

## Introduction

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This is a study of the nature and role of science in the exploration of the Canadian Arctic. It covers the century that began with the British Royal Naval expeditions of 1818 and ended with the Canadian Arctic Expedition of 1913–18, the first major Canadian government-sponsored scientific expedition to the Arctic. That century saw the high noon of the British Empire, and the first great stages in its decline. Canada was a colony in 1818; it achieved Dominion status within the empire in 1867, and was in many ways self-consciously a sovereign nation by 1918.<sup>1</sup> Integral to Canada's self-image as a sovereign nation was its northern status;<sup>2</sup> science in the Arctic was among the tools by which it sought to establish and extend that sovereignty. The century from 1818 encompasses the transition from colonial to national science, from a state of scientific dependence to one of nondependence and integration into an international scientific culture.<sup>3</sup> There are further reasons for ending this study around 1918. In 1920, oil was discovered at Norman Wells on Great Bear Lake in the Northwest Territories, precipitating prompt and major changes in the administration of the North. The ensuing decade marked the advent of the bush plane, transforming access to the Arctic; much work that might formerly have taken months or even years to complete because of problems of access could now be done in

<sup>1</sup> Intention precedes achievement; it was not for another decade that Ottawa believed that the question of its arctic sovereignty was fully resolved, and today that question is very much alive again, and its resolution is by no means assured.

<sup>2</sup> S. D. Grant, *Sovereignty or Security? Government Policy in the Canadian North, 1936–1950* (Vancouver, 1988) p. 3.

<sup>3</sup> R. W. Home and S. G. Kohlstedt, eds., *International Science and National Scientific Identity* (Dordrecht, Boston, and London, 1991) pp. 1–5, 32, 50. S. F. Cannon, *Science and Culture* (New York, 1978) p. 100; the essay by Cannon on Humboldtian science in that volume (pp. 73–110) provides context and background for many of the themes discussed here.

visits of a few days or weeks. The same ease of access facilitated the militarization of the Canadian Arctic, beginning in the 1920s. Taken together, these factors marked a radical transformation in the development of arctic science.<sup>4</sup>

Science is socially based, and has been incorporated in successive phases of national development.<sup>5</sup> The colonial phase was a manifestation of cultural hegemony,<sup>6</sup> with primarily British models, institutions, and even individuals dominating the scene. “Metropolitan science *was* science. . . . Colonial science . . . was . . . ‘imperial science seen from below’.” Imperial science was carried on throughout the empire for economic and intellectual gain, and in such a case, “the central issue becomes no longer science *in* imperial history, but science *as* imperial history.”<sup>7</sup> In these terms, a large part of this book is imperial history.

Science is more than its context: it has its inner dynamic, directed through its institutions and applied through instruments and concepts to an uncompromising natural world. Navigation and even survival in the Arctic demanded knowledge of landforms and ice conditions, currents, weather, the distribution of animals and birds that might serve as food, the limitations of the magnetic compass as one neared the pole, navigation by the sun and stars, ways of satisfying the physiological and psychological needs of men through arctic summers and winters – enough, indeed, to constitute an extensive and utilitarian program of scientific observation, in addition to whatever observations curiosity dictated and time allowed.

The sciences thus featured prominently in arctic exploration.<sup>8</sup> There were approximately two hundred expeditions to the Canadian Arctic be-

<sup>4</sup> Home and Kohlstedt, *International Science*, pp. 14–15.

<sup>5</sup> The notions of colonialism, imperialism, and nationalism have recently come under scrutiny. On colonialism, see N. Reingold and M. Rothenberg, eds., *Scientific Colonialism: A Cross-Cultural Comparison* (Washington, D.C. and London, 1987). For nationalism and internationalism, see Home and Kohlstedt, eds., *International Science*, and the broader account in E. J. Hobsbawm, *Nations and Nationalism Since 1780: Programme, Myth, Reality* (Cambridge, 1990). The most extended treatment of imperialism and science is L. Pyenson, *Cultural Imperialism and Exact Sciences: German Expansion Overseas, 1900–1930* (New York, 1985); *Empire of Reason: Exact Sciences in Indonesia* (Leiden and New York, 1989); see also his brief introduction, “Science and Imperialism,” in R. C. Olby, G. N. Cantor, J. R. R. Christie, and M. J. S. Hodge, eds., *Companion to the History of Modern Science* (London and New York, 1990) pp. 920–33.

