THE CANADIAN ACADEMY OF ENGINEERING/L'ACADÉMIE CANADIENNE DU GÉNIE

In 1980, unlike a dozen or so other countries, Canada had no national Academy of Engineering. The process of the formation of one began that year with the appointment by the Engineering Institute of Canada of a very small Task Force to study Academies in other countries and to advise on the feasibility of having one in Canada. By mid-1985, after studies, consultations and discussions initiated by this Task Force, the decision to establish one was made. Two years later, the Canadian Academy of Engineering was founded as a non-profit, non-government organization to give advice on national problems involving engineering, to identify distinguished engineers, and to identify future engineering challenges. Its Fellows were to be nominated by their peers.

Over the years since 1987, this Academy has grown in membership to around 750 and has participated, both alone and in collaboration with other organizations, in providing studies and advice on a wide variety of achievements, problems and opportunities pertaining to the present and future of engineering in Canada.

The mostly chronologically-arranged historical information that follows is illustrative rather than definitive. It describes most highlights and omits many details. Nor does it discuss details of the Academy's studies and opinions. Additional information - for example, on the Academy's publications, newsletters and list of presidents - can be accessed through its website (https//www.cae-acg.ca), by e-mail (info@cae-acg.ca), from the sources noted in and at the end of this paper, or by contacting CAE headquarters at 55 Metcalfe Street, Suite 300, Ottawa, Ontario K1P 6L5.

Historical Background:

The engineering profession in Canada began its formal existence and structure with the establishment of the 'learned' Canadian Society of Civil Engineers in 1887, the term 'civil' meaning 'non-military.' In 1918 this Society became the Engineering Institute of Canada (EIC). Beginning in 1970, the Institute evolved into a federation of discipline-oriented learned societies.

The licencing of the practice of engineering on a provincial basis began in the early 1920s and, in 1936, a Dominion Council of Professional Engineers (later the Canadian Council (CCPE), and later still Engineers Canada (EC)) was established to provide the associations with a national focus. The Council has also acted as the accreditation agency for undergraduate engineering programs in the universities and as the qualification agency for admission to professional practice.

Along the way, in 1925, an Association of Consulting Engineers of Canada (ACEC) was founded to foster and promote the business of consulting with the Dominion Government. Similar associations with provincial mandates were formed later.

Since 1960, the Royal Society of Canada has had an Academy of Science, to which engineers have been admitted on the basis of their research and publication achievements. However, the majority of engineers follow non-research/publication careers and are not eligible for election to the Society.

Before 1980, unlike the professional structures in countries such as the United States, Britain and Australia, there was no *Academy* of Engineering that recognized high distinction among the members of the profession nationally and offered advice and service to the country. While the idea of a *Canadian* Academy had been informally discussed, no action had been taken towards its establishment. This changed in 1980 when the Engineering Institute took the initiative and established a very small Task Force (of two past presidents) to study this idea and to provide input to the establishment of an Academy. Over the next five years, extended discussions and consultations were held and a variety of organizational options were considered by the Task Force. At a meeting in Ottawa in August 1985, the decision was made by a group of representative senior engineers that an independent Academy should be established and a small executive committee was formed to take the initial steps. Quite soon, this group was expanded to become the Provisional Council of the Academy to draft by-laws and prepare other necessary documentation, and to select the 40 or so of their peers to become founding members. Membership, By-laws and Finance Committees were established. In addition to the Engineering Institute, the formation process for the Academy had the active support of the Royal Society of Canada (RSC) and the National Research Council (NRC).

Management and Administration:

The Academy held its founding meeting on 20 May in 1987 in Montréal during a week spent celebrating the Centennial of the formal founding of the profession in Canada. The honour of being the first member of the Academy was accorded to 98-year-old retired engineer and EIC past president, John Stirling. Robert Legget was elected the founding president of the Academy, with Philip Lapp as president-elect, Larkin Kerwin as vice-president, and Léopold Nadeau as secretary-treasurer. They became the Academy's first Executive Committee. Also, the publication of a regular bilingual *Newsletter* began right way, and has continued ever since, although its format has been electronic since the 2013. The Academy's headquarters have always been in Ottawa. Initially, the NRC provided these facilities, but since 1990 they have been in shared accommodations located in downtown Ottawa.

