8

CANADA

One country, two cultures: Two routes to science communication

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1. Introduction

This chapter provides an account of modern science communication in Canada, including historical factors influencing its development, and the development of the distinct Province of Quebec. Canada is a bilingual country. Over 24 million Canadians (74 per cent of the population) speak English at home, and nearly 8.2 million (23 per cent) speak French. Over 5.7 million people (71 per cent of the population) in Quebec speak only French at home (Statistics Canada, 2017). Britain's conquest of New France[1] in the 1760s and Canada's Westminster democratic governance structures and institutions and membership of the Commonwealth significantly shape the country's activities. The 10 Canadian provinces retain several exclusive rights that the Canadian parliament and the federal government cannot infringe upon, and provinces and territories actively work to preserve their cultural distinctiveness through these rights. Quebec's efforts for political, social, economic and cultural emancipation, starting in the interwar years, continue to influence the lives of Canadians in and outside Quebec. Canada also continues to feel the social, cultural, economic and political impacts of its largest neighbour and trade partner, the United States (Dubas and Martel, 1973; Levere, 1988).

1 New France was the area colonised by France in North America from 1534. It ended with the cession of New France to Great Britain and Spain in 1763 under the Treaty of Paris.

The chapter is divided into two main parts, the history of science communication in Canada, followed by an account of its development in Quebec. Science communication in Canada cannot be understood without considering the 'Two Cultures', with few influences or contact between Quebec and the rest of Canada. Science communication in Quebec largely developed on its own, and later influenced the development of science communication in France and other Francophone nations. Significant space will be devoted in this chapter to its development.

2. Science communication approaches in Canada

2.1. Early approaches to science communication in Canada

Like many other industrialised societies, the first half of the 19th century in Canada was marked by the activities of a commercial and professional bourgeoisie steeped in the cultural and intellectual ideas of the Enlightenment. The thrust of science communication initiatives came from learned societies and a collection of individual initiatives. Among these societies were the Literary and Historical Society of Quebec (1824), the Natural History Society of Montreal (1827) and the Mechanics' Institute (1830). While aimed at the elite, these societies contributed to science communication through talks at libraries and natural history museums, aiming to complement humanist education with science culture (Schiele et al., 1994). Since Montreal was the economic capital of Canada at the time, it is difficult to distinguish Canadian science communication initiatives from specifically Quebec initiatives during those early years. In the early part of the 19th century, the political capital of Canada shifted often, before being fixed at Ottawa on the now Ontario–Quebec border. However, Montreal remained the economic capital well into the 20th century.

Canada's learned societies were created following the reorganisation of British North America as a confederation in 1867. Governor-General, the Marquess of Lorne, founded the Royal Society of Canada in 1882. He suggested it could bring Canada's intellectual centres together if they were modelled on the British Royal Society and the French Académie des Sciences (Levere, 1988). In 1916, the Canadian government created the National Research Council (NRC) of Canada, to promote Canadian scientific progress to the public, along with making investments in science and technology research. World War I provided a push for physics and engineering development, funded in part by university and industry research scholarships for postgraduate studies.

In its aftermath, Canada experienced a rise in the number of young researchers trained in Canadian universities, and publications and communication through scientific events supported by the Royal Society of Canada (Gingras, 1991). The Royal Canadian Geographical Society published the first issue of *Canadian Geographic* in 1930 (RCGS, 2018).

During World War II, Canada collaborated in building atomic bombs, and was caught up in the international movement to simultaneously develop, promote and regulate science. As intervention by federal and provincial governments in scientific research grew, science policy became an important issue for the nation (Gingras, 1991).

2.2. National and provincial government policies and programs

In Canada, national policy is made by the Canadian parliament. However, Canadian provinces retain some responsibilities and enjoy a number of exclusive rights upon which the Canadian parliament and federal government cannot intrude: property and civil rights, administration of justice, natural resources and the environment, education, health, welfare, and municipalities. Provincial activities exist in tandem with efforts stemming from federal government programs and national entities, and provincial and territorial governments often resist federal interference. Each province has its own objectives, interests and practices when it comes to science communication.

Eighty-two per cent of government resources devoted to science communication are expended in the four most populous provinces in Canada (Ontario, Quebec, British Columbia and Alberta). Quebec was the first province to create a science policy, in the 1970s (Dufour and Gringas, 1988); and in 1980 was the first province to set goals for the diffusion of science and technology, and support democratic public debates on important issues (Dufour and De la Mothe, 1993).

A 2011 inventory completed by Schiele, Landry and Schiele of informal science communication activities in Canada catalogued over 700 programs or organisations managing initiatives associated with science outreach, science journalism or science education. According to the Council of Canadian Academies (2014), Quebec, Yukon and the Northwest Territories governments have established visions for science promotion and activities aimed at engaging youth and adults with science. Ontario, Saskatchewan and Alberta focus their financial support on skills development to build workforce capacity and encourage innovation for regional industries. Manitoba and the Atlantic Provinces support science outreach programs that complement their provincial science curricula.

Provincial programs have expanded or been adapted at the national level. For example, Canada's National Science and Technology Week, founded in 1990, was modelled on events already happening in Quebec and British Columbia. *Science Rendezvous*, a community science festival, started in the Greater Toronto Area in 2002 and is now the largest science festival in Canada, with events in over 23 cities (Science Rendezvous, 2018).

Federal and provincial government support for science and science communication has waned during the 21st century. Scientific literacy programs and activities can still be found in all Canadian provinces and territories, but with reduced federal and provincial government funding. Science communication in Canada has diversified and relies more heavily on industry, university and wider public support mechanisms. A number of independent research institutions are now well-respected contributors to science communication in Canada.

2.3. The emergence of professional science journalism

After World War II, scientists and scientific societies in Canada increased their roles as science popularisers and Canada followed the United States in professionalising science journalism. The Canadian section of the US-based National Association of Science Writers (NASW) gained its autonomy in 1970 as the Canadian Science Writers Association (CSWA) (Visser-deVries, 2015).

The 1970s through to the early 1980s saw different publishers entering the market with science-based magazines. Prominent examples include *Science Forums, OWL* and *Science Dimensions*, but none managed to establish themselves on a commercial basis and all were relatively short-lived. The Quebec-based French-language *Québec Science* (1962) and *Les Petis Débrouillards* (1981) are the only science magazines to have found commercial success. Canada's science writing efforts were recognised internationally in 2002 when science writer and broadcaster Véronique Morin was elected as the first President of the World Federation of Science Journalists.

Canada has two well-recognised and long-running television series devoted to science that first aired on Canadian television in 1960: Canada Broadcasting Corporation's (CBC) *Nature of Things* and its French-language equivalent *Aux frontières de la science* (Council of Canadian Academies, 2014). Canada's longest-running radio show *Quirks and Quarks* first aired on CBC Radio in 1975 and is currently broadcast in over 40 countries. Three well-known Canadian science communicators have hosted the show: David Suzuki (1975–79), Jay Ingram (1979–91), and Bob McDonald (1992–present).

Michael Ryan and Sharon Dunwoody conducted one of the first surveys of professional Canadian science communicators in 1975. They surveyed 152 members of the National Association of Science Writers who resided in the US or Canada. Respondents recommended 'aspiring science writers' take more classes in science (in preference to journalism) and practice science writing through part-time jobs or summer jobs, which might suggest a lack of science writing courses that balanced both skills. The survey did not report on where respondents were employed or the kind of work they did.

2.4. Science literacy efforts in Canada and creating a science culture

Like many industrialised countries during the 1980s and 1990s, Canada's investment in science communication was heavily influenced by the Organisation for Economic Co-operation and Development (OECD), and OECD work could be considered one of the main drivers of modern science communication in Canada (Pitre, 1994). In 1984, the Canadian government introduced its first national science and technology policy, the Public Awareness Programme for Science and Technology, subsequently redefined and renamed as Science and Culture Canada in 1987 (Dufour and De la Mothe, 1993). The associated Science and Culture Canada Grants scheme had dual aims of supporting economic development and national unity through scientific literacy efforts. Commentators have argued that this policy was only possible because it recognised provincial autonomy: the focus was provincial and national cooperation, and it emphasised province-building initiatives (Dufour and Gringas, 1988).

