A CENTURY OF MARITIME SCIENCE

The St Andrews Biological Station

EDITED BY JENNIFER HUBBARD, DAVID J. WILDISH,
AND ROBERT L. STEPHENSON

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1 Science in Canada: The Context of the Biological Board of Canada's St Andrews Biological Station

ERIC L. MILLS

The Atlantic Biological Station at St Andrews was one of two marine biological stations founded in 1908 in Canada. Its origins are found in the scientific and political environments of post-Confederation Canada, rather than in earlier British exploratory scientific endeavours: the scientific investigations of the Arctic in the early nineteenth century; the magnetic observatory established in Toronto in 1839; and the influential Geological Survey of Canada that originated in 1842. Its origins were also separate from the ubiquitous amateur science and scientific societies throughout nineteenth-century Canada. Although hydrographic and tidal surveys were established in the 1880s, Canadian marine science in the late nineteenth century was rudimentary. Canadian universities were small, scientific research in them or elsewhere was rare, and governments were interested more in scientific inventory than in broader aspects of science. It was not until 1898 that the need for information on fisheries, increasing self-confidence by academics interested in research, and concern about the intellectual influence of the United States led to the first government support establishing a floating marine laboratory, and then in 1908 two land-based laboratories under the direction of what became the Biological Board of Canada. The early history of the St Andrews Biological Station seems cut and dried at first glance. In short, the story begins with the appointment in 1892 of Edward E. Prince, English in origin, although recruited from Scotland, as Dominion Commissioner of Fisheries. Then followed lobbying of the Laurier government for support of a biological station by Prince and others. In 1898, a board of management of a biological station for Canada was established (renamed the Biological Board of Canada in 1912), followed by more lobbying, this time for money to support a biological

station. When money was granted, the first biological station was a floating one that was moved from place to place and project to project from 1899 until 1907, when it was badly damaged. This was the precipitating event that led to the establishment in 1908 of two fixed and permanent Canadian marine biological stations, one at Nanaimo, British Columbia, the other at St Andrews, New Brunswick. But marine science in Canada, like Canadian science itself, did not begin with these circumstances, which were the outcome of a particularly Canadian and very loosely linked chain of events going back into the mid decades of the nineteenth century.

Science in Canada in the Mid and Late Nineteenth Century

There were no organized marine sciences in pre-Confederation Canada, which until 1867 was made up of small colonies dependent on agriculture and forestry in the hands of immigrants mainly from Britain and, late in the eighteenth century, from the newly independent United States. What science existed was the avocation of the small group of relatively leisured upper-middle-class people, including merchants and soldiers.[1] There were also scientific efforts in the north,[2] mainly (but not entirely)[3] by Royal Navy personnel searching for a Northwest Passage, especially in the first four decades of the nineteenth century. These began with John Ross's exploration of Baffin Bay in 1818, followed by W.E. Parry's voyages into the eastern and central Arctic in 1819–1825, and another expedition by Ross (with his nephew James Clark Ross) in 1829–33. Scientific observations in the north were part of the program of the ill-fated Franklin Expedition of 1845, and had its naturalist Harry Goodsir survived, knowledge of Arctic marine animals would certainly have increased earlier than it did. The many expeditions in search of Franklin did their bit, but in a scattered way that was secondary to their aim to discover the fate of Franklin and his men.[4]

Although there was an increase in interest in science in the early decades of the nineteenth century due to the continued increase in the numbers of United Empire Loyalists, wealthy and well-educated, bringing an interest in good schooling to Canada (i.e., Ontario and Quebec), Nova Scotia, and New Brunswick, science in Canada up to the 1850s was done mainly in an ad hoc way by amateurs and military men. The military in particular, mainly from the Royal Engineers and the Royal Artillery, played an important part in increasing knowledge of natural history, geology, hydrography, and astronomy.[5] And it was their

interest in contributing to magnetic studies of the Earth in efforts such as the "Magnetic Crusade"[6] that led to the first permanent scientific establishment in the Canadas.

The Toronto Magnetic Observatory was founded in 1839 as part of a worldwide magnetic observing network and was staffed by Royal Artillery officers.[7] Of these, the best known and most influential was J.H. Lefroy, who was in Canada between 1842 and 1853, and whose most ambitious project (although virtually unsung) was a search for the north magnetic pole that took him from Toronto as far as the Mackenzie River and Fort Simpson between May 1843 and November 1844.[8] By mid-century interest in magnetics was waning and that in meteorology was increasing; the Magnetic Observatory, linked to North American telegraph networks, became the nucleus of the Canadian Meteorological Service.[9] Although it played no role in marine research, the Magnetic Observatory did provide an early example of the professional, as opposed to the amateur, pursuit of science.