The Academy's mission was, initially:

> Given the essential importance of engineering to the prosperity of Canada and the quality of life of Canadians, the…Canadian Academy of Engineering is to assemble a cadre of Fellows elected from among Canada's most experienced and distinguished engineers, and to make their collective expertise available to

Canada at the national as well as local levels, both in response to requests and invitations and at the initiative of CAE itself.

The Academy was established under Part II of the Canada Corporations Act. Among its tasks were these: to provide independent and expert advice on matters of national importance pertinent to engineering; to recognize outstanding contributions to society and to the country by leading Canadian engineers; to highlight exceptional engineering achievements; and to serve the nation in connection with significant challenges involving engineering and technology. Originally, the Academy was to have a maximum of 250 members. In order to preserve its credibility and impartiality when giving advice, the Academy was to remain independent of regular government funding, but could accept contracts from governments and from private organizations and sponsors. Annual fees, augmented by donations and the earnings of the investment portfolio, and later by contracts, sponsored study income and partnerships with other organizations, have provided the Academy's financial means. As well, the Engineering Centennial Board, having discharged its obligations for the 1987 event, granted its residual $50,000 to the Academy. In the early years, it also received some financial and other assistance from the NRC. There has been no basic support funding from the federal or other governments.

The Academy's Officers and Board Members have been elected at the Annual Meetings. The Boards have conferred in person or electronically four times a year, with communications between Executive Committee members being more frequent. A series of executive directors have taken charge of the day-to-day affairs of the Academy, assisted by part-time or full-time staff and, most recently, with contracted outside help.

The Academy's *Letters Patent* were granted in February 1988.

The first Annual Meeting of the Academy was held in Ottawa in May 1988. Philip Lapp became president, Larkin Kerwin president-elect, James Ham vice-president, and Robert Legget the first past-president. Léopold Nadeau continued as secretary/treasurer. Seven directors were added to the Board. Committees for Nominations and Professional Society Relations were also added. Nadeau was appointed the first executive director of the Academy, with an honorarium, in addition to his duties as secretary-treasurer. Thirty-four new Fellows were elected. Since the beginning, the organization of the Annual Meetings of the Academy has been the responsibility of the president-elect, and this has included the choice of theme for the technical component of it.

In 1988, a Program Committee was established, chaired initially by Leslie Shemilt, followed by Gordon Slemon. The work of this Committee provided the first stage in the development of a great many of the Academy's later activities. Typically, the Committee has met twice yearly, either face-to-face or by teleconference. In 1989, for example, it surveyed the Fellows asking them to identify the 10 most urgent Canadian engineering problems. Leading the list were: the protection of the environment; waste management; urban infrastructure; and energy conservation. The Committee also launched the publication *Engineering Issues* to provide the public, and especially the media, with information on these. The Academy's first formal report was *Managing the Environment - The Engineering Challenge,* by Donald R. Stanley, also appeared as the first *Issue.*

In 1989, an endowment fund was established, donations sought, and action taken to obtain charitable status. The second Annual Meeting was held in Toronto in May of that year, thereby establishing a rotation of venues between Montréal, Ottawa and Toronto that continued until the Calgary meeting in 2001.

The first three years of the Academy were devoted primarily to its internal organization and its committee structure. For example, it became the established practice that nominations for Fellowships were reviewed by the Selection Committee and a list of candidates submitted to a full membership vote.

Beginning in 1990 and continuing for several years, the Academy participated in the activities of the Committee of Parliamentarians, Scientists and Engineers (COPSE), an organization that held regular luncheon meetings and seminars between members of the House and Senate and representatives of the two professions.

