Scientia Canadensis
Canadian Journal of the History of Science, Technology and Medicine
Revue canadienne d'histoire des sciences, des techniques et de la médecine

The Most Select and the Most Democratic: A Century of Science in the Royal Society of Canada

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Volume 20, numéro 49, 1996

URI : https://id.erudit.org/iderudit/800397ar
DOI : https://doi.org/10.7202/800397ar

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Éditeur(s)

CSTHA/AHSTC

ISSN

0829-2507 (imprimé)
1918-7750 (numérique)

Découvrir la revue

Citer cet article

Levere, T. H. (1996). The Most Select and the Most Democratic: A Century of Science in the Royal Society of Canada. *Scientia Canadensis*, *20*, 3–99. https://doi.org/10.7202/800397ar

Résumé de l'article

Cet article rappelle l'histoire de l'Académie des sciences de la Société royale du Canada, de sa fondation en 1882 jusqu'au début des années 1990. Bien que la SRC ait surtout eu une fonction honorifique, l'Académie a tout de même joué un rôle substantiel dans le développement intellectuel du pays à travers ses publications (rôle assumé ensuite par le CNR et d'autres sociétés savantes), son rôle de conseiller auprès du gouvernement, ses actions éducatives auprès du public, son action de représentation du Canada sur la scène internationale et grâce à des enquêtes scientifiques comme celles sur les risques d'un hiver nucléaire ou sur les changements à l'échelle du globe. Souvent, les membres ont, à titre individuel, contribué davantage à la science que la SRC au plan institutionnel mais, comme le montre cet article, les relations dynamiques entre la science, le gouvernement, la SRC et la population canadienne ont été importantes tant pour l'histoire canadienne que pour l'histoire des sciences au Canada.

The Most Select and the Most Democratic: A Century of Science in the Royal Society of Canada*

TREVOR H. LEVERE

ABSTRACT:

This paper is a history of the Science Academy of the Royal Society of Canada, from its foundation in 1882 until the early 1990s. The RSC has always had an honorific role, but it has sought a more substantive one in science, in advising government, in scientific publication (a role that it has largely lost to the National Research Council and to other scientific societies and journals), in educating the public, in representing Canada internationally, and in undertaking scientific inquiries of public import, for example in assessing the risks associated with nuclear winter, or in the Canadian Global Change Program. Often, Fellows of the RSC have individually achieved more in science than the Society has achieved institutionally; but as this narrative shows, the dynamic between science, government, the RSC, and the Canadian public, has been important in Canadian science and in Canadian history.

SOMMAIRE

Cet article rappelle l'histoire de l'Académie des sciences de la Société royale du Canada, de sa fondation en 1882 jusqu'au début des années 1990. Bien que la SRC ait surtout eu une fonction honorifique, l'Académie a tout de même joué un rôle substantiel dans le développement intellectuel du pays à travers ses publications (rôle assumé ensuite par le CNR et d'autres sociétés savantes), son rôle de conseiller auprès du gouvernement, ses actions éducatives auprès du public, son action de représentation du Canada sur la scène internationale et grâce à des enquêtes scientifiques comme celles sur les risques d'un hiver nucléaire ou sur les changements à l'échelle du globe. Souvent, les membres ont, à titre individuel, contribué davantage à la science que la SRC au plan institutionnel mais, comme le montre cet article, les relations dynamiques entre la science, le gouvernement, la SRC et la population canadienne ont été importantes tant pour l'histoire canadienne que pour l'histoire des sciences au Canada.

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1: BEGINNINGS

> "In a country situated as this is, nearly everything is in some sense premature."
>
> William Dawson 1882.[1]

The first meeting of the Council of the Royal Society of Canada was held in the railway committee room of the Parliament Building, Ottawa, on 25 May 1882, and the formal opening of the session took place in the Senate Chamber. The occasion was both notable and public, and "a large number of ladies and gentlemen of the city of Ottawa" were present.[2] The session was the fruit of an earlier gathering. At the end of December 1881, a group of Canada's leading scholars had met in Montreal, brought together by an initiative of the Governor-General of Canada, the Marquess of Lorne. There, they provisionally formed a council and prepared a constitution for the embryonic Royal Society of Canada. Among their number were John William Dawson, geologist and principal of McGill, Daniel Wilson, a major contributor to Canadian anthropology, Thomas Sterry Hunt, chemist, mineralogist, and philosopher of nature, Charles Carpmael, meteorologist, and Alfred Richard Cecil Selwyn, geologist. These were men who had made and were to make major contributions to science in Canada, and their coming together represented a decidedly bright point in the country's intellectual life. Sir Robert Falconer was President of the Royal Society of Canada at its fiftieth anniversary meeting in 1932. He suggested that the timing of Lorne's initiative represented a bid to aid the fledgling nation when it was in a sorry state. 1881, when the Royal Society received its Charter, was an unpropitious year:

> On the Atlantic coast, the native industry of the building of wooden ships, on which the life of the Maritime Provinces had been fed, was on the decline, and, sadly regarding their diminishing importance, they were chafing against the political system into which they had entered under constraint. In Ontario, agriculture had been suffering ever since the close of the American civil war. The farmer had not yet learned to renew the fertility of his soil. ... In the previous ten years, "little capital, lack of transportation to the areas of mineral deposits, absence of adequate geological investigation, and uncertainty in regard to markets, hampered industry." [CHBE vi 611] In the Prairie Provinces ... wheat was still the substance of things hoped for, and ranching was awaiting both the railway and refrigeration. ... All [the

provinces] were critical of Ontario. ... It was, therefore, a time when there was great need for unifying influences.[3]

The universities were for the most part isolated and underfunded, laboratories were few and underequipped, museums scarcely existed, and the development of a research tradition lay in the future.[4] There were, however, a few bright spots in the sciences, both pure and applied. One of the themes running through the Royal Society of Canada's deliberations, identity crises, and initiatives, is the interplay between pure and applied science, especially including engineering. Those sciences of most evident utility, for example geology in its application to mining, were most readily justified and most vigorously developed in Canada. Yet even within those sciences, the tension between abstract curiosity and practical application was from the beginning strong. William Logan, first head of the Geological Survey of Canada, had sought to justify the science by its fruits: "economics leads to science, and science leads to economics."[5] There were thus real pressures militating against the enlargement of theoretical understanding. As Falconer sweepingly put it, "The intellectual maturing of the Canadian people was thus delayed by the conditions of their life. They were, as we have seen, for the most part still in the pioneering stage, and had to devote their energies to the primitive tasks of making a living." Falconer in 1932 was determined that the RSC should be a centre not only for applied science, but also and especially for fundamental research, and what he wrote then was even more true of Canada in the 1880s:

> Placed as we are [in 1932] with a comparatively weak inheritance of culture in the midst of an unusually rich and still partially unexplored material environment, we are exposed more than most to the prevalent temptation of a commercial and industrial age to evaluate science in terms of the wealth that it can produce.

The RSC would seek to resist such temptations, and to engage in "the disinterested pursuit of science."[6] Thomas Sterry Hunt, the philosophically eccentric first president of section III, recognized that in a new country like Canada, pure science would take second place to the solution of practical problems and the subduing of wilderness; but science, he insisted, was a national honour and glory, and for those who began with pure science, application would follow.[7] Looking back to 1881, Falconer identified another problem, that of the level of education of immigrants: "Both

derivation and environment were unfavourable; there was neither intellectual tradition nor sympathy for learning." To compound the problem, "The higher education was defective in facilities for the study of the sciences, just the subjects which would appeal to youth of a new country calling them to explore it."[8]

This is to paint altogether too bleak a picture. There was, especially in English-speaking Canada, an intellectual ferment that found its expression sometimes in the universities, sometimes through the churches, but more vigorously and more consistently through initially local scientific or literary and philosophical societies. The Literary and Historical Society of Quebec had been established by Lord Dalhousie by royal charter in 1824, the Natural History Society of Montreal had started in 1829, and the Canadian Institute (later the Royal Canadian Institute) had been founded in Toronto in 1849. The two latter institutions were the focus of a lively scientific culture. Lorne's vision drew on these resources, on the few government scientists based in Ottawa, and on the few lights in the universities, and called them together in 1881.

There was some debate about the appropriate model for the new Royal Society. First was the issue of its comprehensiveness. Local and provincial literary and philosophical societies often encompassed both the humanities and the sciences, but national societies tended to be either humanistic or scientific, not both. The Royal Society of Canada would encompass both, and would, moreover, represent both English and French humanistic studies. There was an assumption, generally although not always unquestioned, that French and English scientific cultures were part of a universal scientific culture,[9] so that the scientific sections of the Royal Society would not be divided according to language. Within the sciences, there were two very different models, an elite academy like the Royal Society of London, or a much more popular and accessible organization like the British Association for the Advancement of Science. The latter, founded in 1831, was in practice open to anyone with an interest in any branch of the sciences, including, by the 1880s, statistics and geography. Membership in a local scientific society, or contribution to the proceedings of such a society, would more than meet the requirements for membership in the BAAS; the same was true of the American Association for the Advancement of Science. One feature of the BAAS that might have seemed attractive to the fledgling Royal Society of Canada was its mandate to present and represent science throughout Great Britain, which meant that it did not have a metropolitan focus like

the Royal Society of London, but instead held its annual meetings in a succession of provincial towns and cities, generally at the invitation of local philosophical societies. One of the aims of the RSC was to bring together scholars from all parts of the Dominion, and the model of the BAAS was well suited for this purpose. The Royal Society of London was, however, the model chosen for the scientific sections, and the RSC was deliberately constituted as an elite organization. The justifying rhetoric was to stress that the RSC was open to all, with membership based on talent. In the words of J. W. Dawson, "Science and literature are at once among the most democratic and the most select of the institutions of society."[10]

There was in 1881 a nucleus of men of science, mainly located in Montreal, Toronto, and Ottawa, of sufficient stature both nationally and internationally to form a highly reputable scientific society, even though it could not yet measure up to the leading academies of science in Europe and the United States. Canada's leading scientists had more confidence in their own merits than they had in the merits of the country's scholars in the humanities, and privately expressed reservations about the latter's ability to form worthy sections of the RSC.[11] J. W. Dawson, soon, as first President of the Royal Society of Canada to be Sir William Dawson, put the best face on this in his opening presidential address in 1882:

> We are sometimes told that the enterprise in which we are engaged is premature, that like some tender plant too early exposed to the frost of our Canadian spring it will be nipped and perish. But we must remember that in a country situated as this is, nearly everything is in some sense premature.[12]

Dawson thought that it might be fairer to characterize the RSC as immature, rather than premature. In the field of science, there were some substantial achievements, most notably in geology, where the study of the Canadian Shield had given international visibility to work in the Dominion. There had also been some growth of scientific education, and of professional openings in scientific fields, mostly with the government. Openings in science in Canada were generally behind most countries. Apart from the somewhat meagre government grants to the Geological Survey of Canada and the Meteorological Service, there was almost no government support of science. Scientific education was a provincial matter, and was therefore necessarily unequal and imperfect. Knowledge of Canada's flora, fauna, and even geology was inade-

quate, largely because there were so few investigators in these fields. "Were it not for the aid indirectly given us by the magnificent and costly surveys and commissions of the United States, which freely invade Canadian territory whenever they find any profitable ground that we are not occupying, we should be still more helpless in these respects." Scientists in Canada were few, distances were long, and the RSC had accordingly to counter "the evils of isolation". It could do so by providing decent avenues of publication within Canada. Dawson was ambitious for the RSC and for Canadian science, but he was also too modest for the Society to believe that its publications could soon rival the *Philosophical Transactions of the Royal Society of London*. More realistic models for the RSC were the publications of such foundations as the Philadelphia Academy (the American Philosophical Society) or the Boston Society of Natural History. Through scientific publication, the RSC would stimulate "mental and industrial progress", and it could also concentrate the benefits of the several local societies throughout the Dominion.[13]

Dawson in this address was setting out goals and a program for realizing the aims conceived by Lorne and soon expressed in the *Act of Incorporation and By Laws of the Royal Society of Canada. Act of Incorporation 46 Victoria*:

> The objects of the ... Society are: first, to encourage studies and investigations in literature and science; secondly, to publish transactions annually or semi-annually, containing the minutes of proceedings at meetings, records of the work performed, original papers and memoirs of merit, and such other documents as may be deemed worthy of publication; thirdly, to offer prizes or other inducements for valuable papers on subjects relating to Canada, and to aid researches already begun and carried so far as to render their ultimate value probable; fourthly, to assist in the collection of specimens with a view to the formation of a Canadian Museum of archives, ethnology, archaeology and natural history.

Lorne's hopes for the society stressed the building of collections that, "already fairly representative in geology, may hereafter include archives, paintings, and objects illustrating ethnology and all branches of natural history." The RSC was to serve as focus and catalyst for the growth of science in the Dominion, and for the development of representative collections embodying the Dominion's intellectual and material riches. It was to do this through the

leadership of "members who have made their mark by their writings, whether these be of imagination or the study of nature."[14]

There were initially four sections, of which the third and fourth were devoted to the natural sciences. Section III embraced mathematical, chemical, and physical sciences, including mineralogy, then thought to have closer affinities with chemistry than with geology, hence the presence in this section of Bernard J. Harrington, Edward J. Chapman, Thomas Sterry Hunt and Eugene Haanel. Section IV was for geology "and allied subjects", such as palaeontology. The division regarded the human sciences as part of the humanities broadly conceived, so that anthropology, for example, was placed in section II, among the other disciplines practised by anglophone humanists. Geography, including political and human geography, was also placed in section II, although in Britain geography had its own section in the BAAS, and the Royal Society of London had long regarded contributions to geographical knowledge as an appropriate qualification for election to its fellowship. Most of the naval officers who had led voyages of exploration to the Canadian Arctic since the Napoleonic Wars had been elected FRS for just such contributions.[15] Thus Daniel Wilson, among the charter members of the RSC and most distinguished for his anthropological work on the Indian peoples of Canada, was elected to section II, and so, in 1929, was Diamond Jenness, Canada's leading anthropologist and expert on the Inuit. If the medical sciences were regarded as in any way human, they were still firmly ranked with the natural sciences in the organization of the Society, so that William Osler, for example, was a charter member of section IV.[16] Clinical medicine, however, was for more than fifty years little in evidence in the RSC; bacteriology, physiology, biochemistry, and pathology were more usual avenues to election. A. G. Nicholls, for example, was professor of pathology at Dalhousie, elected FRSC in 1908, and published six papers in the *Transactions* of the RSC, on pathology, blood serum, and immunity; he was also influential as editor of the *Canadian Medical Association Journal*. Similarly, James Miller (FRSC 1922), professor of pathology at Queen's University in Kingston, worked on liver atrophy, and the histology of tuberculosis and neoplasms. He published seven of his papers in the *Transactions*. William Boyd (FRSC 1928), professor of pathology at the University of Manitoba, who worked on cancer and other surgical and medical pathology, published two papers in the *Transactions*. Whereas these specialties could and did bring election to the RSC, most physicians were not considered for election. As

Jonathan Campbell Meakins observed as late as 1932 "the lack of influence which the Royal Society might exert upon the science of medicine is emphasized by the fact that there is only one member of Section V [created in 1918 for the life sciences including medicine] who is devoting himself to experimental medicine".[17] Only as medicine became more of an experimental science did it enter more fully into the life of the Society. The social sciences were not prominent in Canada in the early years of the RSC, but when they became so, their practitioners were elected to sections I and II of the Society, although not, as we shall see, without some debate as to whether they belonged to the sciences or the humanities. Another source of blurring between the scientific sections and the others arose because at least some members of francophone section I felt that francophone scientists were part of French-Canadian culture, and accordingly belonged in that section.[18] Thus, although this essay is about the scientific sections, which later became the Academy of Science of the RSC, it is necessary to bear in mind the involvement with science of members of the other two sections, now Academies I and II.

The original members of the RSC, twenty of them in each of the four sections,[19] were nominated by Lorne after inquiry and consultation in Canada and in Great Britain. Thereafter, nomination would be by at least three members, so that the RSC would have the conservative strengths of a self-renewing body.

Apart from the publications of the Geological Survey of Canada, the new *Transactions of the RSC* offered the first national scholarly journal for the publication of scientific papers in Canada. Dawson in his inaugural address had identified the geology of the Canadian Shield as one of the areas in which Canada already enjoyed an international reputation. British geology had enjoyed supremacy in much of the Empire. Formations identified from work in Britain were exported wholesale, and with imperial confidence were identified from Australia to India and to the Canadian Arctic.[20] Sir Roderick Impey Murchison had made almost a crusade of the imposition of his Silurian system on the rocks of the world; by the time the RSC was founded, the correlation of the Silurian series of Europe and North American was in "a somewhat complete and satisfactory condition".[21] The Canadian Shield was, however, distinctive, and its geological study had been almost entirely in the hands of the Geological Survey of Canada. In 1882, the view of the Shield's stratigraphy was essentially the one worked out by William Logan, that the oldest rocks were part of the Lower Laurentian

series. Above these came the Upper Laurentian, and then above these in turn were the Huronian rocks. This view, based largely on observations made from southern Ontario to Lake Superior, and in south-western Quebec, was to undergo considerable change over the ensuing decades, but it looked secure in 1882; certainly the Precambrian rock formations were larger and more completely developed than those in Britain.[22] The first volume of the *Transactions* included one of the accounts that would both extend and modify the picture, in G. M. Dawson's paper "On a General Section from the Laurentian Axis to the Rocky Mountains."[23] Stratigraphy was the principal aspect of Canadian geological work at this date. Thanks largely to the work of William Dawson, Canada was also recognized for contributions to palaeobotany, a difficult field important for biogeography and evolutionary studies, where much had been done unreliably, and where Dawson's work, principally on the Devonian flora, accordingly stood out.[24] The 1882 *Transactions* included Dawson's paper "On the Cretaceous and Tertiary Floras of British Columbia and the North West Territories."[25]

Geology may have been the most prestigious science in the early RSC, but agriculture and forestry were then more important than mining. William Saunders published two papers in the 1882 *Transactions*, both of economic import. Indeed, the title of one of them, "On the Importance of Economising and Preserving our Forests,"[26] advertises the economic aspect; but it also raises that concern with preservation, conservation, and the wise utilization of resources only potentially renewable. This is a theme that has been apparent and urgent within the RSC from its foundation until the present, when it looms large within the Global Change Project. The relations between science, agriculture and settlement were similarly the underlying concerns in Robert Bell's 1883 paper on "Causes of the Fertility of the Land in the Canadian North West."[27]

1882 was important for international science in ways that should have been important for Canada. The International Polar Year,[28] the fruit of an idea and a campaign by the Austro-Hungarian officer Karl Weyprecht, and much facilitated by support from the German Imperial Council, advised by Georg von Neumayer and other scientists, had sought British participation. After all, if circumpolar studies were to be carried out, the sheer extent of the Canadian Arctic (not to mention the relative proximity of Britain's antipodean colonies to the Antarctic) made British participation crucial. It was scarcely forthcoming.[29] In the event, Germany sent an expedition to the eastern Canadian Arctic, the Americans sent

one to Lady Franklin Bay on the coast of Ellesmere Island in the far north of the arctic archipelago, and Britain, with help from the Canadian government, sent a minimal team to the Northwest Territories, for magnetic observations. The Royal Society of Canada was not involved. There was, however, a reason for the selection of 1882 as the start of the International Polar Year that did offer opportunities for the fledgling RSC, and that was the occurrence of a transit of Venus.[30] Here was something that could well be observed from Canada, that would bring Canadian astronomy into the international network, and that could be used to improve the instrumentation in Canada's few observatories. Astronomy in Canada was not vigorously developed in 1882. "... except for its use as a cultural subject in university work and in applications to time, navigation and certain surveying operations, practical astronomical work was limited to its use by the Federal Department of the Interior in the survey of Western lands and the delimitation and marking of International and other boundaries."[31] Reports of transit observations were published in the second volume of the *Transactions of the RSC*.[32]

2: A SCIENTIFIC NATION. SCIENCE AND EMPIRE

The transit observations involved precise observation and measurement, could be justified as pure science, and yet were significant for practical concerns. They illustrated the interdependence of science and praxis that has been a staple of the rhetoric of advocates for science throughout the history of the RSC. It was this interdependence that successive presidents of the Society and of its scientific sections appealed to in their approaches to government, and that William Dawson relied upon in his departing President's Address in 1883.[33] He appealed to utility and intellectual glory in insisting on government recognition. He called for a National Museum, to be supplied from the works of nature and mankind throughout the Dominion; and he made a special appeal to the Hudson's Bay Company for collections throughout its field of enterprise.[34] He welcomed delegates from a dozen scientific and literary societies[35] who were attending this second meeting of the RSC, an indication that the Society had started to function as a focus and catalyst for scientific and literary work throughout the Dominion.[36] He surveyed the state of the sciences in Canada, noting that chemical and physical laboratory science had grown more slowly than field sciences, but that even within the latter, while geology was strong,

there was a need for much more work in natural history and zoology. He also announced that the British Association for the Advancement of Science would be coming to Montreal in the following year, in its first overseas meeting.[37] Dawson was ambitious for science, for himself, and for the RSC. A meeting of the BAAS, held in Canada at the invitation of the RSC, would draw attention to the latter, bringing American and perhaps even European as well as British delegates to Montreal; in 1883, Dawson was hoping for four hundred British delegates. The meeting would bring the RSC into greater Canadian prominence, through thorough newspaper coverage of a major scientific meeting. It would announce Canadian science as important within the British Empire. It would certainly do no harm to Dawson's reputation. Lorne, who had conceived the idea of the RSC, and effectively called it into being, was also keen on the idea of a Canadian visit by the BAAS. A letter from William Spottiswoode to Lorne in 1882 makes it clear that Lorne was keen to facilitate the visit, and saw it as a further contribution to the scientific movement in Canada.[38] That such a contribution was needed for the recognition and maturation of that movement is underlined by a letter from Alexander Campbell to Lorne in 1883. Campbell urged that Sandford Fleming, with whom the idea of a prime meridian had originated, be invited to represent Canada at the Washington conference in 1884 on the establishment of a standard meridian; Canada was not invited, because the organizers had not considered that it was a nation.[39] The RSC would, as host to the BAAS, help to counter such views.[40] The meeting would encourage the recognition due to science, and to scientists – Dawson was knighted in 1884, in spite of the risk of "academical jealousies" that Lorne's successor anticipated.[41] Canada's national stature and independence from the United States would, for Dawson, be enhanced in matters scientific by stressing the imperial connection.[42] Dawson was confident that a demonstration of imperial support for Canadian scientific activities would strengthen the RSC in its approaches to the Dominion government.

Hydrographic Surveys[43]

The RSC not only welcomed the BAAS in 1884, but worked with that organization to set up a committee on tides in Canada. Shipping and the trade that it made possible was reason enough for British interest in Canadian hydrography, an interest that had reaped its first and most spectacular success when James Cook's

hydrographic survey of the St. Lawrence enabled the British to bring their forces confidently to Quebec in 1759. In the 1880s, there were ships of up to 5,000 tons in the St. Lawrence, and bigger vessels were on the way.[44] Tidal surveys were becoming urgent. The BAAS, having through its visit to Montreal announced its imperial character, had a committee investigating tides throughout the world. As one fruit of the Montreal meeting, a corresponding committee of the British Association was set up to cooperate with the RSC's new tides committee. The BAAS committee included Lord Kelvin, J. Couch Adams, and George Darwin, an impressive trio. William Dawson, Sterry Hunt, Alexander Johnson, John George Bourinot, and Principal Grant of the RSC had an interview with the Minister of Marine and Fisheries, and petitioned the House of Commons to encourage tidal observations along Canada's coasts.[45] The RSC and BAAS continued to press the Canadian government to publish tide tables, and to establish stations at key points for continuous tidal observations. A meeting with the Minister of Marine and Fisheries, followed by one with the Prime Minister, appeared to have won approval; but the cost of expeditions to Hudson Bay, and of the survey of Georgian Bay, held up the crucial vote of funds.