Two notable national surveys of science literacy and attitudes towards science have been conducted in Canada. In 1989, Edna Einsiedel conducted a telephone survey of over 2,000 Canadian adults assessing their scientific literacy and attitudes towards science and technology (Einsiedel, 1994). Einsiedel was one of the first researchers to investigate the relationship between knowledge and attitudes using survey data (Bauer, Allum and Miller, 2007). She found that high scientific literacy levels in the Canadian survey population were positively correlated with positive attitudes towards science, particularly trust in science and feelings of efficacy in relation to science. In 2014, a second survey on science culture with 2,004 respondents was conducted by EKOS Research Associates Inc. on behalf of the Council of Canadian Academies (CCA). It showed that, compared with other countries, Canadians' attitudes towards science and technology are generally positive and that people have few reservations about science. Ninety-three per cent of the Canadians surveyed reported an interest in science and technology.

Canadian's factual knowledge about science has improved since Einsiedel's 1989 study. Both surveys used the same seven knowledge-related questions, and findings demonstrated an improvement in the science knowledge of survey respondents for each question. Authors of the 'science culture' report for 2014 attribute this to an increase in the level of education. However, it is important to consider the impact of public attitudes on levels of scientific literacy. Findings of a subsequent survey conducted in 2016 by the Ontario Science Centre show that, while most of the 1,578 respondents were confident about their level of science knowledge, their understanding of controversial topics that divide the Canadian population such as climate change, vaccinations and genetically modified organisms was variable (Montgomery, 2016; Ontario Science Centre, 2016). For example, 89 per cent claimed they understood the science behind vaccinations, but 19 per cent also said (erroneously) that there were links between vaccinations and autism. The Quebec Provincial Government has also produced several studies and reports on the state of science culture in Quebec, and these are discussed in the section on Quebec in this chapter.

2.5. Popular science: Journalists, scientists and the media

Early national and provincial government policies recognised the economic potential of science and technology and guided the science communication research accordingly (Schiele and Landry, 2012). One of the earliest studies, *A Research Study on Science Communication*, conducted in 1973 by Orest Dubas and Lisa Martel, focused on science media reporting. The researchers found that Canada had around two dozen full-time science and technology reporters and as many as 200 reporters who covered at least some stories related to science and technology. The researchers used data compiled by Margaret Brasch from the Journalism Department at Carleton University, and information provided by CSWA (Dubas and Martel, 1973). Building on traditions of media research conducted in the US (see, for example, Friedman, 1986; Dunwoody, 1980; and Nelkin, 1995), Canadian researchers identified how science news develops, how it is reported through various channels, and the various audiences for science news. Through content analyses of Canadian newspapers and surveys with Canadian journalists, researchers have found that 'hard' science news stories in Canada were mostly framed internationally, positively and drawn from wire services (Einsiedel, 1992; Saari, Gibson and Osler, 1998).

Raymond Duchesne (1981) was one of the first Canadian researchers to critique studies of science media reporting in Quebec, arguing that the media representations of science in Quebec served dominant interests and lacked critical perspective. A few years later, Chris Dornan came to the same conclusion for Canadian Anglophone media (Dornan, 1988, 1990).

But writing for the popular media did not always achieve the policy impact that scientists desired. In more recent research, Bentley and colleagues (2011) analysed academic attitudes to popular science publishing. In a comparison of academic authors in 13 countries, they found that Canadians were some of the most productive, publishing more popular science articles in newspapers and magazines than academics in most other countries. But it did not always work for the scientist-authors: John Besley and Kathryn O'Hara drew on survey work to investigate the attitudes of 1,142 Canadian researchers who had received a federal research grant. Using survey questions administered previously in the US with American Association for the Advancement of Science (AAAS) members, they found that Canadian researchers were extremely concerned that policymakers were not using scientific evidence in their decision-making. Canadian researchers wanted to see an impact from their own work rather than just seeing it communicated (Besley and O'Hara, 2018).

2.6. Canadian journalism awards

Canada has a number of awards dedicated to excellence in science media and communication practices. In 1973, the CSWA launched the Ortho Award for print science journalism, and over the years the program has expanded to include awards for radio, television, magazine, newspaper, trade publication, books and the Herb Lampert student writing award. In 1981, the awards were renamed the Science in Society Journalism Awards and were sponsored by government and the private sector. In 1981, Association des communicateurs scientifiques (ACS) created the Fernand-Séguin scholarship to encourage reporting excellence in young science journalists. In 1982, the Royal Canadian Institute created the annual Sandford Fleming Award to recognise Canadians who make outstanding contributions to the public understanding of science. The Royal Society of Canada established the McNeil Medal in 1991, awarded to an individual for the ability to promote and communicate science to students and the public within Canada. Finally, the Natural Sciences and Engineering Research Council of Canada launched the annual Awards for Science Promotion in 2001, to honour individuals and groups who make outstanding contributions to the promotion of science in Canada.

2.7. From scientist to science broadcaster: Fernand Séguin and David Suzuki

Fernand Séguin (1922–86) in Québec and David Suzuki (1936–) in English Canada are examples of scientists turned science broadcasters who achieved national prominence, in different contexts and one generation apart. Séguin started his professional life as a biochemist at Université de Montréal in 1945, and Suzuki as a geneticist at the University of British Columbia in 1963.

Very early in his career (1947), Séguin joined the radio program *Radio-Collège* at Radio-Canada, continuing after its transition to television in 1954. Putting an end to his academic career and devoting himself full time to journalism from the mid-1950s, Séguin scripted his radio and television appearances (*L'école buissonière*, 1955; *La joie de connaître*, 1955–57; *Le roman de la science*, 1957–60; *Les frontières de la science*, 1960–61; *Sciences réalité*, 1975–78). From the 1960s, he developed his own radio and television programs (*Connaissances d'aujourd'hui*, 1965–66; Sel *de la Terre*, 1965–70; *Magazine Science*, 1970–71; *La Science et vous*, 1971–79).

By comparison, Suzuki waited nearly 10 years to make the transition to broadcasting, taking sabbatical leave to host the TV program *Science Magazine* at CBC and the radio program *Quirks and Quarks*. Suzuki was criticised by some peers for taking sabbatical leave to pursue activities unrelated to advancing scientific knowledge (Dornan, 1987). In 1979 he moved over to television to host *The Nature of Things*, motivated to move because of the reach of television and the need for an informed Canadian public that could engage in democratic decision-making (Suzuki, 2006). He worked with the British Broadcasting Corporation (BBC) and the Public Broadcasting Service (PBS) on *The Secret of Life*, which aired in 1993, and with the Discovery Channel on *The Brain*, which aired in 1994. He has authored or co-authored more than 50 books, including 20 books for children. Suzuki is also a well-known critic of government inaction on environmental protection. He remained an academic until his retirement in 2000.

Séguin and Suzuki have received numerous awards for their communication work. Both received the title of Officer of the Order of Canada, and both were elevated to Companions of the Order of Canada (Séguin in 1978, elevated in 1988; and Suzuki in 1977, elevated in 2005). They also received the international UNESCO Kalinga Prize for the Popularisation of Science for their careers as broadcast communicators; Séguin in 1977 and Suzuki in 1986.

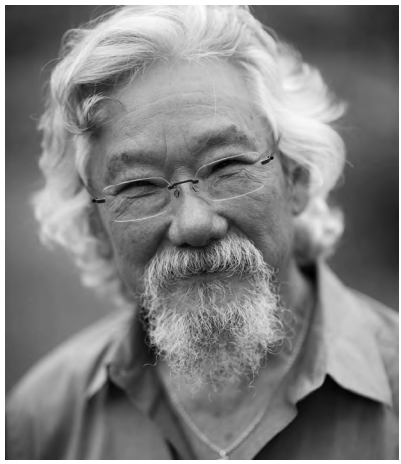

Figure 8.1: Canadian science broadcaster and environmental activist David Suzuki.