In 1991, the Royal Society proposed that, by a change in its Charter, it should become Canada's *National Academy.* The CAE, along with other learned institutions, objected to the all-inclusiveness of this proposal, and it was withdrawn. Two years later, the issue was revived by the Science Minister, with the same result, and again in 1995 involving the Minister of Industry, who turned down the proposal. Cooperation between the institutions became the option.

In September 1991 the Canadian Academy of Engineering formally joined the Council of Academies of Engineering and Technological Sciences (CAETS), the currently 26-member independent, non-political international forum for the discussion and communication of engineering issues. It was created in 1978, and has been headquartered in Washington, D.C.. Its Convocations and Council meetings have been held in alternate years. Usually, small delegations from CAE's Board have attended CAETS meetings and Fellows have contributed to its studies and working groups.

Prior to 1991, the federal government's annual *Science and Technology Week* made no mention of engineering as a separate profession. Accordingly, in April 1992 the Academy joined with CCPE, ACEC, EIC and the Association of Professional Engineers of Ontario, Ottawa Chapter, to launch a major event in Ottawa to promote this awareness among the general public, a week-long *Festival of Engineering,* opened by the then Governor General, the Rt. Hon. Ramon Hnatyshyn. The Honorary Chair was Guy St. Pierre, a CAE Fellow. It was repeated in 1993, in Ottawa and Calgary. Since then it has become a highly successful *National Engineering Week/Month* and is held every March at centres throughout the country.

In 1992 the Canadian Heraldic Authority was asked to grant the Academy an official coat-of-arms, the cost of which was gifted to the Academy. Governor General Hnatyshyn presented it at the 1993 Annual Meeting.

Academy activities have usually taken place in Ottawa, occasionally in Montréal and Toronto, but mostly through teleconferencing and electronic means. Its limited financial base has affected travel and deterred face-to-face meetings. Efforts have also been made from time to time to initiate and sustain regional Fellows' meetings. Between 1992 and 1998, for example, several Academy presidents met with Fellows in the major Canadian cities to encourage continuing local activities, without success. In 1998 regional coordinators were appointed for most provincial capitals to provide, as well, liaison with provincial

governments and the officials of other engineering organizations and to assist with the implementation of recommendations from CAE reports.

In 1994 the Academy reviewed its mission and decided it should be "to enhance, through the application and adaptation of science and engineering principles, the promotion of well-being, and the creation of wealth in Canada." It also adopted the following (non-legal) definition of engineering that reflected the essence of the profession:

> Engineering is a profession concerned with the creation of new and improved systems, processes and products to serve human needs. The central focus of engineering is design, an art entailing the exercise of ingenuity, imagination, knowledge, skill, discipline and judgement based on experience. The practice of professional engineering requires a mastery of engineering methodology together with a sensitivity to the physical potential of materials, the logic of mathematics, the constraints of human resources, physical resources and economics, to the minimization of risk, and to the protection of the public and the environment.

In 1995, the Program Committee was renamed Development and Publications and, later still, Development and Implementation. It continued to play a key role in determining and designing the studies and activities of the Academy.

Also in 1995, the Academy accepted the EIC's invitation for a representative to join the Institute's Advisory Committee of Engineering Society Representatives, which was established to recommend notable engineers for recognition by the Historic Sites and Monuments Board of Canada and the CSTM's Science and Engineering Hall of Fame. Leslie Shemilt was chosen. In 1999, he became the Academy's representative on the Institute's newly established Standing Committee on History & Archives and was encouraged to form an Academy H&A Committee. But shortly thereafter he was replaced by Pierre Franche, who produced the terms of reference for such a committee, and by Robert Savage, who persuaded several Academy members to join him. However, this initiative was short-lived, and none since has succeeded.

In 1997, the Academy welcomed the establishment by the federal government of the Canadian Foundation for Innovation (CFI) whose first president, Keith Brimacombe, was an Academy Fellow. That same year, Pierre Franche succeeded Léopold Nadeau as executive director of the Academy. In 1999, he was succeeded by Philip Cockshutt.