A good case can be made that the first truly Canadian professional and pre-eminent scientific organization was the Geological Survey of Canada (GSC), established under William E. Logan in 1842 to search for economically valuable minerals (notably coal) in the Province of Canada (now Ontario and Quebec), then expanding in time to the Maritimes, and after Confederation from coast to coast.[10] The GSC was very small at first and based initially in Montreal (it moved to Ottawa in 1881) under the influence of the Montreal Natural History Society. Its extensive surveys extended first from Lake of the Woods to southern Labrador, then shortly after Confederation to Nova Scotia and New Brunswick. It made a major move westward when Manitoba and British Columbia joined Confederation in 1870 and 1871. Throughout, most of the scientific officers of the GSC made general collections in addition to geological ones, including in natural history and ethnology, providing a major scientific survey of the expanding country that included marine biology. As one historian has commented, "Early geologists were also explorers, geographers, botanists, zoologists and anthropologists who played a large role in opening up the West and later the Arctic."[11] One example of this, indicating the broad compass of GSC scientists, is George M. Dawson's (figure 1.1) investigation of the Queen Charlotte Islands in 1878, which included a thorough geological survey and mapping, along with detailed information on the Haida Nation, including their language (by Dawson himself), and lists of the invertebrates and plants collected under the names of a number of specialists.[12]

1.1 George M. Dawson, about 1885

In fact, the GSC had become the Geological and Natural History Survey in 1877, and its collections, including those of Dawson and of the first botanist of the survey, John Macoun (appointed in 1882),[13] formed the basis of the Victoria Memorial Museum, which opened in Ottawa in 1910 and is the ancestor of the modern Canadian Museum of Nature.[14] Macoun, who saw no limits to himself in natural history, encouraged collecting of all kinds, including marine collections on the west coast of Vancouver Island, where he joined his collectors William Spreadborough and C.H. Young at Ucluelet in 1909 (figure 1.2).

But Dawson and Macoun, Spreadborough and Young, were the exception, not the rule until well after 1867. One example of how science was done is the early work of J.F. Whiteaves, a young Englishman who came to Montreal in 1862 as an employee of the Natural History Society of Montreal[15] and who dredged in the Gulf of St Lawrence on his own time from 1863 to 1875, before joining the GSC as a zoologist (later a distinguished paleontologist).[16] His catalogue of the marine invertebrates of eastern Canada,[17] summarizing much early investigation along with his own, is an important milestone in Canadian marine science, showing the benefits of both amateur and professional science in the newly united country.

Societies, Universities, and the Teaching of Science

Whiteaves's career highlights the fact that in mid- to late-nineteenth-century Canada, most natural history and scientific work in general was done by amateurs, not by professionals such as those in the GSC. Local societies abounded, including the Montreal Natural History Society (founded 1827), the Canadian Institute (1849, later the Royal Canadian Institute), the Hamilton Association for the Cultivation of Literature, Science and Art (1857), the Botanical Society of Canada (1860), the Nova Scotian Institute of Science (1862), the Entomological Society of Canada (1863), the New Brunswick Natural History Society (1863), and the Ottawa Field-Naturalists' Club (1872). Most published their own journals, some of which survive to this day, and the societies and their journals were the main means of passing information around in Canadian scientific circles until the end of the nineteenth century, when amateur science gave way to government agencies and the universities.[18]

The main national learned society, the Royal Society of Canada (RSC), was established in 1882,[19] based not on the purely scientific Royal Society of London but instead on the broader Royal Irish Academy,

1.2 John Macoun (1831–1920), standing centre, with C.H. Young and William Spreadborough sorting marine specimens

taking in all the branches of scholarly knowledge.[20] As the brain-child of the governor general from 1878–83, John Campbell, the Marquess of Lorne, it was intended to counter influence from the United States and stimulate Canadian learning. Ironically, Canadian scientists such as J.W. Dawson and Daniel Wilson were sceptical initially that the RSC had a role and could survive. But survive it did, although never becoming an important patron and accrediting body like the Royal Society of London, probably because it was seen as non-utilitarian or even anti-utilitarian by governments, especially those of John A. Macdonald (1867–73, 1878–91). Nonetheless, the RSC did lobby government for tidal surveys, fisheries research (especially the foundation of a marine station – see later), a dominion observatory, and much later for federal government support of science, leading after the First World War to the foundation of the National Research Council of Canada.[21]