Three years later, the *Proceedings* of the RSC noted that the government had not yet materially supported the proposal, and that the RSC should push vigorously, before the BAAS lost interest.[46] The RSC did push, and persuaded the Minister of Marine and Fisheries, who in 1891 noted that inadequate information about tides had led to many shipwrecks. "All the observations on the tides which had until quite recently been worked up had been taken and reduced by methods which are now recognized as being inadequate to the solution of the problem. It was therefore decided to take observations at a number of points in the Dominion and have them reduced by modern methods. ..." Three self-recording tide-gauges were imported from Scotland, and Carpmael chose the sites for them, at St. John, New Brunswick, Father Point, Quebec, and South-West Point, Anticosti Island. The plan was to keep the self-recording gauges in operation for nineteen years, to ascertain the long-period tides. Observations over a shorter term (three years) would be necessary at other points, with observations at intermediate points carried out for two months. Observations in Nova Scotia had already been under way for long enough to print tide-tables in 1890.[47] For several years, the "Report of the Tidal Service" was published in the *Proceedings* of the RSC. In 1893,

reporting for the first half of 1892, Carpmael reported on the purchase and destination of three additional tide-gauges, and on the difficulties with their intended sites. At Father Point, Quebec, for example, work was suspended because of difficulties with the rocky site.[48]

W. Bell Dawson was appointed as the engineer in charge of tidal surveys, and his work won him election to the RSC in 1896. He had reported for 1894 that the record for Quebec and St. John was almost sufficient for the calculation of preliminary tide tables for these ports. He also discussed determining currents at the main entrances to the Gulf of St. Lawrence.[49] By 1897, he was able to report on the "Character and Progress of the Tides in the Gulf and River St. Lawrence."[50]

1897 was the year in which the BAAS returned to Canada, this time meeting in Toronto. It had not lost interest in Canadian tides, and on the occasion of this visit, it reappointed the tides committee, adding to the membership Admiral Sir William James Lloyd Wharton, President of the Royal Geographical Society, Hydrographer to the Navy. This made him "the highest authority on the value of the charts in common use in Canadian waters"; British imperial authority at the end of the nineteenth century took clear precedence over Canadian authority in hydrographic lobbying, if not in knowledge of Canadian waters. The enlarged committee of the BAAS lent its support to the advice that the RSC was giving the Canadian government.[51] With continuing scientific and governmental support, however inconstant,[52] the tidal survey was maintained and strengthened. By 1905, the report in the RSC's *Proceedings* was able to announce that not only were several tide tables for local use now issued, but also, "the leading almanacs in Canada are now supplied with reliable tables and information in place of the untrustworthy data formerly published."[53] The *Proceedings* of the RSC for 1906 contained the final report of the Society's Committee on the Coast Hydrographic Survey. Their business ended with the establishment of that Survey. In the previous year, the government had voted over a quarter of a million dollars for a steamer for the Atlantic coast, in addition to the one for the Tidal Survey, a steamer for the Pacific, and related expenses.[54] In 1903, W. Bell Dawson informed the RSC that the surveys had advanced to the point where "a good general knowledge" existed for the tides on both Canada's Atlantic and Pacific coasts.[55]

Here was an enterprise by the RSC that led to important results for both Britain and Canada. British scientists, through the BAAS,

had made the initial suggestion, adopted and pursued by the RSC. The BAAS may have been interested for both disinterested and practical reasons. For the Admiralty, however, British trade was the overriding concern. When Robert Bell, cantankerous geologist, wrote to the Canadian High Commissioner in London, urging that there be a hydrographic survey of Hudson Strait and Hudson Bay, the Commissioner sought advice from the Admiralty. The Hydrographer of the day, F. J. Evans, observed that the Hudson Strait route offered little prospect for immigration. He also noted that, given the climate, a detailed hydrographic survey would take years. This, however, "is a matter which it would appear ... more nearly concerns the Canadian Dominion than the Imperial Government." Funds for hydrographic surveys voted by the House of Commons "are now mainly indeed almost entirely devoted to the surveying of those regions in which our great and expanding trade is forcing itself, and other highways of commerce."[56]

That seemed a clear response, but the issue was complex. By the beginning of this century, the Dominion government surveyed rivers and lakes, but generally not the coast. Alexander Johnson had already argued in 1893 that Canada needed its own Hydrographic Service or Coast Survey.[57] A decade later, he was frustrated by administrative obstacles. "It is obviously difficult," Johnson reported to the RSC after a meeting with the Minister of Marine, "to draw a dividing line between what is imperial and what is local. The Minister undertook to communicate with the Admiralty on the subject so as to settle what Canada must do for itself." Nonetheless, Johnson learned that, in addition to the vessel that the Dominion government already had for hydrographic surveys of lakes and rivers, it had lately bought a special surveying vessel for the Tidal Survey.[58] The advice of the RSC to the Canadian government, aided by the BAAS, had taken six years to get the Tidal Survey established, and a little over twenty years to the satisfactory establishment (although far from the completion) of Canada's own survey of its coastal as well as inland waters. Here was a small but significant step in assertion of Canada's scientific nationhood. The pattern is one that was to be repeated, interspersed with unsuccessful initiatives. The RSC took an active role in the establishment of many of Canada's national scientific establishments and enterprises. Once established, these often outgrew, ignored, or denied their parentage.

Canadian Geology and the Imperial Federation of Science

In 1884, when the BAAS came to Montreal, J. W. Dawson, now Sir William, discussed the relations between geological work in Canada and in Europe.[59] Canada had done fine work in petrology, especially in the microscopic examination of rocks – a subject on which Dawson might have been a little less assertive, given his identification of a mineral formation as the fossil remains of an organism of unprecedented antiquity, *Eozoon Canadense*; but at that time the controversy about it was still lively, and the British naturalist William Carpenter had the intention of publishing a monograph on it.[60] He was on stronger ground in stressing the excellence of Canadian work on the Precambrian rocks, where Logan's work had been ahead of European work, and more recent work in Canada and the United States had maintained at least a North American lead. Three years later, in Queen Victoria's Golden Jubilee year, Dawson was president of the British Association for the Advancement of Science, and the Royal Society of London had the idea of making itself the hub of an imperial scientific union. Dawson saw a way for Canada, through the RSC and the Geological Survey of Canada, to take a leading role in such a union. He wrote in February 1887 to George Stokes, president of the Royal Society of London:

> Referring to your recent presidential address, and to that of last year by Prof. Huxley, and to the proposed action of the Council of the Royal Society on the subject of a scientific federation of the empire under the auspices of that Society, I beg leave respectfully to invite your attention and that of the Council to the aspect of the matter with reference to geological science, which in some important respects will lend itself to such union more readily than most other departments of scientific work. ... The British Empire also possesses exceptional facilities for taking the lead of other nations, in so far as geology and physical geography are concerned. ... In Canada we have the larger half of North America, and much of this very satisfactorily explored. We also have the advantage of the best exposures of the older crystalline rocks, of a development of the Palaeozoic series in the Eastern Provinces, more closely allied to that of Europe than to that of the interior American plateau, and of Pleistocene deposits so extensive and complete that they must ultimately decide many of those questions of glacial geology which have been so much agitated.[61]

Clearly, in Dawson's conception, Canada would take a leading role.[62] The RSC appointed its own committee to look into the

possibility of an Imperial Union of Geological Surveys and Societies. There was some dissent within the RSC. Might not such a union conflict with the International Geological Congress? Would it not be wrong to limit the union to geology? The Congress met in London in 1888, and, as one result of the Jubilee, the Imperial Institute was founded "to illustrate the resources and capabilities of every section of Her Majesty's Dominions." The RSC expressed the hope that the new Institute would make itself a focus for geology, as part of its mandate.[63] But neither the Imperial Scientific Union nor the Imperial Geological Federation came into being at this time. Perhaps the thought that the Empire rather than England might take the lead in some areas, clearly implicit in Dawson's proposals, may have diluted the Royal Society of London's enthusiasm for its idea.

The Longitude and Geodetic Surveying[64]

A more fruitful imperial enterprise advocated by the RSC was the telegraphic determination of the exact longitude of Montreal. Lawrence Burpee[65] on the occasion of the RSC's half-century, observed that "The 1891 meeting in Montreal was marked by a movement, finally successful, to induce the Canadian and British governments to cooperate in determining exactly the longitude of Montreal by the exchange of telegraphic signals with Greenwich. The Royal Society was instrumental in securing the preparation of the first large-scale map of the Dominion; the measurement of the 98th meridian in cooperation with the United States; the establishment of geodetic surveys. It took an active part in the movements for inter-Imperial cables, [and] time reckoning. ..."[66] These developments were all inter-connected. In the *Transactions* of the RSC in 1885 was a paper by W. A. Rogers and C. H. McLeod on the longitude of McGill College Observatory.[67] The redetermination of the longitude of Montreal, reckoned from Greenwich via the observatory at Harvard's observatory in Cambridge, stemmed from observations on the recent transit of Venus, and would serve as the base line for the determination of other Canadian longitudes. A start had been made with the redetermination of the longitude of Toronto, and the determination of that of Cobourg.[68]

By 1890, there were doubts about the accuracy of the value for the longitude for Harvard, and thus of the McGill longitude derived from it. The RSC therefore asked the Governor General to secure the cooperation of the Astronomer Royal at Greenwich in making a telegraphic determination of the exact longitude of Montreal. The British government assented to the Greenwich Ob-

servatory taking part in the undertaking, and the navy estimates for 1891–2 included £350 for instruments and £300 for operations connected with the project. The Canadian Pacific Railway Telegraph Company offered free use of their cable and telegraph lines, McGill's observatory was willing to participate, and all that remained was to obtain a sum from the Dominion government comparable to the vote from London. The Minister of Marine, Charles Tupper, brought the subject "to the attention of his Excellency the Governor-General-in-Council with a view to its consideration in the preparation of estimates to be laid before Parliament."

The reason for approaching the Minister of Marine was that accurate longitude determinations were the foundation for accurate maps. There had been many shipwrecks in the Gulf of St. Lawrence, and indeed all along the Atlantic seaboard, for which there was no explanation. Accurate maps of the coast should reduce the incidence of these disasters.[69] The Canadian government came through with the funds, and Prof. Clement Henry McCleod[70] of the McGill observatory visited Canso, Nova Scotia, the Canadian terminus of the cable from Waterville in Ireland. Preliminary tests were made on 7 and 14 June between Montreal and Waterville.[71] Preparations were judged satisfactory, and all observations were completed so that in 1893 it only remained to complete the reduction the data.[72] With that done, the longitude of Montreal was more accurately known than that of any other point in North America; it could serve as the reference point for a geodetic survey for Canada, and for the mapping of the coasts.

From the Longitude of Montreal to National Survey

In 1898, McCleod met Professor Henry Smith Pritchett in Washington. Pritchett had recently been appointed Superintendent of the US Coast and Geodetic Survey, and was keen to extend triangulation from the Mexican border through the United States into Canada. Clearly the Canadian government would have to be brought in, and McCleod argued that the RSC was the body to get things started.[73] If the extension of the work was carried into Canada, then "it will be possible to compute with great accuracy a spheroid to which trigonometrical operations in the north-western hemisphere may be referred. Hitherto it has been necessary to accept a figure deduced from measurements made in the eastern hemisphere."[74] Pritchett was invited to the RSC's meeting in Ottawa in May 1898. The RSC's council argued in favour of the

extension of the work all the way to the Arctic. This would provide the basis of a "thorough geographical survey" of the Dominion, thus serving an eminently practical purpose while adding to Canada's scientific stature. An appropriation of $10,000 for a few years would suffice, and the RSC urged the government to provide this.[75] In 1899, McLeod, in his Presidential Address to Section III of the RSC, pointed to the obvious commercial advantage of such a work, obvious even to "those who do not see eye to eye with us in scientific affairs." He went on to advocate a Coast and Geodetic Survey for Canada.[76]

The subject had been taken up at the Toronto meeting of the BAAS in 1897, and a committee was struck, with Sandford Fleming and Thomas Keefer among the members. The committee reported in 1903. "There are few countries, if any," it noted, "where the expenditure for surveys per capita of population is as large as it is in Canada. The Department of the Interior is subdividing lands in Manitoba, the Northwest Territories and British Columbia, the Geological Survey Department is surveying and exploring in all parts of the Dominion, the Department of Marine and Fisheries is making a hydrographic survey of our navigable waters, a military survey of the country is in course of execution under the direction of the military authorities, the Department of Public Works and the Department of Railways and Canals are also conducting extensive surveys." All this involved much duplication of effort, which would be avoided by a triangulation as a base for further surveys. They urged a Geodetic Survey for at least the most populated parts of the Dominion.[77] In the following year, they again urged that government be advised to support the survey, and two years later they noted that their committee had made no further representation to government, but that the matter had been taken up by the Canadian Society of Civil Engineers.[78] It may well have been the lack of clear imperial gain that meant that the RSC was unsuccessful here, using tactics otherwise similar to those that it had successfully used for the hydrographic and tidal surveys. It is not without interest that the project was adopted by engineers, members of a profession with which the RSC had unsatisfactory relations for many years.[79]

Marine Biological Station[80]

In 1895, the physiologist Archibald Patterson Knight (FRSC 1892) wrote to Bourinot about the desirability of a lake or seaside laboratory in Canada. In the previous summer there had been seven Canadians at the American marine biological station at Woods Hole, and they should have opportunities in Canada. Knight suggested that a beginning could be made "in connection with the government fish hatcheries," and he was confident that Edward E. Prince,[81] the "fish commissioner," would help the RSC to formulate a plan and present it to the Minister of Marine and Fisheries. Council referred the question to section IV. When the BAAS met in Toronto, a number of new committees were struck, six of them having special reference to Canadian subjects, and among the latter was one to further knowledge of the biology of the lakes of Ontario, and another to establish a biological station in the Gulf of St. Lawrence.[82] The members of the latter committee were Prince (chairman), David Pearce Penhallow (FRSC sec. IV 1885) (secretary), Archibald Byron Macallum (FRSC sec. IV 1901), John Macoun, Edward William McBride (FRSC sec. IV 1909), T. Wesley Mills (FRSC sec. IV 1890), and W. T. Thistleton-Dyer, Director of the Royal Botanic Gardens, Kew. They asked the Minister to provide $15,000 to establish the station and run it as a five-year experiment.[83] The government provided $7,000 for a floating station, intended to investigate the biology of fish, oysters and lobsters. The supervisory board, run by Prince, was otherwise made up of academics, mostly fellows of the RSC.[84] Building at St. Andrews, N.B., was completed in June 1899, and work began in the following month.[85] Reports of the activities of the stations, on the Atlantic coast and also at the mouth of the Go-Home river on Georgian Bay, were published in the RSC's *Transactions* over the following years. In 1907 Prince, now President of Section IV, gave his Presidential Address on the pioneering work of government marine biological stations, and their value to Canadian fisheries.[86] As in the case of the hydrographic surveys, RSC efforts, reinforced by the BAAS, had borne fruit.

A National Museum

One of the purposes for which the RSC had been created was to work towards the establishment of a national museum, as a repository for Canadian culture and for the natural history and

geology of the Dominion. The scientific collections of the Geological Survey were the most important in the country, and they were poorly housed. In the early days, the RSC's *Proceedings* were wistful not practical in tone. "It may be, that in the course of time, we too shall have a Smithsonian Institution to commemorate the growth of science and culture in this Dominion."[87] A decade later, the tone had become impatient. Government had ignored the Society's advice about the need for a museum, and the situation was becoming urgent. Laurier agreed: "That something should be done will go without saying. We cannot be otherwise than alive to the fact that under existing circumstances the valuable collection of the Geological Museum, which has cost a great deal of labour and money, could be at any moment burned to ashes... ."[88] The RSC wanted more than a museum for the geological and natural history collections, and argued for permanent exhibitions in other scientific and cultural fields too. Since the RSC was a national institution, the government should provide quarters for it in the proposed national museum.[89]

The wheels of government sometimes grind exceeding slowly. The Geological Survey's ill-housed museum did not become the National Museum of Canada until 1927, although in 1910 Laurier had established a division of anthropology within the Geological Survey, with offices in the Victoria Memorial Museum. As for housing, this has been a perennial frustration, at least for those who believe that housing appropriate to a national academy requires more than a set of offices in a government building. The RSC, in line with Lorne's aspirations for it, was the first national organization to lobby for a national museum, and it has taken some credit for the latter's establishment.[90] It is hard to see that it was particularly effective in this instance.

The Early Encouragement of Research

The RSC's mandate, expressed by its founder and in the Act of Incorporation, stressed the encouragement of research (described as "studies and investigations"), the publication of transactions including scientific papers, offering inducements for papers on Canadian subjects (thus presumably including Canadian geology, geophysics, and natural history, but not mathematics or general physics), and to help bring to fruition research already begun. Early on, the RSC set up a committee on "the Encouragement of Original Literary and Scientific Work," and it began with a report on fellowships in the USA and in Britain and elsewhere in the Empire. It

found that Canada in 1885 came behind Britain and the USA, but ahead of Australia and New Zealand in the number of fellowships available. Fellowships were crucial if higher education was to be available on the basis of ability, and they were especially important in science "to hasten the development of our natural resources."[91] University endowments were inadequate to provide more fellowships, the committee found problems with government grants, and it saw the best immediate prospects, however dim, in private benefactions.

Alexander Johnson, in his presidential address to Section III that year, reflected on the preponderance of mathematics and physics in the proceedings of the Montreal meeting of the BAAS, and wondered how to encourage those subjects, together with chemistry, in a country that recognized the importance of natural history and geology, but offered neither professional openings nor well-equipped laboratories for the physical sciences.[92] In 1891, the Very Reverend Principal Grant made the same point to the whole Society:

> There is, too, every reason why Canadian natural history should be organized in a strong society. Vast regions of our country, stretching from the lakes to the Arctic Ocean and from the Atlantic to the Pacific, are unexplored. These present important questions, that will take many years for solution in regard to geological structure, ore deposits, the floras and faunas of sea and shore, ... and other matters connected with geography and natural history. The section that deals with mathematics, physics and chemistry cannot make this special Canadian claim. Those sciences belong to no one country. But at any rate our workers in those fields need the same stimulus and aid that is given elsewhere, and their reputation is dear to them and to us as Canadians.[93]

Laboratories were one problem. Publication was another. Before the publication of the *Transactions* of the RSC, and except for the publications of the Geological Society, Canadians seeking to publish their scientific papers did so either in the journals of local natural history societies, or in foreign scientific journals, generally British or American. The problems of botany were typical in this respect: *Le Naturaliste canadien* had been founded in 1869 by abbé Léon Provancher, but English-Canadian botany had no journal, and there was a need for some means "whereby immediate publicn. of every season's botanical field observations throughout Canada may be secured."[94] The development of a national scien-

tific culture required domestic publication, and the RSC offered this in its *Transactions*, distributing the volumes to learned societies internationally, as well as to fellows of the RSC, ministers of education, and Canadian universities. As Grant insisted in the same address, "few expenditures of public money are more profitable to the State than that which provides for the publication of scientific papers." Publication by the Society was, however, not a complete answer. In section III, for example, about a dozen fellows attended the annual meeting until around 1900. They presented usually one paper apiece at the meeting; a year later, eight of these papers were published in the *Transactions*. A way round this delay, adopted by the physicist J. G. MacGregor (FRSC 1882), was simultaneous publication in England.[95]

Yves Gingras has looked at the problem of scientific publication for physicists in the RSC.[96] Around 1900, active research workers, as distinct from professors whose primary occupation was teaching, were elected to the Society.[97] Ernest Rutherford joined in 1900, John McLennan in 1903, and they and other researchers were frustrated by slow publication. They proposed the publication of a bulletin for discoveries that could and should not wait for the next volume of the *Transactions*.[98] The first bulletin was published in 1907, on work directed by Rutherford on radium and radon, just after Rutherford had left for Manchester.[99] The publication of a bulletin for special papers did not solve the problem of a year's delay in publishing the *Transactions*. The RSC's grant was increased to $8,000 in 1913,[100] making it possible from 1914 to bring out the *Transactions* four times a year. In May 1917, the grant was trimmed to $4,000, and publication again became annual.[101] The RSC looked at ways of reducing the lag between the annual meeting and the publication of the *Transactions*.[102]

Apart from publication in its *Transactions*, the RSC sought around the turn of the century to make accessible the work performed in Canadian natural sciences (botany, zoology, entomology, geology and palaeontology) by publishing a series of bibliographies of work done in the previous year. There were also, less systematically, reviews of the history of individual sciences in Canada.[103] Sections III and IV were soon joining forces to urge that the RSC memorialize the government to ask for aid in compiling the bibliography of Canadian scientific publications, "in association with the International Catalogue of Scientific Literature." Twenty other governments were already subsidizing the catalogu-

ing of their national scientific publications, and Canada was left "almost solitary in its absence of due representation."[104]

Another, and more direct form of support for scientific research became possible at the end of the century, when the Council announced that it could supply small sums to support scientific investigations requiring special aid. "The Scientific Sections are therefore asked to report on the [subject] with a view to stimulating scientific research."[105] In 1898, Section IV received $100 for the support of research, and a similar grant was made in 1900 to Section III; a condition of the award was that the results of the research thus supported were to be published in the *Transactions*.[106] When the RSC's grant was increased to $8,000, M. T. White, the Minister of Finance stipulated that, after meeting running expenses and library expenses, part of the remaining funds should be spent on scientific research "on specially approved lines."[107] In 1915, when Louis Vessot King was elected FRSC, the Society made him a grant of $300 "to enable him to continue his work on Meteorological Physics."[108] Major grants were always beyond the Society's budget.

The Dominion Astrophysical Observatory and a New Telescope

That did not mean that the RSC could not precipitate projects in "big science." One such project was the 72-inch telescope at the Dominion Astrophysical Observatory in Victoria. The leading figure in this project was William Frederick King (FRSC 1908), who secured the advocacy of the RSC in persuading government to provide the substantial funds required.

King had worked as a land and topographical surveyor for the Department of the Interior, an instance of the status of astronomy as primarily a practical tool in the nineteenth century. In 1890 King was made chief astronomer of the Department. Edouard Gaston Deville (FRSC 1882) and Otto J. Klotz (FRSC 1910) were the other members of the astronomical branch. A small observatory was built in 1890, succeeded in 1905 by the Dominion Observatory in Ottawa, with King named as Director in 1906. King's work for the Alaska Boundary Tribunal helped to persuade Clifford Sifton as Minister of the Interior that there should be such an observatory. Its work fell into three scientific divisions, geophysics, meridian work, and astrophysics, notably stellar and solar spectroscopy. The latter work was important and successful. King's aspirations for a larger telescope received the support of the American Astronomical Society at its meeting in Ottawa in 1911. A recommendation to

government followed, but the fall of the government prevented any action.

In the following year the RSC took up the cause,[109] adding, despite protests from King, who feared that the extra expense would defeat the project, a request that the new telescope be erected at the best location in Canada for making observations. The Society's resolution was sent to Prime Minister Borden, and after another year of lobbying, the government agreed to buy a telescope with a mirror "of not less than 60 inches in diameter, and as much larger as possible", bearing in mind cost and practicability. The cost would be at least $50,000, plus the cost of the new observatory. John Stanley Plaskett (FRSC 1910) visited observatories in Britain and the USA, as well as instrument makers, to determine the best mode of construction, and William Edmund Harper (FRSC 1924) looked into various sites, and settled on Victoria. Conditions for observing there were far better than at Ottawa, and the RSC was right to push for the site.[110]

Stellar spectroscopy was the key tool in determining the radial velocities of stars, and an international committee was hoping to coordinate the work. The RSC was clear about the significance of such pure research: "On this work, which is probably the most important and most urgent in modern astronomical research, will finally depend our knowledge of the structure, constitution and motions of the Universe." There were only a couple of observatories that were even inadequately equipped to make the necessary observations. Canada, by building its new telescope, would have the biggest one in existence, and could take the lead.[111]

Improbably, the government bought the entire argument, chose a 72-inch telescope, and issued contracts for over $90,000 for the telescope and its mount. They also bought land for the observatory at Saanich Hill near Victoria.[112] Observational work began there in 1918. It is remarkable that useful science had led the government to fund basic research at such a level, and to go ahead with the work and its expense throughout the Great War of 1914–18. The RSC was not the only player, nor only begetter, but it was both effective and important.