<sup>6</sup> Reingold and Rothenberg, *Scientific Colonialism*, p. x.

<sup>7</sup> R. Macleod in *Scientific Colonialism*, pp. 219, 220. Note also Macleod’s statement (p. 232) that “where there was trade, there was the navy, and where the navy sailed, or the army rested, the natural sciences benefited.”

<sup>8</sup> Lamson in D. L. VanderZwaag and C. Lamson, eds., *The Challenge of Arctic Shipping: Science, Environmental Assessment, and Human Values* (Montreal and Kingston, London,

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tween 1818 and 1918.<sup>9</sup> Roughly eighty of them, or forty percent, came back with results that led to scientific publication. In addition, most of the two hundred expeditions led to an extension of geographical knowledge; and in the nineteenth century, the sciences had not been narrowed to their present boundaries, so that geography was still recognized as a science.<sup>10</sup> Most of the officers commanding Royal Naval arctic expeditions in the nineteenth century were elected as Fellows of the Royal Society of London because of their contributions to geographical science. This aspect of northern exploration has been often and well described.<sup>11</sup> Discussions of geography here will, in contrast, mostly be either to indicate its scientific range, or to show the emerging tension between geographical discovery and competing forms of disciplined scientific observation. The heroism, suffering, and occasional dramatic disaster of arctic exploration have also been well described. Thus I have generally subordinated questions of temperament and personality to the scientific work of expeditions. Nonetheless, such questions may bear on scientific developments, and we shall then consider them: Adolphus Greeley's limitations as a commander contributed to the fragmentation and failure of his scientific expedition, just as John Rae's robustness of character and physique underlay his successes.

More often, the stuff of myth and legend is only marginal to our story. John Franklin's first arctic expedition was a disaster, with its survivors being remembered as the men who ate their boots; his last expedition has entered British and Canadian mythology, transforming the "arctic sublime"<sup>12</sup>

Buffalo, 1990) p. 3 notes that some historians insist that early explorations, which made no systematic observations, "belong to a pre-scientific era of arctic operations," whereas others label early navigators "the 'founders' of arctic science." Here I take a social and institutional view: what was regarded then as science by scientists and the spokesmen for scientific institutions counts as science.

<sup>9</sup> A. Cooke and C. Holland, *The Exploration of Northern Canada 500 to 1920: A Chronology* (Toronto, 1978).

<sup>10</sup> M. B. Hall, *All Scientists Now: The Royal Society in the Nineteenth Century* (Cambridge, 1984) pp. 199–215 discusses the nineteenth-century Royal Society's encouragement of exploration, including (pp. 200–5) arctic exploration, and the scientific status of geography. For discussions of earlier scientific geography, see E. G. R. Taylor, *Late Tudor and Early Stuart Geography 1583–1650* (London, 1934), and L. Cormack, *Non Sufficit Orbem: Geography as an Interactive Science at Oxford and Cambridge, 1580–1620*, Ph.D. thesis, University of Toronto (Toronto, 1988). Scientific geography as it emerged in the Renaissance and Scientific Revolution was virtually a precondition for the work discussed here. See also D. N. Livingstone, "The History of Science and the History of Geography: Interactions and Implications," *History of Science* 22 (1984) 271–302.

<sup>11</sup> The most recent work is P. Berton's admirable *The Arctic Grail: The Quest for the North West Passage and the North Pole 1818–1909* (Toronto, 1988).