Source: David Suzuki Foundation, davidsuzuki.org.

Figure 8.2: Canadian science broadcaster Fernand Séguin, 1961.

Source: Archives UdeM, Fonds Fernand Séguin, cote P0241/1fp,05156.

While Séguin remained a committed science educator, Suzuki became an environmental activist. In 1990, he co-founded the David Suzuki Foundation to provide 'evidence-based research, education and policy analysis' in order to 'work to conserve and protect the natural environment, and help create a sustainable Canada' (David Suzuki Foundation, 2018, para. 4). But Suzuki attracted significant criticism in Canada: he announced in 2012 that he was stepping down from the board of his own foundation because of political and media pressure that was putting the charitable status of his organisation at risk (Stoymenoff, 2012). Most recently, business leaders, donors, faculty members and Premier of Alberta Rachel Notley criticised the University of Alberta for awarding Suzuki an honorary degree because he was a critic of the Alberta tar sands development (Bennett, 2018).

2.8. Science centres and museums

In tandem with a focus on science media reporting, Canada has a long tradition of communicating science through science centres. The Council of Canadian Academies (2014) notes that most provinces support science centres, parks and museums to some degree. In 1967 the Canada Museum of Science and Technology opened in Ottawa; in 1969, the Ontario Science Centre opened in Toronto. The Ontario Science Centre was Canada's first interactive science centre, modelled on San Francisco's Exploratorium and Detroit's Museum of Science and Technology. Science centres in other

provinces and territories followed. The Canadian Council of Science Centres (CCSC) (now the Canadian Association of Science Centres (CASC)), was established in 1985 as a national network of science centres in Canada. It represents more than 40 science centres, museums, aquariums and planetariums. Canadian research into the management and design of these centres, audience reception and appropriate of content has made a valuable contribution to the field internationally (see, for example, Schiele, 2008, 2014; Schiele and Koster, 2000).

2.9. Training and research at Canadian universities

Before formal courses in science communication were established, academic research on science communication was supported through other disciplinary programs. Canada's first PhD thesis on a 'science communication' topic was written by Bernard Schiele, a graduate student in education at the University of Montreal in 1978, under the title: *Incidence télévisuelle sur la diffusion des connaissances scientifiques vulgarisées: Science-Réalité, un cas particulier de vulgarisation scientifique* [Televisual incidences on the diffusion of vulgarised scientific knowledge: Sciences-Réalité, a specific case of scientific vulgarisation]. The first master's thesis was produced in 1984 by Suzanne Champagne, who graduated from the Faculty of Social Sciences at Laval University, Quebec City. Her thesis was titled: *La vulgarisation scientifique, ses agents, ses adeptes: le cas du magazine Québec science* [Scientific vulgarisation, its agents, its devotees: The case of the magazine *Quebec science*].

The first accredited science communication qualification in Canada is a multidisciplinary graduate diploma offered in partnership between Science North and Laurentian University in Sudbury, Ontario, since 2005. In 2010, Mount Saint Vincent University created the first undergraduate degree in science communication. The first master's in science communication was launched in 2017 at Laurentian University. This points to the very recent emergence of science communication as an umbrella term for a number of recognised professions. Universities in other provinces, including Quebec, Nova Scotia and British Columbia, offer science communication training as part of other accredited programs. Since 1994, the University of Toronto has offered a master's program in Biomedical Communications, while Carleton University recently acquired a Chair in Digital Science Journalism. Science journalism research and teaching programs are well established at Concordia University (since 2008) and the University of British Columbia (since 2010).

Canadian researchers actively participate in international debates on science communication. An analysis of English-language science communication research output worldwide, distributed through the Web of Science database

(1976–2015), shows that Canada is among the top five countries publishing on science communication and the public, along with the US, the UK, Germany and Australia. A similar pattern is identified in contributions to three of the most relevant international English-language journals in science communication—*Science Communication*, *Public Understanding of Science and Technology* and *Journal of Science Communication*—where Canadian researchers are the fifth most prolific, with 64 papers published between 1994 and 2015 (Barata, Caldas and Gascoigne, 2018). In terms of general science research output, Canada is in seventh place for the number of publications distributed through Scopus Database (1996–2017) and the Web of Science (Schnell, 2017).

2.10. Citizen involvement in science communication

Communication researchers have recorded a shift in science communication to more dialogic models of communication, starting at the beginning of the 20th century (Einsiedel, 2008). Canada has taken part in this shift, but responded later than other industrial societies to calls for policies to support greater citizen participation in decision-making processes or 'upstream engagement'. Canada's first consensus conference was held in Alberta in March 1999 on the topic of food safety (Einsiedel and Eastman, 2000). This event was thought to be too controversial to receive federal ministry support (Einsiedel, Jelsøe and Breck, 2001) but was funded through a range of other sources: Canada's national social sciences research grant body, a provincial government community grant, the University of Calgary and two non-government organisations (the National Institute of Nutrition, and the Food Biotechnology Communications Network).

During the 2000s, governments at various levels supported commissions, citizen conferences and science cafés on health risks including genetic modification and assisted human reproduction. Canadian governments, research institutions and non-profit organisations have come to recognise lay expertise and the co-production of knowledge through government and citizen science initiatives supported by non-profit organisations. For example, Canada's *NatureWatch* web portal, launched in 2000, helps recruit citizen scientists to track changes in the environment through a number of programs: *FrogWatch, PlantWatch, WormWatch, IceWatch* and *MilkweedWatch*. Canada's national web-based portal for citizen science was recently launched on Science.gc.ca. It contains links to 20 Canadian projects requiring citizen input including earthquake monitoring, flu tracking, agriculture and climate condition changes, tree-disease outbreaks, and shark and whale sightings (Government of Canada, 2018).

2.11. Government attempts to muzzle scientists and grassroots resistance

In 2010, Canada came to world prominence for the federal government's attempts to muzzle scientists on controversial issues such as climate change (Turner, 2013). Organisations including the CSWA were instrumental in raising awareness about this issue and advocating for scientists' freedom to speak (see, for example, O'Hara, 2010). In the same year, the Canadian Science Media Centre (SMC) opened as a not-for-profit entity to address the media's lack of access to Canadian scientists and to provide expert support for non-specialist reporters. The non-profit science advocacy group, Evidence for Democracy, was formed in 2012 after thousands of Canadians marched in Death to Evidence rallies calling for more evidence-based decision-making for a strong Canadian democracy (Evidence for Democracy, 2013; Turner, 2013). Evidence for Democracy organised Stand Up for Science rallies in September 2013 in 17 Canadian cities. In 2013, the Professional Institute of the Public Service of Canada (PIPSC) surveyed its scientist members employed in federal institutions and found that 90 per cent of them felt they were not allowed to speak freely to the media about their work (PIPSC, 2013). In 2014, PIPSC and the United States Union of Concerned Scientists (UCSUSA) coordinated a letter signed by 815 scientists from 32 countries to Prime Minister Stephen Harper urging him to lift media communication restrictions on federal researchers and stop drastic funding cuts to the federal science budget (An Open Letter on Science to Canadian Prime Minister Stephen Harper, 2014). According to commentators, science was a major campaign issue prior to the 2015 federal election (see, for example, Halpern, 2015) and attracted extensive media coverage and all-party debates on science policy (CBC, 2015). In 2017, PIPSC launched a new survey and concluded that while there had been some progress, the change of government had not rectified the 10 years of damage to science communication (PIPSC, 2017).

2.12. The impact of new and emerging technologies on science communication

Coupled with government ambivalence towards science communication over the last decade, Canada has experienced the impact of new and emerging technologies and changing economic conditions. These changes have reshaped the mainstream media landscape in many parts of the world, including Canada, and the effects have been exacerbated by neoliberal agendas. The changes and their impacts on Canadian journalism were captured in the Canadian survey report *The Shattered Mirror* (2017). The survey found that Canadians prefer to be informed through the media but on their own timelines and with little or no cost to themselves.