What then of the universities and other institutions of higher learning in Canada during the nineteenth century? The first "university" (little more than a high school in modern terms) was King's College, an Anglican foundation for the children of the establishment, beginning in Windsor, Nova Scotia, in 1789. Thereafter followed Saint Mary's in Halifax (1802, chartered 1852, Roman Catholic); Dalhousie in Halifax (1818, nominally non-denominational, in fact Presbyterian) (figure 1.3); McGill in Montreal (1821, Presbyterian); King's College, Toronto (1827, Anglican; it formed the basis of the secular University of Toronto in 1850); King's College, Fredericton (1828, Anglican); Acadia in Wolfville, Nova Scotia (as Queen's College 1838, Baptist); Mount Allison in Sackville, New Brunswick (1839, Methodist); Victoria College in Coburg, Ontario (later in Toronto) (1841, Methodist); Queen's in Kingston, Ontario (1841, Presbyterian); Bishop's in Lennoxville, Quebec (1843, Anglican); Laval in Quebec City (1852, progeny of the Séminaire de Québec, Roman Catholic); and St Francis Xavier in Antigonish, Nova Scotia (1866, Roman Catholic).[22]

By Confederation in 1867, there were seventeen degree-granting colleges or universities in Canada, most of them with 100 or fewer students.[23] The emphasis, especially in the Anglican institutions, was on the classics or on a broad, general education, but where Scottish influence was strong, some science was taught as part of this, including astronomy, mathematics, physics (as natural philosophy initially), chemistry, botany, zoology, palaeontology, geology, and geography.[24] There were no permanent laboratories for teaching or research. As Jarrell summarizes the situation in nineteenth-century Canada:

1.3 Dalhousie College in 1875

> Science teaching in Canadian universities was a mixture of various elements, with the Scottish and American predominating. From the founding until after the turn of the 20th century, most of the small liberal arts colleges offered general science as part of a general education. For most of the [19th] century, 2 reasons for teaching science were commonly given: science aided the student in learning to think logically, and it exhibited to the student the wonders of God's creation. Little thought was given to preparing future scientists, and those Canadians who became professionals had either to resort to schools overseas (usually German or American) or to virtually train themselves with the help of sympathetic professors ... Typically, 2 professors, one for natural history and geology, the other for physics, chemistry and perhaps astronomy, covered the whole range of science. Laboratory practice was unknown until the present [20th] century.[25]

Under these circumstances, it is not surprising that the marine sciences, like other branches of science, had a tenuous existence in nineteenth-century Canada at least until graduate training became a routine part of the larger university curriculum around 1900.[26]

Even when advanced training and research began in Canadian universities very late in the nineteenth century, the direction of scientific activity was constrained by its distinctive meaning. Governments and the populace at large regarded science as information – for example, on agricultural output, on rainfall, on pest insects, on public health, and the like. Fact-gathering sciences were favoured, especially beginning in the 1880s, notably geology, botany, entomology, and with an emphasis on statistics (e.g., mining information). There was often political pressure (on the GSC, for example) for exactly this, that is, for what has been called "inventory science,"[27] the cataloguing of resources. It was in this utilitarian context that the marine sciences began to expand at the end of the nineteenth century.

The Beginnings of Canadian Marine Science

It is instructive to compare the development of scientific institutions in the United States with those in Canada. A US Coast Survey was established in 1807. The US Fish Commission dated from 1871. In 1888 the Marine Biological Laboratory opened in Woods Hole, Massachusetts. American scientists united in the American Association for the Advancement of Science in 1848, and established the prestigious National Academy of Sciences in 1863. Advanced degrees on the German plan,

like the Ph.D., were being offered by East Coast universities (beginning with graduate degrees at Johns Hopkins in 1876) during the 1880s. By comparison, up to the 1880s Canada could boast only its Geological Survey and Royal Society.