<sup>12</sup> The phrase is Chauncey Loomis's, in his essay of that title in U. C. Knoepfelmacher and G. B. Tennyson, eds., *Nature and the Victorian Imagination* (Berkeley, 1977) pp. 95–112.

into a threatening realm. Starvation, cannibalism, heroism, murder, execution, and ultimate disappearance without trace were part of Franklin's expeditions. The Admiralty's instructions, however, simply stressed geographical discovery and natural science. Franklin worked with the instrument maker Robert Were Fox to develop and promote an improved instrument for measuring magnetic dip and force; geomagnetic work formed a major motive for his last expedition. His second arctic expedition, less remembered than his first or last because it was successful, made major contributions to geography and natural history. Readers of this book will learn why one of the naval officers searching for Franklin described him and his crew as sacrifices in the cause of knowledge.

The framework for this study is set by history and geography. Until the second half of the last century, the history of what is now northern Canada and its arctic archipelago could be broadly split into two. South of the tree line, the fur trade dominated.<sup>13</sup> North of that line, the main motive was the search for the Northwest Passage.<sup>14</sup> The principal agents in the boreal forest were the Hudson's Bay Company and the rival North West Company, hunting and trading in Indian territory.<sup>15</sup> After the companies amalgamated in 1821, the Hudson's Bay Company enjoyed virtually exclusive sway. They provided logistical support for numerous expeditions, including Franklin's, gave selective help to collectors for museums, and sometimes incorporated scientific work in the expeditions they sent out. Their work was mostly on the mainland, stretching to the arctic coast, and much less in the islands to the north.

The northern sea and islands were the realm of whalers and sailors, and of the most northern aboriginal people, the Eskimos or Inuit, who lived and hunted on land and ice. Geographical discoveries in the Arctic were almost always discoveries only to the Europeans, Canadians, or Americans who made them: the explorers often depended for guidance and even survival on the Inuit, whose local knowledge was impeccable, who traveled widely, and who had a pretty fair idea of neighboring topography for many days' travel.<sup>16</sup> The search for the Northwest Passage took place within this context of native expertise, and was, in the aftermath of the Napoleonic Wars, primarily an enterprise of the Royal Navy: only gradually did other powers

<sup>13</sup> The classic study is Harold Innis, *The Fur Trade in Canada: An Introduction to Canadian Economic History* (New Haven, Conn., 1930).

<sup>14</sup> L. H. Neatby, *In Quest of the North West Passage* (Toronto, 1958).

<sup>15</sup> Canada's northern peoples, Indian and Inuit, did not cede their land by treaty, purchase, or force of arms.

<sup>16</sup> See, e.g., J. Ross and J. M. Savelle, "Round Lord Mayor's Bay with James Clark Ross: The Original Diary of 1830," *Arctic* 43 (1990) 66–79 at 67–9.

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and other nations join the search. Those sciences important for navigation were inevitably a first concern for the navy; I shall in general not include in this study navigational practices merely dependent upon science, for example the use of quadrants and of the *Nautical Almanac*, although I shall have a little to say about them in Chapters 1 and 4.<sup>17</sup> What will concern us are observations, collections, and occasionally experiments directed to the confirmation or extension of knowledge.

It is striking that natural history and geology were regularly included in the Admiralty's instructions to its arctic commanders; indeed, these sciences featured prominently in the imperial mandate on land and sea, in Africa, India, Australia, and elsewhere during the nineteenth century.<sup>18</sup> Investigations in natural history might satisfy both scientific curiosity and economic opportunity. Geology was in like case.<sup>19</sup> The potential utility of geological investigations was a large part of their attraction: the discovery of valuable mineral ores might more than justify the expense of an arctic voyage. As coal burning steam vessels entered the Arctic, the search for coal was added to that for ores. Readily available fuel could extend the range and duration of an expedition, and might thereby facilitate a transit of the passage<sup>20</sup> through the archipelago.

<sup>17</sup> Accurate navigation was much improved thereby. See D. M. Knight, *The Nature of Science: The History of Science in Western Culture Since 1600* (London, 1976) p. 142.