Canada's science media have responded to new media in many ways. For example, in 2005, CBC's *Quirks and Quarks* became the first major CBC radio show to be made available as a free podcast. Canada's very active blogging community has been developing from the early 2000s, and recent digital initiatives are helping redefine what independent science communication looks like. These initiatives include *Science Borealis*, launched in 2013 (Science Borealis, 2018), *Hakai Magazine* launched in 2015 (Hakai Magazine, n.d.), and *The Conversation Canada* launched in 2017 (The Conversation Canada, 2018). Twitter, Instagram and YouTube are also supporting a growing number of science communicators engaging a diverse range of publics in digital spaces. For example, in 2013 Canadian astronaut Chris Hadfield used social media (Twitter and YouTube) to communicate about life on board the International Space Station. Over 392,000 people followed him on Twitter while he was aboard the Space Station (Strauss, 2018), and in 2018 he had over 2.3 million followers.

In 2016, the Canadian Science Writers Association changed its name to the Science Writers and Communicators of Canada Association (SWCC) to reflect the new diversity of its membership as well as the declining number of full-time journalists in mass media organisations. SWCC now describes itself as a national alliance of professional science communicators in all media, to reflect the blurring boundaries between journalism, science communication and public relations activities (SWCC, 2017). In 2017, SWCC launched the People's Choice Awards for Canada's favourite science site and Canada's favourite blog to reflect the inclusion of new media.

3. Science communication in Quebec: National emancipation and the centrality of the state

The Province of Quebec is the second most populous and second richest in Canada after Ontario. To many, while Ontario is the successor of the Province of Upper Canada, Quebec is the successor of Lower Canada. Rivalries between the two provinces run deep. The Province of Quebec is the reorganisation of the Colony of New France following the British Conquest in 1763. By comparison, Ontario was founded by the Loyalists, supporters of the British Crown, system of government and way of life. They had resisted the drive for American independence and fled to British-ruled territories in 1783. The two societies, the 'two solitudes', find their origins in these events.

To some extent, the modern tensions between Quebec and the rest of Canada are the continuation of the opposition between 'Canadiens', the conquered French-speaking subjects of a Catholic absolute monarchy, and the 'Empire Loyalists', the defeated English-speaking supporters of the British Crown during the American War of Independence who were forced to resettle in great numbers in Quebec and Ontario. Both the 'Canadiens', the future Québécois and the 'Empire Loyalists' remained attached to their respective religions and institutions and rejected rule by others. The British Empire could only consolidate its hold by ensuring that 'Empire Loyalists' were ruled by the British Common Law, and 'Canadiens' by the French Civil Code. Thus, the creation of Upper and Lower Canada, which only reinforced the distinctiveness of each.

As the British population expanded across Canada, the 'Canadiens', who were at first the largest population and remained so in Quebec, became a minority in Canada as a whole. While English Canadians rallied for King and Empire at the onset of the Great War, French Canadians resisted conscription. As noted above, Canadian provinces retain several exclusive rights upon which the Canadian parliament and federal government cannot intrude; and successive Quebec governments have actively used these prerogatives to preserve and develop French Canada's and then Quebec's cultural distinctiveness.

3.1. The first trends in science communication

The Quebec government brought support to existing learned societies before taking over science communication efforts in the 1840s, becoming the impetus for science communication and the development of science education in general (Chartrand et al., 2008). Yet government activities remained secondary to the efforts of other groups and individuals until the pull of industrialisation from the late 1850s. This led to a full reorganisation of the education system and, from that time on, the sciences were considered to be a necessary condition for economic and industrial development. The second industrial revolution, from the late 19th century, was even more impactful than the first, and prompted the development of vocational education in Quebec and the creation in Montreal of professional schools such as the Surveying School (1907) and the School of Forestry (1910), both affiliated to Quebec City–based Laval University.

In those years, clerics played important and overlapping roles in scientific research and the diffusion of science. They debated publicly in the exploding number of short-lived print journals (Carle and Guédon, 1988): *Le naturaliste canadien* (1868), *La Science populaire illustrée* (1886), *La Science pour tous* (1891), etc. In parallel, the press followed emerging scientific controversies

very closely. The Catholic Church retained control over education and knowledge in general in Quebec, publicly denouncing Darwin's thesis while refraining from formally banning it (Chartrand et al., 2008).

3.2. The catalyst of national affirmation

Because of the political and social context in Quebec, World War II had an impact but it was not the catalyst for science communication as in the rest of Canada and many other countries. What is now known as the public communication of science and technology (PCST) started in Quebec in the interwar period as part of a movement for political, social, economic and cultural emancipation, and led by Brother Marie-Victorin (1885–1944). The objective was to refute the dominant Anglophone discourse that French-Canadians were too 'Latin' and Catholic to be scientifically minded. Vulgarisation not only played a major role to that end, it acquired its contemporary legitimacy (Chartrand et al., 2008).

The founding of the University of Montreal in 1920 revolutionised Francophone post-secondary education in Quebec. Science remained secondary and a majority of graduates were clerics, but it opened administrative and teaching positions to laymen and also opened the first Faculty of Science. In parallel, as a way to increase the number of graduates entering the workforce, the Quebec government created a scholarship program for students wishing to pursue post-secondary education in France. By ensuring a francophone study and work environment in Quebec, the conditions were set for the development of a francophone scientific community. As secondary education underwent reform from 1923, scientists such as Brother Marie-Victorin advocated in magazines and newspapers for greater inclusion of science in the school curriculum. Supporters of French-Canadian economic nationalism, these advocates argued that economic and intellectual independence was impossible without the mastery of knowledge and the control of natural resources (Gingras, 1996). It is with this specific purpose that the Association Canadienne-Française pour l'Avancement des Sciences (ACFAS) [French-Canadian Association for the Advancement of Science] was founded in 1923 (Gingras, 1994). There is no English-speaking equivalent in Canada. Five years later, the Institut Franco-Canadien (IFSC) was founded with the express purpose of improving the exchanges between Quebec and French scientists.

The Great Depression of the 1930s could have led to the shrinking of already limited resources and facilities, potentially plaguing not only PCST initiatives but science education and scientific research in general. However, the active resistance and mobilisation of the scientific community, notably Brother Marie-

Victorin, ensured their preservation and expansion (Gingras, 1996). In 1931, the scout movement-inspired Cercles des Jeunes Naturalistes (CJN) [Circles of Young Naturalists] and the Zoological Garden of Quebec City were founded. In 1933, the first genuine ACFAS conference was held (Gingras, 1994); a scientific exhibition designed by the CJN attracted 100,000 persons in two weeks; and the construction of the Montreal Zoological Garden started. These events demonstrated the growing interest of the public in science and scientific issues. The scientific community brought its support to the Union Nationale party during the 1936 election, and its election gave a voice to the scientific community and ensured its institutionalisation. One of the results of the election was the establishment of ACFAS as the main structure of the scientific community (Duchesne, 1978).

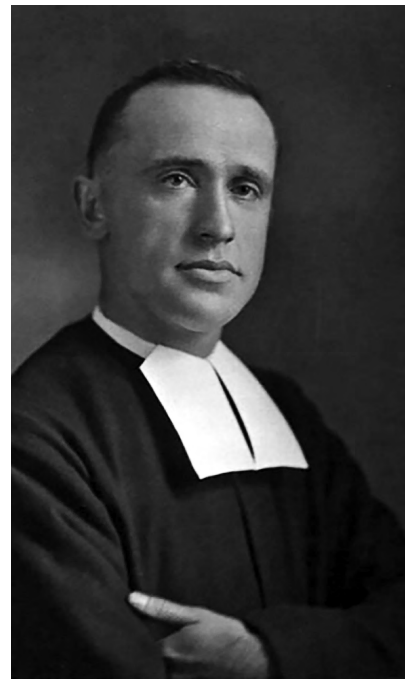

Figure 8.3: Brother Marie-Victorin circa 1920, photographer Albert Dumas.

Source: Collection Centre d'archives de Québec, Bibliothèque et Archives nationales du Québec, cote :P1000,S4,D83,PM39.