The Committee of Parliamentarians, Scientists and Engineers (COPSE) was disbanded in 1992, following a General Election. Several years later, a successor organization - the Partnership Group for Science and Engineering (PAGSE) - was established, involving breakfast discussion meetings between M.P.'s, Senators and representatives of the scientific and engineering communities. Its main concerns have been public policies affecting science and engineering and, in particular, the national levels of R&D activity and federal programs of encouragement for it. It has also submitted annual budget briefs to the House of Commons

Standing Committee on Finance. CAE became a founding member but dropped out after a disagreement in 1996, only to re-join in 1999. The Academy remains a member in 2019.

The 1998 CAETS Council meeting was held in Canada, in Ottawa, coincident with the Academy's Annual Meeting.

Among the conclusions included in the Slemon Report on the Academy's first 15 years (1987-2002) was this one:

> The Academy has worked carefully and confidentially 'to complement the roles and functions of existing national engineering organizations.' Its chosen role has been to provide leadership and advice in matters of general policy for the engineering profession and to leave the implementation of these policies to others. It has cooperated successfully with the Royal Society of Canada on a number of important issues and, not without some difficulties, has established itself as a parallel rather than a subsidiary academy.

In 2000, Micheline Bouchard was elected the first woman president of the CAE. The second, in 2005, was Kathleen Sendall, and the third was Kim Sturgess in 2011.

Over the years, CAE Fellows have participated in conferences on women in science and engineering. The names of several women Fellows have appeared in national listings of notable and influential women and as members of the Order of Canada. CAE has also supported the Canadian Engineering Memorial Foundation, founded in 1990 by Academy Fellow, Claudette MacKay-Lassonde, to commemorate the tragic deaths of 14 women engineering students at L'Ecole Polytechnique in December 1989. The Academy is currently represented by Jeannette Montufar on the Engineers Canada '30 by 30' Committee, examining how by 2030 the profession might have 30% practicing women members.

In 2004, Morrel Bachynski, then the Academy's president, prepared a discussion paper, *The Will to Invent Our Future,* aimed at the articulation of a 5-year plan, for presentation at the forthcoming Annual Meeting. This paper concluded that, over the past 15 years, the Academy had fallen short in the performance of its mission activities. A Task Force on *The Future of Engineering*, chaired by John McLaughlin, was also established to provide background information for the plan and to discuss the challenges the CAE would face over the next 20 years. *A Framework for Discussion* was published in December 2005. Among its conclusions were that, in countries like China, engineers played a prominent role in public policy, but they did not do so in Canada. There was also a need to strengthen technological literacy within Society. In any event, the 2004 Annual Meeting decided that the Academy had to do better.

It should be remembered that, in 1993, the Science Council of Canada had been disbanded, along with its reviews of science and technology policies. By 1999 it had also become evident that the policy of financial independence followed by the Canadian Academy of Engineering was limiting its capability and effectiveness to help undertake this activity and that some form of government support was needed. This led to a joint proposal with the Royal Society of Canada for the establishment of a separate umbrella structure that would allow the members of it to accept government funding and an expansion of their

roles in the provision of expert assessments to the government. It was envisaged that an Academy of Health Sciences would join the RSC and CAE. A meeting attended by over 100 Canadian and foreign organizations was held in October 2000 to discuss this proposal. Subsequently a Working Group was appointed to carry the three-member proposal further. The result was that, in 2002, the Canadian Academies of Science was created to undertake evidence-based assessments (without policy recommendations) at the request of, and with funding from, the federal government. But it was not until February 2005 that the federal budget allocated $30 million over ten years to the Academies. Its Board of Governors met for the first time that September and, in February 2006, Peter J. Nicholson was appointed its first president, along with a staff of a dozen or more researchers. In June 2006, letters patent were granted to the Council and it was renamed Council of Canadian Academies (CCA). Over the years, CAE members have served on its Board, its Scientific Advisory Committee and Expert Panels, have taken part in its studies, and have collaborated with its staff. The Council's federal grant was renegotiated – $15 million over five years – in 2015. No direct funding from these grants has come to CAE.