<sup>18</sup> For the Australian case, see I. Inkster and J. Todd in R. W. Home, ed., *Australian Science in the Making* (Cambridge, 1988): "The early concentration on staple exploitation led to an emphasis on a widely-based 'natural history' programme within the scientific enterprise as a whole. Natural history was suited to both the economic needs of Britain and her colonies and the psychological requirements of the scientific workers concerned." See also D. Fleming, "Science in Australia, Canada, and the United States: Some Comparative Remarks," *Proceedings of the 10th International Congress of the History of Science, Ithaca 1962* (Paris, 1964) pp. 179–96, arguing that natural history was favored in colonial societies because it appeared to be the intellectual aspect of pioneering. The role of the "inventory sciences," encompassing natural history, in Canada is explored in S. Zeller, *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (Toronto, 1987). The British background is explored in D. A. Allen, *The Naturalist in Britain: A Social History* (London, 1976).

<sup>19</sup> The adoption of a stratigraphic order derived from Europe, and its application to remote realms, could serve conceptually as a form of territorial imperialism. J. A. Secord, *Controversy in Victorian Geology: The Cambrian-Silurian Dispute* (Princeton, 1986) pp. 30, 122, and "King of Siluria: Roderick Murchison and the Imperial Theme in Nineteenth-Century British Geology," *Victorian Studies* 25 (1982) 413–42. See also R. A. Stafford, "Geological Surveys, Mineral Discoveries, and British Expansion, 1835–71," *Journal of Commonwealth and Imperial History* 12 (1984) 5–32.

<sup>20</sup> As indicated here, the Northwest Passage is the entire northern route from Europe to Asia. I use passage here for that part of the route that lies through the Canadian Arctic archipelago, but in the ensuing chapters I shall follow the nineteenth-century usage of scientific navigators and explorers, and refer to the whole route and that part of it that lies within the archipelago as the Northwest Passage.

Until very recently, when the feasibility of building a class 8 icebreaker<sup>21</sup> appeared to enter the political as well as the technical realm in Canada,<sup>22</sup> the Northwest Passage from Europe to the Far East by way of the Canadian arctic archipelago was a seldom-realized dream. It dated back to the Renaissance and had endured in spite of repeated evidence that the passage, barely navigable at best, could not be a viable trade or military route. The problem was ice, which in the archipelago often took forms far harder to penetrate than the pack of the Arctic Ocean. Yet the Royal Navy and a host of successors kept sending ships and explorers to find and sail through the passage, or else to reach an economically and scientifically still more useless target, the North Pole. Dreams of glory, national pride, scientific curiosity, employment for the navy in peacetime, and aims at territorial and economic monopoly were all involved, in various combinations. But arching over them all was the continuing myth of the arctic sublime, with its vision of the passage. “The Northwest Passage is as much a cultural artifact as an Arctic navigation route. It is as much a metaphor for human perseverance and ingenuity as a physical reality.”<sup>23</sup> Science too is a cultural artifact, and we shall be exploring the interaction of those two artifacts in investigating the sweep and the detail of the arctic environment.

“Nordicity” is an essential element in Canada’s self-image.<sup>24</sup> The northern frontier has repeatedly served to focus national aspirations, in the Reform party’s platform in 1857, in Diefenbaker’s campaign for a Conservative majority in 1958, with its goal of a new Canada, “a Canada of the North,” and at intervals before, between, and since. In such campaigns, and in the policies entailed by them, science has been co-opted or otherwise involved:<sup>25</sup> this has sometimes been to its advantage, for example in the in-

<sup>21</sup> This is defined as an icebreaker capable of maintaining continuous headway of three knots through solid ice ten feet thick, without backing up and ramming. Such a vessel would, at least in theory, make possible year-round navigation through the archipelago. See K. R. Nossal, “Polar Icebreakers: The Politics of Inertia,” in F. Griffiths, ed., *Politics of the Northwest Passage* (Kingston and Montreal, 1987) pp. 216–38.

<sup>22</sup> J. Clark, statement on sovereignty, in Canada, House of Commons, *Debates*, 10 Sept. 1985, 6462–4; reprinted in Griffiths, *Politics of the Northwest Passage*, pp. 269–73. The Canadian government has since renege on its commitment to build such an icebreaker. This and other developments have prompted inquiries of the kind informing John Honderich, *Arctic Imperative: Is Canada Losing the North?* (Toronto, 1987).

<sup>23</sup> Griffiths, *Politics of the Northwest Passage*, p. 3.

