space Museum, Ingenium. One of the figures reproduced in Made Modern.

The collection of essays in *Made Modern* generate useful and sometimes compelling insights into the role of science and technology in producing distinctly 'Canadian' experiences of modernity. Wide-ranging in focus and scope, the chapters nevertheless create a kind of composite image of Canadian modernity, understood as the effort to create new social and spatial orders oriented around and informed by science, technology, and (as James Hull points out in his chapter) an ideology of "efficiency." Indeed, these essays remind us that it is not merely the existence of technological change or scientific advancement as much as it is the self-conscious experience and collective embrace (or rejection) of them that characterize the modern condition.

From the intimate spaces of the body (and, indeed, the ethereal) to urban technological networks to the large-scale transformation of the St. Lawrence Basin, science and technology have been deeply implicated in the modern re-ordering of Canadian society and environment. From a geographical perspective, *Made Modern* provides important perspectives into the spatial processes and transformations wrought through modern science and technology. The spaces, landscapes, and environments of Canadian technological modernity are sometimes at the forefront of these essays (for instance, those by Theodore, Kranakis, Bocking, Stein, and Macfarlane), while in other cases modernist spatial orderings and their ramifications are more implied than explicit. In this short commentary, I hope to highlight some of these historical geographies and their implications for understanding Canadian modernity.

Geographies of knowledge: A central concern of historians of science and of modernity has been the processes by which society and nature are "rendered technical" through the application of modern science, technology, and administrative systems. The goal of these interventions, James Scott argues in *Seeing Like a State*, has been to promote state power by creating "legible" social and natural orders, permitting their "efficient" management. These interventions are best understood, Tania Murray Li rightly suggests, as part of a broader ideology of "improvement" of society associated with modernist actors (including but beyond the state). Crucially, such schemes manifest as particular reworkings of space and environment, whether through modernist urban planning schemes, rationalized agriculture, or the reconfiguration of 'natural' landscapes such as forests and rivers.

Similar themes and examples abound in the chapters of *Made Modern*. Sera-Shriar, Adcock, and Stuhl trace scientific efforts to incorporate unfamiliar and exotic Indigenous peoples and Northern territories into transnational networks of ethnographic and scientific knowledge, while simultaneously asserting the "Canadian-ness" of these regions. These efforts entailed both the systematic collection of "local" knowledge and the mobilization and circulation of such knowledge within wider scientific and administrative networks, "for Canada and for Science." In bringing the geographies of knowledge production into focus, these accounts remind us, too, of the place- and field-based practices of certain knowledge domains (such as ethnography, geography, geology, and botany) and the practices of authority and credibility that accompanied scientific efforts to validate and systematize such local knowledge within particular centres of calculation.

Social order: as Li and Scott (somewhat differently) suggest, central to the modernist impulse is the desire to create and sustain rationalized biopolitical social orders. This impulse, Li and others note, extends beyond the state's imperatives to maintain social control and exercise coercive power to encompass a wide range of actors, technologies, knowledges, and practices, ranging from the rise of political economy to census taking to public health initiatives—each informed by modern scientific practices of systematic data collection and calculation. Such interventions manifested at a variety of spaces and scales, from the body and the doctor's office, to rural, urban, or even national populations. Indeed, scientific management of bodies, populations, and environments often helped produce particular kinds of spaces of order and control, such as the Indian reserve and urban "slum."

Made Modern contains a number of insightful examples of such modernist social ordering. Emerging and contested scientific understandings of the modern body are explored by Gucciardo and Robertson in their accounts of electrotherapy and atomic theory, respectively. These examples evocatively show how putatively modern scientific theories and practices encountered and addressed the embodied experiences of modernity, in order to "improve" both individuals and societies. Similarly, Hadlaw's chapter on the dial telephone explores how telephone companies' implementation of this new technology required "configuring the user" in their individual interactions with both the telephone itself and the technosocial networks with which it connected. At a wider scale, Adcock illustrates how the "boundary work" of Canadian state efforts to regulate scientific and sporting activities in the Canadian north acted in important ways to define and produce the very categories of people and spaces the state sought to regulate. Kranakis's compelling exploration of farmer Percy Schmeiser's confrontation with Monsanto over Roundup Ready canola turns on the interconnection and contestation of a variety of spaces and their associated orders and identities, from the lab and the canola field, to the very notion of what constituted farming under agricultural modernity.

Reconfiguring space and nature: some of the best-known accounts (and critiques) of modernity explore its radical transformations of both the experience and material qualities of space and nature. From David Harvey's notion of "time-space compression" to Alexander Wilson's exploration of the modernist "culture of nature" (and much, much other work besides), scholars link the ideologies of progress, modernity, and improvement with technological and scientific interventions that substantially reconfigure landscape and nature. Efforts to render the environment as "natural resources" and its transformation into an "organic machine" are typically derided as Promethean, authoritarian, and ultimately doomed to despoliation and failure. Indeed, the standard "declensionist narrative" of a good deal of environmental history reflects the ironic tale of attempted modernist reworkings of nature through technology, and their calamitous results.

The new landscapes and geographies of modernity traced in *Made Modern* share these critiques, but also reflect more complex and nuanced understandings of modernist interventions. Bocking's chapter, subtitled "modernity and disruption," offers a wide-ranging survey of modernity's territories, transformations, and disruptions associated with modern Canada's environmental history, and makes an excellent introduction to the section of the book on "environments." Stein's chapter on the "disruptive" technology of commercial aviation brilliantly illustrates how the advent (and marketing) of long-distance flight influenced long-held Canadian ideas about geography, seasonality, and identity. Macfarlane's exploration of the high-modernist St. Lawrence Seaway project perhaps best illustrates the links between the production of modern social and spatial orders. In reconfiguring the upper St. Lawrence as an industrial hydroelectric and navigation megaproject, Canadians (and their American partners) reimagined both the river and the nation as a space of improvement, efficiency, and control. That such interventions required the erasure of existing settlements and the radical (and problematic) simplification of the river itself, Macfarlane suggests, reveals the project as distinctively high modern, if lacking full coercive power suggested in Scott's conception.

If, as Jorgensen suggests in her epilogue, "Canada is an Anthropocene nation," it is perhaps worth additional consideration to what extent its history embodies the internal contradictions (both ideological and material) of both concepts, modernity and Anthropocene. If there is a shortcoming to the collection, it is in the slight attention paid to modernity's ideological obverse, antimodernism. Though there are certainly examples in these chapters of resistance and friction in individual and collective Canadian reactions to the rise of technological society, the persistence and articulation of critical and alternative visions of science and technology remain somewhat obscure. While the introduction usefully introduces both antimodernism and the idea of "multiple modernities" as both historical and contemporary critical responses to high modernist ideologies, these concepts remain largely unexplored in the individual chapters (with the exceptions, perhaps of Kranakis and Bocking). Presumably antimodernism, too, entails actual and imagined spatial orders—"unimproved" environments and landscapes that perhaps act as spaces of resistance to modernism's juggernaut.

Arn Keeling is a professor of geography at Memorial University, specializing in the historical geography and contemporary legacies of extractive industries in the Canadian North. He is co-editor of ***Mining and Communities in Northern Canada: History, Politics, and Memory****.*

The Canadian Modern

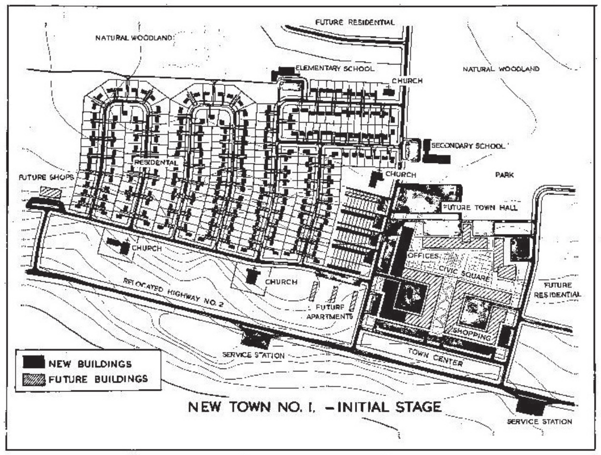
Sverker Sörlin

This book, drawn from a conference at York University, Toronto in 2015, does not try to tell a "story of diffusion from European origins" (4). It tries instead to talk about "relations" between knowledge, machines, materials, and cultural and social embeddedness. The editors, Edward Jones-Imhotep and Tina Adcock, with broad historical competencies in science, technology, and environment call this the lens of the "modern." Certainly, nobody in our time and day, and certainly no serious historian, would argue that science and technology are *not* embedded in societies in multiple ways. But to say it is one thing, to demonstrate it in one single book through a collection of conference papers is another.