Also in 2006 the Canadian Engineering Leadership Forum (CELF) was formed by the Academy, the CCPE, ACEC, EIC, the National Council of Deans of Engineering and Applied Science (NCDEAS), and the Canadian Federation of Engineering Students (CFES). It met several times a year. CELF had evolved from the Canadian Engineering Societies' Committee and the regular meetings of the presidents and executive directors of its member engineering societies that were held to discuss matters of common interest. The Forum continued to meet regularly until 2011. It will be remembered principally for hosting a National Engineering Summit Conference of experts – including CAE Fellows – in 2009, which led to the Montréal Declaration of the profession's commitments to Canadian Society and its future. This Declaration stated that:

> Engineers play a key role in our societal development, contributing to and enabling initiatives that drive economic progress, enhance social and physical infrastructure, and inspire the changes that improve our quality of life.

In September 2006, Michael Ball succeeded Philip Cockshutt as CAE executive director.

In 2007, a paper by Moyra McDill compared the Canadian Academy with several other similar national engineering Academies. In 2008-9, under John Leggat's presidency, the Bachynski five-year plan was revisited and a second plan developed that took into account the successes and failures of the first one. Among the former were involvement in national and international issues, the completion of several good studies, and the continued election of high calibre Fellows. Among the latter were (again) the relatively low visibility of the profession with governments, a lack of involvement by industry leaders in the Academy, the underutilization of the talents of the Fellows, and financial problems. The Academy set itself a number of objectives for the next five years to reinforce the former and to deal with the latter. This second document was, in turn, revisited under president Kim Sturgess in 2012, when the 2009 objectives were again targeted, but in a more modest way.

In 2009, president John Leggat of CAE also served as president of CAETS.

In October 2011, the federal government brought into force the *Canada Not-for-Profit Corporations Act* (CNCA), designed to provide organizations with a more modern governance structure and required organizations such as the Academy to create new sets of by-laws, among other things.

In January 2012, Kevin Goheen succeeded Michael Ball as executive director. Arrangements were also made to have the Academy's archival material stored permanently at the University of Ontario Institute of Technology in Oshawa. Later in the year the president, Richard Marceau, began again to promote the formation of regional Academy activities among members. Since then, active sections have been operating in Montréal and Calgary, the latter having been recently renamed the Western Canada Section.

A revised mission statement for the Academy in June 2012 identified these specifics, in part:

> (The academy) speaks out on issues of importance to Canada and abroad to highlight emerging issues in which engineering has a role and to comment on their importance and implications…
>
> Provides advice in the appropriate form to government, industry, academia and Canadians at large on specific issues where engineering considerations play a role.
>
> Promotes recognition of engineering excellence by electing Fellows…from among Canada's most experienced and outstanding engineers…
>
> Participates appropriately, actively and effectively with like-minded national and international organizations in developing a common voice on issues importance to Canada and the world.

In April 2017, the executive director announced that the administrative and financial services required by the Academy would be contracted out in future.

A survey of Fellows was carried out in July 2018, the main purposes of which were: to understand the aspirations of the Fellows for the work and future of CAE; to gauge the interest of Fellows in participating in the activities of CAE; and to shape a portfolio of initiatives that would help Canada adjust to an advanced technological future. Over 20% of Fellows responded. The main call was for more activity in regard to the provision of strategic advice on matters of crucial importance to Canada. Another was the wish for more Fellows to participate in the assessments being made by the Council of Canadian Academies.

Over the years, the Committee structure within the Academy has evolved to meet current needs. By late 2018, it included these: Fellowship; Finance, Investment and Audit; Honours and Awards; International; Nominating; and Research.

Membership, Awards, Appointments, and Scholarships:

The 44 distinguished founding members (Fellows) of the Academy included 12 from academia and 32 with industrial, government and non-profit backgrounds. Around a quarter of them were francophone. The initial membership fee for Fellows was set at $200. The total (Active) membership of the Academy was to be limited to 250, with up to 40 new Fellows elected annually.