4: THE GREAT WAR (1914–18) AND SCIENCE

War, The Laboratory, and Rhetoric

In 1915, at the first meeting of the RSC since the outbreak of war in Europe, the Hon. Rodolphe Lemieux, President of section I for

1914–15, moved a patriotic resolution moving that the RSC voice its loathing of German atrocities and depredations. The motion was unanimously and enthusiastically carried.[113] Section III added its own resolution:

> Whereas, it is important that the scientific forces of Canada should be organized to aid in the vigorous and efficient prosecution of the war and in the development of Canadian industries to meet the present conditions as well as those which may prevail after the war. Resolved that the Royal Society of Canada respectfully suggests to the Government the appointment of a Committee or Commission of scientific men whose duty it shall be to advise the Government how best to utilize the men and laboratories available for such purposes.[114]

Section IV added that a committee to discuss industrial research had been appointed, to meet with a similar committee from section III, and together they recommended that the RSC should place its services at the disposal of the government.[115] A year later, the Council appointed a committee, consisting of the President and members of each section, "to wait upon the Dominion Government for the purpose of encouraging industrial scientific research and of offering the services of the Society to the Government in the furtherance of this research."[116] The role of scientific research in modern war seems to have been recognized by all parties. The Duke of Devonshire, governor general of Canada and Honorary Patron of the RSC, put it succinctly: "the war has almost been taken from the battlefield into the laboratory, and the work which is being done in the laboratory day by day is becoming more and more important in this war."[117] This image of the sciences and thus of scientists at war undermined Canadian enthusiasm for German scientists. Wilhelm Ostwald, one of the founders of the discipline of physical chemistry, and intellectually a major influence on Canadian research in chemistry, had been elected as a corresponding member[118] of the RSC in 1908, one of a handful of foreign scientists who had been so recognized by the Society. On 15 February 1918, Council approved a motion removing Ostwald's name from the list of corresponding members.[119]

The theme of war in the laboratory was taken up and developed within the RSC. The biochemist and physiologist Archibald Byron Macallum, in his presidential address to section III in 1917, noted that Germany was pre-eminent in many industries, including steel production, "by the application of advanced science to them." The

rest of the world, to compete, would have to apply science to its industries as never before.[120] In the following year, A. Stanley Mackenzie told the RSC that research had become a new watchword, "but it has taken a whole world in arms to write it in large enough letters so that our British eyes could see and read it". The implications for the war were obvious – an intensification of research, especially applied or industrial research. "When in 1917 and 1918 the colossal mechanism of the British Empire began to work in unison, the whole of England became one vast, interlacing, coordinated system of chemical, physical and engineering laboratories."[121] FRSCs were engaged in a range of projects. Among the many topics tackled by McLennan, for example, was the production of helium from Canada's natural gases.[122] Eli Franklin Burton (FRSC 1913) was among his co-workers here, and Burton's war work was cited years later when he received the RSC's Henry Marshall Tory Medal.[123] Large scale production was necessary if helium was to be used in airships, and it was clearly infinitely safer than hydrogen, which was highly inflammable and in some circumstances explosively so.[124] Arthur Stewart Eve, in a post-war account of wartime inventions, talked about wireless communication and submarine location, and underlined Robert William Boyle's work "of the highest order in connection with special detectors."[125] War work was confidential, and research geared to the war effort, unlike research in times of peace, was therefore only circulated among allies, and was not published in the usual journals. After the war, there were various moves towards internationalism, within and outside science. Politically, the League of Nations was the most ambitious enterprise. Less ambitious was the International Research Council, formally constituted in Brussels on 1 January 1920, with national committees to be formed in each member country. The IRC was in one respect a continuation of wartime exclusivity, for it firmly refused to admit "the nationalities which formed the Central Powers" – a decision that distressed those nations that had remained neutral during the years of conflict.[126]

National survival during the war had made urgent short-term demands on science. In the long term, however, economic rather than military survival would demand an enlarged research base in the universities and in industry, a continued national enhancement of industrial research, and the strengthening of university programs in scientific teaching and research. These would provide the foundation for industry and the military. Mackenzie an-

ticipated that "The effect of the war upon Science should then result in industrial revolution," which would include the scientific use and conservation of hitherto squandered and pillaged natural resources. All this lay in the future. Meanwhile, Canada needed but lacked a national research institute.[127]

The RSC, The Honorary Advisory Council, and The National Research Council[128]

Governments could not but be aware of the importance of scientific and industrial research in time of war.[129] German factories had, until the war, supplied much of the world with optical instruments and dyestuffs, including the khaki dye used for British army uniforms. Germany also had a lead in the production of steel, and in some explosives. In 1915, the United Kingdom appointed a committee of the Imperial Privy Council for Scientific and Industrial Research, with an advisory committee of eight individuals to develop research for war and peace.[130] The USA had formed a National Research Council too,[131] very much along the lines discussed in the RSC and advocated by it to government.[132] The Australian government[133] had established an Advisory Council for applied science, New Zealand and India had indicated their wish to cooperate with the imperial government, and it remained for Canada to play its part. On 6 June 1915, the Dominion government established a committee of the Privy Council, with the Minister of Trade and Commerce as Chair, and also including the Ministers of the Interior, Agriculture, Mines, Inland Revenue and Labour. Under this committee, the government set up an Honorary Advisory Council for Scientific and Industrial Research, with eleven members from government, industry, engineering, and the universities. Byron Macallum was the administrative chairman, and besides him there were five FRSCs on the committee. The committee's mandate was very broad, covering almost every aspect of the organization and application of scientific research, the effectiveness of that research, the utilisation of natural resources, and ways to increase the supply of science graduates and their use by industry and government.[134]

The RSC had "memorialized" the government, advocating such a committee. The example of other nations was there for the Canadian government to see, and the rhetoric of the application of science to winning the war was everywhere accepted as truth. The governor general had presented it as at once a self-evident truth and a patriotic duty. So although the RSC's advice was taken, it was

only one factor, even though Macallum announced to the RSC that, the Society having made its recommendation, and offered its services "collectively and individually ..., it is a subject for congratulation" that the government had established the Council, with FRSCs a majority on it.[135] When initiatives advocated by the Society were adopted, it is often hard to discern whether the responsibility and credit lay principally with the Society, or with individual fellows, or with other advocates of these initiatives.

Still, the RSC had contributed to the decision to found the Honorary Advisory Council. When the Council recommended the foundation at Ottawa of a National Research Institute, with laboratories that could help industry, set up studentships and fellowships in the sciences, and awarded research grants, a major step had been taken in the development of scientific research in Canada.[136] During the war, scientists had been engaged in military research, other projects had been shelved, and there were not even enough good candidates for the few fellowships available.[137] The National Research Council would help to change that picture. The very strengths of the Council, the scale of its funding, and the nature of its publications, soon made the NRC the major player in Canada outside the universities. Those successes, and decisions taken within the RSC about its own publications and organization, led to frustrations within that body, and, for almost half a century, to a loss of purpose, partly retrieved in recent decades by a major series of initiatives.[138]

5: GROW AND DIVIDE

The RSC from the beginning was an embodiment of at least three cultures, English and French Canadian humanistic culture, including the human sciences, and the physical and "natural" (i.e. earth and life) sciences. The social sciences were not easy to pigeon-hole, and initially they did not loom large in the Society.

The division of the sciences into two sections lumped chemists, physicists, astronomers and mathematicians together. Humanists who regard the sciences as alien may not realize how unintelligible scientific specialties may be to scientists in other fields. In 1895, Bernard J. Harrington made this explicit in his presidential address to section III: "Should the mathematical members of the section not enjoy the technicalities of the subject, I must remind them that my chemical formulae are but a slight return for the mathematical hieroglyphics with which I have been tortured in years gone by."[139]

This posed not only challenge, frustration or enrichment, at the meetings, but also made for difficulties in elections, where a simple majority was required. In section III, for example, there were not enough physicists or chemists to give a majority of the votes to a candidate in physics or chemistry, so support was needed from another discipline. There were inevitably political questions about the appropriate balance within the sections, as well as about the relative merits of the candidates.[140]

As the sciences became more established in the universities, and as scientific research became stronger in Canada, there were obvious pressures to enlarge the membership from the twenty per section when the RSC was founded. Increases to twenty-five were approved, and in 1905 the number per section had increased to twenty-five, which could be increased to thirty if the section wished.[141] Three years later, section IV was recommending that its membership be increased to forty.[142] Section IV was particularly under pressure because, thanks in part to the Geological Survey of Canada, there were numerous candidates for election. Professor J. G. Adami (FRSC 1902) gave notice of motion that at the 1909 meeting he would propose that section IV be replaced by two sections, one devoted to the life sciences, the other to geology and palaeontology.[143] Then Errol Bouchette of section I (FRSC 1905) argued that Canada was getting cosmopolitan immigration, and therefore needed to know about the groups already here. This suggested to him that the RSC should establish a new section for political, social, and economic studies.[144] Neither this proposal nor Adami's was accepted. Section III objected to more sections, and instead membership was increased, so that in 1912 sections I, II, and III had an entitlement of forty members, and section IV, rather than being allowed to split, could increase to fifty.[145]

Research in physics and chemistry had intensified during the war, and, with support from the universities and the NRC, expanded after it. Mineralogy, originally lumped in as a sub-discipline of chemistry, had also expanded, with more minerals serving industrial and agricultural needs, and mining and geology developing in tandem. In 1918, mineralogy moved across into section IV of the RSC, joining geology. At the same time, what Adami had proposed a decade earlier was implemented, so that the life sciences separated from the earth sciences, and the inadequacy of the old notion of natural sciences embracing geology and biology was formally recognized in the establishment of section V. Section III, now without its mineralogists,[146] was to have forty

members, like sections I and II; section IV, for geologists and mineralogists, was reduced to twenty-five, and section V, for those in the life sciences, would have forty members.[147] Section I wanted scientific papers in French to be included in their sessions, although Council asked the Honorary Secretary to correspond with Section I about publishing such papers in the *Transactions* of the scientific sections.[148]

As the RSC completed its transformation from a society whose members had often been more distinguished for teaching or academic administration than for research, to one whose members were elected for their researches, there was increasing pressure to expand the membership of scientific sections, and to present the results of their research at increasingly crowded meetings.[149] Section III's report in 1923 explained that they had had to hold simultaneous sessions, for chemists, and for the other disciplines. How else could they get through 103 papers in a couple of days? Chemists were the biggest problem,[150] and section III wanted to solve it by having another section just for them.[151] Such pressures led to increasing numbers of scientific FRSCs, and to increasing dominance of scientists within the Society. From around 1920 to 1970, scientists constituted approximately two thirds of the total membership.[152]

The Society appointed a special committee on membership that reported in 1926.[153] They recommended the removal of all restrictions limiting the total fellowship to any prescribed number, but that each section be allowed to nominate no more than three new fellows a year. They ducked the question of "la représentation scientifique de la langue française," that section I continued to agitate.[154] Prior to 1927, there were no French-Canadian scientists in the scientific sections, so that, for example, the botanist frère Marie-Victorin[155] was elected to section I in 1924. There were institutional reasons for this. Scientific research in anglophone Canada took root in the universities from the 1890s. Corresponding developments in francophone institutions in Québec came later. The new faculty of sciences at the University of Montreal accepted its first students in 1920, and marks the real beginning of a francophone scientific movement and ethos.[156] Marie-Victorin was chosen to teach botany in that faculty. He had published some thirty articles on the flora of Quebec, and his *Croquis laurentiens* had just appeared. He had had to get special permission from his superiors to accept the post. When he took the appointment, he had no degree in science, although he soon submitted a doctoral

dissertation on the ferns of Quebec. Thus although he was a prominent botanist within Quebec, he was not at first part of the wider national and international scientific community. It was therefore natural that his election to the RSC was to Section I. Once he had gained recognition in the wider scientific community, it was equally natural that he should transfer to section V (created in 1918); he did so in 1927, the first French-Canadian scientist to do so.[157] Once a tradition of scientific research existed in francophone institutions, the science sections rather than section I became the appropriate home for francophone scientists.[158] The pathologist C. L. Pierre Masson[159] (section V, 1931), Guy Frédéric Marrian (section V, 1937), and then a steady stream of elections beginning in 1942, brought Quebec science firmly into the Royal Society of Canada.[160] The first generation of graduates of the faculty of sciences at the University of Montreal (including Léon Lortie, Jacques Rousseau, Georges Préfontaine, and Pierre Dansereau) was particularly successful in gaining election to the scientific sections. It is also worth noting that the first year in which three French-Canadian scientists were elected was also the first year in which two women scientists were elected.

Besides the problem of finding a home for French-Canadian scientists before the establishment of the necessary research institutions, there was a different kind of demarcation issue. The formal compartmentalization of the society on a disciplinary basis introduced too many barriers, so that, just as mineralogists had been allocated exclusively first to the chemists and then to geologists, so chemists and biochemists, for example, now found themselves separated into sections III and V. Hopes were expressed in 1930 that there could at least be a joint session between these groups in the following year.[161] The problem is an old one, and the tensions underlying it have led repeatedly within the Society to calls both for interdisciplinary cooperation, and for division into more focused and more isolated disciplinary enclaves. When in 1993 the Society met in Montreal to coincide with other scientific meetings, and thus chose not to meet with the other and larger range of learned societies gathered in Ottawa, it did so in response to the disciplinary thrust of the Academy of Sciences, the totality of the scientific sections.

6: THE RSC FELLOWSHIPS ENDOWED BY THE CARNEGIE CORPORATION

The conscription of scientists for war had helped to create a research base in Canada; the end of the war facilitated expansion from that base. The NRC and the universities both played a role, but there was a considerable lag between potential and achievement in Canadian scientific research. In 1928, H. M. Tory,[162] president of the NRC and also of section III of the RSC, sent the latter the text of his address to them, to be read in his absence. He sketched needs and problems in research. He began by claiming that "It is probably correct to say that seventy-five percent of the work of industrial research, apart from the inventional side, rests upon physics or chemistry." Industrial research, based upon industrial science, itself of very late development, thus required not only technical and vocational schools, but also universities, which provided training in fundamental or pure science, and in research. Canada's educational system was weakest in its postgraduate or research training. "The fact is that until very recent years the great majority of our best university graduates ... have gone abroad to get that training. Many of them have permanently remained abroad." The NRC had given research grants and scholarships, and had been using the universities to the limit of their capacities. What Tory wanted was that suggestions made by the NRC, emerging in part from work done in their own laboratories, should be implemented by the universities, to provide a research base tied to industrial needs.[163]

The Carnegie Corporation in New York had also been scrutinizing Canadian research performance and potential, and decided that it could make a difference in Canada by dipping into its envelope for the British colonies and dominions by providing research fellowships, at first limited to mathematics and science, initially ten of them for five years. Since most Canadians who had pursued scientific research careers outside Canada had gone to the USA, it may be that the Carnegie Corporation was less worried than Tory about the undocumented correlation between study abroad and permanent emigration. In any event, their fellowships were specifically for study abroad. They first approached the NRC under Tory to ask that organization to administer the program. Tory at first was inclined to accept, but then decided that that would be improper for an official body. He thereupon suggested that the Carnegie Corporation approach the RSC. The latter was not an official body, in the sense of being a government organization.

That carried financial disadvantages; the RSC has always been cash poor. But this meant that it could accept the Carnegie offer, and it did so.[164] In 1928, in addition to and prior to the commencement of its fellowship support, the Carnegie Corporation gave the RSC an endowment grant of $25,000, a very substantial boost to the Society's reserves.[165]

The fellowships were to be known as the Royal Society of Canada Fellowships, endowed by the Carnegie Corporation. After five years, the initial dedication to the sciences was to give way to an even split between the sciences and the humanities and social sciences. One each would then go to mathematics, chemistry, physics, geology, and biology. Further negotiation changed the distribution, which began with two fellowships for subjects under each section, which meant six altogether for the sciences.[166]

A cheque for ten fellowships of $1,500 each duly reached the RSC at the end of 1931, with the assurance that a similar amount would be sent in each of the next four years.[167] The RSC had not only the administration of the fund, but also a completely free hand in selecting the fellows and establishing the terms of the fellowship.

After the first five years, the RSC persuaded the Carnegie Corporation to renew the grant on an annually decreasing basis, the aim being for the RSC to raise funds elsewhere so as to continue the program. Section V in 1937 urged the Council to approach the Dominion Government for funds to make up the difference, and argued that research fellowships for young Canadian scholars were a higher priority than the general endowment fund.[168] The government, at least for a time, agreed to provide an increased grant for this purpose. The program continued into World War II.

Wartime circumstances led to the suspension of the program after 1942, and in 1943 the RSC returned a cheque for $12,000 to the Carnegie Corporation.[169]

In 1945, the RSC, not for the first time, requested an increase in its government grant, primarily to fund future fellowships.[170] Its officers explained that they wanted $5,000 for the ordinary appropriation, $17,500 for ten fellowships, and another $1,000 to administer the fellowship program. The Carnegie Corporation had been priming the pump; they had given around $140,000 in total when "the dislocation of war made it impossible to continue." Ninety Canadians had obtained a training in advanced research, most of it now proving useful to Canada:

> Of those who held Fellowships in past years, Dr. E. W. R. Steacie, Dr. George Volkoff, and Dr. P. M. Hurley did important work on the development of the atomic bomb; many others since the beginning of the war have been engaged on secret war investigations, the nature of which has not yet been revealed.
>
> This war has emphasized as never before the importance of, indeed, the absolute necessity for, a large and continuing supply of men trained for research. Such men render immense service to the nation in time of peace; in time of war their training may be vital to our continued existence as a nation. The cost of maintaining this supply is, and will always be very small, because in any one year only a few students appear ... who have both the desire and the mental equipment to carry on fundamental research with success.

There was no duplication in this program with the NRC and the universities, because the range of sciences covered by the fellowships was much wider than those covered by the NRC, and because, unlike university fellowships, the RSC awards were given for the performance of some specific piece of research.[171] It was time for the Canadian government to take over what the Carnegie Corporation had so well initiated. "We do not consider it consonant with the national dignity of Canada", the RSC advised the government, "to continue to be dependent on a foreign source for the support of a project of which Canada reaps the benefit."[172]

The argument met with some success; grants from $100 to $1,500 at a time came in from the provinces.[173] The Dominion government was less receptive. At the same time, and without being overly protective of national dignity, James Collip and Séraphin Marion approached the Carnegie Corporation again, and were informed by Whitney Sheridan that it was right and proper for the Corporation to return to the RSC the $12,000 already given to and returned by the Society. There could be no grant for an extended period, since the Corporation was taking stock of the program of its British Dominions and Colonies Fund, to decide how best to contribute in future. The combination of government grants and the returned Carnegie money made it possible to revive the fellowships for several years after the war.[174] The program had been an important one, and not only for war work. Most of the recipients did work important for Canada and for science, and most of them returned to Canada. Typical in this respect were Maxwell J. Dunbar, awarded a fellowship for work at Yale on the marine biology of the Arctic, and Louis Siminovitch, awarded a fellowship for work at Harvard on applications of physical chemi-

cal principles and methods in organic chemistry.[175] The Carnegie Corporation's philanthropy, the RSC's selection of fellows, and the government's temporary support, made a powerful national case for the support of research.

7: BETWEEN THE WARS: RESEARCH AND PUBLICATION

We have seen that publication of research findings was from the beginning part of the RSC's mandate. As research began to flourish in Canadian universities, and in such government projects as the experimental farms, so the Society grew, and was able to publish a selection of the papers presented at the annual meeting. Publication was an essential part of the promotion of research. Less essential, but important for the recognition that it gave to science and to Canadian scientists, was the award of medals for distinguished research.

Medals

The Society's earliest medal was the Flavelle Medal, endowed in 1924 by a gift from the meat packer, financier and philanthropist Sir Joseph Flavelle (1858–1939). In its early years, it was awarded for distinction in any branch of science. It was first awarded to Charles Edward Saunders in 1925 for his work on cereal breeding. John McLennan won it in 1926 for work in physics, Frederick Banting in 1931 for work on insulin, Lash Miller in 1938 for chemistry.

Then in 1941 two more medals were established, the Willet G. Miller Medal offered every two years in geology, palaeontology and mineralogy, and the Henry Marshall Tory Medal in physics, chemistry, mathematics, astronomy "or allied sciences." Miller (1867–1925) had been a mining geologist and provincial geologist for Ontario, a guiding force for the mining industry in the province. Tory (1864–1947), whom we shall encounter repeatedly in the RSC's history, regarded the creation of the National Research Council's laboratories as his principal achievement; he established the medal himself, and left the Society an endowment for it. Norman Levi Bowen won the first Miller Medal in 1943 for his work in petrology and mineralogy. Other recipients included Tuzo Wilson (1955) and William Fyfe (1985). The first Tory Medal went to John Lighton Synge for work in applied mathematics and mathematical physics. Subsequent recipients included Gerhard Herzberg (1953) and John Polanyi (1977), both later to be Nobel laureates.

With the Miller Medal in the earth sciences, and the Tory Medal in the mathematical and physical sciences, the Flavelle Medal became the Society's award in the biological and medical sciences. Then came the Eadie Medal[176] for applied science, including medicine (1975) – thus, for example, Bernard Etkin won it in 1980 for contributions to engineering, and Bernard Cinader in 1982 for medical research. Subsequent awards were the Jason A. Hannah Medal for the history of medicine (1976); and the McLaughlin Medal (1978) for medical science. Thus medical science now has more awards than any other discipline in the Society.

In 1980, the Society established the Rutherford Memorial Medal, named for Ernest Rutherford, and replacing the Rutherford Memorial Scholarship founded in 1952. There is one Rutherford Medal for chemistry, and one for physics. Still more recent is the Sir John William Dawson Medal, established in 1985 for "important and sustained contributions by one individual in at least two different domains." Three of the first four recipients had done significant work in the natural sciences. The most recently established of the Society's medals is the McNeil Medal[177] for the Public Awareness of Science (1991), awarded for outstanding contributions to the promotion and communication of science to students and the public.

Publication

Distinction in science is inseparable from publication. Not every paper given at the annual meeting or otherwise submitted to the RSC could be published in the Society's *Transactions*. The size of the governmental grant placed severe limits on the selection. Increased regard for scientific research during World War I had resulted in an increased grant, reduced once more in 1919. Publication of the *Proceedings and Transactions* for that year was made possible only because of a special grant of $3,000 from the Advisory Council for Scientific Research. Even then, the problem of speed of publication remained. The best that the RSC had managed was quarterly publication for a while, but that had not lasted. Annual publication in fast-moving fields of science was simply too slow, especially when many scientific journals appeared monthly, and were available to private subscribers around the world. An added complication was that the sciences were becoming increasingly specialized, so that the sheer range of a volume of the *Transactions* would make most of it of no interest to other scientists. Complaints to this effect were balanced by complaints about the dearth of specialist societies that

might undertake publications by discipline. "The Canadian research worker is usually in touch with such societies in the US, Britain or Germany and too often his work is published abroad. There is a marked unwillingness to form small national scientific societies in special fields with struggling attempts to maintain journals which would be, for some time at least, quite limited in circulation."[178]

For better or worse, the *Transactions of the RSC* were all that was available in Canada for most areas of science. A letter to the Minister of Finance, pointing out that Canadians would otherwise be forced to publish abroad, resulted in a partial restoration of the grant to $8,000.[179] This did not address some of the underlying problems. One journal could not hope to publish all significant original scientific research performed in Canada, and the complaint that many Canadians had to publish in foreign journals remained a frequent one.[180] By the mid-1920s, even the RSC's General Editorial Committee was wondering whether help from the NRC and, to a lesser extent, from the universities, would offer more than a short-term band-aid for the scientific part of the *Transactions*.[181] By this time, members of the NRC had come to recognize that modifying the RSC's journal would not be enough. Tory in particular had come to realize that grants to the RSC, whether from government, universities, or the NRC, would not offer any long-term solution. In 1925, he wrote to Walter Murray, president of the University of Saskatchewan and member of the NRC, to tell him that

> I am not personally in favour of tying up the university to anything in the way of permanent assistance to the Royal Society of Canada and in this I am sure I am in agreement with most of the younger scientific men of the country. I have been hoping that we could get far enough forward with the research organization in Canada that a nucleus of publication work could be begun. We shall never get recognition scientifically until we have some scientific journals of our own.[182]

The NRC and the universities did give grants to the RSC for publication, but even within the Society there was a sense of frustration about its scientific publications. Were these grants a real solution, or did they offer merely temporary relief?[183] There was another problem, illustrated by F. M. G. Johnson's remark in 1932 that the RSC's publications did not give "a fair picture of chemical

research in Canada, since probably the more important papers are published elsewhere."[184]

Various disciplines within the RSC began to agitate for specialist journals of their own. The botanists, for example, felt that it was time for their own journal, and in 1926, Section V appointed a committee to look into ways and means.[185] What turned out to be the most fruitful initiative came from the NRC, when, following the 1926 meeting of the RSC, a committee consisting mainly of physicists was established to make plans for a new journal for the publication of Canadian scientific research. The members were Augustin Frigon of the École Polytechnique in Montreal, together with five members of Section III of the RSC, Robert William Boyle, Arthur Stewart Eve, George H. Henderson, John Patterson, and Henry Marshall Tory, head of the NRC.[186] The *Canadian Journal of Research* was the result of their work; its first issue appeared in 1929. Contributions came mostly from chemists, physicists, and biologists. Meanwhile, financial constraints had reduced the print run of the RSC's *Transactions*. The *Canadian Journal of Research* soon had a wider distribution than the RSC's journals, and, at least for physicists, largely replaced the *Transactions* as the organ for Canadian publication. As Gingras has observed, however, the proportion of physics papers published in Canada was scarcely affected. A majority of physicists from McGill and Toronto continue to publish abroad.[187]

The *CJR* was narrower than the *Transactions* of the RSC, but it still embraced a wide range of sciences, and so could not establish itself as *the* journal for separate disciplines. The RSC still served as the organization best representing Canadian science. So it was that the NRC decided in 1938 to approach the RSC to urge closer cooperation between the two organizations in the publication of scientific papers.[188] By 1940, the RSC leant towards combining its own *Transactions* and the *CJR*,[189] but a year later had reversed its stance. The proposal then became that the *Transactions* would continue to publish appropriate papers in the disciplines falling under sections I, II, and IV, whereas papers under sections III and V would be passed to the NRC. A joint editorial board should be set up with the NRC for the *CJR*, with three chemists, three physicists, three botanists, and three zoologists.[190] The *Transactions* for sections III and V were slimmed down, and a joint editorial committee was appointed in 1942. Members of the committee were appointed by the RSC and the NRC, and there was also an editor-in-chief named by the NRC.[191] The stipulated disciplinary representation

on the board led to independence among the sections of the *CJR*, which from 1944 were published separately.