Confederation, coming nearly a century after the independence of the United States, made a difference in this regard, even though Canada had only a tenth of the population of the United States, had achieved political independence much later, was made up of a huge and nearly ungovernable land area, and was dependent on Britain for a good deal of its scientific and technical horsepower. But an even greater influence than Confederation on the spread of learning was the completion of the Canadian Pacific Railroad from central Canada to Vancouver in 1885 (it was preceded by the completion of the Intercolonial Railway in the Maritimes and eastern Quebec, 1872–6). The railway network expanded inexorably, and in 1903 the railroad reached St Andrews, New Brunswick, making that summer destination easy to get to from the inland cities (a factor in the account that follows). Access to both coasts was now straightforward, opening up the continental interior and the coasts to commerce and scientific investigation.

The railroad links were attended by union of most of the north with Canada (the North-West Territories in 1870 and the Arctic islands in 1880), and the entry of Alberta and Saskatchewan into Confederation in 1905, giving Canada pretty largely the geographical form it has now. But even more important was the increase in Canadian population, for example from 5,371,315 to slightly over 7,200,000 between the censuses of 1901 and 1911 and to over 8,000,000 soon after, as well as the nature of its employment. At first, agriculture attracted most of the immigrants, but by the beginning of the First World War they were arriving to take up manufacturing and other urban occupations, centred on the rapidly growing cities of Montreal and Toronto.[28]

In this dynamic context, very rapid changes in Canadian science, including the marine sciences, began in the 1890s and increased after 1900, coinciding with Wilfrid Laurier's Liberal government from 1896 to 1911. They were based on the development of a Canadian scientific profession in government and later the universities in the 1880s and after (in which the GSC played a pioneering role), beginning in government surveys and later university teaching. But there had been earlier needs to investigate the waterways of Canada.

In the late eighteenth and into the nineteenth centuries, most of the charting (hydrography) of Canadian waters had been done by British

surveyors, one notable example being the surveys conducted by H.W. Bayfield from Lake Superior to Newfoundland between 1816 and 1856.[29] Inland, much valuable hydrographic surveying during the early nineteenth century was carried out by surveyors of the Board of Works (established in 1841) in preparation for canal building. After Confederation it became necessary for Canada to do more surveying and hydrography, and to this end the Department of Marine and Fisheries asked the British Admiralty to help establish a Canadian hydrographic survey. Commander J.G. Boulton arrived in Canada in 1883 as head of the Georgian Bay Survey – the direct result of the steamship *Asia*'s sinking with loss of life during a fall gale in September 1882.[30] Most of the early surveys were confined to the Great Lakes, but gradually work on the coasts increased.[31] The first Canadian survey of the sea was of Burrard Inlet by W.J. Stewart, an engineering graduate of the Royal Military College. Surveys of the important shipping lanes in the lower St Lawrence River followed in 1905; this and later surveys were more in Canadian hands because British ships were being withdrawn from Canada to meet the increasing naval threat from Germany perceived in Britain.[32]

The Hydrographic Survey of Canada (renamed the Canadian Hydrographic Service in 1928) evolved from the Georgian Bay Survey after 1904–5, first devoting itself to inshore charting with small vessels, although the Royal Navy still did major work on the West Coast until 1910 and on the East Coast until 1913.[33] Canadian hydrography was put on a new basis and given modern equipment when the CSS *Acadia* was commissioned for the Hydrographic Service in 1913, beginning its work in Hudson Bay that very year and playing an important part in the Canadian Fisheries Expedition of 1915.[34]

Hydrography in Canada has been largely independent of other branches of marine research since its inception – as has the study of tides, which, counter-intuitively, began independently of hydrography. Despite the importance of tides to navigation, and the entreaties of merchants bringing cargoes through the shoals of the tidal St Lawrence, John A. Macdonald's governments resisted many requests to begin systematic tidal surveys.[35] By 1884, the only major systematic tidal information from Canadian waters (apart, possibly, from naval dockyards) came from Cumberland Sound, Baffin Island, during the first International Polar Year, 1882–3).[36] That year the British Association for the Advancement of Science met in Montreal and formed two committees to deal with tides. The first, including the great geophysicist G.H.

Darwin and the director of the Toronto Observatory, Charles Carpmael, was concerned with reducing tidal observations and producing tide tables worldwide, concerns central to nineteenth-century tidal science.[37] The second, under Alexander H. Johnson, professor of astronomy at McGill, was set up to ask for government funds for Canadian tidal observation stations. There was no response to its entreaties year after year until finally in December 1889 the committee, bolstered now by prominent businessmen from the Montreal shipping community, again petitioned Minister of Marine and Fisheries Charles Hibbert Tupper for a tidal survey. They got a small parliamentary appropriation in 1890.