Fellows have been inducted into the Academy on the basis of having had careers, given services and made contributions to engineering, the profession and society that surpassed what would normally be considered a successful career in the candidate's field. Election has always been through nomination by existing members, verification by Committee, and voting by the membership. There has also been an underlying obligation that inductees be prepared to contribute to the life and work of the Academy. Permanent residence in Canada has been a requirement for foreign-born inductees.

It is well-known that, until relatively recently, the engineering profession was dominated by men and that it was not until the 1970s that the number of women in it began to grow. Strong support and encouragement for women in engineering was initially provided, for example, by CAE Fellow, Claudette Mackay-Lassonde. The first woman to be inducted into the Academy, in 1988, was Danielle Zaikoff, and several others followed her over the next few years. As noted above, three women engineers have served as presidents of the Academy. Engineers Canada has reported that, by 2016, women made up 13% of practising professional engineers.

There were 107 Academy members by 1989 and, by January 1991, the annual dues for Fellows had been raised to $250. By 1994, the Academy's total membership had reached 200, of whom 60% were from industrial backgrounds, 25% were from academia, and 15% from the government/non-profit sector.

The membership category of Honorary Fellow was created in 1995 to recognize members who had reached the age of 80 and who no longer wished to be Active. It carried reduced fees but no voting rights. This allowed for a lower Active membership number. In 1999, however, Honorary Fellows were renamed Emeritus Fellows. This allowed the Academy to induct into Honorary Fellowship engineers (and non-engineers) who had made truly outstanding contributions to engineering and to the profession in Canada.

In 2001, after comparison with the practices in other Academies, and the need for more income, it was decided to remove the 250 cap on CAE's membership and to allow the election of up to 50 new members annually. The qualifications for Emeritus status were also eased. Around this same time, the elective Board position of vice-president was eliminated.

By 2002, the Academy had almost 300 Active and Emeritus Fellows, of whom 55% had industrial and consulting backgrounds, 37% were from academia, and 8% from the government/non-profit sector. But from then on, the membership numbers began to shift to the academic sector. By 2007, the Academy had 384 Active and Emeritus Fellows, of whom 48% had industrial connections, 44% were from academia and 8% from government/non-profit.

Also in 2007, the Academy established an award to recognize extraordinary efforts made by Fellows in its service. The first recipient, in 2008, was Clement Bowman. Later that same year, it became the Léopold Nadeau Memorial Award in recognition of Dr. Nadeau's own service to the Academy and to engineering, and Morrel Bachynski was named to receive it. Later recipients have been Philip Cockshutt in 2012, and John Leggat in 2018.

In 2008, Clement Bowman received the prestigious Global Energy International Prize awarded By Russian President Dimitri Medvedev.

The Academy's highest award, Honorary Membership, was given first to Mike Lazaridis and Arthur Carty in 2008.

As noted, when first established the Academy's membership was dominantly from industry, and this remained so for over a decade. By 2012, the membership included 354 Active Fellows, 49 new Fellows, 149 Emeritus Fellows and 3 Honorary Members, for a total of 555. Only 30 women were members of the Academy, or 6% of the total membership. But the Fellows' affiliations had changed significantly: 40% were from industry, 54% from academia, and 6% from the government/non-profit sector. While the actual number of industry Fellows had doubled between 1994 and 2012, the number of academics had increased by a factor of six. The government sector was half what it had been. It was evident that the sector imbalance between industry and academia could become even more pronounced.

These developments had been the result of a change in the numbers of nominations in each of the three sectors and, while it reflected the strengths and talents of the engineering schools in Canada, it meant that the CAE's ability to take advantage of industry's market enterprise, engineering design and production experience, and advice of an economic nature would be in ever-shorter supply. This situation, as it was developing, had been brought to the Board's attention. In 2011, it was decided that an Ad Hoc Committee under past president Axel Meisen should examine it, along with slow growth in the induction of women Fellows. The Committee's main recommendation was that no formal measures should be taken by the Academy, but that more active nomination of industry-based and women engineers should be encouraged. This message was repeated in 2018 by president Eddy Isaacs. The Meisen Committee also recommended the introduction of International Fellows, to recognize special contributions to Canadian engineering by engineers abroad, and the Board agreed.