Canada's modernity is marked by science and technology. This credo is repeated in several places in this book. Stephen Bocking claims in his chapter that his "colleagues in this volume" have asserted that science has become "central to the history of Canada" (251). His own contribution lies particularly in locating this centrality to a range of sites and spaces, often in the field where knowledge was produced with close relations to state ambitions and to extractive industries. His characterization of the other chapters is in my reading correct: that is an underlying shared assumption, often made explicit. Canada is presented throughout as a country of modernity, of technology, of reliance on science, of the applications of science, all central to its formation. It is probably also true, to the extent such a grand statement can be 'true'.

After having read thirteen chapters agreeing to this overarching credo—and I say this with no irony—I am even more convinced than I was before that science, technology and modernity fit very well together in the Canadian experience. A question I have been pondering during my reading is rather another one: couldn't the same book of science and modernity have been compiled for many nations? If so, how does the Canadian story relate to other countries who made the modern, or were made modern, or both? Aren't science and technology conditioned by modernity, formative forces in it, and in criticizing it? If so, what is then special with 'the Canadian modern'?

The editors' introduction is an impressive review of the copious literature on modernity and modernization. A fundamental tension is introduced. On the one hand, Canada is the quintessential modern nation, with huge infrastructures, pronounced urbanization, an articulated and proud nation building, up-to-date and functioning health- and education systems, deeply enmeshed in global commerce and with a technologically advanced economy. On the other hand, Imhotep-Jones and Adcock wish their book to distance Canadian history of science and technology from diffusionist and universalizing stereotypes that used to be a common feature of colonial science. They rather suggest a relational history, of material artifacts, of "ambiguities, contradictions, and



Ontario Hydro blueprint. One of the figures reproduced in Made Modern. © Ontario Power Generation.

instabilities."(4) The modernity that they grapple with is one where "meanings and experiences" are unsettled. The volume sets out to explore how science and technology have "formed the sites for Canadians to imagine, renounce, and reshape themselves as modern." (4)

It is a book that also wants to address deep seated problems of the historiography of modern science and technology as triumphalist, Western-centric, and Euro-normalizing in that awkward old way that put most peoples in "the waiting room of history," as Dipesh Chakrabarty famously noted in *Deprovincializing Europe* (2000), which is already a while ago. This remains a timely agenda, reflecting progress in these sub-disciplines over the last couple of decades, but also one that raises expectations. Perhaps also questions: what does it actually mean? Is it an attempt to tease out commonalities from a rich diversity, and thus to replace the conventional universalism with a new, different coherent narrative? Or does the collection suggest that no such coherence exists?

The York conference was held in honour of the US-born astronomer turned Canadian/historian Richard Jarrell (d. 2013 and a founder of this journal) who in the 1980s and 1990s suggested that Canada was vast and diverse, and important enough to be regarded as a national case in its own right. This included a "utilitarian focus" that may distinguish Canadian techno-science history from some of the standard European and US based ones— and not just sees it as a lesser version of these. Against this background the chapters in this book invite deep engagement with "the particularities of specific sites and localities." They wish to "begin to locate the place of knowledge in Canada" (16). This grand ambition, given the vastness of the subject, is offered with an element of excuse; after all there isn't very much research done, but someone must get this work started!

The chapters live up to stated ambitions very well, at least when it comes to site specificity. Several hone in on individual scientist biographies. Edward

Jones-Imhotep takes on Gerald Bull, whose checkered career as a ballistic and high altitude weapons constructor took him from Cold War military projects, via McGill's engeering department and private projects in the US, all the way to the unlikely role as collaborator with China, apartheid South Africa, and, ultimately, developer of Scud missiles and the Babylon "supergun" project for Saddam Hussein's regime, a step too far for which Bull was ultimately assassinated, likely by Mossad agents. Jones-Imhotep calls it "an anti-case study" in the spirit of Jarrell's search for counternarratives. Quite at the other end of the spectrum, David Theodore explores the career of Christopher Thomson, a physicist with New Zealand roots who pursued computerized analysis in the Montreal Neurological Institute in the early 1970s. His machinery was modest indeed, but his personal skills were vast. Theodore's analysis revolves around the concept of "trained acquaintance" (171), coined by Norbert Wiener in *Cybernetics* (1948). Wiener thought of a small-scale version of interdisciplinarity, literally embodied in one person or a small team, where each member knew just enough of the others' expertise to function together. Theodore calls this "small science", in contrast to big science and mega-size teams such as the Manhattan project or the CERN accelerator in Geneva. But also to suggest a possible small history, in contrast to what Bruce Hevly once called "big history"— in his afterword to a book he co-edited with Peter Galison, *Big Science: The Growth of Large-Scale Research* (1992) — a strand of history writing that since then has had a fabulous career along several trajectories.

Other cases of smallness, or marginality, in this volume are found in chapters on medical and ethnographic practices. Being modern could also mean to deviate, appropriate normal science and tweak it for popular digestion or sectarian pursuits. Dorotea Gucciardo takes a close look at how new knowledge of the role of electric signals in the human body travelled quickly in the late 19th century to medical and psychiatric clinics, rather than to the big hospitals and medical research centers. The body could in the intimacy of a closer doctor-patient relation be regarded as "a battery" (86) and electrotherapy was suggested as a cure for anything from neurasthenia to hysteria. A few decades later a small group of believers in Kitchener-Waterloo became convinced that "cosmic rays", Robert Millikan's concept from 1925, could indeed have a healing effect, as Beth A. Robertson explains. These magic rays could gracefully rejuvenate and perfect the human body through its own "atomic content" (115), shared by everyone, claimed Thomas Lacey, a semi-famous medium and peace prophet who led the Kitchener-Waterloo atomic spiritualists in this personalized version of 'atoms for peace' *avant le mot*. New technology could also mobilize ordinary citizens, as Jan Hadlaw explains in an entertaining chapter on the "mysteries" of the Bell rotary telephone, introduced in the late 1920s, in fact taking away some intimacies that had been there with the switchboard girls, and some of their extra services too, like giving the time and chatting for a second.

These papers are very true to Richard Jarrell's ambition to turn Canadian history of science away from "great men" and "pure science" (105), and here it really pays off. They also bring the social, even vernacular dimensions of the circulation of science and technology close to the fore. "Canadians", a word that often appears throughout the volume, here also gets flesh, blood, and even names. However, just as Cold War oddballs were a numerous species and small collaborative and computerized teams were quite normal in any country in the 1970s, not much of these vernacular medical and communication histories comes across as Canadian. Pseudo-scientific spiritism was everywhere, electrotherapies, too, not to speak of dial telephones.

Efraim Sera-Shriar presents British physician Richard King's 1830s ethnographic travels in Arctic British Canada. He fits the pattern of an expedition scientist, pursuing a marginal and small-scale project, although his work style was common in colonial expeditions around the world, and with considerable consequences as his ideas were living on institutionally in the Ethnological Society of London, which he cofounded. King was just an unusually sensitive and sympathetic fieldworker, with empathy, fairness and an eye for indigenous virtues and suffering, but structurally and functionally just as imbued with racist conceptions as most others. Expeditions, of which we encounter several in this volume, were always political and a chief means of claiming sovereignty in the north and therefore restricted for foreigners. When almost a century later American explorer G. P. Putnam gets access to the Eastern Canadian Arctic, twice in 1926 and 1927, it turns out his field practice was more that of a sinister bird hunter than that of a scientist, causing a minor crisis. Making astute observations about the floating and broad skill sets of northern scientists, Tina Adcock shows how the Putnam incident reflects a common pattern. Both institutional and self-proclaimed field scientists often were, also, intrepid hunters, they picked up local knowledge, they collected intelligence, in essence carried a versatile if sometimes dangerous expertise. In response to Putnam's transgressions Canadian scientists and public officials enacted "boundary work" in Thomas Gieryn's sense, to defend their expertise turf but also their nation.

These are excellent case studies of historical realities that may in some sense be very Canadian, insofar as they touched upon sensitive geopolitical and power relations, to the British in the 1840s, and to the Americans in 1920s. They enrich our knowledge about the social function of field science, expertise, science-policy relations, and about Canadian history in ways that would have made Jarrell proud. But they have fairly little to say about 'the modern', more than the obvious, that these are the kinds of processes we should expect as societies modernize, not just in Canada.