Yet universities and research institutes did not receive the funding and the support to match the development of science and the growing numbers of students. Fundamental research was stifled. In parallel, the Union Nationale government favoured staunch conservative policies in all domains and upheld the continued domination of the Catholic Church on educational matters. Although the 1949 Royal Commission on National Developments in the Arts, Letters and Sciences recommended financing universities, the Union Nationale government refused all subsidies, denouncing federal interference in provincial prerogatives. The 1953 Royal Commission of Inquiry on Constitutional Problems, called by the Quebec government, made similar recommendations (Gouvernement du Québec, 1956), but they failed to meet the demands of the scientific community (Duchesne, 1978).

This period came to be known as the Great Darkness. Growing dissatisfaction with the situation in Quebec was expressed as early as 1948 by the artist Paul Émile Borduas (1905–60) in the *Manifeste du Refus global* [The Global

Rejection Manifesto], the publication of which was the catalyst for the growing radicalisation of the movement for secularisation and national emancipation. The success of PCST, as for other conditions of this emancipation, was seen as resting on the successful taking and exercising of political power by nationalist and progressive actors.

3.3. The Quiet Revolution and the pull of independence

The 1960 election of the Liberal Party became the catalyst for the modernisation of all aspects of Quebec life. Now the State, regardless of the political party in power, was the motor behind the development of science and technology. Although individual initiatives remained a significant feature, the role of the State in the development and evolution of Quebec since the 1960s (and not least of all in PCST) cannot be understated (Duchesne, 1978). The 1961 Royal Commission on Education in the Province of Quebec, commonly known as the Parent Commission, advocated and guided a deep reform of the education system. Although scientific research was still not seen as a fundamental issue and the business community wished to tie it to economic development, the commission prioritised fundamental research (Gouvernement du Québec, 1965). Although the CJN started to wane, the government promoted scientific leisure activities, such as science fairs, through the *Conseils du loisir scientifique* and the *Association des jeunes scientifiques*. In 1962, ACFAS created *Le Jeune Scientifique,* which remains today Canada's oldest and only science magazine for adults. This French-language magazine was renamed *Québec Science* in 1970 and is published today. In 1968, ACFAS created the *Conseil de la jeunesse scientifique* (Gingras, 1994).

It was not until the 1970s that PCST became a priority for the State. The lagging of research in Quebec became a critical issue to universities, the scientific community and the business community. At this time, a large proportion of Québécois were reaching adulthood. This generation was not only literate and critical but they were also active participants in the debates of the time. Independence was the main issue. The Quebec nation had come of age and, thus, the more nationalist the party in power, the more its PCST initiatives were aimed at independence. In 1971, the new liberal government published *Les principes de la politique scientifique du Québec* [The Principles of the Quebec Science Policy] (Gouvernement du Québec, 1971), which emphasised fundamental research and science training. The same year, an interdepartmental committee on science policies was set up, followed in 1972 by the Science Policy Council. In 1974, ACFAS set up the Fédération du loisir scientifique (Gingras, 1994). During those years, a new generation of science communicators and journalists came of age, which notably manifested itself with the renaming of the *Le Jeune Scientifique* to *Québec Science* (1970).

With the 1977 election, the Parti Québécois government prepared for independence, imposing French as the only official language in the Province. The Quebec branch of the CSWA broke away to reorganise itself as the ACS. A new press agency solely dedicated to PCST was founded the very next year, Agence Science-Presse, launching its own science magazine: *Hebdo-Science*. The Parti Québécois launched the most thorough reform of education and PCST to date. In 1978, the government published a white paper on cultural development (Gouvernement du Québec, 1978); in 1979, a green paper on science policy (Gouvernement du Québec, 1979); and, in 1980, another white paper entitled *Un projet collectif: énoncé d'orientations et plan d'action pour la mise en oeuvre d'une politique québécoise de la recherche scientifique* [A Collective Project: An Orientation Statement and Action Plan for the Implementation of a Quebec Scientific Research Policy] (Gouvernement du Québec, 1980). In this last paper, the government announced a significant allocation of resources for university and industrial research and the sponsorship of vulgarisation and scientific leisure, including a Maison des sciences [House of Science] to be built in Montreal. In the same vein, the Semaine des Sciences [Science Week], the Petits débrouillards movement and the magazine *La puce à l'oreille* (1982) were launched. In 1981, the Conseil du développement du loisir science [Science Leisure Development Council] replaced the ACFAS-promoted Conseil de la jeunesse scientifique. However, to the great disappointment of the Parti Québécois government and the nationalist intellectuals, the Quebec electorate rejected independence by a large majority in the 1980 referendum.

3.4. The 1980s economic crisis and the neoliberal shift

In the 1980s, Quebec felt the full thrust of the economic crises that had been brewing since the mid-1970s. From 1982 on, governments around the world were compelled to improve their countries' competitiveness through reform. The Parti Québécois was no exception. In this new context, and at the behest of the OECD (1980, 1981), the reform of PCST and its promotion was seen as crucial to what the Parti Québécois government called the 'technological turn' (Gouvernement du Québec, 1982). Now State policy would promote PCST for economic growth, regardless of the party in power, and often to the detriment of other ends (Pitre, 1994).

Contrary to what may be expected, there was little to no direct influence of ideas coming from the American tradition of 'scientific literacy', British 'public understanding of science' or French 'culture scientifique, technique et industrielle', which were all emerging in parallel. In fact, it was the development of PCST in Quebec that influenced the development of PCST in France during those years (Santerre, 2008).

Without doubt, the 1980s were the high point of State intervention in PCST: the State published a number of official papers promoting PCST and enacted numerous policies aimed at supporting, developing and providing resources for PCST. In 1983, the Ministry of Higher Education launched a program designed to support the development of PCST and, in 1985, the ministry itself was reorganised as the Ministry of Higher Education and Science. Although the government put a stop to the creation of a Maison des sciences et des techniques, it published in 1986 a report entitled *La diffusion de la culture scientifique et technique au Québec* [Science and Technical Culture Diffusion in Quebec] (Gouvernement du Québec, 1986), and in the following year it inaugurated an International Science Fair, an exhibition entitled *Images du futur* [Images of the future] dedicated to high-tech applications in the arts, and *Expotec*, a yearly exhibition on a science topic.

The year 1988 was particularly momentous. First, the government published the *Énoncé d'orientations et plan de développement de la culture scientifique et technique au Québec* [Policy Declaration and Development Plan of Science and Technology Culture in Quebec] (Ministère de l'Enseignement supérieur et de la Science, 1988), which identified as the main dissemination channels educational institutions, media, leisure, exhibitions, science camps, museum institutions and interpretation centres. Second, the city of Montreal launched its first Cultural Municipal Policies in science, technology and heritage. Third, the government started to support PCST magazines in order to consolidate this new sector and to help new magazines establish themselves. Fourth, the government set up programs to sponsor national (i.e. Quebec-based) PCST organisations and major national PCST events: Agence Science-Presse, La Société de la Semaine des sciences and, from 1992 on, the Festival du international du film scientifique [International Science Film Festival] and the Expo-sciences panquébécoise [Panquebec Science fair]. Fifth, the government created support programs for temporary and traveling science and technology exhibitions. Finally, the Musée de la Civilisation [Civilisation Museum] was inaugurated in Quebec City.

The first half of the 1990s was especially dynamic as well. In 1992, an internal government document entitled *Les défis de la culture scientifique et technique au Québec* [Challenges of Science and technical culture in Quebec] (Ministère de l'Enseignement supérieur et de la Science, 1992) acknowledged the existence of PCST infrastructure and made recommendations to make science learning more attractive, stimulate the involvement of scientists, promote a positive image of science, increase the resources of local organisations and promote the collaboration of existing public networks. Among notable events were the transformation of the *Semaine des sciences* into the *Quinzaine des sciences* [Science Fortnight] and the renaming of the *Société de la Semaine des science* to

Société de la promotion de la science et de la technology, and the enlargement of its mandate. The Petits débrouillards movement rapidly expanded and spread internationally, not only to Francophone countries, but also to the Czech Republic and Slovakia as well (Les Petits Débrouillards, n.d.). The launch of *Les Petits Débrouillards* book series and the inauguration of the Montreal Biodôme, an indoor zoo with the recreation of natural habitats, all happened around that time.