The first Canadian tidal observation stations were established at Pointe-au-Père and Anticosti Island, in the Magdalen Islands (Îles de la Madeleine), at St Paul Island (all three on the way into the Gulf of St Lawrence), and at Saint John, New Brunswick. In 1893, the Canadian Tidal and Current Survey was established under W. Bell Dawson (the son of the principal of McGill, J.W. Dawson, and brother of G.M. Dawson), who remained its superintendent until 1924, when it was united with the Hydrographic Service (it became part of the Canadian Hydrographic Service in 1928, uniting charting and tidal surveys). At first, the Tidal Survey was poorly funded, but with time it expanded and tide tables for all major Canadian ports were produced.[38]

But it was the fisheries that were most closely related to the beginnings of the mainline marine sciences in Canada. With Confederation, fisheries became (as they still are) a federal responsibility, at the beginning under the wing of the Department of Marine and Fisheries, established in 1868. Initially there was no regulation of the main fishery, in the Atlantic, and resources were heavily used by Canadian and American fishermen. It was widely believed that finfish, lobsters, and oysters were decreasing, but there was nothing but hearsay to judge one way or another.[39] Pleas for fishery regulation and study of the fisheries, combined with support of pure science, began in the 1880s, one example of which is the Guelph biologist J.P. McMurrich's 1884 article "Science in Canada," calling for fisheries stations and steamers to "adopt measures for the increase of our fisheries, by informing us of the real extent, of which we are comparatively ignorant, and by preventing their wanton destruction."[40] But there was little or no home-grown talent to apply to these problems, and no immediate response to McMurrich's entreaty.

Under these circumstances – the need for advice on fisheries problems and the small, relatively undeveloped science of late-nineteenth-century Canada – it is no surprise that the Canadian government looked

once again to Britain for help. In 1892, upon the advice of an eminent Scots fisheries biologist, W.C. M'Intosh of the University of St Andrews, it appointed Edward E. Prince dominion commissioner of fisheries (figure 1.4). Prince's pedigree was excellent, and his political savoir faire proved to be outstanding. "The genial Professor Prince"[41] began early to make a mark in Canada and was an important presence from his arrival in 1893 until his retirement in 1924.[42]

Within the first year, Prince suggested a marine biological station for Canada and a "complete biological survey of coastal waters." As Jennifer Hubbard has shown in her detailed analysis of Prince's influence, there were a number of factors at work, among them certainly the need for more information on Canadian fisheries, the prevailing interest in Europe and North America in marine stations as locations for advanced research in marine biology, the increasing interest in Canadian universities in having laboratory facilities on lakes and the oceans, and an underlying sentiment that Canada should be matching the United States in its research capabilities. The biggest problem, at least in the short term, was that no one in the Department of Marine and Fisheries showed the slightest interest in marine laboratories.

The Royal Society of Canada endorsed the plan for a marine station in 1896, but it was given real impetus when the British Association for the Advancement of Science met in Toronto to great fanfare in 1897. A British Association committee for a Canadian biological station was set up, and a part of the committee, bolstered by Canadian academics from Toronto, Laval, and McGill, along with members of the Royal Society, the Nova Scotian Institute of Science, and the Natural History Society of Montreal, met with the minister of marine and fisheries in April 1898 to ask for support. As Hubbard has written:

> The delegates' arguments were of a kind long used by scientists to get government funding. These "classical" arguments began with an appeal to national pride: "Canada is the only civilized country where no Marine Biological Station has been established." But this argument only works if very tangible benefits are promised. They argued that the fishing industry would generate greater revenues through improved practices. Furthermore, a Canadian station would provide precise scientific observations relating to the conditions of fish stocks, their size and locations, how they could be increased, how harvesting methods could be improved, and so on. But this would require "exact scientific investigation into such questions."[43]