Since 2015, voting by Active members for new Fellows has been done online.

The Academy announced in June 2017 that, partnered with SAE Foundation Canada, it had established two annual student awards aimed at recognizing the importance of aerospace, automotive and transport design engineering. One, the *CAE Bruce Aubin SAE Aerospace Design Award*, valued at $800, and the other the *CAE William G. Belfry Memorial SAE Scholarship*, valued at $2000, would be given annually to top engineering students from across Canada. The first awards were made in 2017.

Also in 2017, the Academy inducted its first two International Fellows.

Historically, the annual fees paid by Fellows have risen with inflation. By 2018, for example, the Active member fee was $380 and the Emeritus one $90. But lifetime active memberships could also be purchased for $3,800, and the fees for Fellows over the age of 90 could be waived.

Of the 57 new Fellows inducted in 2018, 26 were from academia, 27 from industry and four from the government/non-profit sector. Seventeen were women. And two were International Fellows. The Academy's total membership numbers at the end of December 2018 were: 533 Active, 192 Emeritus, 5 aged 90+, 5 Honorary, and 4 International, for a total of 739. The affiliations of industry and academic members were now about the same - 46% - with the remaining 8% being from the government/non-profit sector. Women Fellows accounted for 10% of the total. There were 140 names on the *In Memoriam* list. Over the years since 1987, a number of Fellows have also resigned their membership in the Academy.

By 2018, *seven* honorary members had actually been inducted: Mike Lazaridis, Arthur Carty, Clement Bowman, Terrence Matthews, Norbert Morgenstern, Leslie Wardrop and Julie Payette. Morgenstern had, however, remained on the Active list, and Wardrop died in September 2017, at the age of 101. The Rt. Hon. Julie Payette is Canada's present Governor General.

Many Fellows of the Academy have, over the years, received awards from other organizations, including the Order of Canada and the Provincial Orders, medals from the Canadian 'learned' and industrial societies and the regulatory associations, honorary degrees from the universities, and awards from international organizations. These have been faithfully recorded in the Academy's *Newsletters.*

Comparisons with three foreign Academies: The U.S. National Academy of Engineering, was founded in 1964, and currently has around 2,000 members in all classes; the U.K. Royal Academy of Engineering was founded in 1976 as the Fellowship of Engineering and now has around 1,500 members; the Australian Academy of Technological Sciences was founded in 1975, added 'and Engineering' to its title in 1987, and now has around 900 members. All three are older and larger than the Canadian Academy. The National Academy of Technologies of France, on the other hand, was not founded until 2000. Its present membership is under 300.

Advisory, Collaborative and Other Activities:

Since its inception, the Academy has studied a variety of subjects related to its missions, mostly through Committees and Task Forces set up for the purpose. Among the subjects tackled have been: engineering research and research generally in Canada and in the Canadian universities; Canadian competitiveness in high technology and technology and entrepreneurship – particularly those done by groups under the chairmanship of Roger Blais; natural disaster reduction; lifelong learning by engineers; engineering education; the engineering profession and its competence; nuclear waste; climate change and the environment; policymaking for science and technology; the future of engineering in Canada; energy studies, and particularly the 'pathway' studies initiated by Clement Bowman and Richard Marceau; and a study of Canada's northern oceans.

The Academy has also collaborated in studies with other engineering societies in Canada, and with those involved with learned and policy matters, such as the Royal Society of Canada and the Council of Canadian Academies. CAE has also reacted to studies published by other organizations, and it has participated in the on-going work of, for example, CAETS, CELF and PAGSE. It has also met formally with representatives of other national academies for discussions on specific subjects of engineering concern. The reports from all of these activities represent a very large contribution to the historical, current and future development of engineering in Canada. In what follows, only parts of it will be mentioned. Fellows of the Academy have also been appointed to prestigious leadership positions in Canada. Again, only a few of these will be mentioned.