The fiscal year of 1994–95 saw the opening of the Montreal Biosphere (an environmental museum), the Botanical Garden Complex (a botanical and entomological museum), the Armand Frappier Museum (a human health museum) and the Cosmodome (a space museum). The same year, the government published a report on the importance of PCST entitled *Miser sur le savoir* [Bet on Knowledge] (Gouvernement du Québec, 1994). The third (and largest to date) international conference of the PCST Network took place in Montreal alongside an international science exhibition, with exhibits coming from world-class institutions and with the support of both the federal and provincial governments. This conference became the basis for the first global survey of science culture: *When science becomes culture: World survey of scientific culture*. Finally, in 2000, the Montreal Science Centre or, more accurately, the Interactive Science Centre (iSci), was inaugurated.

And yet, at the turn of the 1990s, neoliberalism and its state counterpart, new public management, finally took precedence over all other priorities of the State. As a result, PCST was left to individual, associative and community actors while the State largely disengaged itself. In 1994, the Science Development Directory was transferred from the Ministry of Education to the Ministry of Commerce, Science and Technology. The next year, the narrow defeat of the second referendum broke the momentum for independence and, with it, for state- and nation-building. The government still ordered a number of studies on the state of PCST in Quebec at the turn of the 2000s (Gouvernement du Québec, 2002a, 2002b), but the State ceased to be the main driving force behind PCST. The last study ordered by the Quebec government on PCST was published in 2004 (Gouvernement du Québec, 2004).

4. The future for modern science communication in Canada

Recent surveys of Canadian science communicators identified though Twitter and Instagram show that, compared to traditional science communication professionals, social media communicators are younger, paid less (or not at all) for their science communication activities, and have been communicating

science for fewer years than other kinds of science communicators (Riedlinger, Barata and Schiele, 2019). They are more likely to have a science background (rather than communication, journalism or education background) and are less likely to be members of professional associations. These communicators tend to be based in Ontario, Quebec and British Columbia, and communicate with each other through their own informal networks. Canadian social media science communicators are primarily located in the provinces identified by Schiele and Landry (2012) as the most prolific regions for science communication in Canada, where Canada's most prestigious and traditional universities are located, and where the bulk of Canada's population is concentrated. While some science journalists and communicators in Canada mourn the perceived loss of control over science communication as a loss of quality and accuracy, others welcome digital technology for the public engagement potential it offers. For example, Canadian science Instagram communicator Samantha Yammine was recently criticised in a *Science* magazine op-ed piece for trivialising scientific endeavours on social media (Wright, 2018). However, supporters of Yammine argued that she was successfully responding to the Instagram medium in her communication (see, for example, Lougheed, 2018; Marks, 2018). *Science* has subsequently published an article by Yammine and other social media communicators on the benefits of social media for science communication (Yammine, Liu, Jarreau and Coe, 2018). Social media platforms are allowing space for sociopolitically motivated communicators in Canada to work productively. The impact of these social media science communication efforts is difficult to assess; yet open science for consensus building and support for science in society efforts are needed in Canada now more than ever.

Canada has seen increased investments in science as described by the Naylor Report and the Global Young Academy, but science communication and outreach efforts are still needed to support science culture nationally (Boon, 2017a). Funding for activities happens at the federal level through agency funding; however, Canadian scientists, science communicators and science policymakers have criticised some recent initiatives for being primarily aimed at youth rather than adults, supporting mainly traditional and established organisations rather than innovative science communication initiatives, and having limited connection with the current and broader community of science communicators in Canada. While some science communicators are actively advocating for greater institutional support for a wider range of science communication initiatives (see Boon, 2017b), governments and scientific communities have been slow to respond.

Austerity continues to dominate public policy in Quebec, and science culture has ceased to be a priority. The Society for the Promotion of Science and Technology dissolved in 2010 and State-sponsored PCST in Quebec has come to an end. PCST actors and networks in Quebec persevere although they face difficulties in achieving an online presence in a global, yet overwhelmingly Anglophone, social media environment. However, the European Union program *Horizon 2020* may very well encourage a new period of renewed government interest in science communication.

References

An Open Letter on Science to Canadian Prime Minister Stephen Harper. (2014). Retrieved from s3.amazonaws.com/ucs-documents/science-and-democracy/canada-letter-word-by-country.pdf.

Association des communicateurs scientifiques de Quebec (ACS). (2018). Our association. Retrieved from www.acs.qc.ca/notre-association.html.

Barata, G., Caldas, G. and Gascoigne, T. (2018) Science communication research: National and international contributions. *An Acad Bras Cienc.*, *90*(2.1), 2523–42. doi.org/10.1590/0001-3765201720160822.

Bauer, M. W., Allum, N. and Miller, S. (2007). What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda. *Public Understanding of Science*, *16*(1), 79–95. doi.org/10.1177/0963662506071287.

Bennett, D. (2018, 25 April). Notley disagrees with University of Alberta honorary degree for David Suzuki. *Globe and Mail*. Retrieved from www.theglobeandmail.com/canada/article-notley-disagrees-with-university-of-alberta-honorary-degree-for-david/.

Bentley, P. and Kyvik, S. (2011). Academic staff and public communication: a survey of popular science publishing across 13 countries. *Public Understanding of Science*, *20*(1), 48–63. doi.org/10.1177/0963662510384461.

Besley, J. and O'Hara, K. (2018, 14 April). Scientists hit the streets to command policy-makers attention. *NatureIndex*. Retrieved from www.natureindex.com/news-blog/scientists-hit-the-streets-to-command-policy-makers-attention.

Boon, S. (2017a, 13 September). Science funding in Canada should include science communication. *Watershed Notes* [Blog post]. Retrieved from snowhydro1.wordpress.com/2017/09/13/science-funding-in-canada-should-include-science-communication/.

Boon, S. (2017b, Sept 11). Canadian science needs more than funding: it needs public champions. *Science Borealis*. Retrieved from blog.scienceborealis.ca/canadian-science-needs-more-than-funding-it-needs-public-champions/.

Borduas, P.-E. (1948). *Refus global*. Montréal: Mithra-Mythe.

Carl, P. and Guédon, J.-C. (1988). Vulgarisation et développement des sciences et des techniques: le cas du Québec (1850–1950). In D. Jacobi and B. Schiele (eds), *Vulgariser la science. Le procès de l'ignorance* (p. 201). Seysell: Champ Vallon. doi.org/10.7202/1002104ar.

Carpentier, J.-M., and Ouellet, D. (1994). *Fernand Seguin: le savant imaginaire*, Montréal: Libre Expression.

CBC. (2015, 10 October). All-party election science debate. *Quirks and Quarks*. Retrieved from www.cbc.ca/radio/quirks/quirks-quarks-for-oct-10-2015-1.3264916/all-party-election-science-debate-1.3264954.

Chartrand, L., Duchesne, R. and Gingras, Y. (2008). *Histoire des sciences au Québec de la Nouvelle-France à nos jours*, Montréal: Boréal. doi.org/10.7202/045475ar.

Council of Canadian Academies. (2014). *Science culture: Where Canada stands*. Retrieved from www.scienceadvice.ca/en/assessments/completed/science-culture.aspx.

David Suzuki Foundation (2018). About us. Retrieved from davidsuzuki.org/about/.

Dornan, C. (1987). Science as ideology: The problem of science and the media reconsidered (PhD thesis). McGill University. Retrieved from www.mcgill.ca/ahcs/graduate/grads.

Dornan, C. (1988). The 'problem' of science and the media: A few seminal texts in their context, 1956–1965. *Journal of Communication Inquiry*, *12*(2), 53–70. doi.org/10.1177/019685998801200205.

Dornan, C. (1990). Some problems in conceptualizing the issue of 'science and the media'. *Critical Studies in Media Communication*, *7*(1), 48–71. doi.org/10.1080/15295039009360163.