<sup>24</sup> An extended and thoughtful essay is L.-E. Hamelin, *Canadian Nordicity: It’s Your North Too*, trans. W. Barr (Montreal, 1979).

<sup>25</sup> Cf. Lamson in VanderZwaag and Lamson, *Arctic Shipping*, p. 5: “Debate about the origins of arctic science may be of interest to scholars; however, there is general consensus that political and economic circumstances were – and remain today – principal factors in

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ception of Canada's Polar Continental Shelf project in 1958.<sup>26</sup> The Arctic has never before been so accessible.

Those politicians who over the years have directed attention northward have recognized what is for Canada a looming geographical fact. In a timely look at the circumpolar North, Armstrong, Rogers, and Rowley proposed a broad and comfortably elastic approach to the arctic and subarctic regions. There are, as they observed, many definitions of these regions, and we shall briefly note some of them in this book. The tree line, the Arctic Circle, the southern limit of permafrost, and other more complicated demarcations have been used as boundaries. Armstrong and his coauthors proposed, however, not to adopt any single definition, but rather to think of the regions as "a group of concepts and attributes, concerned with climate, vegetation, fauna, presence of ice and snow, sparseness of human habitation, . . . and many other factors." In these terms, Canada "is a northern nation in a more important sense than the others; it is the second largest country in the world, and three-quarters of it lie within our area."<sup>27</sup> If one considers only land north of the tree line, Canada has more arctic territory than any of the other seven arctic nations.<sup>28</sup>

Our main geographical focus will be the Canadian archipelago, and the continental coast from Hudson Strait between Davis Strait and Baffin Island in the east to the Beaufort Sea and the Alaska boundary in the west. This was the maze of ice, sea, cold, reefs, and currents that confronted those who would navigate the passage in the few short months of arctic summer. Important also will be the sub-Arctic and Arctic down the Mackenzie River from Great Bear Lake, and northern regions reached from the Mackenzie Valley. We shall look at expeditions, at their mandates, and at their scientific work. Where this spills over, as it did into the Rocky Mountains in John Franklin's second expedition, we shall incorporate such work in our journey. Similarly, expeditions making preliminary stops on Greenland's west coast did scientific work there; except for such studies, Greenland will

promoting scientific enterprise." In fact, scholars have paid very little attention to "the origins of arctic science"; hence this book.

<sup>26</sup> There are many arguments about the deleterious effects of the combination of politics and bureaucracy on arctic science. See, e.g., chaps. 7 and 8 in VanderZwaag and Lamson, *Arctic Shipping*. For the Polar Shelf project, see M. Foster and C. Marino, *The Polar Shelf: The Saga of Canada's Arctic Scientists* (Toronto, 1986).

<sup>27</sup> T. Armstrong, G. Rogers, and G. Rowley, *The Circumpolar North: A Political and Economic Geography of the Arctic and Sub-Arctic* (London, 1978) pp. 1, 4. To arrive at this figure, they include the northern parts of the provinces (except Nova Scotia, New Brunswick, and Prince Edward Island) with the whole of Labrador, the Northwest Territories, the Yukon Territory, and the Arctic archipelago.

<sup>28</sup> *Ibid.*, p. 73.

be outside our story.<sup>29</sup> The exclusion of Alaska in the west conforms largely though not entirely to political realities: Alaska was Russian before the United States purchased it, and did not welcome investigations by other nations. Where expeditions aiming at Canadian territory carried out work in Alaska, as happened with the Canadian Arctic Expedition of 1913–18, we shall note it. Baffin Bay was important for the earliest nineteenth-century naval expeditions: from the period of the Franklin searches, in mid-century, expeditions and explorers of several nationalities pushed northward between Greenland and the archipelago. These waters and their enviroing lands will assume increasing prominence during our discussion of the second half of the nineteenth century.