That said, it should be acknowledged that the large majority of chapters—more than I can cover here—offer distinct and invariably entertaining and well-written insights into modern Canadian history, sometimes from fresh and novel angles, such as air travel. Canadians feared flying in the wintertime, despite the fact that harsh winters were the basis for Confederation era boosterism—according to Carl Berger's essay "The true north strong and free" in Elspeth

Cameron's collection *Canadian Culture* (1997). As Blair Stein explains in *Made Modern*, technology could take that fear away, with cabin pressurization and luxury on board. Hence, being Canadian was not just to endure the cold but, on the contrary, to be able to overcome anxieties by means of technology, and at the same time conquer the vast distances that were a hallmark of the nation—the land of "too much geography" in Mackenzie King's famous phrase—and do it in all seasons.

Eda Kranakis writes about Monsanto and the prairies in ways that make us see high-modernity agriculture as an arena of gene-patent rights. Andrew Stuhl returns to Vilhjalmur Stefansson's iconic, and infamous, Canadian Arctic Expedition (1913-1918), at the same time a national trauma and triumph. He uses the multivolume *Report* of the expedition (1919-1926) to reflect on what kind of work the expedition actually did. Applying James Secord's circulation concept, he refers especially to work by Lissa Roberts in order to seek the deeper significance of the *Report* and finds it to be a much more complex and wide-reaching object than previous historiography rendered it. It was widely distributed to libraries, institutions, and key scientists, and it worked meticulously to "project intellectual authority over the Arctic" (294), serving as an instrument of what Janice Cavell and J. D. Noakes called "Acts of Occupation" (2010).

Gene-tech prairies, Stephen Bocking's scientific landscapes, and the geopolitical significance of expeditions are chapters grouped into an "environment" section. They provide materials that may be used if one wanted to draw up a more specifically Canadian modern history of science and technology. Perhaps this is precisely because these chapters are not just situated, in the lab, clinic, or government office. The landscape/environment scale is large enough, and 'geographical' enough to make it non-replicable, although of course similar processes happened elsewhere, in Russia, Alaska, and Scandinavia.

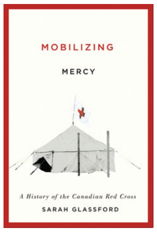
It could have been useful to supplement the national focus with a more articulated comparative approach. The editors spare no effort in assuring readers that Canadian technoscience was always transnational and to analyse relations between objects, models, methods, and bodies is a good way to connect dots and bring structure to diversity. However, after having pondered carefully on the collective effect of all chapters, each with a strong and valid point of view—and some truly excellent—my initial reaction does not go away. The Canadian experience of science and technology does share similarities with many countries with vast territories, rich resources, often an OECD membership, and in some cases also one of NATO. Such countries typically organize, with some variations of course, strong institutional approaches to their national resources, such as CSIRO in Australia, the US Geological Survey, the Geological Institute of Denmark, the large resource-oriented public agencies of Sweden, or museums and their expertise in almost every country.

Institutions get little attention in this volume and I don't think it would have violated Richard Jarrell's program if they had. It could have helped build a more consistent pattern out of the search for diversity and detail that he has apparently inspired. Because, after all, despite the merits of the individual contributions, it is hard to see what is so deeply Canadian with them. Many countries have an airline, military research, and built oil riggs (completely absent in this volume, just as forests are) and huge hydro-electric dams. In most there were also markets for spiritualist applications of physics and ectoplasma. At least in some countries there are vast hinterlands rich on resources where "landscapes of science" took shape with research stations and bodily practices and elaborate acts of occupation. Were all these nations also "made modern"? The editors don't say it explicitly, but there is an, albeit timid, exceptionalist assumption underpinning the volume that I will not confront. But I would have liked them and their chapter authors to engage with it more actively. Argue it, question it. What is so very, very modern with science and technology in Canada, after all?

It is possibly the temptation of any edited collection to somewhat overstate its case. That may not be such a bad thing either. There is a virtue in pushing your argument to make an imprint. And it's true that a patchier, more marginal and site-specific character of science and technology is now the norm rather than the exception. Technoscience micro-narratives abound. Sooner or later they will feed broader insights. The importance of figures like Jarrell, and now of this collection, is also that: to give us the infinite detail of the modern experience. It has been progressive, path breaking, and necessary to make sense of what goes on in nations and regions of all shapes and sizes. But there is also a time for what Charles Tilly called *Big Issues, Large Structures, Huge Comparisons*, in a book by that wonderful title in 1984. Telling from this generous and well-crafted volume Canada has a lot to offer in such work.

Sverker Sörlin is Professor of Environmental History and co-founder of the Environmental Humanities Laboratory at the KTH Royal Institute of Technology, Stockholm. He specializes in Arctic and Canadian science, environment and policy and was recently a fellow of the Peter Wall Institute for Advanced Study at UBC. Recent books in English include, ***The Environment – a History of the Idea*** *(co-authored with Libby Robin and Paul Warde; Johns Hopkins 2018) and* ***Grounding Urban Natures: Histories and Futures of Urban Ecologies*** *(co-edited with Henrik Ernstson; MIT Press 2019). He serves on editorial advisory boards of* ***The Anthropocene Review*** *(SAGE),* ***Environmental Humanities*** *(Duke), and* ***Environment and Planning E: Nature and Spac****e (SAGE), and is a prize-winning author of narrative non-fiction, essays, biographies, journalism, and scripts for television and film.*

Book Reviews / Comptes rendus



Sarah Glassford. *Mobilizing Mercy: A History of the Canadian Red Cross.* Xix + 408 pp., plus figs., bibl., index. Montreal & Kingston: McGill-Queen's University Press, 2017. $39.95 (paperback).

The Canadian Red Cross Society (CRCS) is an endearing symbol of Canada and Canadian values. For more than a century, the organization has supported humanitarian aid efforts throughout the country and around the world. In *Mobilizing Mercy*, historian Sarah Glassford investigates the emergence, growth, and longevity of the CRCS, questioning how the organization adapted to changing social currents while upholding its core responsibility of providing help and support for the vulnerable.

Glassford blends institutional history with social history, offering a diverse perspective of the CRCS that reflects the organization's place in the broader milieu of Canada. "To trace the history of the Canadian Red Cross is, in many ways, to trace the history of twentieth-century Canada," Glassford contends, strongly introducing her topic with an ambitious statement (8). The organization formed in the late nineteenth century, and Glassford traces the key people and ideas behind its inception and evolution through the 1970s. Documenting nearly one hundred years of history is a challenging and daunting task, but Glassford skilfully navigates the many and varied currents of ninetieth- and twentieth-century Canada in a manner reflective of the events and issues that influenced the development of the CRCS.

Militarism, patriotism, and maternalism influenced the Canadian Red Cross Society, Glassford argues. She attributes the organization's history of adaptability to a recognition and embrace of these shifting cultural values, demonstrating how and why the CRCS drifted from its original mission while maintaining a core humanitarian identity. The survival and longevity of the organization hinged on the concept of care, the driving motivation for the individuals who supported the CRCS as a tool for helping vulnerable people both in Canada and around the world.

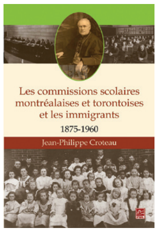
Glassford's chorological approach is clear and easy to follow. Chapters 1 and 2 examine the military origins of the Canadian Red Cross Society, tracing its beginnings during the Northwest Uprising of 1885 to its first successful wartime effort during the South African War at the turn of the century. Chapters 3 and 4 also explore the influence of war on the organization, as Glassford investigates patriotism and social health values among Canadians during the First World War and interwar period. Chapter 5 considers the organization's efforts during the Second World War, a six-year period marked by successes and challenges that later defined the CRCS in the postwar years. Chapter 6, the final and perhaps most ambitious section of the book, traces the organization's growing internationalism and humanitarian efforts in Canada and aboard between 1946 and 1970.

Mobilizing Mercy is rich on the recorded history of the Canadian Red Cross Society. Glassford draws on memoirs, private papers, news clippings, magazine articles, parliamentary debates, government records and a range of other primary documents from local, provincial, and national repositories. Her reading of Canadian Red Cross history includes organizational committee minutes, annual reports, and promotional materials from the CRCS. She also examines the writings of prominent middle-class women, including Nellie McClung and L.M. Montgomery. Her work is admittedly thin on francophone voices, a silence that "reflects their conspicuous absence from most CRCS activity before the Second World War rather than a decision to exclude or ignore them in the course of my research" (23). Nevertheless, Glassford's command of the evidentiary record is impressive and she deserves credit for producing as thorough a history of the CRCS as the documents would allow.

Glassford is at her best when discussing the *people* who created, maintained, and shaped the Canadian Red Cross Society. Anecdotes and references to such individuals as George Ryerson (soldier-surgeon and key figure in the founding of the CRCS); Charlotte Whitton (founder of the Canadian Welfare Council); Adelaide Plumptre (president of the Ontario Division of the CRCS in the 1920s); and W. Stuart Stanbury (architect of the Society's free blood transfusion service and advocate of postwar internationalism), illuminate the complex and important decisions underlying the history of the Canadian Red Cross. At times Glassford's analysis slips, as if to suggest the CRCS was a self-thinking monolithic entity. Overall, though, her work demonstrates the centrality of individual voices to the social and political developments documented in the book.