The year 1944 also saw the union of Canada's several chemical organizations into the Chemical Institute of Canada. The stress upon research directed to the purposes of war, and the special role of chemists in that endeavour,[192] accelerated and directed the professional organization of their science. They promptly asked for representation on the editorial board of the *CJR*, and were allowed to nominate one member. This disciplinary thrust continued, and not only for chemistry. In 1951, the *CJR* was replaced by six disciplinary journals, including the *Canadian Journal of Chemistry*.[193] In physics, chemistry, and biology, the RSC surrendered control of disciplinary publication.

Between the wars, however, the RSC in its *Transactions* published some of the most important work to come out of Canada, including much of the key work of John Cunningham McLennan on a wide range of topics in physics. McLennan was the most productive physicist in Canada throughout the 1920s. Gingras has noted that he supervised twenty-five of the twenty-seven doctoral students in physics between 1918 and 1932, obtained half of all the bursaries granted by the NRC in those years, and, with his students, wrote so many papers published in the RSC's *Transactions*, mainly on spectroscopy and low temperature physics, that Ernest Rutherford in England was moved to observe that "You must cost a lot of printing to your Society."[194]

The RSC published many of the key papers that Banting, Best, Collip, and MacLeod wrote on insulin, papers that helped to establish biochemistry's independence from physiology and chemistry.[195] Of course these scientists did not publish exclusively with the RSC. A fair number of Banting and Best's papers in 1922 appeared in the *American Journal of Physiology*, but the RSC published the majority of these crucial early papers. In 1931 Banting received the Society's Flavelle Medal for his work: "No other discovery in medical science during the last century has been as far-reaching in its benefits to mankind as insulin."[196] In 1938 the Society once again argued to the Minister of Finance that it needed an increased grant, primarily to assist in publishing scientific findings; it prominently advanced Banting's work on insulin as supporting evidence.[197] The RSC also published some early work on vitamins, for example some of A. T. Cameron's work on vitamin-deficient diets.[198]

Even more prominent in the RSC's case was geological work. For example G. S. Hume and F. H. McLearn's work on the fossil-bearing rocks of Alberta had yielded crucial information for those drilling for oil.[199] Joseph Burr Tyrrell in 1926 published results from his study of the Kirkland Lake fault, and of the relation of the fault to the occurrence of ores.[200] Shortly thereafter, E. W. Todd showed that ores existed only where the fault intersected certain types of rock.[201] These researches, the RSC told the Minister of Finance, led directly to the establishment of the Macassa gold mine.[202] William Logan had assured a parliamentary committee in the 1850s that science led to economics, and the RSC was eager to maintain that argument.

Scientific research depended for its utility on effective dissemination. In 1929, the volume of *Proceedings* and *Transactions* was over 1,500 pages; by 1939, it was down to 800 pages, largely because of lack of funds. The government had not responded generously in 1938, so the RSC repeated the argument loud and clear in 1939: "The work of scientists in Sections III, IV, and V ... is enormous and has resulted in public utility and wealth for Canada." One had only to look at the work of Banting on insulin, Charles Saunders on Marquis wheat, or Rutherford on radioactive disintegration. Less dramatic but still important was the work of Archibald Gowanlock Huntsman on marine boring organisms, which "has saved large sums of money to the country in the construction of docks and piers." Geologists "in the discovery and exploitation of our gold, copper, and oil fields have added largely to our mineral wealth. The support given to the Royal Society by the Government of Canada has thus been an excellent investment yielding rich returns, but such returns can be increased by more substantial grants permitting a wider field of publication."[203] The financial argument for the support of scientific publication was generally an effective one; but before government responded, Canada was once again at war. The case for the support of science in time of war had been decisively made in World War I. It was to be made even more strongly in World War II. The secrecy of military science was, however, scarcely conducive to increased publication.

8: THE RSC AND THE SECOND WORLD WAR

World War I had seen the development of industrial, applied, and even pure research as instruments of national and imperial policy.

The RSC had urged on the government the development of advisory and research institutions that would contribute to the war effort, and ensure competitive prosperity for the nation in the subsequent peace. The birth of the National Research Council, the expansion of university research, and the development of government physics laboratories, were all consequences of this new valuation of science. They were all in place when first European and then world war broke out again.

Fellows of the RSC were again engaged in science for war.[204] Their work ranged from public health and preserving food,[205] through to germ warfare and the atomic bomb. Geologists too had a role, for the mineral resources of the nation were crucial for the allies, as they had been in 1914–18.[206] As one indication of the involvement of scientists in the war effort, consider the 1945 award of the Society's Tory Medal to Otto Maass (FRSC 1922), MacDonald Professor of Physical Chemistry at McGill University, General Director of the Pulp and Paper Research Institute of Canada, Assistant to the President of the NRC, and Director of Chemical Warfare and Smoke of the Department of National Defence. The citation for the medal noted that

> From the outbreak of war, he has played the leading role in placing chemical research in Canada at the disposal of the government. After his visit to England in 1940, he initiated the programme of research in high explosives which has had spectacular success. He was the driving force behind the development of the Chemical Warfare organization in the Department of National Defence; and he played a major role in the establishment of its tremendous experimental station at Suffield.[207]

Guilford Bevil Reed, a bacteriologist, was engaged in secret war work,[208] as well as on less secret work on the chemotherapy of gas gangrene,[209] and was awarded the Flavelle Medal in 1947.[210] E. W. R. Steacie, George Volkoff, and P. M. Hurley did important work on the development of the atomic bomb.[211] All in all, as Harold Caswell Cooke (FRSC 1923) noted, the war had "emphasized as never before the importance of, indeed, the absolute necessity for, a large and continuing supply of men trained for research. Such men render immense service to the nation in time of peace; in time of war their training may be vital to our continued existence as a nation."[212]

Whereas the NRC had engaged as an organization in war work,[213] the RSC's participation was through the services of in-

dividuals, a circumstance vaguely troubling to the physicist J. K. Robertson, President of the RSC in 1945. "I sometimes wonder," he remarked, "if as a Society we play as important a part as an organization such as ours should play in the life of the Dominion."[214]

9: REORGANIZATION?

One daunting model of an organization that did play a major role in national life was the Royal Society of London. That body at the end of the war set about organizing an Empire Scientific Conference for 1946, to advance research throughout the Empire, and to help science to take the leading role in peace that it had during the war. There were over 110 delegates, roughly one-third of them from the United Kingdom. The Canadian delegation, led by the NRC's C. J. Mackenzie, included eleven FRSCs, among whom were Otto Maass, Charles Best, and J. B. Collip. Canada stacked up pretty well against other parts of the Empire, and Sir Thomas Holland noted that when it came to mineral resources, Canada had the best evidence. The war had indeed encouraged the nations within the Empire to explore their resources and to see how they complemented one another. Perhaps the main impression left on the delegates from the RSC was the wealth and influence of the Royal Society of London compared with their own Society. The Canadian delegates talked about the RSC's relative weakness, and, not for the first time, they wondered if one problem might not lie in the union in one Society of scientists and humanists. One of these groups would, like the Royal Society of London, concern itself only with science, the other would deal with "arts and letters".[215] The idea that the mere avoidance of working with humanists could resolve a crisis of morale and confidence amounting to cultural cringe was itself symptomatic of the RSC's problems. Finding a post-war mission was clearly imperative, and would increasingly engage the Society's energies.

Discontent was loudest among the scientists. In 1949, Section III reported to Council that, "insofar as the Physical Sciences are concerned, the Royal Society of Canada is not of great value. We suspect that this is true of other sciences as well." Was the Society useful? Should it be reorganized? Steacie and other physical scientists identified several defects: the divergence of interest between the sciences and the humanities; neither momentum nor continuity in policy and action, because the President and other officers had too short a term to achieve anything; a lack of activity

between the annual meetings; and a lack of correlation between the number of members in a section, and the number of practitioners in the relevant disciplines. Section III proposed, among other things, that there be two essentially independent branches, for the sciences and the humanities respectively, each with their own president for a term of five years, and with no joint president (or else a purely nominal or formal one). Longer terms for the officers would give them a chance to achieve something.[216]

The union within the RSC of the scientific sections with the humanities and social sciences has generally been more popular with the latter sections, and the Society has repeatedly debated the issue, each time leaving its pluridisciplinary character fundamentally unchanged. Longer terms for the officers were to be beneficial for the continuity that makes effective action possible. The Society's difficulties were, however, not primarily structural, and stemmed from a lack of clear purpose, a lack felt most strongly in the scientific sections as professional and specialist organizations took over more and more the responsibility for publication, while governmental agencies, including research councils and laboratories, became the effective organs for official science policy.

The RSC awarded medals, more a recognition than an encouragement of research, sometimes, like the Nobel prizes, coming many years after the work for which they were given. Charles Best got his RSC medal almost 30 years after his work on insulin. Huntsman likewise received his medal late in the day. The RSC also awarded scholarships and fellowships, some in science, and the Carnegie program had been genuinely valuable for Canadian science. Again, the RSC, at the request of the Royal Society of London, had solicited funds in Canada for the Lord Rutherford Memorial Fund, a source of fellowships open to citizens of the Commonwealth.[217] Two such fellowships were awarded in Canada in ensuing years, after the RSC and NRC had consulted about the candidates, for example in 1953 for research at the Cavendish laboratory in Cambridge.[218] This was a very small number compared with the NRC fellowship program. The RSC in the immediate post-war decades was, at least for the sciences, largely drifting, an elite honorific society, but one of little practical import for the development of the sciences in Canada. The RSC's problems, however, although unique in Canada, were not unique internationally, and some of them were unavoidable. In his Presidential Address to the Society in 1955, Edgar William Richard Steacie spoke of the problems of "Science and the National Academy."[219] The recogni-

tion by governments of the importance of science meant that "more and more scientists are employed by governments. As a result the national academies have to a considerable extent lost their position as authoritative government advisory bodies. ... It seems to me that no national academy which maintains its independence can regard itself as a government advisor by divine right." Steacie, however, drew a distinction between power and influence; the power of academies of science had diminished, but this did not necessitate any decrease in their influence. Here he contrasted the recent histories of the Royal Society of Canada and the Royal Society of London. The latter had lost power, but not influence, because it was "a working society. ... It has concentrated on doing a job, ... [and] it has shown an ability to move with the times by, for example, recognizing the need for having leading industrial scientists among its members."[220]

One area where the Royal Society of Canada set about doing a job in the post-war years was oceanography. It did so by founding the Canadian Committee on Oceanography, a body that was soon active in developing its field through symposia, publication, and lobbying.

10: THE CANADIAN COMMITTEE ON OCEANOGRAPHY

In 1948, oceanography had been carried on for some thirty years under the auspices of the Fisheries Research Board. During the recent war, the results of that work had been important for national defence, and after the war defence research laboratories remained interested in physical oceanography, for example in acoustics and wave forecasting. A committee of the NRC and the Fisheries Research Board was revived after the war as the National Committee on Oceanography under the joint auspices of the NRC, the Royal Canadian Navy, and the Fisheries Research Board. The RSC recommended "that there be established in Canada an Institute of Oceanography,"[221] and sent copies of its resolution to the organizations involved in the National Committee, and to the Universities. The recommendation gave expression to a widely shared conviction.[222] In the late 1940s and the 1950s the University of British Columbia, Dalhousie, and McGill all embarked on graduate research and teaching in oceanography. Canada's principal oceanographic institute, the Bedford Institute of Oceanography, was founded in 1962.

In February 1949 Canadian delegates from the RSC and the NRC participated in a meeting of the Pacific Science Association in New Zealand, where oceanographic issues were prominent.[223] Soon thereafter, the RSC authorized A. G. Huntsman to arrange a symposium as part of the campaign for the proposed Institute of Oceanography. The symposium included contributions by the meteorologist Andrew Thomson, the geophysicist Tuzo Wilson, the economist D. C. MacGregor, and the fishery biologist Wilfred Templeton. Huntsman introduced the proceedings with the statement that "Canada has more oceans than any other country. ... So important are oceans for Canada! Yet so imperfectly are they known that within the year an island reputedly larger than Prince Edward Island has been discovered in our private ocean."[224]

One year later, with no Canadian oceanographic institute yet in sight, the RSC's council gave their "hearty approval" to a proposal by the parasitologist Thomas Wright Moir Cameron that the Society create a standing committee on oceanography. Huntsman, here representing the Fisheries Research Board as well as the RSC, agreed to chair the committee, which was established on 28 March 1950.[225] The other members of the committee were W. A. Clemens of the University of British Columbia, G. S. Field of the Defence Research Board, H. B. Hachey, Chief Oceanographer of the Joint [National] Oceanographic Committee based at St. Andrews, New Brunswick, J. B. Tulley of the Pacific Biological Station at Nanaimo, B. C., J. Tuzo Wilson of the University of Toronto, and W. Templeman, Director of the Newfoundland Biological Station at St. John's.[226] It was a high-powered group, which at its first meeting at the Royal Military College in Kingston that June considered how to connect its activities to those of the NRC (they proposed to act for the NRC's Council on Geodesy and Geophysics), and then set about gathering a profile of the state of knowledge about Canada's oceans, so as to determine what most needed doing.[227] A year later, at their meeting of 5 June, the Committee had undergone some changes (F. Kenneth Hare joined it), had decided that it needed to determine the availability of maps, and their adequacy for the different fields involved. Over the decade, they gathered information, and held symposia, the last of which was to be held in 1958, addressing the role of the environment in producing life, or how oceans make fisheries. Their years of effort underlined the fragmentary and incomplete nature of oceanographic knowledge:

> We still lack a basic attack on the general problem that the oceans present as forming the intermediate and life-creating layer of the earth, and as having reciprocal effects in their relations with the lithosphere below and with the atmosphere above. The Society could take the lead in integrating the various earth sciences by having them adequately represented in one of its Sections, so that lithosphere, hydrosphere and atmosphere ... could be considered together.[228]

The importance of the topic, and the potential offered through the RSC for cooperation between different disciplines, led the Society to reinstate the Committee in 1959. In February of that year, Max Dunbar wrote to Pierre Daviault, President of the RSC, urging the Society's involvement in a plan originating with Dr. L. A. Walford of the United States Fish and Wildlife Service, to compile an atlas of "the distribution of environmental parameters and of as many living organisms as possible in the North Atlantic."[229] Dunbar expanded on his proposal in a letter to Hachey at St. Andrew's, stressed the need for Canadian-US cooperation in what had to be a joint venture, and went on to discuss the problem of preparing base maps of the North Atlantic from Equator to Pole.[230] Hachey's response was to underline the mismatch between resources and needs:

> To my mind, your project is fundamental to fisheries research and falls within the responsibilities of the Fisheries Research Board. ... The project ... involves physical and chemical oceanographers, and is put forward as another project that requires immediate and continued attention. The Joint Committee on Oceanography has recently given very serious attention to the situation in Canada, where national requirements in oceanography far exceed the personnel and facilities to carry them out. As a result, developments are in the offing, involving the NRC, as well as other government departments subscribing to [the Joint Committee on Oceanography], which will in time improve the situation. In the meantime, the oceanographic groups operated under [the Fisheries Research Board] are unable to meet the present demands placed upon them, I would assume that your proposed project will mean further demands in one form or another.[231]

The work of the Fisheries Research Board in relation to oceanography was fundamental to its mandate, but it was clearly overburdened. N. H. Grace, President of Section V of the RSC, had been in touch with Gordon Hodgson of the Alberta Research Council, and

suggested that the petroleum industry might find it useful to support Dunbar's initiative.[232] Ultimately, there was to be a convergence of the interests of oceanographers and those of the oil companies, especially in the Beaufort Sea. But although the RSC through its symposia could draw attention to scientific issues and to the utility of a multidisciplinary approach, it lacked the resources to transform initiatives like Dunbar's into programs of research. That was left for governmental agencies, universities, and, where it impinged on their potential profits, oil companies and other large-scale commercial enterprises. When the RSC underwent a reorganization into three sections or academies, with all the sciences in Section III, there seemed to be no clear role for a separate Committee on Oceanography, which was accordingly disbanded.[233] An interdisciplinary division was created within section III, a successor and in part an outgrowth of the former interdisciplinary Committee on Oceanography. In 1967 there were thirty-two fellows in the interdisciplinary division, seven of them in oceanography.[234] Dunbar's proposal of 1959 was not acted on, but its spirit resurfaced in 1981, at a seminar held in Washington, DC, on Non-governmental Hemispheric Cooperation in Science and Technology. The participating organizations were the Mexican Academy of Scientific Research, the US National Academy of Science, and the RSC. There was a proposal for cooperation in oceanography, but no vote, and thus no resolution.[235]

11: A POLICY FOR SCIENCE: A ROLE FOR THE RSC?

Academies?

In 1960, the Society determined that the three science sections should merge into one. Gilbert de B. Robinson explained that "the arbitrary restrictions imposed on the various scientific disciplines" were no longer realistic – where, for example, could one fit biophysics or geophysics?[236] More than ever, he claimed, "it is necessary that some body be able to speak with authority for science as a whole." The explosive growth of specialized scientific societies reinforced that need.[237] The decision to merge the three sections was not taken without arousing some opposition, notably in the old section IV.[238] Still, the move was made, and Robinson's notion that Section III might with a unified voice "speak for science as a whole" was part and parcel of the RSC's wish to act and to be seen as the national Academy. In 1964, the Council appointed a President's Committee to study the role of the Society as

an Academy.[239] The Society's mills ground slowly. Nine years later, at the meeting of the Conference of Learned Societies in Kingston, John Herbert Chapman, President of the science section of the RSC, expressed the willingness of the Society "to serve Canada more actively as an academy."[240] Section III wanted to modify its name to the "Science Academy," a decision opposed by Section II, whose Council argued that such a move would undermine the effectiveness of the Society as an integrated organization.[241] None the less, the changes eventually happened, and sections I and II were also reborn as Academies I and II. In 1982, the Development Committee of the RSC, drawing in part on Larkin Kerwin's paper of 1976–77 on the need for a national academy and on its role, presented a report to Council. They recommended that the government be asked to confirm the Society as the National Academy, and that the three constitutive Academies (the old three sections) act as National Academies in their fields.[242]

This was not merely a matter of appearance, or even of authority. It was also a matter of action and function. Nowhere was this more apparent than in the area of science policy, where the RSC increasingly wanted a responsible role. It has often been argued that Canadian science policy was an outgrowth of the wars, with the National Research Council as one of the first fruits of the interplay of science and government in peacetime. The dependence of the state upon science was even more vigorously underlined during the war of 1939–45 than it had been in 1914–18, and was a commonplace in the postwar years. It crystallized in the 1960s, when the term *science policy* entered public debate.[243]

In 1962–63 the report of the Glassco Commission was released, strongly critical of the lack of direction of the post-war expansion of science. This led to proposals that the government of Canada should set up an Advisory Science Council without executive functions, to be helped in formulating its advice by a fact-finding Secretariat. The Secretariat was established in the Privy Council office in 1964, but the establishment of the Science Council had to wait until 1966. Meanwhile, the RSC argued that its science section, pending the creation of the Science Council, "should offer its advisory services in matters affecting the official science policies of the Canadian Government, and in the appointment of senior scientific administrators."[244] The offer was not accepted.[245] The RSC had lobbied for the establishment of the Science Council.[246] That establishment was followed by a series of reports, of which the

fourth, published in 1968, was *Towards a National Science Policy in Canada.*

The Society took its own steps to address the need for a national science policy, in a symposium in 1964 on the organization and support of basic scientific research in Canada.[247] H. E. Duckworth, as chairman of the symposium, stressed the need to support science and scientists: "The alternative to retaining [young scientists] is to revert to the status of a sort of scientific crown colony."[248] An important theme of the symposium was the question of a partnership in science between government, industry, and the universities.[249] The issues were unavoidable, and Léo Marion, in his presidential address to the RSC in 1965, stated in exasperation that "an over-all policy on science has become a necessary evil."[250] John Spinks had been more diplomatic during the 1964 symposium. Canada, he explained, was, like other countries, not yet in possession of "an entirely satisfactory solution to the difficult problem of the relation of science to government. This is not surprising, since the entire question of science policy in the context of government is new."[251] As always, in addressing new questions, the first stage was the collection of data; in 1965, Gilbert Robinson agreed to chair a standing committee of section III of the RSC, to survey the status of science in Canada.[252]

Lamontagne

In 1967, the government appointed the Senate Special Committee on Science Policy, known after its chairman as the Lamontagne Committee. The Royal Society saw this as both opportunity and challenge. If it could persuade the Committee to adopt its views about the support and role of science and technology in Canada, it could contribute both to national advancement, and to its own desired stature as a truly national academy. In 1968 section III set up its own committee on science policy, with the aim of advising on a brief to the Lamontagne Committee.[253]

Besides collecting data, the task of Robinson's committee on the status of science in Canada, the RSC undertook one other preliminary survey before preparing its brief to the Lamontagne Committee. It sent out a questionnaire to the fellows of section III. The results, ranking in order those topics that fellows wished to include in their brief, were: (1) national objectives of research; (2) the relative importance of fundamental and applied research; (3) the funding of research; (4) the role of the RSC; (5) research in relation to natural resources; (6) the roles of government, industry, and the

universities; (7) research funds as a percentage of gross national product; (8) environmental pollution; (9) the national management of research; (10) the availability of qualified scientists; (11) science education; (12) the roles of the Science Council and the Science Secretariat.[254]

It is striking that education (including what was to become a major concern of the RSC, the development of public awareness of science) ranks so low on the list. Also lacking was any serious discussion of technological innovation, relations between science and technology (except with reference to industry), and the role and status of engineers. Since engineering had not been granted the same status within the Society as the traditional sciences, it is not surprising that technological issues did not loom large in the Society's deliberations, although they were addressed in the RSC's symposium on research in Canada, held during the 1968 meeting in Calgary. Omond Solandt, FRSC and Chairman of the Science Council, took the broadest view on that occasion, urging the need for encouraging industrial research and development, and of encouraging scientists to take cognizance of social and economic problems.[255] Whereas the Science Council, while recognizing the importance of pure, fundamental, or curiosity-oriented research, urged that research be encouraged and directed towards specific nationally significant goals, there were many in the RSC who argued against such direction;[256] it seems likely that the high ranking of the issue of the relative ranking of fundamental and applied research reflects both debate and defensiveness. In March 1969, C. W. Carter, a member of the Lamontagne Committee, wrote to Léon Lortie, President of the RSC, arguing that evidence already presented to the committee made it clear that Canada could not explore every research avenue, and that "our Science Policy should be output-oriented towards specified objectives of special interest to Canada." Without such direction, Canadian science would be aimless: "If Canada has a Scientific Policy at the present time, it has been acquired largely by accident."[257] Since there was now to be a national science policy, the RSC was naturally concerned about its own role in the formulation of that policy, and that perhaps explains the low ranking of the Science Council and the Science Secretariat on the list. The NRC was a different matter, and although it did not feature in the headings for the first dozen topics on the RSC list, its very existence, and its potential rivalry with the RSC, helped to frame the latter's agenda. Solandt had urged a reduction of the barriers between the social and the natural scien-

ces; section III of the RSC seemed at first largely innocent of the former, although H. R. Wynne-Edwards, reviewing the current status of science policy in Canada before section III in 1969, with reference to the Lamontagne Committee and to the Science Council, correctly observed that "Science policy as now proposed emerges as an arm of economic policy, and the programs proposed in Report No. 4 of the Science Council are social and economic, with social and economic goals."[258] In that case, there would be a substantial role for the Letters and Human Science Section (section II) of the RSC, as that section indicated in a memorandum submitted to the Lamontagne Committee.[259] Finally, in considering the list of priorities in section III's survey, we should note that implicit in its concern about the role of the Society was the issue of representation – who should speak for science? – ; and the nature of Canadian participation in international scientific endeavours and organizations. Here was a potential source of conflict with the NRC.

Section III of the RSC prepared a draft of its brief to the Lamontagne Committee in the fall of 1968, and submitted it in 1969. The RSC stressed the need for first-class research training and employment opportunities within Canada, and the importance of industrial research and technological development to ensure the proper utilization of natural resources. It argued for the fundamental unity of basic research, applied research, and technological development (a unity not apparent in its own organization), and accepted the need for supporting targeted research. The RSC could act as Canada's intellectual monitor of progress in science and the arts. The Science Council, meanwhile, should be strengthened: "We consider that as a public body, it is a better advisor to the Prime Minister than any office with similar function within the government."[260]

It was far from clear that the Lamontagne Committee would share that view of the Science Council. The senators on the Lamontagne Committee had asked the Canadian scientific community "Who speaks for science?", and the Chemical Institute of Canada, the Canadian Association of Physicists, and the Engineering Institute of Canada sponsored a conference in Ottawa that summer. C. E. Dolman, President of the RSC, attended the meeting with R. E. Folinsbee, President of Section III and chairman of that section's standing committee on science policy. It became apparent that the senators considered that the Science Secretariat and Science Council were "creatures of government, as well as its expert advisers. It

was rather shocking to hear the Science Council placed in this category, since the Royal Society had strongly advocated its formation as the voice of science for the country at large, standing independently of any political or commercial pressures. Lamontagne ... plainly felt there should be a separate department of science in the government."[261] It also became clear during the meeting that Lamontagne was not convinced that the RSC was either willing or able to serve as the intermediary between science and government, and there was besides a widespread sentiment at the conference that the RSC was insufficiently representative to act in such a manner. Even some among the fellowship of the RSC, for example Louis Siminovich, had little time for the RSC here.[262]

Although it began to seem unlikely that the RSC would win acceptance as the representative of Canadian science in its dealings with government, there seemed a good chance that the Society might come to represent Canadian science internationally. J. M. Harrison, in an address to the RSC on "The Royal Society of Canada and Research," suggested in 1968 that the Society could, with appropriate government support, undertake "the role of an academy in international organizations of a non-governmental nature regardless of their discipline."[263] This was a goal that the RSC pursued with considerable energy. In 1970, Dolman wrote to W. G. Schneider, president of the NRC, that the RSC was "extremely anxious to establish a more clearly defined and honoured role for the Society in national and international affairs."[264] In 1973, the Lamontagne Committee recommended that the RSC, with the assistance of a special grant from the newly established Ministry of State for Science and Technology, should assume "the overall responsibility for developing and maintaining relations with foreign private scientific and engineering bodies, in close cooperation with the International Branch of the Ministry and the specialized scientific and engineering associations existing in Canada." There was, however, the criticism that the RSC lacked "the confidence of the scientific community."[265] Assuming responsibility for Canadian relations with foreign and international non-governmental scientific and engineering bodies meant taking over that responsibility from the National Research Council, which *did* enjoy the confidence of the scientific community, and the RSC set about the sensitive business of building the confidence needed if it was to take over the field of non-governmental international representation.