I refer interchangeably to the Canadian and the arctic archipelago. Britain assumed sovereignty over the archipelago during the nineteenth century, and some of the limits of that sovereignty were defined by treaty and diplomacy with Russia and with the United States. But there were serious potential conflicts, especially between Britain and the United States and in an attempt to head off such conflicts, Britain transferred the archipelago to Canada in 1880. Most but not all of the islands in the archipelago had been discovered by the British, but there remained whole areas of the Arctic Ocean that were unexplored even by 1880; the archipelago is difficult of access and it is large, with six of the thirty largest islands in the world. At the turn of the century, the Norwegian Otto Sverdrup discovered a major new group of islands west of Ellesmere Island. Canada's title under these circumstances was precarious, in spite of a plaque subsequently placed on Melville Island claiming the archipelago from the mainland to the North Pole.<sup>30</sup> Questions of sovereignty underlay much of the deployment of science in these years.

If science and colonialism, imperialism, and nationalism provide recurring themes, so too does the interplay of science and internationalism. The Arctic is circumpolar, shared by nations with similar geographical conditions and with continental shelves sloping into the same all but landlocked ocean. Ocean currents and ice movements, the migration of animals and birds, the distribution of plants, the variation of geophysical phenomena,

<sup>29</sup> Greenland needs a separate study. The best early account is H. Rink, *Danish Greenland: its People and Products* (London, 1877; reprinted London, 1974); T. R. Jones edited a valuable collection of scientific papers, *Manual of the Natural History, Geology, and Physics of Greenland and the Neighbouring Regions . . .* (London, 1875) and there is an important journal, *Meddelelser om Grønland*.

<sup>30</sup> M. Zaslow, *The Opening of the Canadian North 1870–1914* (Toronto and Montreal, 1971) p. 267. The plaque was placed there by Captain J. E. Bernier in the winter of 1908–9; see chap. 9.



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and (with some contested restrictions of recent date) the movement of native peoples are no respecters of political frontiers. The need for international cooperative research was recognized in the nineteenth century. The Arctic was an important region for geomagnetic research, containing as it does the north magnetic dip pole: the international magnetic study instituted by the explorer-scientist Alexander von Humboldt and the mathematician Carl Friedrich Gauss of Göttingen led to the particular prominence of magnetic work in explorations of the Canadian Arctic. The Imperial German Council was the first government to endorse the principle of coordinated scientific work, in an enterprise that, drawing on the vision of one man, the Austro-Hungarian officer Weyprecht, led to the International Polar Year of 1882–3. And, to take just one other example, Charles Darwin's ideas about geographical distribution led to the incorporation of botanical studies in the Canadian Arctic with those of other arctic regions. As Weyprecht observed over a century ago, the earth "should be studied as a planet. National boundaries, and the North Pole itself, have no more or less significance than any other point on the planet, according to the opportunity they offer for the phenomena to be observed."<sup>31</sup> In these terms, the Arctic was a global laboratory, in contradistinction to a strategic resource depot.<sup>32</sup>

These issues will be pursued in the following chapters, sometimes thematically, more often within the chronological framework of the history of arctic expeditions and exploration. Since the development of a naval tradition of scientific work was a necessary prelude to the scientific mandate of Royal Naval arctic expeditions, a preliminary chapter discusses the emergence of that tradition, and its first deployment in the Arctic.<sup>33</sup> The choice of expeditions discussed is based on their scientific significance, and the degree to which they help to elucidate informing themes. This means that we shall often ignore expeditions that are prominent in the annals of exploration, but of only trivial scientific significance, such as Peary's attempts at reaching the pole. Where several well-documented expeditions could serve to make essentially the same points in a given period, I have discussed the expeditions that make those points with the greatest clarity, using economy, drama, and the extent of documentation as additional selection criteria. The most numerous scientific expeditions in the Canadian Arctic from 1818

<sup>31</sup> Weyprecht, as quoted in VanderZwaag and Lamson, *Arctic Shipping*, p. 16.

<sup>32</sup> Lamson in *Arctic Shipping*, pp. 16–18.

<sup>33</sup> This was Constantine Phipps's expedition, which got as far as Svalbard (Spitsbergen), and it is the only expedition to the east of Greenland that we shall notice. After the Napoleonic Wars, British Arctic exploration concentrated on the Canadian Arctic, the subject of chapters 2 to 10 in this book.