Readers of *Scientia Canadensis* will find Glassford's work useful for understanding the institutional and social history of Canadian humanitarianism, but do not expect a detailed investigation of the practices underpinning medicine or healthcare in nineteenth- and twentieth-century Canada. While Glassford discusses medical issues central to the CRCS and its various branches — physicians and nurses, disease prevention and mitigation, blood donor drives and water safety campaigns, among others — her book concentrates on the politics of "renewal and obsolescence," characterized as central to understanding the history of the Canadian Red Cross Society (275). In this vein, *Mobilizing Mercy* makes a welcomed contribution to Canadian history that will appeal to readers interested in the social and cultural dimensions of Canada's leading humanitarian aid organization.

Matthew S. Wiseman, University of Toronto



Jean-Philippe Croteau. *Les commissions scolaires montréalaises et torontoises et les immigrants, 1875-1960.* Québec: Presses de l'Université Laval, 2016. 288 p. 39,95$. ISBN 978-2-7637-3207-7

Dans le champ de l'histoire de l'éducation au Canada, le principe des deux solitudes est, d'ordinaire, assez rigoureusement tenu. On ne peut guère le reprocher aux chercheurs, tant la complexité des systèmes scolaires provinciaux rend les études comparatives difficiles. L'historien Jean-Philippe Croteau n'a pas reculé, pour sa part, devant ce défi. Son ouvrage, qui s'appuie en partie sur ses travaux de doctorat complémentés d'autres recherches, s'intéresse aux modèles d'intégration des immigrants adoptés par les commissions scolaires montréalaises et torontoises de la fin du XIXe siècle aux années 1960. Faisant directement écho aux enjeux contemporains qui concernent la gestion de la pluralité, cette étude met à l'épreuve des idées reçues sur la présumée « différence québécoise » en matière d'intégration scolaire des immigrants. L'auteur les nuance considérablement, arguant qu'il existe également une « différence ontarienne ». Il soutient, par ailleurs, que « les institutions scolaires protestantes participent elles aussi activement à la formulation et à la diffusion d'un modèle scolaire québécois » (258).

L'ouvrage se divise en 5 chapitres. Un premier, « L'axe comparatif : Toronto-Montréal », établit le contexte du développement des deux villes et présente la genèse de leur système scolaire respectif. Une fois posés les éléments de contexte comme l'industrialisation et la croissance urbaine, l'insistance est mise sur les facteurs religieux qui ont eu une forte influence sur la configuration des systèmes. La grande homogénéité britannique et protestante de Toronto au XIXe siècle permet à la ville de se doter plus rapidement que Montréal d'un système public duquel cherchera à se séparer la minorité Irlando-catholique. Solide, ce système public permet l'implantation d'une loi de scolarisation obligatoire dès 1871 (on attendra jusqu'en 1943 au Québec). Il en va autrement à Montréal où l'entreprise éducative s'établit plus strictement sur des bases confessionnelles aux lendemains des troubles de 1837-1838, avec une faible intervention étatique. L'Église catholique se pose alors en résistante de la marée anglo-britannique. Or les protestants de Montréal se réclament eux aussi du principe de confessionnalité scolaire qui, stratégiquement, leur permet de se doter d'écoles bien à eux. Dans ce dense chapitre introductif de 37 pages, Croteau s'appuie à bon escient sur une vaste panoplie d'études afin de fournir des repères utiles à quiconque n'est pas familier avec ces questions. Mais comme plusieurs des éléments de contexte présents reviennent dans les chapitres subséquents, cette partie du livre aurait pu être resserrée pour faire place à une nécessaire présentation critique des sources historiques utilisées.

Dans les quatre chapitres qui suivent, les commissions scolaires de chacune des deux métropoles canadiennes et leur façon particulière de « canadianiser les immigrants » sont présentées tour à tour. Le chapitre 2 s'intéresse aux écoles publiques ontariennes réunies au sein du Toronto Board of Education (TBE). Jusqu'à la Deuxième guerre, le caractère majoritaire de la population d'origine britannique et de religion protestante de cette ville donne une grande force d'assimilation à ces écoles. On y promeut avec confiance une *« anglo-conformity »* assez peu contestée. Cela n'empêche pas la TBE de devoir composer avec des demandes des communautés immigrantes concernant la langue d'enseignement et l'appartenance religieuse. Les choses se modifient après 1945, avec la montée de revendications communautaires qui ont pour effet d'assouplir ce modèle assimilationniste et d'en tempérer la dimension patriotique. Il faut toutefois attendre les années 1960 pour que l'éducation à la citoyenneté prenne résolument, à la TBE, le tournant du multiculturalisme.

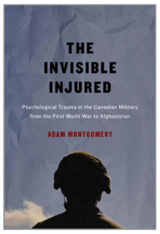
L'Église catholique et les nationalistes irlandais de Toronto s'opposeront, ont le sait, à ce conformisme social anglo-protestant. Le chapitre 3 met en lumière l'histoire du Toronto Separate School Board (TSSB) qui s'amorce dans la seconde moitié du XIX^{e} siècle. Promouvant avec vigueur l'héritage religieux et culturel de l'Irlande dans ses premières années, cette commission scolaire modère ensuite ses ardeurs pour valoriser, au tournant du XX^{e} siècle, une *« catholic conformity »* plus près des valeurs prônées par les écoles publiques. La diversification de l'immigration catholique (Italiens, Polonais, Allemand, Ukrainiens) favorise un tel tournant. Pour s'attirer les immigrants, la TSSB se bat toutefois à armes inégales : son sous-financement étatique, longtemps maintenu, rend ses écoles moins attractives. Après 1945, la TSSB cherche à son tour à mieux refléter le cosmopolitisme canadien tout en cherchant à préserver sa spécificité. Ce chapitre consacre aussi une place importante à l'épopée des Franco-ontariens puisque la donne linguistique ayant un impact important sur la configuration de la TSSB. Bien connue de manière générale, cette histoire de l'enseignement français en Ontario l'est moins en contexte torontois, précise l'auteur.

Si de manière générale, les politiques assimilatrices du système scolaire Toronto ont été peu contestées par les groupes d'immigrants, c'est que le monopole linguistique anglophone a facilité les choses, soutient l'auteur. Il en va autrement à Montréal qui doit composer avec une double majorité, ce qui entraîne une configuration différente de son système scolaire. Ces thèmes sont abordés au chapitre 4, consacré à la Commission des écoles catholiques de Montréal (CECM). Siège de l'identité culturelle et religieuse du groupe canadien-français, l'école catholique francophone ne réussit pas à s'imposer auprès des immigrants. La force d'attraction de l'anglais, langue de la mobilité, entraîne ainsi le développement d'un secteur anglo-catholique. Croteau souligne que, jusque dans les années 1940, la crainte de l'apostasie inquiète bien davantage les autorités de la CECM et de l'Église que l'anglicisation des immigrants. Dans l'après-guerre, cette sensibilité se transforme mais sans qu'il soit possible de renverser la vapeur. Il faut attendre les lois linguistiques des années 1970 pour que de véritables changements voient le jour.

Le cinquième et dernier chapitre aborde l'histoire de la commission protestante de Montréal. S'il est vrai que les élites éducatives protestantes ont valorisé une éducation conçue comme universelle, semblable à celle des écoles publiques torontoises, leur statut minoritaire au Québec les a aussi amenées à brandir le drapeau de la confessionnalité et à défendre le caractère britannique et protestant de leurs écoles, soutient l'auteur. Le rapport à l'immigration est surtout étudié dans ce chapitre à travers le cas des enfants juifs.

Assurément, Jean-Philippe Croteau signe une étude bellement rédigée et érudite. Pour mieux prendre la mesure de sa contribution de recherche, on aurait apprécié toutefois qu'y soient mieux départagées les contributions neuves des connaissances déjà établies sur la question. Sur le plan méthodologique, l'auteur a cherché à mettre en lumière l'agentivité des groupes d'immigrants dans cette trajectoire éducative. Il y parvient assez bien, montrant comment ceux-ci utilisent la rivalité confessionnelle pour obtenir différents privilèges dans les deux villes. La lecture de cet ouvrage favorise assurément une meilleure connaissance du rôle historique de l'école dans l'intégration des immigrants au Canada. Si l'échelle d'analyse — macroscopique — ne permet pas d'approfondir les mécanismes précis grâce auxquels sont promus les modèles de citoyenneté (les cursus, les manuels et la pédagogie sont peu examinés), l'étude pose de manière solide un cadre de réflexion grandement susceptible de stimuler d'autres recherches.