Dubas, O. and Martel, L. (1973). *Media impact: A research study on science communication* (Vol. 2). Ministry of State, Science and Technology.

Duchesne, R. (1978). *La science et le pouvoir au Québec (1920–1965)*, Québec: Éditeur officiel.

Duchesne, R. (1981). L'état et la culture scientifique des québécois. *Les Cahiers du Socialismes*, *8*(Fall), 109–38.

Dufour, P. and De la Mothe, J. (1993). *Science and technology in Canada*. Detroit: Gale/Cengage Learning.

Dufour, P. and Gingras, Y. (1988). Development of Canadian science and technology. *Science and Public Policy*, *15*(1), 13–18.

Dunwoody, S. (1980). The science writing inner club: A communication link between science and the lay public. *Science, Technology, & Human Values*, *5*(30), 14–22. Retrieved from www.jstor.org/stable/689304.

Einsiedel, E. F. (1992). Framing science and technology in the Canadian press. *Public Understanding of Science*, *1*, 89–102. doi.org/10.1088/0963-6625/1/1/011.

Einsiedel, E. F. (1994). Mental maps of science: Knowledge and attitudes among Canadian adults. *International Journal of Public Opinion Research*, *6*(1), 35–44. doi.org/10.1093/ijpor/6.1.35.

Einsiedel, E. F. (2008). Public participation and dialogue. In M. Bucchi and B. Trench (eds), *Handbook of public communication of science and technology* (pp. 173–84). London: Routledge.

Einsiedel, E. F., Jelsøe, E. and Breck, T. (2001). Publics at the technology table: The consensus conference in Denmark, Canada, and Australia. *Public Understanding of Science*, *10*(1), 83–98.

Evidence for Democracy. (2013). About E4D. Retrieved from evidencefordemocracy.ca/en/about.

Friedman, S. M. (1986). The journalist's world. In S. M. Friedman, S. Dunwoody and C. L. Rogers (eds), *Scientists and journalists: Reporting science as news* (pp. 17–41). New York: The Free Press.

Gingras, Y. (1991). Physics and the rise of scientific research in Canada. Montreal: McGill-Queen's University Press.

Gingras, Y. (1994). *Pour l'avancement des sciences: histoire de l'ACFAS, 1923–1993*, Montréal: Boréal. doi.org/10.7202/305406ar.

Gingras, Y. (1996). Marie-Victorin intellectuel. In *Frère Marie-Victorin, Science, culture et nation*, Montréal: Boréal.

Gouvernement du Québec. (1956). *Commission royale d'enquête sur les problèmes constitutionnels*. Québec: Éditeur officiel.

Gouvernement du Québec. (1965). *Rapport Parent*. Québec: Éditeur officiel.

Gouvernement du Québec. (1971). *Les principes de la politique scientifique du Québec*. Québec: Éditeur official. doi.org/10.7202/040482ar.

Gouvernement du Québec. (1978). *La politique québécoise du développement culturel* (vols 1 and 2). Québec: Éditeur officiel. doi.org/10.7202/1054250ar.

Gouvernement du Québec. (1979). *Pour une politique québécoise de la recherche scientifique*. Québec: Éditeur officiel. doi.org/10.7202/1054250ar.

Gouvernement du Québec. (1980). *Un projet collectif: énoncé d'orientations et plan d'action pour la mise en oeuvre d'une politique québécoise de la recherchée scientifique*. Québec: Éditeur official. doi.org/10.7202/1054250ar.

Gouvernement du Québec. (1982). *Le virage technologique. Bâtir le Québec – Phase 2. Programme d'action économique 1982–1986*. Québec: Éditeur officiel. doi.org/10.7202/600896ar.

Gouvernement du Québec, Conseil de la Science et de la Technologie. (1986). *La diffusion de la culture scientifique et technique au Québec*. Québec: Éditeur officiel. doi.org/10.3138/cmlr.44.4.739a.

Gouvernement du Québec, Conseil de la Science et de la Technologie. (1994). *Miser sur le savoir*. Québec: Éditeur officiel. doi.org/10.3138/cmlr.44.4.739a.

Gouvernement du Québec, Conseil de la Science et de la Technologie. (2002a). *La culture scientifique et technique au Québec: un bilan*. Québec: Éditeur officiel. doi.org/10.3138/cmlr.44.4.739a.

Gouvernement du Québec, Conseil de la Science et de la Technologie. (2002b). *Enquête sur la culture scientifique et technique des Québécoises et des Québécois*. Québec: Éditeur officiel. doi.org/10.7202/1055295ar.

Gouvernement du Québec, Conseil de la Science et de la Technologie. (2004). *La culture scientifique et technique: une interface entre sciences, la technologie et la société*. Québec: Éditeur officiel. doi.org/10.3138/cmlr.44.4.739a.

Government of Canada. (2018). Citizen Science Portal. Retrieved from science.gc.ca/eic/site/063.nsf/eng/h_97169.html.

Hakai Magazine. (n.d.). About us. Retrieved from www.hakaimagazine.com/about-us/.

Halpern, M. (2015, 27 October). How science helped to swing the Canadian election. *The Guardian*. Retrieved from www.theguardian.com/science/political-science/2015/oct/21/how-science-helped-to-swing-the-canadian-election.

Les Petits Débrouillards (n.d.). Histoire. Retrieved from www.lespetitsdebrouillards-idf.org/qui-sommes-nous.

Levere, T. H. (1988). The history of science of Canada. *British Journal of Historical Science*, *71*(4), 419–25.

Lougheed, T. (2018, 27 March). ICYMI. Social media sells science short. Sad! *Science Writers and Communicators of Canada*. Retrieved from sciencewriters.ca/6002325.

Macleod, D. (1996). A small band of devotees: Recent history of Canadian science and technology. *Journal of Canadian Studies*, *31*(2), 183–189.

Marks, G. S. (2018, 20 March). A scientist responds to that 'Science' Instagram essay. *Massive Science*. Retrieved from massivesci.com/articles/instagram-science-sam-women-representation/.

Ministère de l'Enseignement supérieur et de la Science. (1988). Énoncé d'orientations et plan de développement de la culture scientifique et technique au Québec, May. doi.org/10.4000/books.pum.18232.

Ministère de l'Enseignement supérieur et de la Science, Direction du développement scientifique. (1992). Les défis de la culture scientfique et technique au Québec, réflexions sur les pratiques et les strategies ministèrielles en mantière de culture scientifique et technique, May. doi.org/10.4000/books.pum.18232.

Montgomery, M. (2016). Canadians and science literacy: We're No 1…um…maybe not. Retrieved from www.rcinet.ca/en/2016/09/23/canadians-and-science-literacy-were-no-1um-maybe-not/.

Natural Sciences and Engineering Council of Canada. (2015). *NSERC 2020: A strategic plan*. Retrieved from www.nserc-crsng.gc.ca/NSERC-CRSNG/NSERC 2020-CRSNG2020/NSERC2020-2020CRSNG_eng.pdf.

Nelkin, D. (1995). *Selling science: How the press covers science and technology*. New York: Freeman.

O'Hara, K. (2010, 29 September). Canada must free scientists to talk to journalists. *Nature*, *467*. doi.org/0.1038/467501a.

OECD. (1980). *Changement technique et politique économique: la science et la technologie dans le nouveau contexte économique et social*. Paris: OECD. doi.org/10.3406/estat.1991.5574.

OECD. (1981). *La politique scientifique et technologique pour les années 1980*. Paris: OECD.

Ontario Science Centre. (2016). *Ontario Science Centre survey reveals gap in public understanding of critical scientific issues* [News release]. Retrieved from www.ontariosciencecentre.ca/Media/Details/432/.

PIPSC. (2013). *The big chill: Silencing public interest science, a survey*. Retrieved from: www.pipsc.ca/portal/page/portal/website/issues/science/bigchill.

PIPSC. (2017). *Defrosting public science: A survey report on federal government efforts to reverse the effects of The Big Chill*. Retrieved from www.pipsc.ca/sites/default/files/comms/Defrosting-report-e_v4%202_1.pdf.