What About the Engineers?

The lack of engineering representation within the RSC was a major hurdle. A move to elect applied scientists (including some engineers, although mostly academic ones) found expression in the By-laws in 1970, when a quota of not fewer than three from those disciplines was superimposed on the normal number.[266] In 1974, an RSC proposal began by stating the need for a non-governmental organization to represent Canadian science internationally, because that was the way it was done in most other developed countries. The RSC, joining forces with the Canadian Council of Professional Engineers and the Engineering Institute of Canada "offer, as joint venturers, to carry out by contract the non-governmental activities now coordinated by the National Research Council's Office of International Relations." The RSC proposal was for a trial period of two or three years.[267] It was also written in such a way as to emphasize the role that individual societies would still play, so as to minimize the opposition: "the Royal Society of Canada would offer its services, as a catalyst, rather than usurp the place of the specialized societies to represent their membership."[268] The RSC's Committee on International Relations reached agreement with "a majority of Canadian scientific societies" about representing them.[269] How to accommodate the engineers remained a key problem.[270] In January 1976, W. G. Schneider, President of the NRC, wrote to W. Bennett Lewis, President of the RSC's Academy of Science, listing the international organizations in which Canada had an interest, and in which engineering and the applied sciences were central. From the NRC's point of view, "if the non-governmental international science activities can be contracted out, it would be preferable to have one body that could effectively manage the whole package," thus avoiding a split between basic and applied science. Indeed, the NRC would only contract out its international responsibilities if the engineering affiliations were included.[271]

Claude Fortier, Vice-Chairman of the Science Council, pointed out a different aspect of the same problem in 1976. The RSC could be seen as a federation of three national academies,[272] and so had "all the makings for serving the role which we expect from national academies in providing a pool of expertise which no advanced country can afford to be without." That didn't mean that it could speak with a single voice for science, since scientists were individualists, and "the various components of the scientific and technological community are so very diverse." Senator Grosart

commented in exasperation that "if the scientists do not find one voice no one is going to listen to them."[273]

The search for unity was a slow and ultimately a frustrating one. In October 1977, the RSC, the Engineering Institute of Canada, and the Canadian Council of Professional Engineers met. As the RSC saw it, they agreed to work together, and, effectively giving substance to the RSC's proposal of 1974, also agreed to approach the NRC in a joint venture to negotiate a contract for international representation.[274] The engineers' perception of their agreement was not as enthusiastic as the RSC had hoped. In May, L. M. Nadeau, General Manager of the Canadian Council of Professional Engineers, wrote to B. A. Gingras, vice-president of the NRC, to say that his organization was entirely happy with the NRC as its representative in non-governmental affairs. If the NRC wanted to contract out this field to a private organization, the Professional Engineers would endorse the recent RSC proposal, but "to the engineering community, however, this alternative would definitely be a second choice."[275] The NRC carried out a survey of national scientific and engineering societies, and the result of that survey, completed in the late fall of 1979, made it clear that there was general satisfaction with the NRC as international representative. The NRC therefore decided to continue its role as Canadian representative to international scientific and engineering non-governmental organizations.

The loss of an international contract was a set-back for the RSC, but scarcely an unpredictable one. The role of applied science had always been clearly perceived within the Society, but in practice the RSC distinguished between applied science and engineering. It did so in a fashion increasingly at odds with the profile of research in Canada. In 1965, Section III appointed a committee to investigate "the Adequacy of Science Representation" in the Society. It reported in 1967. Section III had 375 fellows, amounting to roughly ten per cent of scientists engaged in research in Canadian universities and government laboratories in recognized disciplines, although some areas, for example mathematics and plant biology, were under-represented, whereas others, for example geology, were much more highly represented. Forty-six of the science fellows were or had been engaged in applied scientific research, but that didn't allow for the majority of engineers, who were not employed either by universities or in government laboratories. "For reasons of urgency, recognition of subject areas in engineering research should be given priority over other subject areas that are inade-

quately represented, and the criteria for selection should be similar to those adopted by the National Academy of Engineering in the United States."[276] Prompt recognition should be given to chemical, aeronautical, space, electronic, computer, and nuclear engineering because of current research in those fields "and recent increased recognition of engineering and applied science by the Royal Society [of London] and the National Academy of Sciences-National Academy of Engineering [US]." The Royal Society of London, for example, recognized eight areas in engineering. Such recognition was approved by the RSC. The committee on science representation first recommended the establishment of a new engineering subject division within Section III, but then they back-tracked, and recommended merely the recognition of applied science candidates.[277] There had been some thought of electing engineers to the Interdisciplinary Division, but that was soon dismissed because engineering was just too big an area to absorb into the division.[278] The RSC failed adequately to come to terms with engineering research.

Then, in the late 1970s, representatives of engineering organizations inquired informally if the RSC would be interested in establishing an academy of engineering, like that in the USA. There had been some interest within the RSC in assisting the Engineering Institute of Canada to develop its own Academy, in close association with the Royal Society.[279] But, as D. G. Hurst remarked, nothing happened; there had been little enthusiasm, and little action in response. Now, he reported in 1984, some engineers were trying to revive the idea of establishing an Academy of Engineering, and he urged to RSC to review its position. Hurst warned the RSC of the dangers of inaction. The RSC's lethargy in scientific publication had led the NRC to publish the *Canadian Journal of Research*, since when "essentially very few papers on original scientific research have been published by the Society. This separation of the Society from the mainstream of scientific communication was perhaps a major feature in its decline. The two approaches are different, but there may be a lesson here." Hurst urged the RSC to seek a mechanism "for having a Canadian Academy of Engineering as a component of the Royal Society of Canada but distinct from the existing trio of academies and from the Fellowship."[280] This did not happen.

The International Foundation for Science

In the years of national awakening to the need for a science policy for Canada, the Royal Society was concerned to function more effectively as the national academy. Section III, transformed into the Academy of Science, sought a corresponding role for itself. The search was at first more frustrating and frustrated than successful; most frustrating was the failure to take over from the NRC the role of Canada's representative organization in dealing with international non-governmental scientific organization. As time passed, there were also successes, achievements ranging from the symbolic to the substantive. One area that was both substantive and symbolic was the RSC's role in the International Foundation for Science, and it was linked in its conception to the Pugwash conferences held in the late 1960s, and named for Pugwash, Nova Scotia, where Cyrus Eaton's hospitality had initiated the still continuing series.

The pattern whereby scientists from developing countries were trained in research in developed countries had not always worked: "The apparatus and sources of information required by modern science were not widely available. ... Young scientists from developing countries, who had been trained abroad, were often reluctant to return home where support for their research was inadequate." Discussions and proposals in the USA were followed by further discussions in Sweden. In 1970 the Royal Swedish Academy of Engineering Science and the Royal Swedish Academy of Science, with support from UNESCO, held a meeting in Stockholm, attended by representatives from sixteen countries. They set about organizing an International Foundation for Science (IFS), and by May 1972 fourteen academies had become founding members.[281] Canada was not among the founding members, but was admitted in 1972, with the RSC as the adhering body, and funds provided through the RSC by the International Development Research Centre,[282] a public corporation established by parliament in 1970 to encourage research into ways of adapting science and technology to the needs of developing countries.

The IFS was established "to promote in developing countries meritorious research in the fields of the natural, social and behavioural sciences and technology," helping to support young scientists to do research in their own countries, finding funds, and abstaining from military research.[283] It aimed to provide practical

help in the shape of instruments, equipment, journals, technicians, and funding for full-time research. "A condition is that most of the scientific work must be done in the scientist's own country (or region)."[284] In 1973, Tuzo Wilson attended a meeting of the IFS in Amsterdam, at which five fields were selected for support: work on grain and vegetables, food preservation, fish breeding, the microbiology of forest soil, and the chemistry of natural products.[285]

In 1977 the RSC's International Relations Committee reported that "membership in the [IFS] constitutes the most important affiliation of the Society at present."[286] It certainly was in monetary terms. The RSC transmitted $170,000 from the IDRC to the IFS in 1978, and received $20,000 in overhead from the IDRC. Gordon Butler, FRSC, was vice-president of the IFS, and the Society also had members on the Foundation's grant screening committees.[287] The RSC was active in the IFS until 1979, when the IDRC withdrew its support. The RSC nonetheless is still the adhering body for Canada, although it has not had a representative on the IFS's governing body for some years.

Pugwash

The idea of the IFS had originated in discussions at Pugwash conferences. Pugwash's objectives were, broadly speaking, to foster national and international discussion of vital issues. In practice, the focus had been predominantly on international security, and scientists (including political and social scientists) had been the principal contributors to the discussions. In 1974, Pugwash was planning a symposium on the spread of nuclear weapons. There had been informal assurances from the USA that as far as the Americans were concerned, this symposium or future symposia could be jointly sponsored by the American Academy of Arts and Sciences, the National Academy of Science, and the RSC. Canada was "unique in having had the capacity to fabricate nuclear weapons since the beginning of the 'atomic age,' but having chosen not to do so." John Polanyi, a founding member of the Canadian Pugwash Committee and FRSC since 1966, therefore suggested that for this symposium it seemed best to decline formal RSC sponsorship, but that Canadian participation in the international activities of Pugwash be handled by a committee of the RSC, along the same lines as the Pugwash Committee of the American Academy of Arts and Sciences.[288]

Polanyi's proposal was an attractive one, since it involved the RSC in significant international activity as a non-governmental organization, and the role of American academies provided a precedent and a model. There was, however, already some uneasiness at the prospect that the RSC might become involved in intergovernmental conflicts. Even before Polanyi had asked the Society to form its Pugwash Committee, the Society had approved a resolution that it should not, in general, "take public positions on behalf of its members on any matter, except on issues directly affecting the Society itself."[289] The RSC's Pugwash Committee, with Polanyi as its founding chairman, was an active one, organizing meetings in Canada, and sending representatives to meetings abroad.[290] After Polanyi's term as chairman, the RSC reasserted its caution about taking a public stand: "While the Executive endorses the object of the Pugwash Conferences, it does not wish at this time, to sponsor the Canadian Committee for Pugwash Conferences in a general all-encompassing sense. It is prepared to do so, however, for a specific undertaking. ..."[291] Cautious or not, however, the RSC continued to administer the funds of the Pugwash Committee, and to make sure that this was recognized among its international activities.[292] The RSC and Pugwash separated amicably in the early 1990s, although the Society still acts as a trustee of Canadian Pugwash's endowment funds.

The RSC did recognize the validity and importance of the work done by Pugwash and by the International Foundation for Science. It also recognized that participating in non-governmental international organizations[293] helped it to gain recognition as the national academy. The Society's international activities in recent years have increasingly been related to specific issues, and in this sense its national and international mandates have increasingly coincided.

Issues and Symposia

The RSC began to organize symposia within the context of the Annual General Meeting in the 1950s, as a response to the trend away from individual papers. Some symposia, originally published in the Transactions, were republished in the *Studia Varia* series, which ran from 1957 until its end in 1970. At the same time (1956–57), stand-alone discussion meetings and workshops began independently of the Annual General Meeting. Ten of the publications under the *Special Publication* series that resulted were in the earth sciences, starting with *The Grenville Problem* in 1956; two were

biological, and one was cartographic.[294] The *Symposia* series started in 1970, publishing proceedings of events distinct from the AGM.

The Society addressed a variety of issues by means of symposia, e.g., on Canada's oceans (1949), on basic scientific research in Canada (1964), on the tundra environment (1970), and on other subjects where expertise in diverse fields could usefully be brought to a common focus. Following F. Kenneth Hare's symposium on the tundra environment, with its clear message about pollution and conservation, Section III made recommendations about environmental conservation, and discussed ways in which it might provide leadership in vital problems facing the country. The members of the section decided that a program of symposia offered the best route, and "as a first step in this programme the Section recommends the support of Dr. Duckworth's proposal for a symposium on mercury pollution."[295] A symposium on "Mercury in Man's Environment" followed in 1971.

The Lamontagne *Report*[296] had recommended that government should contract out appropriate studies to the RSC, [297] and had also urged that the Society become more involved with matters of national importance. The Society welcomed these recommendations.[298] Government contracts and symposia could reinforce one another, and both would enable the Society to play a significant national role. At hearings of the Lamontagne Committee in August 1976, Senator Buckwold asked Larkin Kerwin, then PRSC, if the RSC could do more studies like those on mercury in the environment (1971 symposium). Could the RSC "carry out scientific investigation at a non-governmental, non-political level, with the aim of drawing to the attention of Canadians the scientific facts of these situations?" Kerwin's response was emphatically positive.[299]

The Society wanted to be useful to Canada. The federal government wanted new scientific researchers "to be related both in numbers and in orientation to the opportunities and needs for research in Canada."[300] The appointment of the Lamontagne Committee was predicated upon the national importance of science and technology. In 1973, it had recommended that government departments, especially the Ministry of State for Science and Technology and the Science Council, should contract out to the RSC studies that they needed on questions of science for policy.[301] On 21 July 1975 the Prime Minister, Pierre Trudeau, wrote to the President of the RSC to say that Cabinet had authorized MOSST and the Department of Supplies and Services (DSS) to request government departments and agencies to offer the RSC some of their contracts for

services for a trial period of three years. The RSC was invited to submit a proposal for a year's study of how the Society could further serve the interests of the country, "and in particular the needs of the Government of Canada."[302] The Society established a planning committee that held its first meeting in October 1975. It considered both national and international issues important to Canada, and prepared a preliminary list of 33 topics.[303] There were also meetings with officials from MOSST, clarifying the role of the RSC so as to answer the question, "why contract out to the Royal Society when there are the Science Council, Economic Council, etc., within the government structure?"[304] As the planning committee neared the end of its deliberations, Larkin Kerwin, PRSC, wrote to Trudeau arguing for enhanced support of science, in Canada's fundamental interests. Trudeau replied agreeing with the principle, and stressing the need to establish priorities – a process assisted by the RSC's planning committee.[305]

On 15 April 1977, the cabinet gave its approval to a contract with the RSC for a project on public education about nuclear energy. The Society would identify and assess the major issues related to the use of nuclear power in Canada, hold public and specialist conferences, seminars, and workshops, and issue progress reports.[306] In cooperation with the Science Council, the RSC established a committee on nuclear issues in the community. Given public debate about the export of uranium and of Canadian nuclear reactors, this contract was both sensitive and timely.[307]

Symposia and Research: From Mercury to Nuclear Winter

Symposia became increasingly a tool used by the RSC in exploring issues of broad public or national interest, sometimes although by no means always as part of a project for which government had issued a contract. Early symposium proceedings had been published in the *Transactions* and *Proceedings*, and, since the mid-1950s, there had also been a series of special publications and of *Studia Varia*. In the 1970s, the Society, responding to the need to be more than an "honour society", increased the number and range of its symposia, and began to publish symposium proceedings in a separate series. The Society had organized a stream of symposia since the mercury one, including "Communications into the Home" (1972), "Physics and Chemistry of Ice" (1972), "Energy Resources" (1973), "Waste Recycling and the Environment" (1974), "Perspectives in Spectroscopy" (1974), and "Problems of Atlantic Canada" (1975), and, in response to a request in 1977 from the

Department of Communications, "Hermes (the Communications Satellite)."[308] Keith Laidler was chairman of the Society's very active Committee on Symposia from 1971 to 1987.

In January 1980 the committee on international relations reported that the US National Academy of Sciences had approached the RSC and suggested the establishment of a joint committee on acid rain. A meeting held in Toronto on 10 January had developed a proposal for such a joint committee. Kenneth Hare took a leading role in this, and in developing the Royal Society's role in the study.[309] The 1980 meeting was followed in May 1981 by a seminar on non-governmental hemispheric cooperation in science and technology held in Washington DC, with the participation of the Academies of Science of Canada, Mexico, and the USA. There were discussions about a variety of topics, including oceanography, botany (the Flora of North America), and geology (the Decade of North American Geology). Acid rain proposals were not developed beyond those from the 1980 Toronto meeting, but the recommendations from that meeting were circulated. There should be a joint US-Canadian committee (which Mexico was now invited to join), charged with promoting

> cooperative studies for the amelioration of problems owing to acid precipitation in Canada and the United States and periodically to assess progress in research and regulation. ... The Committee should specify activities to advance understanding of acid precipitation and develop consensus between scientists in Canada and the United states on such matters as emission inventories, transportation processes and pathways, primary and secondary chemical and biological effects, standard techniques of monitoring these effects, and other issues as may be deemed necessary.[310]

A second meeting of the Committee was scheduled for Toronto for June, with subsequent meetings in fall and winter. When the American, Canadian, and Mexican academies had their second seminar on hemispheric cooperation, they identified four priority areas: biotechnology (especially genetic engineering), computation and informatics, the environment (with the acid rain problem specifically identified, as well as the disposal of radioactive wastes, and atmospheric carbon dioxide), and energy. There were American and Canadian panels looking at the reports arising from the US-Canadian Memorandum of Intent on trans-boundary air pollution (August 1980),[311] because American authorities did not consider the joint committee of the RSC and the NAS "an accept-

able instrument and appointed their own panel without Canadian membership. At the request of the Federal Government, the Society appointed a comparable peer panel of its own ... The panel included Canadians as well as American, Swedish and Danish scientists."

There followed in 1984 a major review, *Long-Range Transport of Airborne Pollutants in North America: A Peer Review of Canadian Federal Research*, which helped to strengthen within the RSC's Academy of Science "a demand that the Society should be active in socially important issues involving impartial and scholarly reviews of evidence."[312] Following a recommendation by the RSC, the Department of National Health and Welfare carried out further work.[313]

On the RSC's completion of its acid rain review, Charles Caccia, Minister for the Environment, wrote to Marc-Adélard Tremblay, PRSC, thanking the Society and asking them to undertake a study of the environmental consequences of nuclear winter.[314] Kenneth Hare prepared a proposal to the RSC entitled "Nuclear Twilight," suggesting a brisk and comprehensive series of consultation, a workshop, and a report that fall.[315] There was a public meeting in Ottawa that summer,[316] with a program covering nuclear winter scenarios, effects on the atmosphere and simulation models, evidence from an examination of natural catastrophes, impacts to the biosphere, effects on society, and three-dimensional circulation models. The report was published in 1985.[317]

While the acid rain study was under way, Academy III recommended in 1983 that the Society "undertake the study of water quality of the Great Lakes," in cooperation with a similar study by the US National Academy of Sciences. The next environmental issue tackled by the RSC was that of lead in the environment. A five-volume report was published in 1985–86.[318]

Environmental issues were ever more pressing and, in their reticulation, ever more complex. Their recognition led during the 1980s to change within national and international unions and academies, including the RSC. The Society's programs, formerly "suggested or requested in a particular area for a particular reason," came by the late 1980s to address major social or intellectual needs, none more pressing or more all-encompassing than the problems of global change, "the dilemma we find ourselves in today – how we may continue to live on this fragile planet."

The Canadian Global Change Program

The Royal Society's Canadian Global Change Program emerged from the initiative of the International Council of Scientific Unions (ICSU) to understand anthropogenic global environmental change. In November of 1983, the ICSU steering committee met in Paris. Here they agreed that at the 20th general assembly of 1984, scheduled to be held in Ottawa, the last day of the symposium would be devoted to global change issues.

At the symposium, member scientists delivered scientific lectures on aspects of their own research that related to global change. William Fyfe, Raymond Price and Digby McLaren, all of whom were active in global change affairs, were among the Canadian representatives in Ottawa.[319] Fyfe was asked to present a summary of the symposium and to outline the proposal for an International Geosphere-Biosphere Program (IGBP).[320] He suggested that ICSU was the ideal forum for global change research because it is a source of knowledge about international scientific expertise.[321] McLaren, Fyfe, and others recognized the potential for the RSC to present itself as a source of information on scientific expertise within Canada, and to coordinate the Canadian counterpart to the IGBP. The Ottawa meeting of ICSU closed with the decision to study the possible nature of an International Global Change Program by forming four study groups.[322] Over the next two years, the lack of enthusiasm in Europe evaporated, and the International Geosphere-Biosphere Program was formally founded at the 1986 ICSU meeting in Berne, Switzerland.

Fyfe promoted the possibilities for a potential (and unique) role for Canada in this international program. Canada is ideal for a leadership role in global change: its large land mass, Arctic and wetland ecosystems and surrounding three oceans made it a good base for research. In 1985, Fyfe, as the recipient of the Willet G. Miller Medal, spoke at the RSC's general meeting in Montreal. His chosen topic was global change.[323] An RSC ad-hoc committee on Global Change was set up. It held its first organizational meeting in December 1985, with Fyfe as chair and over thirty academic and government scientists present. Fyfe, with the help of George Garland and Michael Dence, produced a Canadian proposal for presentation at the Berne ICSU meeting based on the recommendations of the ad hoc Committee.[324] The committee recommended that there should be a permanent secretariat in Canada to coordinate national and international activities, and to look for opportunities for interdisciplinary research inside and outside Canada. The RSC

was ideally placed to establish this secretariat with the support of outside federal, provincial, and granting organizations;[325] RSC received support from NRC, NSERC and SSHRC in setting up its program, and from NRC for the Canadian secretariat.[326]

The Society held a symposium on Global Change at its annual meeting of 1987 at McMaster University. Included was a workshop on the social and cultural aspects of global change for Canada.[327] This was the first step in bringing in the other two academies, and to underline the role of multidisciplinary coordination adopted by the Society. The participation of Fellows from the humanities and social sciences, including economics and demography, would help to unify and energize the Society. That at least was and remains the hope, as yet unrealized.[328]

Besides the efforts to integrate the humanities and social sciences into a Canadian Global Change Program, there were wider efforts in these years. In 1987–88, the International Federation of Institutes for Advanced Studies, then directed by Ian Burton (FRSC 1983), was advocating an international Human Dimensions of Global Change Program (HDGCP). The Canadian program has been generally more successful here than the international one, although its successes have not been notably within the RSC.

The Canadian Global Change Program, the largest the RSC has attempted, offered the Society an opportunity to show its capacity to act as Canada's national academy. McLaren, president of the RSC from 1987–1990,[329] saw it as giving "scope for leadership and a unifying theme for all disciplines."[330]

The RSC's AIDS project, launched in 1987, was another major undertaking involving the sciences and the humanities. It set out to examine the medical, legal, social, and ethical implications of the AIDS epidemic in Canada. There were four major working sub-committees, focusing on economics and epidemiology; medical aspects; the social, legal, and ethical aspects of AIDS; and research. Three publications reporting on studies carried out by the Society were published in 1988, offering both a perspective and a strategy for Canadians.[331] Forty-eight recommendations were made, concerning prevention of the spread of the disease; testing for HIV; the care and treatment of the infected; areas of research; and the organization of research – a coordinated approach was clearly indicated.

The Global Change and AIDS projects were used to demonstrate the Society's capacity, worthy of greater financial support. They reinforced the legitimacy of the Society's approach to the govern-

ment for direct funding.[332] The RSC saw itself as a forum for a kind of interdisciplinary exchange that could not be achieved within the individual government departments. It seemed clear to the RSC that global change was necessarily an interdisciplinary enterprise, so that it was inappropriate for any single government department to be selected as host.[333]

The granting councils, SSHRCC and particularly NSERC, had funded the RSC since the mid–1970s. Their combined grant to the Society had grown to $100,000 by 1986, and the Research Councils were unhappy at carrying a burden that they considered lay outside their mandate. They did not wish to renew their support when the second five-year term of their arrangement with the RSC ended in 87–88. Serious support for the Society as a whole was needed, and the task of approaching the Prime Minister to seek a new form and an increase in the basic grant was given to Digby McLaren when he became President-elect in 1986–87. Michael Dence, Honorary Treasurer of the RSC, and newly installed as Executive Director in 1986, assisted McLaren.