Louise Bienvenue, Université de Sherbrooke



Adam Montgomery. *The Invisible Injured: Psychological Trauma in the Canadian Military from the First World War to Afghanistan*. Xiv + 319 pp, plus index. Montreal: McGill-Queen's University Press, 2017. $31.46 (cloth)

Adam Montgomery's work summarizes a century of the politics, practice, and cultural impact of psychological treatment in the Canadian military. As the subtitle indicates, Montgomery begins his work with a look at the phenomenon of shell-shock and the debates between the military and medical establishment about the best methods of care, and the post-war debates within the broader medical establishment about the same subject. Montgomery's work places the phenomenon of mental trauma resulting from wartime experience under serious study from multiple perspectives and lenses, and brings the study of Canadian psychological and moral injury out of the literature concerning the First and Second World War and into the 21st century. Over six chapters, Montgomery provides clear examples of how each manifestation of military trauma (shell shock, battle exhaustion, post-Vietnam syndrome, PTSD, operational stress injury) were each the product of their time and place, governed by military restrictions, contemporary conceptions of the "worthy" sick and the masculine ideal governing the military conception of resilience. These diagnoses had an impact beyond medical health, touching on a soldier's economic and cultural well-being. Readers will rapidly catch on to the cyclical nature of this history as wartime emergency shows the need for psychological treatment and screening of military personnel. The end of the emergency results in rapid demobilization of these same structures and concepts, until very recently.

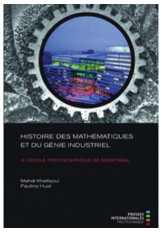
Montgomery builds his study from a stable of strong historical studies of Canadian treatment of psychological trauma, such as Terry Copp and Bill McAndrew's 1990 work *Battle Exhaustion*, Allan English's 1996 *Cream of the Crop*, and Ben Shephard's 2001 *A War of Nerves*, among the many works listed in his extensive bibliography. As such, his early chapters do not contain many surprises for those familiar with the history of military psychology. Readers should consult Meaghan Fitzpatrick's 2017 work *Invisible Scars: Mental Trauma and the Korean War* for a more detailed accounting of military psychology in this period than is available in Montgomery's brief section on the subject. Montgomery made extensive use of Canadian medical journals and where the primary material is weak, reached out to interview key military members who provide an inside view of the Canadian military's responses to trauma.

My only major critique is that in his transitional chapter from post-war trauma studies to the tumultuous 1990s, Montgomery's focus on Canada slips. That is not a bad thing as he is able to capably point to the international developments in the field of psychology that had a determining influence on the West's discussions concerning trauma and military service. His close focus on Canadian Vietnam veterans eclipses the experience of thousands of Canadians who were on peacekeeping missions during this time, each with their own horrors. As the DSM-III was being debated, Canadians in Cyprus were caught between warring Greek and Turkish forces. In the years 1976 to 1980 approximately 1 in 14 Canadian soldiers who died on active service died as the result of suicide, less than the population at large but a not insignificant number. Now that Montgomery has provided the synthesis of national and international developments in military psychology, it would be worth further study of this period in the Canadian Armed Forces given the prominent attention paid to shell shock and battle exhaustion in the World Wars, and post-1994 attitudes towards PTSD and military service.

Chapter 5 of Montgomery's work is indisputably his most important achievement, capably exploiting the material laid bare in the Sharpe Inquiry into the Croatia mission. The inquiry laid bare in a systematic way the myriad challenges facing Canadians returning from one of the most difficult overseas missions to that point, their challenges in obtaining help, the informal stigma that would deride their masculinity and threaten their place within the military family, and formal processes that would see them medically discharged if they admitted to exhibiting post-traumatic stress or addiction. Montgomery's research partnership with Colonel (Retired) Stephane Grenier, further developed in Grenier's excellent 2018 memoir co-authored with Montgomery *After the War*, provides the reader with important insights into how the military approached mental trauma as it entered the new millennium, and changing appreciation for the value of peer support and the ethics of redeploying military members who suffer from PTSD. What is old is new again.

There is much here for military historians, but I wager *The Invisible Injured* will be on bookshelves of historians of Canadian medicine and psychology well into the future. It is an important contribution to our understanding of how medical concepts develop, are propagated, find acceptance or are otherwise moderated. It is a history of the conversations between and within medical circles, the military, and the culture at large. No small achievement, that.

Andrew Burtch, Canadian War Museum



Mahdi Khelfaoui et Pauline Huet. *Histoire des mathématiques et du génie industriel à l'École Polytechnique de Montréal.* Montréal: Presse internationale Polytechnique, 2016. 176 p. 29.95 $. ISBN 9782553017001

L'année 2014 marque le vingtième anniversaire du département de mathématiques et de génie industriel de l'École Polytechnique de Montréal (ÉPM). Mais, les deux disciplines dont on retrouve les noms dans la dénomination du département ont été activement présentes dans cette institution bien avant la fondation de ce département. Le livre de Mahdi Khelfaoui et Pauline Huet retrace l'histoire de celles-ci depuis leur introduction dans la première école d'ingénieurs francophone au Québec fondée en 1873. On y retrouve, sans surprise pourrait-on dire, trois chapitres, l'un sur les mathématiques, l'autre sur le génie industriel, et un dernier sur les 20 dernières années au cours desquels ces deux disciplines ont été réunies sous l'égide d'un même département.

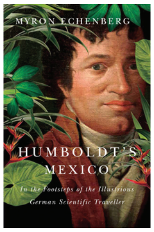
Le premier chapitre, *Le département de mathématiques jusqu'en 1994*, nous laisse un peu sur notre faim quant aux premières décennies de l'histoire de l'École Polytechnique et à la place qu'y occupent les mathématiques. Jusqu'en 1951, le regroupement des professeurs de mathématiques ne semble pas avoir de statut officiel dans l'institution. Pour les années antérieures à cette date, les archives de l'École sont plutôt lacunaires en ce qui a trait aux mathématiques. Mais elles s'étoffent par la suite. Aussi, les problématiques que rencontrent les professeurs de mathématiques sont plus clairement énoncées et précisées à partir de ce moment. La présence d'un département de mathématiques à l'intérieur d'une école d'ingénieurs est inhabituelle, alors que les cours de mathématiques sont le plus souvent à la charge du département de mathématiques de l'université à laquelle l'école est associée. La question du bien-fondé de la raison d'être d'un tel département dans une école d'ingénieurs se pose donc nécessairement. Corolairement, la formation des professeurs d'un tel département devrait-elle refléter les besoins spécifiques à la formation de futurs ingénieurs? Aussi, comment les cours de mathématiques donnés aux étudiants doivent-ils prendre en compte ces besoins? Le département de mathématiques doit-il être uniquement un département de service ? Ce sont toutes ces questions et les discussions qui en découlent qui animent la description que font les auteurs à partir des documents d'archives de l'ÉPM. C'est donc une histoire interne à l'ÉPM qui nous est présentée. On aurait aimé parfois avoir aussi un regard sur ce qui se passait dans d'autres institutions similaires. Toutefois, le travail d'archives semble vraiment exhaustif. On suit pas à pas les méandres de ces discussions et elles sont présentées de façon intéressante. Il va sans dire que le qualificatif « appliquées » ajoutée au nom du département en 1979, apparaît dans ce contexte naturel… et peut-être nécessaire face au désir d'autres départements de prendre en charge l'enseignement des mathématiques et aussi pour mieux représenter les orientations de la recherche qui se mettent en place à cette époque.

Le second chapitre s'intitule *Émergence et développement du génie industriel: 1966-1994*. Le génie industriel est une discipline relativement jeune. Après avoir retracé succinctement les débuts de celui-ci aux États-Unis, puis au Québec, principalement autour du Centre d'organisation scientifique de l'entreprise (COSE) créé en 1962, les auteurs se focalisent sur les différentes étapes de l'évolution du génie industriel à l'ÉPM. Dans un premier temps, c'est par des cours qu'il prend pied au sein du département de génie mécanique, à partir de 1966. L'évolution du nombre d'étudiants et de diplômés à la fois au baccalauréat et à la maîtrise entraîne la formation d'un département indépendant en 1971. Mais la survie de la discipline à l'ÉPM n'est pas totalement assurée. Dès avant la formation du département, plusieurs mettaient en question l'opportunité d'avoir des programmes de génie industriel alors que des programmes en apparence similaires existaient déjà à l'École des hautes études commerciales (HEC) et à l'École des relations industrielles de l'Université de Montréal. Il fallait donc bien définir la nature particulière du génie industriel. La proximité avec l'industrie, l'importance relative du traitement quantitatif des problèmes à résoudre, et donc de la place des mathématiques, principalement de la recherche opérationnelle (RO) et de la statistique, le rôle des sciences sociales et des sciences humaines, en n'oubliant pas les difficultés du développement de la recherche pour une discipline tout compte fait nouvelle, tout cela participe à une dynamique particulière d'un tel département dans une institution tournée vers le génie, souvent avec des tensions aussi bien à l'interne du département qu'avec le reste de l'institution. Les auteurs décrivent clairement et précisément ces tensions, et leur relative résolution, par des données qualitatives et quantitatives, tant au niveau de l'enseignement que de la recherche.