Pitre, R. (1994). La culture scientifique et technique et les politiques scientifiques au Québec: le rôle de l'OCDE. In B. Schiele (ed.), *When Science Becomes Culture*, Proceedings II, Sainte-Foy: Multimondes.

RCGS. (2018). About us. Retrieved from www.rcgs.org/about/history/rcgs_cg1930.asp.

Riedlinger, M., Barata, G. and Schiele, A. (2019). The landscape of science communication in contemporary Canada: A focus on anglophone actors and networks. *Cultures of Science*, *2*(1), 51–63. Retrieved from cos.cnais.org.cn/html/collection-full-text.html?id=2083a2b0e95d49fb9651d432bac21665&num=5.

Ryan, P. M. and Dunwoody, S. L. (1975). Specialized training and the science writer. *Journal of Technical Writing and Communication*, *5*(2), 82–90. doi.org/10.2190/98ug-a2hw-w96w-dk33.

Saari, M.-A., Gibson, C. and Osler, A. (1998) Endangered species: science writers in the Canadian daily press. *Public Understanding of Science, 7*, 61–81. doi.org/10.1177/096366259800700105.

Santerre, L. (2008). From democratization of knowledge to bridge building between science, technology and society. In D. Cheng, M. Claessens, T. Gascoigne, J. Metcalfe, B. Schiele and S. Shi (eds), *Communicating science in social contexts: New models, new practices*, New York: Springer. doi.org/10.1007/978-1-4020-8598-7_17.

Schiele, B. (2008). Science museums and science centres. In M. Bucchi and B. Trench (eds), *Handbook of public communication of science and technology* (pp. 41–54). London: Routledge. doi.org/10.4324/9780203483794.ch4.

Schiele, B. (2014). Science museums and centres: evolution and contemporary trends. In M. Bucchi and B. Trench (eds), *Routledge handbook of public communication of science and technology* (pp. 56–73). London: Routledge. doi.org/10.4324/9780203483794.ch4.

Schiele, B., Amyot, M. and Benoit, C. (1994). Quebec: Overview of scientific and technological culture and assessment of government action. In B. Schiele (ed.), *When science becomes culture* (pp. 13–72). Ottawa: University of Ottawa Press.

Schiele, B. and Koster, E. H. (2000). *Science centers for this century*. Quebec: Editions Multimondes.

Schiele, B. and Landry, A. (2012). The development of science communication studies in Canada. In B. Schiele, M. Claessens and S. Shi (eds), *Science communication in the world* (pp. 33–63). Springer, Dordrecht. doi.org/10.1007/978-94-007-4279-6_3.

Schiele, B., Landry, A. and Schiele, A. (2011). *Science communication in Canada: An inventory for the major PCST initiatives carried out in Canada*. Research report to the Korean Foundation for the Advancement of Science and Creativity. Montreal: CIRST-UQAM, University of Quebec at Montreal.

Schnell, J. (2017, 19 June). Canada at 150: The Canadian research landscape. *Clarivate Analytics*. Retrieved from clarivate.com/blog/science-research-connect/canada-150-canadian-research-landscape/.

Science Borealis. (2018). About us. Retrieved from scienceborealis.ca/about-us/.

Science Rendezvous. (2018). About Science Rendezvous. Retrieved from www.science rendezvous.ca/about/.

Statistics Canada (2017). English, French and official language minorities in Canada. Retrieved from www12.statcan.gc.ca/census-recensement/2016/as-sa/98-200-x/2016011/98-200-x2016011-eng.cfm.

Stoymenoff, A. (2012, 17 April). David Suzuki forced to resign from board of foundation by 'vicious' media attacks. *Vancouver Sun.* Retrieved from www.vancouverobserver.com/sustainability/2012/04/17/david-suzuki-forced-resign-board-foundation-vicious-media-attacks.

Strauss, S. (2018). Bye-bye moonwalks: Hello Tweets. *Science Writers and Communicators of Canada*. Retrieved from sciencewriters.ca/.

Suzuki, D. T. (2006). *David Suzuki: The autobiography*. Vancouver: Greystone Books.

SWCC. (2017). Mandate. Retrieved from sciencewriters.ca/Mandate.

The Conversation Canada. (2018). Who we are. Retrieved from theconversation.com/ca/who-we-are.

Turner, C. (2013). *War on science: Muzzled scientists and wilful blindness in Stephen Harper's Canada*. Vancouver/Berkeley: Greystone Books.

Visser-deVries, A. (2015). CSWA/ACRS celebrates 45th anniversary. History. Retrieved from sciencewriters.ca/History.

Weigold, M. F. (2001). Communicating science: A review of the literature. *Science Communication*, *23*(2), 164–93. doi.org/10.1177/1075547001023002005.

Wright, M. (2018). Instagram won't solve inequality. *Science*, *359*(6381), 1294. doi.org/10.1126/science.359.6381.1294.

Yammine, S. Z., Liu, C., Jarreau, P. B. and Coe, I. R. (2018). Social media for social change in science. *Science*, *360*(6385), 162–63. doi.org/10.1126/science.aat7303.

Canada and Quebec timeline

Event	Name	Date	Comments
First interactive science centre established.	The (traditional) Canada Museum of Science and Technology in Ottawa	1967	1969: The Ontario Science Centre opens in Toronto. This was more interactive
First national (or large regional) science festivals.	Science fairs in Winnipeg, Edmonton, Toronto, etc.	1959	2008: Science Rendezvous is now the largest science festival in Canada
Association of science writers or journalists or communicators.	Canadian Science Writers Association (CSWA) formed. Now renamed (SWCC)	1970	1977: The Association des communicateurs scientifiques de Quebec (ACS) formed
First university courses to train science communicators.	A graduate diploma by Science North and Laurentian University	2005	2008: First undergraduate degree at Mount Saint Vincent University, Halifax
First master's students in science communication to graduate.	First master's thesis by Suzanne Champagne, Faculty of Social Sciences, Laval University	1984	1997: The English-language master's by Chantelle Bita Kudsi at McGill University, Montreal
First PhD students in science communication graduate.	First French-language PhD was Bernard Schiele, Faculty of Education, University of Montreal	1978	1987: Canada's first English-language PhD: Chris Dornan, Communications Program, McGill University, Montreal

Event	Name	Date	Comments
First national conferences in science communication.	Conference Association Canadienne Française pour l'Avancement des Sciences	1933	1971: The first annual meeting of the Canadian Science Writers' Association
National government programs to support science communication.	National science and technology strategy (InnovAction) released	1987	2007: A federal strategy to foster a culture that values entrepreneurship and gets Canadians excited about science
First significant initiatives or reports on science communication.	Symons Royal Commission on Canadian Studies acknowledges the role of science in society in Canadian culture	1975	1980: Quebec government white paper, *Un projet collectif*, plus other reports 2014: Academies report, *Science Culture*
National Science Week founded.	Semaine des Sciences [Science Week] launched in Quebec	1980	1990: First National Science and Technology Week
First significant radio programs on science.	*Radio-Collège* at Radio-Canada	1941	1975: *Quirks and Quarks* airs on CBC Radio
First significant TV programs on science.	CBC's *Nature of Things* airs on television	1960	1960: Fernand Séguin hosts *Aux frontières de la science* 1979: David Suzuki hosts *The Nature of Things*
First awards for scientists or journalists or others for science communication.	The Canadian Science Writers Association (CSWA) launched the Ortho Award for print science journalism	1973	1981: The Fernand-Séguin scholarship to encourage young science journalists 2001: NSERC Awards for Science Promotion
Date hosted a PCST conference.	Third PCST conference held in Montréal, 'When Science Becomes Culture'	1994	2004: The 4th World Conference of Science Journalists in Montreal 2017: 'Science and You' Conference in Montréal
Other significant events.	Report by Orest Dubas and Lisa Martel, *Media impact: A research study on science communication*	1973–75	1989: Edna Einsiedel conducts surveys on public perceptions of science
	The first consensus conference held on the topic of food safety	1999	
	The Canadian Science Media Centre opens	2010	

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