The CGCP was funded outside the RSC's core funding. At NSERC, Janet Halliwell was especially receptive and supportive of the RSC's efforts at an overhaul at the critical time when RSC was trying to get CGCP off the ground.[334] Global change would enable the RSC to test and determine its capacity to act as a forum for multidisciplinary exchange.

As Minister of State for Science and Technology from 1985 to 1989, Frank Oberle was most receptive and liked the idea of a national academy developing science culture within Canada. He addressed the Council of the Society in September 1987.[335] In the preceding months of negotiation, several departments (Energy, Mines and Resources, Health, and Secretary of State) had agreed to respond to an invitation from the Minister of State for Science and Technology, and to contribute $50,000 apiece. This was added to similar contributions from MOSST and Regional and Economic Expansion, for a total of $250,000 to pay for the preparation of the three plans requested by MOSST (Corporate Plan, Plan for the Evaluation of Research, and Plan for the Advancement of Women in Scholarship and Science – first submitted together as the Society's Development Plan, 1989).[336] MOSST provided a further $250,000 for other expenses, and to restore the RSC's General Fund.

Global change, however, was funded outside the RSC's base grant,[337] through NSERC, and earlier through NRC for the Canadian national committee to the IGBP. These funding sources

have since been replaced, and Canada's Green Plan now pays for the CGCP.

Through the CGCP, the society has acted as a coordinator of different governmental and non-governmental agencies – it has been the coordinator of research and research products from government, industry and universities. As so often before, the RSC has selected members for its committees by drawing not only on its Fellows, but also on outside expertise.

Through the CGCP, the RSC brought together experts from many disciplines. The issues raised are too important to remain the preserve of specialists. McLaren had the idea of taking the Global Change program with its social, scientific, and moral problems to the general public. One of the most striking ways in which he effected this was in *Planet Under Stress*, an early initiative of McLaren's when he took over as President in 1987, which was published in 1990.[338] The development of this volume was in parallel with efforts to organize and develop CGCP, and was separately funded. The CGCP's quarterly publication *Delta* is a means for disseminating information about national and international activities in global change research.[339] Such developments, valuable for scientists and government, are very much in line with the Society's recent assumption of responsibility for promotion of the public awareness of science.[340] The CGCP underlined the particular role the RSC could play as a coordinating body, among different scientific disciplines, between the sciences and the humanities, and between academics and public policy makers.

The working groups for the Canadian global change effort were developed in parallel with the working groups for the IGBP: (1) terrestrial-atmosphere interactions, (2) marine-atmosphere, (3) geological processes, past and present and (4) solar emissions in the upper atmosphere. In the Canadian program, arctic-atmosphere interactions were substituted for the study of solar emissions.[341]

13: CONCLUSION

In its development plan presented in 1989, the RSC projected by 1993–94 a five-fold increase in activity over that of 1987–88. The main impetus for this projected increase was the urgency of the problems of global change. The Society wanted to extend its roles of advising governments, both federal and provincial, and informing the public – and it has been doing so, about AIDS, nuclear safety,[342] air pollution, and many other issues.

In its development plan, the Society announced that its substantive strategic goals were:

(1) To promote learning and research in the Arts and Sciences in Canada and increase the importance of scholarship in national life; and
(2) To stimulate cross-disciplinary research and learning.

These goals were partly responses to perceived national needs, and partly directed at strengthening the intellectual vitality of the RSC itself. They represent the product, not the end-point, of a century's development.

The science sections of the RSC began well, and contributed significantly to the national scene. In its early years, the RSC had brought together the Canadian scientific community. The proportion of Canadian scientists active in research and elected to the RSC was high. Major research findings were announced at the Society's meetings, witness for example the many papers by McLennan and his students and co-workers. Attendance at the Society's annual meetings was numerous, and there was competition for places on the program to present scientific papers. Then came decline, in attendance, in the number of scientific papers read, and in the significance of those papers. Important results were increasingly seldom first announced at the RSC's meetings. By the end of World War II the Society entered a period of marginalisation in science. Among the factors that contributed to this state were the rise of the NRC as a primary source for government advice, displacing the RSC; inadequacies in the rapidity and dissemination of scientific publication by the Society; the multiplication of disciplinary scientific societies, which became the forums for scientific publication and announcements, where increasing numbers of scientists who were not FRSCs had the opportunity to present their findings; reduced funds, leading to a general reduction of activities; and excessively short terms for the executive, which undermined continuity and denied officers the time needed to get results. Recognition of individual achievements was well and good, and this the RSC offered, but more was needed. The utility of the Society was further undermined by a feeling on the part of many scientists that they were somehow hampered by being yoked with humanists and social scientists.

There were repeated efforts to increase the utility and importance of the RSC, but for the science section these were largely unsuccessful until the mid-1960s, when questions of science policy led to a national debate about two questions: what was science

good for? and what was good for science? The RSC's contributions to this debate involved proposals for an enhanced role for the Society, in ways reflecting hopes for enhanced status as much as an enhanced role in addressing national needs. Responses to these proposals were also mixed, ranging from encouragement to marginalisation. Still, the net effect was to turn the Society's collective mind to ways in which it could be useful to Canada, and to encourage government to turn to the Society for expert advice, especially on scientific matters.

Consideration of scientific questions of public import led the Society to tackle the complex of issues that come under the umbrella of global change, and at the same time to cooperate with other national and international bodies in seeking solutions. In the process, the Society has lately become more active, more visible as the national Academy, and more useful. It made up much of the ground lost earlier in the century, and is striving towards its strategic goals, in spite of recent severe reductions in funding – a perennial theme.[343]

ACKNOWLEDGMENTS

* It is a pleasure to thank several scholars for their support and help. In 1990 the Hon. Jules Deschênes, President of the Royal Society of Canada, and Dr. Michael Dence, Executive Director of the Society, invited me to write this essay. The President and Council of the RSC made available the Royal Society Papers in the National Archives of Canada, MG 28 I 458. Dr. Dence, Professors Yves Gingras, Suzanne Zeller, and Roderick Home, and Judge Deschênes all read the manuscript and made valuable suggestions. Professors Robert Haynes and David Hayne (as PRSC and Honorary Editor of the RSC, respectively) were encouraging in their support. Professor Hayne also proof-read my typescipt with great care. Jill Lazenby, Marianne Stevens and Michael Huarte provided impeccable research assistance.

NOTES AND REFERENCES

1 Quoted by Sir Robert Falconer, "The Intellectual Life of Canada as Reflected in its Royal Society", *The Royal Society of Canada: Fifty Years Retrospect* (Ottawa, 1932) p. 13. For recent histories of the RSC, seen respectively from the vantage points of Académie I and Academy II, and thus complementing this essay, see Andrée Désilets, *Un siècle d'histoire: l'Académie des lettres et des sciences humaines de la Société royale du Canada* (Ottawa, 1977), and Carl Berger, *Honour and the Search for Influence* (Toronto, 1996).

2 *Proc. RSC 1* (1882) i–v.

3 Falconer, *The Royal Society of Canada: Fifty Years Retrospect* (1932) pp. 9–10.

4 A. Johnson, "Presidential Address", *Trans. RSC 3* (1885) sec. III, 1–6.

5 Logan, evidence in Canada (Province), *Report of the Select Committee on the Geological Survey, Printed by Order of the Legislature* (Quebec, 1855) M. Zaslow, *Reading the Rocks*; S. Zeller, *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (Toronto, 1987).

6 Falconer (1932) p. 20.

7 T. Sterry Hunt, "The Relation of the Natural Sciences: Inaugural Address", *Trans. RSC, 1* (1882), sec. III, 1–7.

8 Falconer (1932) pp. 10–11.

9 For a recent debate about the universality or otherwise of scientific culture, see Paolo Palladino and Michael Worboys, "Science and Imperialism", *Isis 84* (1993) 91–102, and Lewis Pyenson, "Cultural Imperialism and Exact Sciences Revisited", ibid 103–8. There was, within the RSC, some attempt by Section I to retain within its membership those scientists who wrote their papers in French; see below.

10 J. W. Dawson, "Presidential Address", *Proceedings of the Royal Society of Canada* [henceforth *Proc. RSC*] *1* (1882) vi–xi.

11 Daley and Dufour, "Creating a 'Northern Minerva': John William Dawson and the Royal Society of Canada", *HSTC Bulletin 5* (1981) 3–13.

12 J. W. Dawson, *Proc. RSC* (1882) vi.

13 Dawson, *Proc. RSC* (1882) vi-xi.
14 Marquess of Lorne, "Inaugural Address", *Proc. RSC 1* (1882) v–vi.
15 T. H. Levere, *Science and the Canadian Arctic: A Century of Exploration* (Cambridge University Press: New York, 1993).
16 Although Osler did a good deal of important and original work, especially in pathology, he published outside the Society's *Transactions*.
17 J. C. Meakins, "Clinical Medicine and the Royal Society", *The Royal Society of Canada: Fifty Years Retrospect* (1932) p. 171.
18 See below; a major reason for this divergence was the different development of institutions of scientific research in francophone and anglophone Canada.
19 The founding members of section III were Charles Baillargé, Herbert A. Bayne, Charles H. Carpmael (vice-president of Sec. III), Edward J. Chapman, John Bradford Cherriman, Edouard Deville, Nathan Fellowes Dupuis, Sandford Fleming, Pierre Fortin, Gilbert P. Girdwood, F. W. Gisborne, Eugene Haanel, Thomas E. Hamel, Bernard J. Harrington, Christian G. Hoffmann, Thomas Sterry Hunt (President of Sec. III), Alexander Johnson, James T. Loudon, Thomas Macfarlane, James Gordon MacGregor. The founding members of section IV were Loring W. Bailey, George Barnston, Robert Bell, George M. Dawson, John William Dawson (President of RSC), Edwin Gilpin, J. Bernard Gilpin, James A. Grant, John Matthew Jones, Joseph-Clovis-Kemner Laflamme, George Lawson (vice-president Sec. IV), John Macoun, George F. Matthew, Alexander Murray, William Osler, William Saunders, Alfred Richard Cecil Selwyn (President Sec. IV), D. N. St. Cyr, Joseph Frederick Whiteaves, Robert Ramsay Wright.
20 The description of the arctic archipelago as Canadian had become a political as well as a geographic label in 1881, when Britain transferred the islands to Canada See M. Zaslow, ed., *A Century of Canada's Arctic Islands 1880–1980*, RSC 23rd Symposium (Ottawa, 1981).
21 J. William Dawson, "On some Relations of Geological Work in Canada and the Old World", *Trans. RSC 2* (1884) sec. IV, 1–6; various publications by Stafford, including *Scientist of Empire*.
22 J. W. Dawson, *Trans. RSC* (1884) sec. IV 1–6; George Albert Young, "Some Aspects of the Geological Studies of the Canadian Shield 1882 to 1932", in *The Royal Society of Canada: Fifty Years Retrospect* (Ottawa, 1932) pp. 123–9 at 123–4.
23 G. M. Dawson, *Trans. RSC 1* (1882) sec. IV, 39–44.
24 Levere, *Science and the Canadian Arctic* (1993) p. 302.
25 J. W. Dawson, *Trans. RSC 1* (1882) sec. IV, 15–34.
26 W. Saunders, *Trans. RSC 1* (1882) sec. IV, 35–8. The other paper was his "On the Introduction and Dissemination of Noxious Insects", *Trans. RSC 1* (1882) sec. IV, 77–80.
27 *Trans. RSC* 1 (1883) sec. IV 157–62.
28 Levere, *Science and the Canadian Arctic* (1993) pp. 307–37; W. Barr, *The Expeditions of the First International Polar Year, 1882–83*, The Arctic Institute of North America Technical Paper No. 29 (Calgary, 1985).

29 Canadian involvement in the Second International Polar Year, 1931–32, was not great either, in spite of its obvious importance to Canada and the recommendations of the RSC (see *Proc. RSC* S3 25 (1931) xxxii–xxxiii). The next major international polar enterprise, the International Geophysical year 25 years later, did have significant Canadian involvement: J. Tuzo Wilson, *IGY: The Year of the New Moons* (Longmans: Toronto, 1961).

30 The parallax of the sun could be obtained by observing transits of Venus from places on the earth where the displacement by parallax was greatest The parallax of the sun was important because it was the key to the accurate determination of the sun's distance from the earth, and because that distance connected terrestrial measurements with celestial ones, geodesy and navigational science were potentially great beneficiaries of good transit observations. Transits of Venus were infrequent, occurring only 4 times every 243 years, so the opportunity offered in 1882 was significant.

31 J. S. Plaskett, "Fifty Years of Canadian Astronomy", in *The Royal Society of Canada: Fifty Years Retrospect* pp. 117–21 at 117. Richard A. Jarrell, *The Cold Light of Dawn: A History of Canadian Astronomy* (Toronto, 1988).

32 Alexander Johnson, "Preparations at McGill College, Montreal, for observing the Transit of Venus, December 6th, 1882", *Trans. RSC 1* (1883) sec. III, 83–5; Charles Carpmael, "Reports on the Transit of Venus of December 6th, 1882: General Report", *ibid.*, 87–9.

33 *Proc. RSC 1* (1883) ii–lvii.

34 Levere, *Science and the Canadian Arctic* (1993) p. 342. S. Zeller, "The Spirit of Bacon", *Scientia Canadensis* (1989) 81.

35 Invited societies were: Literary and Historical Society of Quebec, Natural History Society of Montreal, Canadian Institute (Toronto), Natural History Society of New Brunswick, Nova Scotia Institute of Natural Science, Literary and Scientific Society (Ottawa), Historical and Scientific Society of Manitoba, Entomological Society of Ontario, Institut Canadien (Quebec), Historical Society of Montreal, Numismatic Society of Montreal, Historical Society of Halifax, Geographical Society of Quebec, Institut Canadien-Français (Ottawa), Field-Naturalists' Club (Ottawa).

36 In 1884, Thomas Sterry Hunt, now vice-president of the RSC, informed the fellows that "It is in the world of science that the importance of a national organization such as ours becomes more especially evident". [*Proc. RSC 2* (1884) xxii–xxiv.]

37 For a detailed account of the visit of the BAAS in 1884, see "A Royal Society of Canada Symposium to Mark the 150th Anniversary of the foundation of the British Association for the Advancement of Science (1831–1981) Held at York, England, 3 September 1981", ed V. de Vecchi and T. H. Levere, *Trans. RSC* S4 *20* (1982) 469–547.

38 Spottiswoode to Lorne, 1 Feb 1882, Public Archives of Canada [henceforth PAC] MG 27 I B4 #70.

39 A. Campbell to Marquess of Lorne, 15 May 1883, PAC MG 27 I B4 #109.

40 *Proc. RSC* S2 *3* (1897) xvii-xxx. Following the Washington conference, the RSC "took steps to bring to the attention of the Imperial Government the desirability of giving effect to the ... resolution ... which implies the unification of time-reckoning at sea". Lloyd's, the shipping insurance agency, was in favour of this, and the Admiralty expressed itself as willing, as long as other powers also agreed. But the United States declined an invitation from the British Government, which thereupon dropped the issue. For similar reasons, the Royal Society was not willing to act at the time, partly because it was too late to effect changes for the 1901 *Nautical Almanac*. The RSC argued in 1897 that "the astronomers of the world as a class are in favour of the change, provided that it could be carried into effect" at a convenient time, such as the beginning of the century. The RSC's Council "trust that in the interest of commerce, shipping and general progress, even if it should cause some inconvenience to a few astronomers, the adoption of the reform will not be long delayed", thus taking a more forward position than the Royal Society of London.
41 Marquess of Lansdowne to Lorne, 21 Dec 1883, PAC MG 27 I B4 #75.
42 For relations between nationalism, continentalism, and imperialism in this period, see C Berger, *The Sense of Power ...*; for the use of science as a tool in nation building, see S. Zeller, *Inventing Canada*.
43 For background on the development of Canadian hydrographic surveys in this period, see Don W. Thomson, *Men and Meridians* vol. 2 (Ottawa, 1967) pp. 202–20.
44 Within twenty-five years there would be vessels of almost thrice the tonnage.
45 *Proc. RSC 3* (1885) iii.
46 *Proc. RSC 5* (1887) v.
47 "Report of Council", *Proc. RSC 10* (1892) ix–x.
48 *Proc. RSC 11* (1893) viii–ix.
49 "Report of Progress for the Year 1894 in the Survey of Tides and Currents in Canadian Waters", *Proc. RSC* S2 *1* (1895) xix–xxii.
50 *Trans. RSC* S3 *2* (1897) sec. III 51–68.
51 "Report of the Committee on the Coast Hydrographic Survey", *Proc. RSC* S2 *11* (1905) ix–xi.
52 In 1899, the Council recorded that the Minister of Marine and Fisheries could only provide about half the previous year's allocation for the surveys See *Proc. RSC* S3 *5* (1893) xviii–xix.
53 "Survey of Tides and Currents in Canadian Waters", *Proc. RSC* S2 *11* (1905) ci–cv at ci.
54 *Proc. RSC* S2 *12* (1906) xxi.
55 W. Bell Dawson, "Presidential Address to Section III. Methods of Investigation of Tides and Currents", *Proc. RSC* S3 (1910) 3–18.
56 F. J. E[vans] to ?, letter n.d., PAC MG 27 I B4 #72.
57 Johnson, "On the Need of a 'Coast Survey' for the Dominion of Canada", *Trans. RSC 11* (1893) sec. III, 55–60.
58 A. Johnson, *Proc. RSC* S2 *9* (1903) xli–xlii.

59 J. W. Dawson, "On some Relations of Geological Work in Canada and the Old World", *Trans. RSC 2* (1884) sec. IV 1–6.
60 C. F. O'Brien, "*Eozoon Canadense* 'The Dawn Animal of Canada'", *Isis. 61* (1970) 206–23, and *Sir William Dawson: A Life in Science and Religion*, Memoirs of the American Philosophical Society 84 (Philadelphia, 1971). Carpenter was an expert on the Foraminifera, see W. B. Carpenter, T. R. Jones, and W. K. Parker, *Introduction to the Study of the Foraminifera* (London, 1862).
61 Dawson to Stokes, 17 Feb 1887, in *Proc. RSC 5* (1887) vi–vii. Dawson opposed the glacial theory, which implied that most of Canada was once covered by deep ice sheets. He argued that there had been mainly floating ice during marine submergence, and that glaciers existed only on high ground. He was wrong about this, as he was about *Eozoon*. G. M. Dawson also initially opposed the glacial theory, but his work in western Canada led him in 1897 to accept it. See O'Brien, [*J. W. Dawson*], and W. A. Johnston, "Fifty Years of Pleistocene Geology in Canada" in *The Royal Society of Canada: Fifty Years Retrospect* (1932) pp. 132–5.
62 This was not just Dawson's view, nor was it short-lived. See, for example, Herbert M. Ami, "Synopsis of the Geology of Canada. (Being a Summary of the principal terms employed in Canadian Geological Nomenclature)", *Trans. RSC* S2 *6* (1900) sec. IV, 187–225, which contains strong statements about the uniqueness of Canada's rocks, and the lack of proper international terms in which to describe them.
63 "Imperial Scientific Affiliation", *Proc. RSC 7* (1889) x–xi.
64 For a comprehensive account of the foundation and first decade of the Geodetic Survey of Canada, see Don W. Thomson, *Men and Meridians* vol. 2 pp. 221–30.
65 FRSC (sec II) 1911.
66 L. J. Burpee, "Introduction", in *The Royal Society of Canada: Fifty Years Retrospect* (1932) p. 5.
67 *Trans. RSC 3* (1885) sec. III, 111.
68 A. Johnson, "Presidential Address", *Trans. RSC 3* (1885) sec. III, 1–6 at 5–6. For the prior history of the determination of Toronto's longitude, as well as for its redetermination, see Charles Carpmael, "The Longitude of the Toronto Observatory", *Trans. RSC 6* (1888) sec. III 27–53.
69 McCleod, "Presidential Address: A Trigonometrical Survey for Canada", *Trans. RSC* S2 *5* (1899) 3–7.
70 FRSC 1893.
71 "Report of Council", *Proc. RSC 10* (1892) ix–xi.
72 McCleod, "Memorandum as to preparations for the proposed transatlantic longitude determinations: Greenwich—Waterville—Canso—Montreal", *Trans. RSC 10* (1892) sec. III, 33–4; "Memorandum on the work of the Montreal Longitude Determination", *Trans. RSC 11* (1893) sec. III, 51–3; "Determination of Longitude of Montreal", *ibid.* ix–x.
73 McCleod to J. G. Bourinot, 11 April 1898, PAC MG 27 I I62 vol. 2.
74 McCleod to Bourinot, 13 May 1898, PAC MG 27 I I62 vol 2.
75 *Proc. RSC* S2 *5* (1899) xxii–xxiii.

76 *Trans. RSC* S2 *5* (1899) sec. III, 3–7.
77 *Proc. RSC* S2 *9* (1903) xxi–xxiv.
78 *Proc. RSC* S2 *10* (1904) xiii; *ibid.* 12 (1906) xxi–xxii.
79 See below.
80 For a detailed history, see Jennifer M. Hubbard, *An Independent Progress: The Development of Marine Biology on the Atlantic Coast of Canada, 1898–1939*, Ph.D. dissertation, University of Toronto, 1992; see also Hubbard, "The Commission of Conservation and the Canadian Atlantic Fisheries", *Scientia Canadensis 12* (1992) 22–52.
81 FRSC 1902.
82 *Proc. RSC* S2 *4* (1898) vii–viii.
83 "Biological Station in Canada", *Proc. RSC* S2 *4* (1898) xiii.
84 *Proc. RSC* S2 *5* (1899) xxi–xxii.
85 *Proc. RSC* S2 *6* (1900) xiii–xv.
86 "The Biological Investigation of Canadian Waters. With Special Reference to the Government Biological Stations", *Trans. RSC* S3 *1* (1907) 71–92.
87 *Proc. RSC 5* (1887) i–xliii.
88 *Proc. RSC* S2 *3* (1897) xi–xii.
89 *Proc. RSC* S2 *4* (1898) xiv.
90 See, e.g., L. J. Burpee in *The Royal Society of Canada: Fifty Years Retrospect* (1932) p. 2.
91 *Proc. RSC 3* (1885) xxix–xli.
92 A. Johnson, "Presidential Address", *Trans. RSC 3* (1885) sec. III, 1–6.
93 G. M. Grant, "Presidential Address", *Proc. RSC 9* (1891) xxx–xl at xxxiii.
94 George Lawson, "On the Present State of Botany in Canada, with suggestions as to promising lines of investigation, and a proposal for united effort in systematic observation throughout the several Provinces and Territories", *Trans. RSC 9* (1891) 17–20.
95 Yves Gingras, *Physics and the Rise of Scientific Research in Canada*, trans P. Keating (Montreal and Kingston, London, Buffalo: McGill-Queen's University Press, 1991) p. 86.
96 Gingras (1991) pp. 85–101.
97 See Gingras (1991) pp. 11–82 on "Establishing Research" in physics in Canada.
98 Gingras (1991) p. 87; *Proc. RSC* S2 *11* (1905) ii–iii.
99 Rutherford's work at McGill is described in A. S. Eve, *Rutherford* (London, 1939) and in Thaddeus J. Trenn, *The Splitting of the Atom: The History of the Rutherford-Soddy Collaboration* (London, 1977).
100 *Proc. RSC* S3 *7* (1913) xxxv–xvi.
101 *Proc. RSC* S3 *14* (1920) viii–ix. Gingras (1991) p. 97. The $8,000 per annum was restored in 1920, and continued until the depression led to a reduction to $5,000 in 1932–33, then to $4,500 in 1933–34. This was the level until 1949, when it again rose to $8,000, then $12,000 in 1953–54. The NRC took over providing the grant in 1957–58, increasing it to $17,000 in 1958–59 (the extra $2,000 was a nominal amount towards rental of quarters in the NRC Sussex Drive building, the first

time that the RSC had a specific space allotment). The Canada Council was formed at that time and also began to provide $10,000 yearly. When NSERC and SSHRCC were founded in the mid-1970s, they took over the role of providing the RSC's subsidy. This continued for ten years, during which the combined grant from the Research Councils to the RSC rose to $100,000.

102 Gingras (1991) pp. 87–8, 96–7.

103 See, e.g., D. P. Penhallow, "A Review of Canadian Botany from 1800 to 1895", *Trans. RSC* S2 *3* (1897) sec. IV, 3–56.

104 *Proc. RSC* S3 *2* (1908) xlv.

105 PAC MG 27 I 62 vol 2.

106 *Proc. RSC* S2 *6* (1900) x.

107 *Proc. RSC* S3 *7* (1913) xxxv–xxxvi.

108 *Proc. RSC* S3 *9* (1915) xliv.

109 *Proc. RSC* S3 *6* (1912) xxvi.

110 Further background is given in Don W. Thomson, *Men and Meridians* vol. 3 (Ottawa, 1969) pp. 211–21.

111 *Proc. RSC* S3 *7* xxviii; J. S. Plaskett, "Fifty Years of Canadian Astronomy", in *The Royal Society of Canada: Fifty Years Retrospect* (1932) pp. 117–20; Jarrell, *The Cold Light of Dawn.*

112 *Proc. RSC* S3 *8* (1914) xvii–xviii.