Le troisième chapitre est consacré à *La fusion et l'évolution du département de mathématiques et de génie industriel depuis 1994*. Pourquoi une telle fusion de ces deux départements ? Dans un contexte de restrictions budgétaires affligeant toutes les institutions universitaires du Québec, le directeur de l'ÉPM y voit trois avantages. D'abord, « permettre aux méthodes quantitatives de la RO et des statistiques industrielles d'être intégrées à la formation et aux activités de recherche en génie industriel. » Il faut dire que les professeurs de RO avaient quitté le département de génie industriel dans les années quatre-vingt pour rejoindre le département de mathématiques appliquées. Ensuite, « assurer un meilleur arrimage du département de mathématiques appliquées aux besoins de l'ingénierie. » Enfin, « favoriser une 'synergie' au sein du personnel » (105). Dans les années qui ont précédé la formation du nouveau département et dans celles qui l'ont suivi, plusieurs départements pensent qu'il serait judicieux de rapatrier dans leur sein les cours de mathématiques et de sciences sociales, humaines et administratives (SSHA). Ce ne sera qu'avec l'embauche de nouveaux professeurs au début des années 2000 et la révision de cours au milieu de cette décennie que cette question sera mise, plus ou moins, sur la glace. Néanmoins, plusieurs croient que l'existence de trois sections dans le nouveau département, section production, section management de la technologie et sections mathématiques, entraîne un danger d'une balkanisation de fait du département. Des tensions se manifestent. La résolution de ces tensions, l'évolution des programmes d'enseignement et de recherche dans les deux disciplines et les rapprochements impliqués constitue l'essentiel de ce dernier chapitre.

Comme mentionné plus haut, le livre repose sur une étude attentive des archives et des publications de l'ÉPM. Les auteurs fournissent au lecteur des informations précises et détaillées des différentes étapes de l'implication des mathématiques appliquées et du génie industriel à l'ÉPM. Les analyses accompagnées de nombreux tableaux résument bien l'évolution du corps professoral, des programmes d'enseignement, des groupes de recherche et de leur orientation. Cette étude se révèle donc un apport très sérieux à notre connaissance de l'histoire des mathématiques et du génie industriel à l'ÉPM. Elle constitue de la sorte une riche contribution à des recherches à venir portant plus généralement sur l'histoire récente des mathématiques ou du génie au Québec

Louis Charbonneau , Université du Québec à Montréal



Myron Echenberg. *Humboldt's Mexico: In the Footsteps of the Illustrious German Scientific Traveller.* 288 pages. McGill-Queen's University Press: Montreal & Kingston, London, Chicago, 2017. $39.95 (softcover). ISBN 9780773549401.

Alexander von Humboldt (1769 – 1859) was a Prussian geographer, a naturalist, and an explorer. Between 1799 and 1804, he travelled extensively in Latin America. His description of the journey was written up and published in an enormous set of volumes.

Humboldt graduated from the Freiberg School of Mines in 1792 and was appointed to a Prussian government position in the Department of Mines. At Freiberg, he met a number of men who proved important to him in his later career, including Spaniard Manuel del Rio, who became director of the School of Mines in Mexico City.

Humboldt sought authorization to travel to Spain's colonies in the Americas. With the accession of the Bourbons to the Spanish throne they embarked on the reform in Spain and Spanish America. They already authorized and funded expeditions to the Viceroyalty of Peru, to Chile, New Granada. New Spain, etc., to gather information about plants and animals, assess economic possibilities, and provide plants and seeds for the Royal Botanical Garden in Madrid. When Humboldt requested authorization to travel to Spanish America with his own financing, it was granted, a feat in itself. As a result, Humboldt was given extraordinary access to crown officials and written documentation on Spain's empire. Spain under the Hapsburg monarchy had guarded its realms against foreigner travellers and intruders. Humboldt was granted access to crown officials and written documentation on Spain's empire.

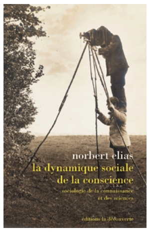
Myron Echenberg presents a guide with historical and cultural context to Humboldt's travels in Mexico. The adventures range from inspections of colonial silver mines and hikes to the summits of volcanoes to examination of secret Spanish colonial archives in Mexico City and scientific discussions of archaeological sites of pre-Hispanic cultures.

The book is divided into three parts: 1. Arrival in Mexico, 23 March to 12 April 1803: From Acapulco to Mexico City; 2.Visits to the Mexican Heartland, 14 May to 10 October 1803: Silver Mines and Active Volcanoes; 3. Homeward Bound, 30 January to 7 March 1804. Demography, Disease, and Departure from Veracruz. The book ends with Humboldt's Legacy, A Guide to Publications by or about Alexander von Humboldt in Mexico, A Guide to Readings on Humboldt, Citations, and Bibliography.

It is not clear why the author selects the picture on the dust cover although better pictures of Humboldt are known. Also, it is not clear why there is duplication of pictures in the text. Finally, the author did not write enough about Humboldt's role with Manuel del Rio who discovered the metal vanadium in a mineral from Zimapan. In fact, it was Humboldt who gave a sample of the Zimapan mineral to the German chemist Friedrich Wöhler in 1803. The metal was discovered in an iron ore by the Swedish chemist Nils Serfström who was working in Berzelius' laboratory. Berzelius then wrote to his student Wöhler that the metal described by Del Rio is the same as that described by Serfström. This is a well known story in the history of chemistry but probably not known to other historians and to the general public: vanadium was discovered in Mexico. Further, it is one of the most important contributions of Humboldt for Mexico and therefore should have been stressed. The book makes an enjoyable reading because it reminds us of the old times in Mexico.

Myron Echenberg is Professor Emeritus of History and Classical Studies from McGill University in Montreal. He got PhD from University of Wisconsin at Madison. His area of specialization: African History, French Empire in Africa, and the Social History of Medicine in Africa.

Fathi Habashi, Laval University,



Norbert Elias. *La dynamique sociale de la conscience. Sociologie de la connaissance et des sciences.* Paris : La Découverte, 2016. 332 p. 42,95 $. ISBN 9782707176325

Près de trente ans après la disparition d'Elias, on peut se réjouir de la parution en français de *La dynamique sociale de la conscience*, ouvrage composé de six articles initialement parus en anglais et en allemand entre 1960 et 1985. L'intérêt de cette publication dépasse de très loin celui de la simple érudition, puisqu'elle ordonne ni plus ni moins que la vision éliassienne du rôle des sciences, déjà présente en filigrane de son *Processus de civilisation*, et de la sociologie plus spécifiquement. La structure générale de l'ouvrage peut se ramener à deux volets : sur le premier, Elias fait état de ce qui lui apparaît être les apories de la réflexion académique sur le développement des sciences ; sur le second, il propose un modèle sociologique jugé mieux à même de rendre compte de la façon dont les savoirs sont produits, validés et intégrés aux consciences des sociétés à travers l'histoire.

Ce qui frappe en premier lieu, et donne la clef de lecture de l'ensemble de ces écrits, c'est la sévérité du constat posé par Elias à l'endroit de notre compréhension des avancées de la connaissance humaine, lesquelles sont encore « largement perçues comme une accumulation de détails ou d'anecdotes historiques ; pas vraiment comme autant d'aspects d'un processus social de longue durée qui nécessiterait d'être expliqué au moyen d'une théorie sociologique de vaste ampleur » (245). Le professeur de Leicester se fonde là sur une triple critique des historiens, des sociologues et des philosophes. Aux premiers, il reproche de manquer d'une théorie des processus de développement des sciences et de se limiter, par le fait même, à « livrer un amoncellement de situations instantanées » (116). Cette faiblesse de l'historiographie s'origine, selon lui, dans la difficulté des historiens à s'émanciper du mythe du « caractère authentique des idées d'un scientifique isolé » (177). Thomas Kuhn lui-même fait les frais de cette critique : loin de constituer un progrès épistémique, son concept de révolution scientifique ne serait, au fond, « qu'un rafraichissement de la vieille "théorie du grand homme" » (119).