1.4 Edward E. Prince at St Andrews, NB, right, with A.G. Huntsman, left, and an unidentified young researcher in between

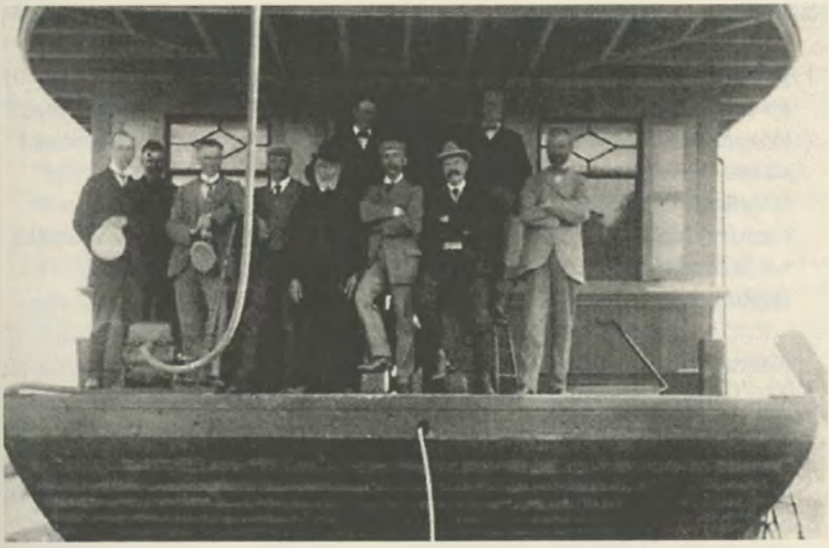
Moreover, "university researchers would aid the Dominion government in solving fisheries problems, and the government would have first claim on the information they generated."[44] This, combined with the argument that such a station would keep Canadian researchers at home rather than losing them to the United States, was persuasive – $15,000 was provided to build a marine station and maintain it for five years under the direction of a board of management (named the Biological Board of Canada in 1912) chaired by Prince.

When the first marine station came into use in 1899, it was a floating one (figure 1.5), its design based on a precursor in the United States, but probably inspired by John Murray's *Ark* in the Firth of Forth, which later became the nucleus of the Scottish station at Millport, a vessel and events with which Prince was certainly familiar. The floating station was towed from location to location, beginning its scientific life in St Andrews, New Brunswick, for the first two years, then in Canso, Nova Scotia, in 1901–2, Malpeque Bay, Prince Edward Island, in 1903–4, and Gaspé, Quebec, in 1905–6. In each location research centred on the problems of the area – including, but not exclusive to, "sardines" in New Brunswick, groundfish in Nova Scotia, oysters in Prince Edward Island, and so on. For the first time, university researchers could readily find laboratory facilities on the Atlantic coast and spend their summers as unpaid "volunteers" in marine research that benefited them and the country.

When the floating station was damaged en route to the north shore of the Gulf of St Lawrence and had to be abandoned in 1907, it seemed a disastrous end to such promising investigations. But the speed with which a replacement for the floating station was provided suggests that something more satisfactory than the floating station had been planned for some time. With careful consideration of all the important factors, including the local fisheries, the richness of the marine biota, water quality, the availability of land, access to supplies, social factors, and ease of access from central Canada (the railroad link that opened in 1903 proved a great convenience if not a determining factor), the choice was St Andrews, New Brunswick.[45] The Atlantic Biological Station opened there in 1908, and there it has remained ever since.

The St Andrews Biological Station in Context

The two marine biological stations that opened in Canada in 1908, the Atlantic Biological Station at St Andrews and the Pacific Biological Station at Nanaimo, British Columbia, institutionalized marine biology



1.5 Canada's First Marine Biological Station

in a literal and figurative way upon their opening. It may seem surprising that their history was so short – a mere decade from initial funding of a movable station, to permanent establishments on both coasts. But such was the case. While the marine environment had been studied episodically in various ways from the French regime in the seventeenth century until permanent stations were founded in the early twentieth century, there is no common narrative, no historical imperative, that unites the varied charting, explorations, tidal surveys, and marine collecting that took place in Canada until 1898. What gave rise to the first government funding of marine biological research in Canada between 1898 and 1908 was partly the need for information about the fisheries. But it was more than "inventory science" – it was the need to develop a Canadian scientific identity uniting utility with scientific understanding that lay behind the origin of Canada's first marine stations. That a small group of Canadian university-based scientists could carry this off in the face of government indifference makes this a particularly interesting case study to historians, and possibly also to today's marine scientists, who should find it easy to identify with the problems that their intellectual ancestors faced in our own time of governmental indifference to science in Canada.

NOTES

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