113 *Proc. RSC* S3 *9* (1915) xliii–xliv.

114 *Proc. RSC* (1915) xxxiii.

115 *Proc. RSC* (1915) xxxv.

116 *Proc. RSC* S3 *10* (1916) xxv. Aspects of the drive for industrial research in Canada are described by Philip Enros in "The University of Toronto and Industrial Research in the Early Twentieth Century", in Richard Jarrell and Arnold Roos, eds., *Critical Issues in the History of Canadian Science, Technology and Medicine* (Thornhill, 1983), 155–66, and in "The Bureau of Scientific and Industrial Research and School of Specific Industries: The Royal Canadian Institute's Attempt at Organizing Industrial Research in Toronto, 1914–1918", *HSTC Bulletin 7* (1983) 14–26. See also *Scientia Canadensis 15* no. 2 (1991), published as Richard A. Jarrell and Yves Gingras, eds., *Building Canadian Science: The Role of the National Research Council* (Canadian Science and Technology Historical Association, Ottawa, 1992).

117 *Proc. RSC* S3 *11* (1917) xxvii–xxix at xxviii.

118 The category of Corresponding Fellow had been inaugurated when Lorne returned to Britain in 1883, and became the first member in that category. It became a way for the Society to recognise foreigners, but faded after World War II until it was revived in 1992 through the new category of Foreign Fellow. The move came from Academy III, despite some opposition within the Academy, and allows the Society to recognize, among others, former Canadians who have won great distinction in other countries.

119 RSC Minutes of Council, PAC MG 28 I 458 vol 1.

120 A. B. Macallum, "The Old Knowledge and the New", *Proc. RSC* S3 *11* (1917) lix–lxxiii.

121 R. F. Ruttan, "Presidential Address: International Co-operation in Science", *Proc. RSC* S3 *14* (1920) xxxv–lvi at xxxix.
122 J. C. McLennan, "The Production of Helium from the Natural Gases of Canada", *Trans. RSC* S3 *13* (1919) 53–6. See also McLennan, "Annual Popular Lecture: Recent Advances in Physics", *Proc. RSC* S3 *15* (1921) lix–lxvii.
123 *Proc. RSC* S3 *41* (1947) 65.
124 The best known instance was the Hindenburg disaster of 1937, but there were numerous instances during World War I, several involving the destruction of hydrogen-filled airships.
125 A. S. Eve, "Some Great War Inventions", *Proc. RSC* S3 *14* (1920) xv–xvi. Boyle's war work justified his election as FRSC in 1921.
126 Ruttan, *Proc. RSC* S3 *14* (1920) xxxv–lvi. Brigitte Schroeder-Gudehus, *Les scientifiques et la paix: la communauté scientifique internationale au cours des années 20* (Montréal, Presses de l'Université de Montréal, 1978).
127 A. Stanley Mackenzie, "The War and Science", *Trans. RSC* S3 *12* (1918) 1–6.
128 For background, see Mel Thistle, *The Inner Ring: The Early History of the National Research Council of Canada* (Toronto, 1966); *Scientia Canadensis 15* no 2 (1991). Wilfrid Eggleston, *National Research in Canada: The NRC 1916–1966* (Toronto, 1978). Yves Gingras, *Physics and the Rise of Scientific Research in Canada* (Montreal and Kingston, 1991).
129 The argument of this paragraph is taken from "The Honorary Advisory Council for Scientific and Industrial Research in Canada", *Proc. RSC* S3 *11* (1917) xvi–xxi.
130 Roy McCleod and E. Kay Andrews, "The Origins of the D.S.I.R.: Reflections on Ideas and Men, 1915–1916", *Public Administration 48* (1970) 23–48.
131 *Science* 25 Aug. 1916, 264–6.
132 Hon. Treasurer RSC to D. C. Scott, Hon. Sec. RSC, 12 Sept. 1916, PAC MG 28 I 458 26.
133 There is an account in *Nature* 9 March 1916, 38, but this was over-sanguine. The Australian Prime Minister in 1915 promised more than was actually forthcoming; it was not until 1920 that the Commonwealth Institute of Science and Industry came into effect.
134 *Proc. RSC* S3 *11* (1917) xvi–xxi.
135 A. B. Macallum, *Proc. RSC* S3 *11* (1917) xii.
136 *Proc. RSC* S3 *12* (1918) xvi–xviii. 10 George V. Appendix No. 5. A.1919. Proceedings of the Special Committee Appointed to Consider the Matter of the Development in Canada of Scientific Research, *National Research Council. First Proceedings* (Ottawa, 1919), consulted in PAC RG 77 accn. 90–91/153 box 1.
137 *Proc. RSC* S3 *13* (1919) xv–xvi.
138 See below. For research in the NRC, see Gingras (1991), Gingras and Jarrell, eds. (1992), and the earlier accounts W. E. K. Middleton, *Physics at the National Research Council of Canada, 1929–1952* (Waterloo: Wilfrid Laurier University Press, 1979) and N. T. Gridgeman, *Biological*

Sciences at the National Research Council of Canada: The Early Years to 1952 (Wilfrid Laurier University Press, Waterloo, 1979).

139 B. J. Harrington, "On Some of the Advances in Mineralogical Chemistry", *Trans. RSC* S2 *1* (1895) sec. III 3–17.

140 See, e.g., Gingras (1991) pp. 88–90.

141 *Proc. RSC* S2 *11* (1905) viii.

142 *Proc. RSC* S3 *2* (1908) xlv.

143 *Proc. RSC* S3 *2* (1908) xxxvi.

144 *Proc. RSC* S3 *3* (1909) lxvii.

145 *Proc. RSC* S3 *6* (1912) xxiv.

146 This was a reversal of Council's prior position. See Minutes of Council 15 Feb. 1918, PAC MG 28 I 458 vol. 1.

147 *Proc. RSC* S3 *12* (1918) xxii–xxiii.

148 Minutes of Council 15 Feb 1918, PAC MG 28 I 458 vol. 1.

149 *Proc. RSC* S3 *15* (1921) xxi–xxiii, *17* (1923) xxxiii.

150 For background, see C. J. S. Warrington and R. V. V. Nicholls, *A History of Chemistry in Canada* (New York and London: Pitman Publishing Corporation, 1949), for the Chemical Institute of Canada.

151 "Report of Section III", *Proc. RSC* S3 (1925) xxxvi.

152 The peak came around 1955, with about 68.5% scientists. Much of the difference between the sciences and Sections I & II in these years comes from government scientists, notably in the Geological Survey and the National Research Council, with a sprinkling from Fisheries, Agriculture, etc. The proportion of government scientists has since dropped to about a sixth, and, for the RSC as a whole over the past two decades, academics have generally constituted 85% or more of new fellows.

153 *Proc. RSC* S3 *20* (1926) xxxvi–xxxix.

154 *Proc. RSC* S3 *20* (1926) xlii.

155 Louis-Philippe Audet, *Le frère Marie-Victorin, éducateur* (Montréal: Éds. de l'Érable, 1942); Robert Rumilly, *Le frère Marie-Victorin et son temps* (Montréal: Frères des Écoles chrétiennes, 1949).

156 Raymond Duchesne, "D'intérêt public et d'intérêt privé: l'institutionnalisation de l'enseignement et de la recherche scientifique au Québec (1920–1940)", in *L'Avènement de la modernité culturelle au Québec*, ed. Yvan Lamonde & Esther Trépanier (Québec: IQRC, 1986) pp. 210 et seq. Also important in establishing research was the Ecole supérieure de chimie at Laval, which accepted its first students in 1921.

157 *Proc. RSC* S3 *21* (1927) xxxiv.

158 There is a useful discussion of related issues in Marcel Fournier, *L'entrée dans la modernité: science, culture et société au Québec* (Montréal: Éds. Saint-Martin 1986).

159 Masson was unusual in publishing several of his papers in the *Trans. RSC*.

160 Among those elected in the 1940s were Georges Préfontaine [sec V, 1942], Jacques Rousseau [sec. V, 1942], Léo Marion [sec. III, 1942], Jules Labarre [sec. V, 1945], Louis Berger [sec. V, 1946], Adrien

Cambron [sec. III, 1948], René Pomerleau [sec. V, 1948], Pierre Dansereau [sec. V, 1949], Armand Frappier [sec. V, 1949].

161 *Proc. RSC* S3 *24* (1930) xxxv.

162 E. A. Corbett, *Henry Marshall Tory, Beloved Canadian* (Toronto, 1954).

163 H. M. Tory, "Presidential Address. Section III", *Trans. RSC* S3 *22* (1928) 165–78.

164 PAC MG 28 I 458 vol 30.

165 The RSC launched a campaign for matching donations from corporations and from its own fellows. Corporate support was negligible; by 1932, donations from the approximately 300 FRSCs reached $10,770.

166 *Proc. RSC* S3 *26* (1932) vii–xi.

167 L. J. Burpee, 29 Dec. 1931, H. M. Tory Papers vol. 22, PAC MG 30 D 115.

168 *Proc. RSC* S3 *31* (1937) xlvii-xlviii; Minutes of Council 13 Feb. 1937, PAC MG 28 I 458 1.

169 See below, "The RSC and the Second World War" *Proc. RSC* S3 *41* (1947) 33.

170 H. C. Cooke, "Memorandum in support of the requested increase in grant to the Royal Society of Canada, 16 Jan. 1945", in Council Minutes 27 Oct. 1945, PAC MG 28 I 458 vol. 1. *Proc. RSC* S3 *40* (1946) 35–7.

171 Cooke, "Memorandum" 16 Jan. 1945, PAC MG 28 I 458 vol. 1.

172 *Proc. RSC* (1946) 35–7.

173 *Proc. RSC* S3 *39* (1945) 33, *40* (1946) 35, *41* (1947) 33.

174 PAC MG 28 I 458 vols 30–1.

175 See, e.g., *Proc. RSC* S3 *35* (1941) 31, *41* (1947) 35.

176 Endowed by Bell Canada, and named for its past Chair of the Board, Thomas Wardrope Eadie.

177 Funded by the McNeil Consumer Products Company.

178 T. L. Walker, "Mineralogy in Canada, 1882–1932", in *The Royal Society of Canada: Fifty Years Retrospect* (1932) p. 150.

179 *Proc. RSC* S3 *14* viii–ix.

180 E.g., J. Playfair McMurrich, "Presidential Address. The Royal Society of Canada: Its Aims and Needs", *Proc. RSC* S3 *17* (1923) liii–lxiii.

181 "Report of the General Editorial Committee", *Proc. RSC* S3 *20* (1926) xxxi–xxxiv.

182 Tory to Murray, 3 Feb 1925, from Mel Thistle, *The Inner Ring: The Early History of the National Research Council* (Toronto: University of Toronto Press, 1966) p.173, quoted in Gingras, *Physics and the Rise of Scientific Research in Canada* (1991) pp. 102–3. My account of "The Birth of the *Canadian Journal of Research*" follows Gingras.

183 "Report of the General Editorial Committee", *Proc. RSC* S3 *20* (1926) xxxi–xxxiv.

184 F. M. G. Johnson, "Chemistry and the Royal Society of Canada", in *The Royal Society of Canada: Fifty Years Retrospect* (1932) p. 116.

185 "Report of Section V", *Proc. RSC* S3 *20* (1926) lvi.

186 Gingras, *Physics and the Rise of Scientific Research in Canada* (1991) p. 187; pp. 102–14 recount "The Birth of the *Canadian Journal of Research*, and have provided part of the framework for this account.
187 Gingras (1991) pp. 110–11.
188 Gingras (1991) p112; "Co-operation with the National Research Council Regarding Publication", *Trans. RSC* S3 *33* (1939) 58–60.
189 *Proc. RSC* S3 *34* (1940) 48–9.
190 *Proc. RSC* S3 *34* (1940) 48–9; *ibid.* S3 *35* (1941) 34–5.
191 Gingras (1991) p. 113, indicates a smaller committee than does *Proc. RSC* S3 *36* (1942) 35, which lists the following FRSCs appointed to the editorial board of the *CJR*: Chemistry: C. C. Coffin, A. R. Gordon, E. W. R. Steacie; Physics: M. F. Crawford, E. L. Harrington, W. H. Watson; Biological Sciences: E. H. Craigie, A. G. Huntsman, C. L. Huskins, R. Newton, J. M. Swaine, R. B. Thomson.
192 National Research Council, *War History of Division of Chemistry* (Ottawa, n.d.). For WWI, see R. MacLeod, "The Chemists Go to War: The Mobilization of Civilian Chemists and the British War Effort, 1914–1918", *Annals of Science 50* (1993) 455–81, (which merely touches on the Canadian story, but has many parallels), and C. J. S. Warrington and R. V. V. Nicholls, *A History of Chemistry in Canada* (New York: Pitman, 1939).
193 *Proc. RSC* S3 *39* (1945) 35–6; Gingras (1991) pp. 112–3.
194 Gingras, *Physics and the Rise of Scientific Research in Canada* (1991) pp. 72–3; Rutherford to McLennan 1 Feb. 1929, University of Toronto Archives, McLennan MSS, scrapbook letters p. 100.
195 Michael Bliss, *The Discovery of Insulin* (Chicago and Toronto: Chicago University Press, 1982) Collip's discovery of parathyrin, which controls the calcium content of the blood, was published in the *Trans. RSC* (1925) V 25–6 (with E. P. Clark).
196 *Proc. RSC* S3 *25* (1931) xx. Charles Best had to wait until 1950 for his Flavelle Medal.
197 *Proc. RSC* S3 *32* (1938) 37–43.
198 "The Effect of Thyroid Feeding of Rats on a Vitamin-Deficient Diet", *Trans. RSC* (1921) sec. V 29–36.
199 E.g., McLearn, "The fossil zones of the upper Cretaceous Alberta shale", *Trans. RSC* (1937) IV 111–20.
200 Tyrrell with R. E. Hore, "The Kirkland Lake Fault", *Trans. RSC* (1926) IV 51–63.
201 For the geology of Kirkland Lake, see R. J. W. Douglas, ed., *Geology and Economic Minerals of Canada* (Ottawa: Dept. of Energy, Mines and Resources Canada, 1970), pp. 204–5.
202 *Proc. RSC* S3 *32* (1938) 39.
203 Victor Morin, "Representations Made to the Government, and Statements Presented to the Minister of Finance", *Proc. RSC* S3 *33* (1939) 41–5.
204 For a wide-ranging account, see Wilfrid Eggleston, *Scientists at War* (Oxford: Oxford University Press, 1950).

205 See, e.g., W. H. Cook, "Some War-Time Food and Supply Problems", *Trans. RSC* S3 *39* (1945) sec. V, 29–48.
206 A useful survey is Charles Camsell, "Presidential Address Canada's Position in the Mineral Situation of the British Empire", *Proc. RSC* S3 *25* (1931) xxxv–liii.
207 *Proc. RSC* S3 *39* (1945) 42–7.
208 Military science and secrecy go together, in sometimes troublesome fashion. See John Bryden, *Deadly Allies: Canada's Secret War 1937–1947* (Toronto, 1989).
209 G. B. Reed, "Presidential Address: Chemotherapy of Gas Gangrene", *Trans. RSC* S3 *37* (1943) sec. V, 1–10.
210 *Proc. RSC* S3 *41* (1947) 65.
211 M. Christine King, *E. W. R. Steacie and Science in Canada* (Toronto, Buffalo, London: University of Toronto Press, 1989). *Science in Canada: Selections from the Speeches of E. W. R. Steacie*, ed. J. D. Babbit (Toronto: University of Toronto Press, 1965) pp. 107–9. R. Bothwell, *Nucleus: The History of Atomic Energy of Canada Ltd.* (Toronto, 1988). H. C. Cooke, "Memorandum in support of the requested increase in grant to the RSC", 16 Jan. 1945, PAC MG 28 I 458 vol. 1.
212 Cooke, 16 Jan. 1945, PAC MG 28 I 458.
213 The NRC produced a series of mimeographed accounts, *The War Histories of the National Research Council*, in 1946 and 1947; the histories include the activities of the Division of Applied Biology, the Division of Chemistry, the Division of Mechanical Engineering, the Division of Physics, the Radio Branch, and a series of medical accounts by associate committees of the NRC Radar development was particularly striking, see W. E. K. Middleton, *Radar Development in Canada: The Radio Branch of the National Research Council of Canada, 1939–1946* (Waterloo: Wilfrid Laurier University Press, 1981). See also W. Eggleston's 50th anniversary account, *National Research in Canada: The NRC 1916–1966* (Toronto: Clarke Irwin, 1978).
214 "Opening Remarks by the President", *Proc. RSC* S3 *39* (1945) 27–8.
215 "The Royal Society Empire Scientific Conference", MS 26 Oct. 1946, PAC MG 28 I 458.
216 "Report from Section III on Reorganization of the Society", in Council Minutes RSC 19 Feb. 1949, PAC MG 28 I 458 vol. 1. The term of President was first extended to three years (not five) in 1978, beginning with Robert Bell. The term has recently been reduced to two years.
217 *Proc. RSC* S3 *45* (1951) 31–3.
218 *Proc. RSC* S3 *47* (1953) 26.
219 *Proc. RSC* S3 *49* (1955) 49–56.
220 The RSC did elect a few leading industrial scientists during the 1950s, mainly in the earth sciences, but the move died out within a few years, yielding to the rising tide of academic scientists
221 PAC MG 28 I 458 vol. 100.
222 Report of Section V, *Proc. RSC* S3 *42* (1948) 56–7.
223 PAC MG 28 I 458 vol. 1.

224 "Symposium: Canada's Oceans – Known and Unknown", *Proc. RSC.* S3 *43* (1949) 151–91 at 153. Aerial photography by the Royal Canadian Air Force showed that some islands, including Cornwallis and Borden, consisted of two islands; the most dramatic discovery of a new island was that of 9,600 sq. km. Prince Charles Island in Foxe Basin; see J. L. Robinson, "Changing the Arctic Maps", *The Beaver,* Outfit 282, No. 3 (Dec. 1951) 8–9 & No. 4 (March 1952) 24–6.
225 J. A. Pearce to Huntsman [1950], PAC MG 28 I 458 vol. 100.
226 PAC MG 28 I 458 vol. 1.
227 RSC Council Minutes 14 Oct. 1950, ibid.
228 Standing Committee on Oceanography, Report to the Council of the RSC, 15 May 1958, PAC MG 28 I 458 vol. 100.
229 Dunbar to Daviault 24 Feb. 1959, PAC MG 28 I 458 vol. 58.
230 Dunbar to Hachey 18 March 1959, PAC MG 28 I 458.
231 Hachey to Dunbar, 23 March 1959, PAC MG 28 I 458 vol. 58.
232 Grace to Dunbar, 23 March 1959, PAC MG 28 I 458 vol. 58.
233 16 June 1961, PAC MG 28 I 458 vol. 100.
234 16 June 1961, PAC MG 28 I 458 vol. 100. 5 June 1967, PAC MG 28 I 458 vol. 53.
235 PAC MG 28 I 458 vol. 35.
236 In spite of the unifying vision implicit in creating a single section for all the sciences, Section III, subject divisions were formed within the year At first there were eight science Divisions, Mathematics (M), Physics (P), Chemistry (C), Geological Sciences (G), Plant Biology (PB), Animal Biology (AB), Microbiology and Biochemistry (MB), and Interdisciplinary (I); a decade later, Applied Science(AS) became the ninth Division, and by 1975 Medical Science (MS) had been created (from MB) as the tenth. This latter move underscores the tendency to consider Medical Science as an applied science analogous to engineering. The same tendency is evinced by the Eadie Medal, first awarded in 1975; it has been given in the life sciences as well as in the engineering and applied physical sciences. The ten Subject Divisions were clustered into three groups, reminiscent of the original Sections, with G, I, and later AS brought together as group B. The nomination and election practices fostered by the Divisions remained in place until the reforms of 1990, when the sciences reverted to four Divisions within Academy III.
237 *Proc. RSC* S3 *54* (1960) 50.
238 *Proc. RSC* S3 55 (1961) 32. In 1963, the *Transactions* appeared for the first time with contributions from geology and biology together in the new Section III, but without any contributions from physics or chemistry. The growth of discipline-based societies and the need for speed in publication were taking their toll.
239 *Proc. RSC* S4 *2* (1964) 45.
240 "Independent Academy for Science Urged as Learned Societies Meet in Kingston", 5 June 1973, PAC MG 28 I 458 vol. 9.
241 RSC, Minutes of Council 13 Oct. 1973, PAC MG 28 I 458 vol. 2.

242 Development Committee, Report to Council, 30 May 1982, PAC MG 28 I 458 vol. 2. Kerwin explored the role of national academies in several forums, see, e.g., "Study to Identify Specific Missions in the Natural and Human Sciences ...", 25 Oct. 1976, PAC MG 28 I 458 9.
243 G. Bruce Doern, *Science and Politics in Canada* (Montreal: McGill-Queen's University Press, 1972).
244 C. E. Dolman, Pres. Sec. III, draft of proposed letter to the Prime Minister, [? Dec. 1965], PAC MG 28 I 458 vol. 9.
245 "The government did not take this offer very seriously, having in mind the general inactivity of the society during most of its previous history": G Bruce Doern, *Science and Politics in Canada* p. 137.
246 See, e.g., Léo Marion, "Science Policies and the Universities – Presidential Address", *Trans. RSC* S4 *3* (1965) 3–9; Jules Pelletier to C. E. Dolman, 14 June 1965, PAC RSC MSS. C. E. Dolman, Pres. Sec. III, RSC MSS, draft of proposed letter to the Prime Minister, ca. Dec. 1965, urged that, pending establishment of the Science Council, "the Science Section of the Royal Society of Canada should offer its advisory services in matters affecting the official science policies of the Canadian government."
247 Published in *Trans. RSC* S4 *2* (1964), sec. III 325–61.
248 Ibid, 5–6.
249 C. M. Drury, ibid., 355–61.
250 L. Marion, *Trans. RSC* S4 *3* (1965) 3–9.
251 J. W. T. Spinks, "The National Research Council Forecast of Support Needed for Basic Research in Canadian Universities", *Trans. RSC* S4 *2* (1964) 327–37.
252 PAC MG 28 I 458 vol. 53.
253 *Proc. RSC* S4 *6* (1968) 73. The members (with alternates) were H. E. Duckworth (G. N. Patterson), R. Gaudry (J. W. T. Spinks), and F. K. Hare (P. G. Rooney).
254 C. J. Bishop, memorandum to fellows of section III, 8 August 1968, PAC MG 28 I 458 vol. 22.
255 RSC Symposium: "Directions of Research in Canadian Universities", *Trans. RSC* S4 *6* (1968) 3–83; O. M. Solandt, "National Science and Engineering Critique", PAC MG 28 I 458 vol. 22.
256 See, e.g., A. E. Douglas, "Towards a National Science Policy, or Away", *Trans. RSC* S4 *7* (1969) sec. III 297–302.
257 Carter to Lortie 11 March 1969, PAC MG 28 I 458 vol. 22.
258 *Trans. RSC* S4 *7* (1969) sec. III 303–12.
259 [1969] PAC MG 28 I 458 vol. 22: the section included geography (cartography, geomorphology, meteorology, hydrology, biogeography, toponymy, demography, archaeology, etc.) and social science, politics, economics; anthropology (ethnography, folklore); industrial relations and human relations; and statistics.
260 Section III, "Brief Submitted by the Royal Society of Canada to the Special Committee of the Senate on Science Policy Draft", 16 Oct. 1968, and RSC, "Brief to the Special Senate Committee on Science Policy", 1969, PAC MG 28 I 458 vol. 22.

261 Maurice Lamontagne, *A Science Policy for Canada Report of the Senate Committee on Science Policy. Volume 1. A Critical Review: Past and Present* (Ottawa, 1970) p. 255.
262 C. E. Dolman, "Report on the National Science and Engineering Conference Held at Carleton University, Ottawa, July 31 & August 1, 1969, and on the Meeting of the Enlarged Steering Committee Held at the Beacon Arms Hotel, Ottawa, September 5, 1969", 5 Sept. 1969, PAC MG 28 I 458 vol. 9. cf. Lynn Trainor, "The Voice of Science on Parliament Hill", *Canadian Forum* (Oct. 1969) 151: "For the most part, the scientific associations in Canada are democratically organized and not particularly addicted to the elitism so characteristic of scientific societies in the US and Europe. (Only the Royal Society lacks contact with and support from the grass roots of the scientific community.)"
263 *Trans. RSC* S4 *6* (1968) 3–8.
264 Dolman to Schneider, 1 Dec 1970, PAC MG 28 I 458 vol. 31.
265 Maurice Lamontagne, *A Science Policy for Canada Report of the Senate Special Committee on Science Policy. Vol. 3. A Government Organization for the Seventies* (Ottawa, 1973) pp. 749, 753.
266 This lasted until the clause disappeared in 1982.
267 "A Proposal for Canadian International Non-Governmental Representation", 1974, PAC MG 28 I 458 vol. 38. "Response of the Royal Society of Canada to A Science Policy for Canada ... vol. 3", printed *Annex to Proceedings of Senate Special Committee*, 6 Feb. 1974, PAC MG 28 I 458 vol. 44.
268 G. D. Garland, Chairman of RSC Committee on International Relations, letter to members of Council, Academy of Science, 30 Dec. 1974, MG 28 I 458 vol. 38.
269 International Relations Committee report 1977, PAC MG 28 I 458 vol. 32.
270 Ibid.
271 Schneider to Lewis 23 Jan. 1976, PAC MG 28 I 458 vol. 38.
272 This position was not formally taken by the RSC until the 1980s.
273 Fortier in Lamontagne *Committee* "Evidence: Extract from printed Proceedings", MG 28 I 458 vol. 44.
274 Garland, "Committee on International Relations Report to Council", Feb. 1978, PAC MG 28 I 458 vol. 38.
275 Nadeau to Gingras [15] Jan. 1978, ibid.
276 Report of the Committee on Adequacy of Science Representation, 2 Oct. 1967, MG 28 I 458 vol. 34.
277 MG 28 I 458 vols 34, 35.
278 Peter M. Millman, "Areas of Scientific Research Covered by the Interdisciplinary Division of Section III of the RSC", 5 June 1967, PAC MG 28 I 458 vol. 53.
279 Council of RSC, Annex A to Minutes of Meeting, 25 May 1981 for 31 May, PAC MG 28 I 458 vol. 2.
280 D. G. Hurst, "Notes on an Academy of Engineering", 3 Jan. 1984, RSC MSS.