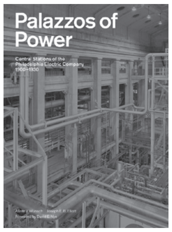
A propos des sociologues, le ton n'est pas moins tranché. Ils ne parviendraient pas à se départir des variantes du déterminisme marxiste, en accordant systématiquement une préséance aux facteurs économiques dans leurs analyses du développement des connaissances. Ce faisant, les sociologues s'enfermeraient dans un perspectivisme de principe, consistant à rapporter de façon directe et univoque l'état des connaissances à celui des rapports de force entre quelques groupes sociaux. Or, nous dit Elias, cela revient ni plus ni moins qu'à faire le lit des thèses de la relativité des valeurs et de la dépendance immuable des catégories de pensée à leur contexte social de production. Là où la rigueur scientifique et l'attention aux réalités historiques devraient plutôt nourrir un programme de recherche portant sur les conditions sociales de l'autonomisation progressive des savoirs scientifiques.

Pourtant, c'est bien aux philosophes qu'Elias consacre le plus d'attention et adresse ses critiques les plus rudes. Ils représentent à ses yeux le principal obstacle à la conduite d'un programme d'études des sciences réaliste, parce que fondé sur le constat de leur double nature cognitive et sociale. Les philosophes ne pourraient l'admettre car ils demeurent arcboutés sur les apriorismes kantiens du sujet autonome et de la raison innée. Karl Popper représente à ses yeux l'archétype de cette appréhension anti-sociologique des savoirs, pétrit qu'il est de la croyance voulant que les sources de la certitude scientifique reposent uniquement sur les lois de la logique, dont chacun serait doté en vertu de la nature ou de quelque intervention divine. Celui-ci se révèlerait au fond moins soucieux de la façon dont les scientifiques, dans leur diversité, « procèdent *en fait* » que de leur dire comment ils « *devraient* procéder » (69).

Face à cela, Elias propose une théorie générale du développement des savoirs visant à saisir, d'une part, les conditions sociales de production des catégories de pensées, et, d'autre part, la nature de leurs relations avec les concepts scientifiques. On le comprend, pour l'auteur, les savoirs profanes et les savoirs savants ne diffèrent pas tant en nature qu'en termes de conformité aux réalités observées. Sur cette base, tout l'enjeu de son programme consiste à expliquer « comment et pourquoi la production du savoir humain, de non-, pré- et proto-scientifique, est *devenue* scientifique dans un ensemble de plus en plus vaste de domaines de problèmes » (149). Dans cette perspective, Elias donne à voir ce que le développement des sciences doit au fait de s'appuyer sur des pratiques, dont la discussion rationnelle est le parangon, et des institutions sociales (universités, sociétés savantes, laboratoires, agences de financement, etc.) qui, historiquement, ont concouru à doter un certain nombre de savoirs d'un degré d'adéquation au réel tel qu'ils se sont trouvés soustraits à l'historicité et à la contingence de leur contexte de découverte. C'est à la faveur de ce processus continu mais non-linéaire d'apprentissage intergénérationnel qu'une somme grandissante de connaissances rationnellement fondées se sont vues intégrées au fond cognitif partagé de nos sociétés, « conformément à leur double fonction de moyens de communication et de moyens d'orientation » (141).

En conclusion, *La dynamique sociale de la conscience* fournit un cadre d'analyse du développement des sciences clair et stimulant. Au-delà de son intérêt propre, il a pour double mérite de renseigner sur l'état des oppositions dans le domaine des études sur les sciences à l'époque où Elias s'affaire à y contribuer, et de rassurer, il faut bien le dire, sur la pertinence des schèmes de pensée qui sont venus constituer le lot commun de la sociologie des sciences ces dernières décennies – rares étant ceux à retomber aujourd'hui dans les antiennes de l'empirisme naïf, des apriorismes kantiens ou des déterminismes stricts. On peut toutefois regretter (et s'étonner) de n'avoir croisé à aucun moment dans cet ouvrage les noms d'Emile Durkheim, de Marcel Mauss ou de Robert K. Merton, qui tous trois comptent parmi les plus illustres fondateurs de la sociologie des connaissances et dont les analyses précèdent celles d'Elias et entretiennent avec elles une proximité non négligeable dont on aurait apprécié mieux comprendre les ressorts et les éventuelles limites.

Johan Giry, Université du Québec à Montréal



Aaron V. Wunsch & Joseph E.B. Elliott. *Palazzos of Power. Central Stations of the Philadelphia Electric Company, 1900-1930.* New York: Princeton Architectural Press, 2016. 160 p. 29.99$US, ISBN 978-1-6168-9500-6.

Plusieurs villes nord-américaines sont parsemées de centrales électriques impressionnantes tout droit sorties d'une époque révolue. Ce livre, fruit d'une collaboration entre un historien, Aaron V. Wunsch, professeur à l'Université de Pennsylvanie, et un photographe, Joseph B. Elliott, professeur d'art au Muhlenberg College, fait le pari de rendre hommage à celles de Philadelphie alors qu'elles sont en voie de transformation ou même de destruction. À la croisée de l'histoire des techniques, de l'architecture et des entreprises, il relate l'histoire de ces centrales construites par la Philadelphia Electric Company tout en les replaçant habilement dans le contexte plus large des villes nord-américaines du début du XXe siècle.

L'ouvrage, de grand format, est divisé en trois parties. Dans la préface, David E. Nye, historien accompli de l'électricité, rappelle que Philadelphie a longtemps été considérée comme « l'atelier du monde » de par son activité industrielle foisonnante, permise notamment par la proximité du charbon venant du nord-est de la Pennsylvanie. Il différencie deux modèles de centrales électriques, liés à l'évolution des réseaux de distributions de l'électricité. Le premier, entre 1880 et 1900, est caractérisé par des centrales de petite taille situées dans le centre-ville. La proximité par rapport aux consommateurs est nécessaire puisque le courant continu utilisé rend coûteux le transport de l'électricité sur de longues distances. Avec le second, l'introduction du courant alternatif permet de construire des centrales plus massives dans des secteurs industriels éloignés du centre, une délocalisation aussi encouragée par une disponibilité plus avantageuse du foncier en périphérie.

L'essai de Wunsch se sert des centrales électriques de la Philadelphia Electric Company comme d'un tremplin pour explorer l'histoire de cette compagnie mais aussi le contexte plus général. L'architecture des stations étudiées, surtout néo-classique, n'était pas anodine. Alors que le monopole « naturel » de cette compagnie privée était fortement contesté, elle servait à polir son image aux yeux des clients, des décideurs et des investisseurs. Elle permettait aussi d'associer symboliquement la compagnie à d'autres institutions socialement acceptées, de la banque à la bibliothèque, en empruntant le même vocabulaire architectural néo-classique.

L'alliance entre William C. L. Eglin et John T. Windrim fournit à Wunsch l'occasion d'aborder la fameuse relation entre ingénieur et architecte, deux des professions au centre des réformes urbaines au début du XXe siècle. Le premier, ingénieur électrique et président en 1908 de la National Electric Light Association, groupe de pression important luttant contre l'intervention gouvernementale dans le secteur de l'électricité aux États-Unis, et le second, architecte prolifique à Philadelphie, collaborèrent autour de la conception de plusieurs centrales électriques en Pennsylvanie dans les premières décennies du XXe siècle. Cette association illustre certains des courants sociaux de l'époque. Les vœux de grandeur, de géométrie et de régularité dont on lit les traces dans l'architecture des centrales reflètent les idéaux du mouvement City Beautiful et rappellent la fameuse exposition internationale de Chicago en 1893. Le paternalisme industriel (welfare capitalism) se laisse aussi deviner dans l'organisation interne des centrales, qui devait maximiser la productivité des travailleurs et éviter les grèves et sabotages par une importante division spatiale du travail. En soulignant la contribution de l'ingénieur aux décisions esthétiques ainsi que celle de l'architecte aux questions techniques, Wunsch complique la coutumière opposition — trop simpliste — entre ces deux professions.

On regrettera toutefois la mise en page de cette section. La richesse des nombreuses images d'archives, de l'élévation au schéma technique, n'est pas mise en valeur par leur présentation en format très réduit sur des pages pourtant de grand format. Ces pages qui présentent les illustrations sont donc partiellement vides : il aurait été plus logique d'agrandir les images pour faciliter leur analyse indispensable à la compréhension du texte qui les accompagne. On déplorera aussi le regroupement des images sur deux pages consécutives au lieu d'être présentées à côté du texte qui y renvoie.

La dernière section présente les magnifiques photos des centrales prises par Elliott entre 2000 et 2002. Dans un court préambule, il soutient que, parmi les villes américaines, Philadelphie est celle qui conserve aujourd'hui le plus riche patrimoine industriel datant de la période entre le XVIIIe siècle et le début du XXe siècle. Sur les quatre stations majeures édifiées par la Philadelphia Electric Company, une seule est encore en service — bien que peu de l'équipement originel demeure — une autre a été reconvertie en bureaux et les deux autres sont laissées à l'abandon. Les photographies rendent compte de l'étrange beauté de ces bâtiments où se côtoient simultanément des turbines énormes et des corniches en terracotta, gages d'un savant dosage entre modernité et appel à la tradition. Quasiment dépourvues de figures humaines, les images capturées donnent l'impression de visiter une civilisation disparue depuis des siècles.

Comme le montre admirablement ce livre, l'histoire de l'électricité est celle d'une invisibilisation progressive. Les stations d'abord au cœur de la ville déménagent vers des zones industrielles éloignées des badauds. Les pylônes électriques sont enfouis. Les machines sont camouflées par des façades néo-classiques. Bref, tout est fait pour effacer le lien entre la production et la consommation d'énergie. Pourtant, l'impact environnemental du charbon de la Pennsylvanie, pour ne nommer que celui-ci, est bien réel. Retracer l'histoire de ces centrales électriques permet de rappeler que la consommation d'électricité et d'énergie en général a des conséquences concrètes et immédiates sur nos sociétés. Espérons que l'exercice d'archéologie industrielle mené par Wunsch et Elliott animera un intérêt pour ces centrales avant qu'elles ne disparaissent complètement.

Clarence Hatton-Proulx, Institut national de la recherche scientifique

Benoît Godin.
***L'innovation sous tension : histoire d'un concept*.**
Québec : Presses de l'Université Laval, 2017. 491 p. 49,95$. ISBN 978-2-7637-2706-6

Paradoxalement, l'innovation n'est pas un nouveau concept, mais une idée dont les avatars ont beaucoup évolué. Très documenté, bien écrit, bien traduit et passionnant, le livre de Godin capte l'attention du lecteur dans les méandres de l'histoire du concept. Née dans un monde où l'immobilisme était l'attribut de la perfection, l'innovation est une idée ancienne. Comme le note l'auteur, les philosophes grecs voyaient le changement comme un signe de dégénérescence et d'appartenance au monde matériel, mais pour l'Église médiévale, l'amélioration de l'âme était positive (77).

De l'Antiquité à la Réforme, l'innovation est une impossibilité matérielle ; au mieux, une simple transformation, une *innovo.* Alors que la science interroge les certitudes religieuses en astronomie et en médecine, la nouveauté transgresse la règle d'or de la perfection : l'immuabilité. L'absence de changement dans le monde des idées apporte l'ataraxie du « sommeil dogmatique » (Kant, *Critique de la Raison pure,* 1781), la quiétude du pouvoir établi, l'apathie de la paix perpétuelle (Kant, *Vers la paix perpétuelle,* 1795), alors que le changement annonce le chaos des disputes aux issues incertaines. L'innovation apparaît à la Réforme comme l'aveu d'une erreur : le monde n'est plus le Cosmos créé par Dieu, une immense « monade » (Leibniz, *Monadologie,* 1714) aux éléments nageant dans l'harmonie préétablie. L'innovation se développe-t-elle dans le monde stable, immuable, anhistorique, décrit par Platon (*République,* –374) ou par More (*Utopie,* 1516), ou dans un monde imprévisible, impitoyable (Machiavel, *Le Prince,* 1513) obligeant le prince à innover, ou encore dans un monde en évolution, historique, théorisé par Darwin (*L'Origine des espèces,* 1859) ?

L'innovation radicale naît comme un interdit et croît dans un monde intelligible en révolution. La formule de Galilée, « L'Univers est écrit en langage mathématique », n'est pas l'ultime avatar de l'antique Cosmos, mais l'aveu que nous sommes loin d'en connaître tous les mystères, le monde spirituel échappant d'ailleurs aux lois matérielles. Cela répond-il à l'interdiction d'innover, proclamée par Edward VI d'Angleterre en 1548 ? Les facettes de l'innovation à la Renaissance dénoncent son ambivalence au moment où l'Occident change d'épistémè (99).

Irrésistible, inéluctable, l'innovation moderne est un mal pour les religieux, jusqu'à ce que les sciences et les techniques prouvent qu'elle est bénéfique. Au plan philosophique, la modernité fait de la vie la référence ultime, alors que temporalité et liberté sont pensées ensemble pour la première fois. La modernité crée une crise dans la culture européenne, que la conscience historique inaugure; Nietzsche et Dilthey (*Le Monde de l'esprit,* 1911) font de l'innovation une condition formelle de l'objet historique, qui peut dès lors générer l'idéologie de l'homme nouveau ou la métaphysique de l'originaire (Heidegger, *Être et Temps,* 1927). Elle fusionne la création, l'invention et la *Weltanschauung* qui la produit comme un inconscient historique. Désormais, l'innovation *a* et *est* une histoire. Cette dimension historique intrinsèque absorbe la réalité, en assume la perte et restitue celle-ci sous forme critique (Adorno).

Du XVI^e^ au XX^e^ siècle, les paradigmes occidentaux sont questionnés. L'innovation devient la nouveauté (313). Le monde moderne reçoit une pléthore de réalisations matérielles, audacieuses, novatrices ; dans les sciences et les techniques, l'innovation réifie le progrès, anime les révolutions industrielles, synthétise le savoir préexistant. L'innovation radicale ne rejoint les sciences qu'au XX^e^ siècle. Auparavant, elle n'appartenait qu'à la politique et aux arts. Aujourd'hui, l'innovation se retrouve dans toute activité humaine, à l'instar de l'évolution et de l'inconscient qui avaient un sens restreint avant d'envahir la culture et de générer de nouveaux paradigmes. C'est là que l'essai de Godin se montre… novateur. Au lieu de ne traiter que des dimensions philosophiques de l'innovation ou de ses aléas matériels, il rejoint les deux niveaux de la réflexion et explique clairement le passage de l'un à l'autre.

Mais l'auteur n'aborde guère l'avenir de l'innovation. Est-elle capable de se pérenniser ? Oui, car les mêmes idées politiques sont perpétuellement recyclées depuis Machiavel. Les récurrences de la mode vestimentaire, architecturale, littéraire questionnent la pertinence de cette pérennisation. La « tradition du nouveau » conjugue audace et conformisme. L'art moderne rejette la tradition et fait de l'expérimentation sa règle jusqu'à son autodestruction. Il dissout les œuvres et leurs références à la nature et à la beauté. En art moderne, l'innovation radicale interdit la restauration de l'ancien et rompt avec le passé, mais sa critique intrinsèque fait d'elle l'autrice des productions artistiques (Schoenberg, Brecht). L'innovation radicale édulcore le concept d'art et le lie à la transgression comme acte libérateur. Mais l'innovation crée-t-elle une chose *ex nihilo,* ou n'est-elle encore qu'un accommodement du vieux ?

L'essai décrit bien les métamorphoses de l'innovation, ses nombreuses sources sont pertinentes, convaincantes, intéressantes, mais les effets pervers qu'engendrent les nouveautés techniques dans l'environnement, par exemple, sont absents du livre. Ils font pourtant partie de l'histoire du concept. L'auteur se montre peu critique envers son sujet, et il termine d'une curieuse manière : « Au XXe s., l'innovation deviendra un mot populaire d'une grande valeur ; un mot « magique ». Mais, comme l'indique John Pocock au sujet du mot révolution, « le terme [innovation] cessera peut-être bientôt d'être employé, dénué qu'il est de toute signification par un usage constant et excessif » (417).

Cette phrase, qui anticipe la fin du vocable, ne s'applique certainement pas à l'idée d'innovation ! Actuellement, l'innovation technoscientifique est encouragée par les gouvernements alarmés par l'état lamentable dans lequel l'industrie l'a plongée. On voit apparaître des ministères de l'innovation. Celle-ci fera partie de la solution en générant de nouveaux modes socio-économiques dans le cadre de la révolution scientifique qui s'amorce. Mais Godin ne semble pas très optimiste. Alors que des concepts sans fondements (alchimie, sociobiologie) tombent en désuétude, d'autres renaissent périodiquement de leurs cendres (guerre sainte) et certains contribuent à construire de nouvelles théories scientifiques (réfutabilité) et un nouvel art de vivre. Le concept d'innovation est de cette dernière trempe.

Malheureusement édité sous une couverture noire plutôt austère, ce livre offre une excellente histoire du concept d'innovation, agrémentée d'une bibliographie de 72 pages.

Jacques G. Ruelland, Université de Montréal