281 Gordon C. Butler [vice-president of IFS and former Director of the Division of Biological Sciences of the NRC], "Science and Development. The Role of the International Foundation for Science", [1980?], PAC MG 28 I 458 vol. 32.
282 The IDRC provided $40,000 for the initial subscription. Ibid.
283 IFS Statutes, 9 July 1971, ibid.
284 Olof Edqvist, "Assistance to Scientific Researchers in Under-Developed Countries – IFS", Feb 1973, ibid.
285 J. T. Wilson, report on IFS meeting in Amsterdam Oct. 1973, 14 March 1974, ibid.
286 International Relations Committee Report 1977, ibid.
287 Ibid. 1978.
288 RSC Council Minutes 1974 John C. Polanyi to Claude Fortier 29 August 1974, PAC MG 28 I 458 vol. 34.
289 Council Minutes 2 June 1974, MG 28 I 458 vol. 2.
290 See, e.g., "Report of the Committee on International Relations", 1976/7; J. Larkin Kerwin, "Notes and News from the President", Dec. 1976, PAC MG 28 I 458 vol. 9. The Pugwash Committee was the principal organizer of a symposium, "Dangers of Nuclear War by the Year 2000", held at Trinity College, Toronto, in May 1978.
291 Committee on International Relations, draft minutes, 31 Jan. 1980, citing letter to William Epstein 22 Oct. 1979, PAC MG 28 I 458 vol. 38.
292 RSC Committee on Development 1981, ibid.
293 Other such involvements were the RSC's membership in the Canadian Commission for UNESCO, which dates from spring 1974 (PAC MG 28 I 458 vol. 38), and in the International Centre of Insect Physiology and Ecology, which operated an institute in Nairobi (Report of the Committee on International Relations 1977).
294 James E. Thomson, ed., *The Grenville Problem*, RSC Special Publication No. 1 (1956). The biological publications were M. J. Dunbar, ed., *Marine Distributions*, RSC Special Publication No. 5, and T. W. M. Cameron, ed., *Energy Flow – its Biological Dimensions*, RSC Special Publication No. 13 (published for the Canadian Committee for the International Biological Programme). The cartographic publication was No. 7, W. F. Ganong, *Crucial Maps in the Early Cartography and Place-nomenclature of the Atlantic Coast of Canada* (1964).
295 *Proc. RSC* S4 *8* (1970) 25.
296 Vol. 3 p. 756.
297 The report recommended that contracts should also go to SCITEC (Association of the Scientific, Engineering and Technological Community of Canada) The RSC was for a while in the 1970s envisaged as the spokesman for Canadian science, but was unsuccessful in this role, in contrast to ACFAS (Association canadienne-française pour l'avancement des sciences); see Yves Gingras *Pour l'avancement des sciences: histoire de l'ACFAS 1923–1993* (Boréal, 1994). The problem of finding an appropriate spokesman for science was not a new one. In 1923, when the rise in the number of scientists had already begun to underline the RSC's role as an elite institution, Robert Thompson of

Section V had urged the Council to consider transforming the RSC into a Canadian Association for the Advancement of Science (Gingras, *Physics and the Rise of Scientific Research in Canada* p. 95).

298 S. D. Clark, PRSC, revised draft letter to Maurice Lamontagne, 30 Dec. 1975, PAC MG 28 I 458 vol. 9. See also printed *Annex to Senate Committee on Science Policy* (RSC response of 6 Feb. 1974, published 12 Aug. 1976) 20:17, PAC MG 28 I 458 vol. 44.

299 *Proceedings of the Special Committee of the Senate on Science Policy Issue No. 20* pp. 20:1–24, copy in PAC MG 28 I 458 vol. 44.

300 C. M. Drury, Minister of State for Science and Technology to S. D. Clark, PRSC, 11 May 1976, PAC MG 28 I 458 vol. 9.

301 *Report* vol. 3 (1973) p. 757. Studies of "policy for science" were, in this proposal, to be contracted out to SCITEC.

302 Reported in S. D. Clark, PRSC, to W. G. Schneider, Pres. NRC [1975] PAC MG 28 I 458 vol. 31.

303 "Final Report Study to Identify Specific Missions in the Natural and Human Sciences and to Recommend Policies and Procedures for Undertaking Such Missions", 30 Sept. 1976, PAC MG 28 I 458 vol. 31, and follow-up document 25 Oct. 1976, PAC MG 28 I 458 vol. 9. Topics included (3) The impact of science and technology on Canadian culture; (4). Uses of artificial satellites (assessment of experiments to be done with CTS); (6). Ecological agriculture; (10) The cultural, social and ethical implications of nuclear energy; (11) Population policy and the energy crisis; (25) Stratospheric pollution, especially the effect on the ozone layer; (26) Effects of atmospheric pollution (medical, social, agricultural, economic). D. G. Hurst was engaged by the RSC to develop possible projects, and remained in an honorary capacity as Executive Director to help with projects, although hampered by a lack of support for the projects proposed.

304 10 March 1976, re RSC meeting with D B. Dewar and others from MOSST, PAC MG 28 I 458 vol. 31.

305 Kerwin to Trudeau, 9 Aug. 1976, and Trudeau to Kerwin, 1 Nov. 1976, PAC MG 28 I 458 vol. 9.

306 D. G. Hurst, draft memorandum to PRSC on "Public Awareness of Nuclear Issues", [April 1977], PAC MG 28 I 458 vol. 100. Apart from this contract, there was one from the NRC for a study of scientific publication in Canada (PAC MG 28 I 458 vol. 31.

307 See R. Bothwell, *Nucleus: The History of Atomic Energy of Canada Ltd.* (Toronto, 1988). Wilfrid Eggleston, *Canada's Nuclear Story* (Toronto, 1965).

308 PAC MG 28 I 458 vol. 31. *Hermes (The Communications Satellite) / Hermès (le satellite technologique de télécommunications: son fonctionnement et ses applications* ed. Irvine Paghis, 3 vols. (Ottawa, 1978), the RSC's 20th symposium volume. For a list of symposia and other publications, see R. H. Hubbard and P. Garneau, *Index to the Transactions and Other Publications of the Royal Society of Canada* (Ottawa: Royal Society of Canada, 1987), Appendix II.

309 Committee on International Relations, draft minutes 31 Jan. 1980, PAC MG 28 I 458 vol. 38.
310 Seminar on Non-Governmental Hemispheric Cooperation ..., 5 May 1981, PAC MG 28 I 458 vol. 35.
311 The Academies of Science of Mexico, USA, and Canada, *Summary Report, Second Seminar on Non-Governmental Hemispheric Cooperation in Science and Technology*, 3–4 June 1982, PAC MG 28 I 458 vol. 35.
312 A different kind of peer review in which the RSC first engaged in the 1980s was its monitoring for NSERC, through John H. Hodgson, of a study by the Canadian Association of Physicists on "Future Trends in Physics Research".
313 RSC, *Development Plan* (1989) p. 10.
314 Caccia to Tremblay 16 Feb. 1984, PAC MG 28 I 458 vol. 100.
315 F. K. Hare, "Nuclear Twilight: A Proposal to the Royal Society of Canada" (1984) PAC MG 28 I 458 vol. 100. See below for Hare's role in the nuclear safety review.
316 22–23 Aug. 1984, PAC MG 28 I 458 vol. 100.
317 *Nuclear Winter and Associated Effects: A Canadian Appraisal of the Environmental Impact of Nuclear War* (Ottawa, 1985).
318 RSC, *Commission on Lead in the Environment: Reports*, 5 vols. (Ottawa, 1985–86).
319 Canadian Participants in ICSU meeting: see T F. Malone and J. G. Roederer, eds., *Global Change* (Cambridge: Cambridge University Press, 1985): A. Driemanis, Dept. of Geology, University of Western Ontario (UWO); W. S. Fyfe, Dept. of Geology, UWO; W. W. Hutchison, ADM, EMR Earth Sciences Sector [Hutchison was not a FRSC, but received the RSC's Bancroft Award in 1980]; R. A. Price, Director General, Geological Survey of Canada; R. W. Stewart, Alberta Research Council; J. R. Vallentyne, Canadian Centre for Inland Waters, Great Lakes biolimnology laboratory.
320 Fyfe was asked to close the session with a summary His talk was shocking and controversial. This eminent geologist started his summary with a slide of a skeletal naked black girl. His second slide was of an African swamp created by injudicious irrigation. The third slide was a Brazilian rain forest after the soil had been washed away. Fyfe's message was that the situation was real and urgent, and that scientists needed to recognize the important global changes that were going on. At the end of Fyfe's talk, Sir Arnold Bergen, formerly of McGill University and the UK-Canada Rutherford Lecturer to Canada in 1984, as well as Foreign Secretary of the RSL, stood up and, in a confrontation that could not have been more eloquent had it been staged, exclaimed that the members had come to discuss scientific problems, and Fyfe's paper had nothing to do with science.
321 W. S. Fyfe, "The International Geosphere-Biosphere Program: Global Change" In T. F. Malone and J. G. Roederer (eds.), *Global Change*, (Cambridge, Cambridge University Press, 1985), p. 506.
322 Later a fifth study group on Remote Sensing was added in collaboration with CODATA.

323 *Trans. RSC*, ser. 4, *23* (1985) 193–9.
324 RSC, CGCP report #1: *Global Change: The Canadian Opportunity*, May 1986
325 CGCP report #1 p. 13.
326 Hare, *Delta 1* 15
327 David Braybrooke and Gilles Paquet, "Human Dimensions of Global Change: The Challenge to the Humanities and the Social Sciences", *Trans. RSC* ser. 5, *2* (1987) 271–91.
328 HDGCP has, however, stalled A definitive statement has not yet emerged for an international program.
329 In 1985–86 Digby McLaren was honorary RSC treasurer. In his opinion the RSC was weak and could do better. When it came time to look for a new president, McLaren, who had retired from government service, was an attractive choice, for his energy and experience. He had been the RSC and NAS foreign associate. In the year preceding his tenure he was given a free hand as president-elect. He worked closely with Michael Dence on the Global Change project, and in shaping the RSC's future direction. The term of president was extended for McLaren.
330 D. McLaren, *Proc. RSC* ser. 6 *1* (1990) appendix C p. 93.
331 M. Chrétien, ed., *AIDS: A Perspective for Canadians (Summary Report and Recommendations)*; *AIDS: A Perspective for Canadians (Background Papers)*; D. Spurgeon, ed., *Understanding AIDS: A Canadian Strategy*.
332 In his dealings with government granting agencies, McLaren used Larkin Kerwin's 1976–77 document on the need for a Canadian national academy, and on such an academy's role. When Gilles Paquet became secretary-treasurer in 1983–88, this report became the basis for "Have Gun Will Travel", an address delivered at a meeting of the Ottawa chapter.
333 The Canadian Global Change Program Phase I Proposal to NSERC August 1988 W. Richard Peltier, University of Toronto (Chairman); William S. Fyfe, University of Western Ontario; Thomas C Hutchinson, University of Toronto; Digby J. McLaren, University of Ottawa; Michael R. Dence, Royal Society of Canada, p. 6.
334 J. Homer-Dixon interview notes with McLaren & Dence Feb. 1994.
335 Ibid.
336 By the time the plans were submitted in March 1989, William Winegard, a former metallurgical engineer and university president, had succeeded Oberle. He was less supportive of the Society than his predecessor had been.
337 $1,000,000 for five years.
338 C. Mungall and D. J. McLaren, eds., *Planet Under Stress: The Challenge of Global Change* (Toronto: Oxford University Press for the RSC, 1990). McLaren had been the convenor of two Dahlem Conferences in Berlin 1986, and editor of the published report, D. J. McLaren and B. J. Skinner, eds., *Resources and World Development*, Dahlem Workshop Reports (John Wiley, West Sussex, 1987).

339 Also important, although developed independently of and parallel to the CGCP was the new interdisciplinary environmental journal, *Ecodécision*, founded in 1991, as a result of the government's desire to promote the use of French in science (after the Institut Pasteur in France had decided to publish mainly in English). The journal's environmental emphasis was largely the consequence of Lucien Bouchard's being the Minister of the Environment when the government decided to put money into the project. McLaren asked Jules Deschênes, then President-elect, to steer the project for the Society.

340 Following the submission of its *Development Plan* in 1989 (see below), the RSC was told that government would increase its general level of support to $1,000,000, linked to the Society's assuming responsibility for three specific national programs: the evaluation of research in Canada; encouraging the advancement of professional opportunities for women in scholarship; and the promotion of the public awareness of science

341 There was also an interest in the health issues of global change, but no money from the MRC: Homer-Dixon interview notes with McLaren & Dence Feb. 1994. The CGCP working groups listed constituted the main framework for the project in its formative years; they have since been replaced by other groups.

342 The government of Ontario had commissioned Kenneth Hare to make a report on nuclear safety. He brought the RSC into the project, and his report was published as one carried out by the Society: F. K. Hare, *The Safety of Ontario's Nuclear Power Reactors: A Scientific and Technical Review, Vol. 1: Report, Summary, and Other Background Papers, Vol. 2: Appendices* (Toronto, 1988). The series of studies that Hare led for the Society gave it valuable experience that was helpful in getting support later in the 1980s.

343 The third goal was cost effectiveness. A mismatch between slender resources and large ambitions has been a recurrent theme in the RSC's history, although not one that I have developed in this account.

BIOGRAPHICAL NOTE

Trevor Levere is Director of the Institute for the History and Philosophy of Science and Technology in the University of Toronto. His publications include *Science and the Canadian Arctic: A Century of Exploration* (Cambridge U. P., 1993). His current research is on the interplay between the development of concepts and apparatus in the history of 18th- and 19th-century chemistry.

Appendix

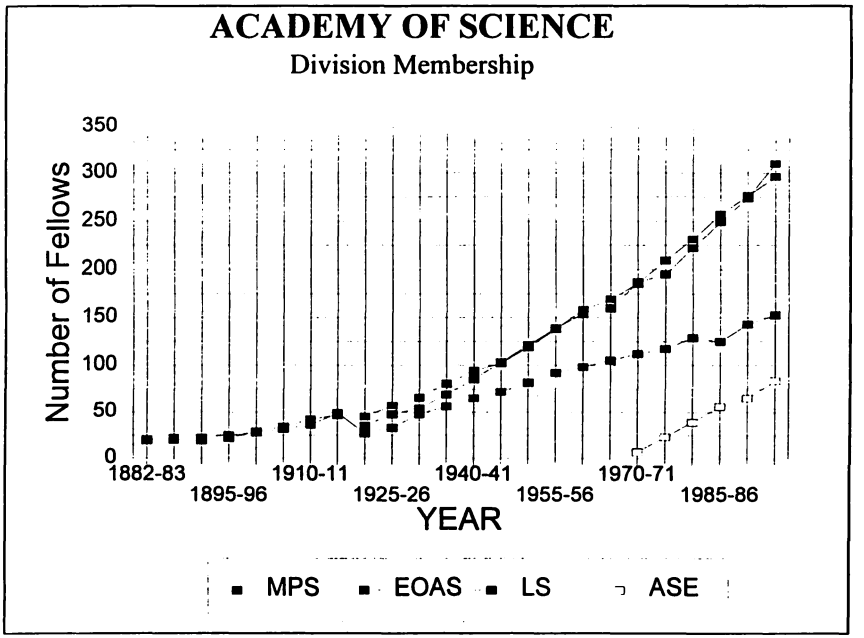
ACADEMY OF SCIENCE
MEMBERSHIP in the ACADEMY OF SCIENCE of the ROYAL SOCIETY OF CANADA

The Tables and Charts presented here summarize the growth of what is now the Academy of Science of the Royal Society of Canada from an original membership of 40 Fellows in 1882 to over 850 in 1996–97. The growth of the Science Sections which eventually merged into the present Academy is compared, at five-year intervals, with that of the rest of the Society in Table I and Chart 1 *(Membership by Academy)*. After two decades of minimal growth the Science Sections grew considerably faster than the other Sections of the Society, reaching almost 70% of the total by 1955. Since then,

TABLE I: FELLOWS IN THE ROYAL SOCIETY OF CANADA

YEAR	Acad.'s I & II	Academy III		TOTAL	Other
	No. of Fellows	No. of Fellows	% of Total	No. of Fellows	Foreign Fellows
1882–83	40	40	50.0	80	0
1885–86	41	42	50.6	83	6
1890–91	40	41	50.6	81	8
1895–96	50	47	48.5	97	9
1900–01	55	57	50.9	112	10
1905–06	59	65	52.4	124	13
1910–11	63	78	55.3	141	11
1915–16	71	96	57.5	167	13
1920–21	83	107	56.3	190	13
1930–31	93	138	59.7	231	16
1934–35	111	210	65.4	321	12
1940–41	117	251	68.2	270	15
1945–46	129	286	68.9	415	9
1950–51	148	331	69.1	479	9
1955–56	163	376	69.8	539	9
1960–61	189	417	68.8	606	3
1965–66	214	442	67.4	656	3
1970–71	228	490	68.2	718	2
1975–76	270	548	67.0	818	1
1980–81	360	621	63.3	981	1
1985–86	423	691	62.0	1114	0
1990–91	514	765	59.8	1279	0
1995–96	616	837	57.6	1453	6

FIGURE I



the rate of membership growth in natural and applied science has changed little, while that of the humanities and social sciences in Academies I and II has accelerated, so that the proportion is moving steadily back to the equality of representation found in the Society's earliest years.

Table II and Figure 1 record the main internal changes within the Academy over its history. The two founding Sections of Mathematical, Physical and Chemical Sciences (Section III) and Geological and Biological Sciences (Section IV) have been reformed several times since 1882. In 1974, the Academy of Science was formed and is now organized into four Divisions: Applied Sciences and Engineering (ASE), Earth, Ocean and Atmospheric Sciences (EOAS), Life Sciences (LS) and Mathematical and Physical Sciences (MPS).

Three main changes in the structure of the Academy are incorporated in Table II. The first conforms to the formation of a Biological Sciences Section (Section V) in 1918, with the Geological Sciences remaining as Section IV. The second corresponds to the period beginning in 1961 when the three science Sections were combined in 1961 into one Science Section, which became the new

TABLE II: ACADEMY OF SCIENCE MEMBERSHIP

Division	MPS			EOAS			LS			ASE			Other Fellows	
	Section III: Mathematics, Physics and Chemistry			Section IV: Geology, Biology									Correspond. Members	Unattached Members
YEAR	Active	Retired	Total	Active	Retired	Total								
1882–83	19	0	19	20	0	20							0	
1885–86	20	0	20	20	2	22							1	
1890–91	17	2	19	20	2	22							1	
1895–96	20	2	22	24	1	25							3	
1900–01	25	4	29	27	1	28							3	
1905–06	30	4	34	30	1	31							6	
1910–11	34	8	42	34	2	36							7	
1915–16	40	7	47	41	8	49							8	
	Section III: Mathematical, Chemical & Physical Science			Section Iv: Geological Science (incl. Mineralogy			Section V: Biological Sciences							
	Active	Retired	Total	Active	Retire	Total	Active	Retire	Total					
1920–21	38	7	45	23	4	27	29	6	35				5	0
1925–26	50	7	57	33	0	33	37	11	48				8	0
1930–31	62	4	66	48	0	48	38	16	54				9	0
1934–35	74	7	81	55	1	56	54	15	69				9	2
1940–41	83	11	94	64	1	65	74	12	86				7	1
1945–46	91	11	102	70	2	72	89	14	103				7	5
1950–51	103	16	119	80	2	82	104	17	121				7	5
1955–56	119	19	138	84	8	92	120	19	139				2	5
1960–61	137	21	158	91	7	98	133	21	154				1	5
	Section III: SCIENCE													
	Group A: Mathematics, Physics & Chemistry			Group B: Earth Sciences			Group C: Biology, Molecular Biology & Medical Science			Group B: Applied Science				
1965–66	146	23	169	95	10	105	140	20	160				1	5
1970–71	165	21	186	97	15	112	149	38	187	7	0	7	0	4
	ACADEMY OF SCIENCE													
	Active	Calendar only	Total	Active	Calendar only	Total	Active	Calendar only	Total	Active	Calendar only	Total		Specially Elected
1975–76	196	13	209	111	6	117	185	10	195	23	0	23	0	4
1980–81	222	9	231	123	6	129	209	13	222	39	0	39	0	5
1985–86	251	6	257	121	4	125	239	10	249	55	1	56	0	3
	Mathematical & Physical Sciences Division			Earth, Ocean & Atmospheric Sciences Div'n			Life Sciences Division			Applied Sciences and Engineering Division			Foreign Fellows	
1990–91	265	11	276	139	4	143	265	9	274	63	2	65	0	3
1996–97	282	14	296	147	6	153	294	16	310	80	4	84	4	2

Section III, within which there were eight Subject Divisions. These were clustered somewhat informally into three Groups, corresponding approximately to the previous three Sections. Group 'A' included mathematics, physics and chemistry, Group 'B' comprised earth sciences and an Interdisciplinary Subject Division, which include geographers, meteorologists, astronomers and emerging disciplines such as computer science, while Group 'C' grouped the biological sciences. By 1970, Applied Science had been added to Group 'B' as a ninth subject Division, and a tenth subject Division, Medical Science, was include in Group 'C' in 1974 , when Section III was renamed the Academy of Science,. This structure continued until 1990 when the Academy was recast into the present four Divisions.

For the purpose of illustrating the growth of the Academy membership, the present Divisions are used, with minor variations, as the equivalent of previous Sections. Thus, the Mathematical and Physical Sciences (MPS) Division is equated with the original Section III. The members in the original Section IV attached to the geological sciences are taken as equivalent to those in the Earth, Ocean and Atmospheric Sciences (EOAS) Division, while the biological sciences in Section V(after 1919) has grown into the Life Sciences (LS) Division. The Applied Science and Engineering (ASE) Division had no explicit equivalent prior to 1970. For consistency, the Interdisciplinary Subject Division has not been included with Earth Sciences. Rather, its members during the period from 1961 to 1991 have been assigned to the Division they joined, or could have been expected to join, in the reorganization of 1991. Most astronomers, for example, are now within the Mathematical and Physical Sciences Division, meteorologists are found in the Earth, Ocean and Atmospheric Sciences, some computer scientists and others in Applied Science and Engineering and a few in Life Sciences.

In Table II Fellows are shown as 'Active' or 'Retired', terms which date from earlier years when Fellows were expected to give papers regularly at the Annual General Meeting. When the Society reorganized into Academies, the 'Retired' category was replaced by that of 'Calendar Only', a somewhat more restrictive term for those who, in retirement, no longer pay dues or take part in any Society activities. Only the total for each Division is plotted in Figure 1. Table II also lists two additional forms of Fellowship. The election of prominent non-Canadians not living in Canada who had links to the Society and its objectives as Corresponding Members was

initiated early by the Society but fell into disuse after 1940 until revived recently under the designation of Foreign Fellow. Before 1915, Corresponding Fellows were not assigned to Sections, so the numbers listed here for that period are extracted from the Society list on the basis of profession or position. The election of a few Canadians as Unattached Fellows began in the 1930's. The category was modified to Specially Elected Fellow when the Academies were formed in 1974, since which time they have been attached to specific Academies. As with Foreign Fellows, the number of Specially Elected Fellows has risen marginally in recent years.

Only the broad outline of the ways in which the Academy of Science has changed as it has grown can be discerned in this summary. A more detailed analysis would demonstrate, for example, the growth of Medical Science in recent decades, paralleling that of Applied Science, and the more prominent place of mathematics within the MPS Division in the last three decades. These and other illustrations of how the Academy reflects the changing face of science in Canada will be possible once a data base of past and present membership, now in progress, has been completed.

Michael R. Dence
Secretary, Academy of Science

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