The Royal Society of Canada played a role in the process that founded the Academy. It was not surprising, therefore, that the CAE's first collaborations after 1987 should be joint committee studies with the Royal Society on Disaster Reduction, Health and Safety, Public Awareness and Research, but only one of them – Disaster Reduction – reached completion. In 1988, the Royal Society received federal funding for a major study of university research, to which the CAE made a submission. However the report, in the Academy's view, did not deal adequately with *engineering* research.

Also in 1988, the Academy co-hosted with the Royal Swedish Academy of Engineering Sciences, a Symposium in Ottawa on *Industrial Progress through Science and Technology,* which was attended by King Carl XVI Gustav of Sweden.

In 1989, the Academy supported the expansion of the laboratory activities of Atomic Energy of Canada Ltd.. From 1989 until 1992, it participated with the Royal Society in nuclear waste studies associated with the Federal Environmental Assessment Review Office (FEARO) and, in 1996 and 1997, in the public hearings that resulted from the report on this waste issued by AECL. One result of this work was the passing in 2002 of a Nuclear Fuel Waste Act. In 1991 the CAE and Royal Society were linked into a Committee on Health and Safety, which reported in 1993, but the Academy felt it lacked engineering content. It therefore produced a paper of its own, in the *Engineering Issues* series, authored by Mark Abbott and Ernest Siddall.

Early in 1991, the Academy established a Task Force to examine and report on engineering research in the Canadian universities. Its report – the first formal one by the CAE – was issued in August and emphasized the distinction between scientific and engineering research. It called upon engineering professors to increase their contributions to the solution of current and future *engineering* issues in Canadian society, and called for funding more closely linked to the users of the research. In 1992, emphasis was placed on the promotion and implementation of the widely-distributed report. In 1995, CAE joined with CCPE, ACEC and EIC in supporting the recommendations of the National Advisory Board on Science and Technology (NABST) which had emphasized points raised in the Academy's report. The CAE also supported the commercialization efforts for university research of NABST's successor, the Advisory Council on Science and Technology (ACST), noting especially that there was a shortage in the universities of experienced commercialization people. The report also influenced the work of the federal granting agency for university research, NSERC.

In 1996 the Academy participated in the unsuccessful effort to have the International Thermonuclear Experimental Reactor (ITER) sited in Canada.

From its earliest days, the Academy focused on engineering education. Responding to a report from CCPE and the National Committee of Deans of Engineering and Applied Science (NCDEAS), a Task Force was set up to examine even more significant changes in the engineering process. In August 1993, a well-discussed CAE report *Engineering Education in Canadian Universities* appeared, including 61 detailed recommendations directed at the faculties, the profession, industries and governments. Another Task Force was set up to implement these recommendations. In 1996, a committee with representatives from the Academy, CCPE and the Deans produced a report indicating the progress made in implementation, which had been slow. In 1998 a third Academy Task Force which, in December 1999, produced a report that made many fewer and more general recommendations. Again, discussions were widely held.

With regard to lifelong learning within the profession itself, and in response to the approaches being taken by the provincial associations, in 1996 the Academy established a Task Force to provide it with advice. CCPE was involved in the discussions. The report was published in 1997.

Beginning in 1994, representatives of the Academy, together with those of CCPE, ACEC and EIC have been invited from time to time to appear before the House of Commons Standing Committee on Finance to discuss the government's policies affecting engineering priorities.

CAE has long been concerned with the role of engineering in Canada's marketplace competitiveness, entrepreneurship and innovation. The 1989 annual meeting, for example, included a session on them. In 1995, a Task Force chaired by Roger Blais produced a major report, *Technological Entrepreneurship and Engineering in Canada.* By 1997 its findings had been widely discussed. In March 1998, the Academy produced *Wealth Through Technological Entrepreneurship* based on the Blais report. Among its major recommendations was one encouraging the establishment of "a broadly-based cooperative effort involving the engineering profession, business leaders, governments and the general public." A national committee was suggested, unsuccessfully, as the means for implementing the recommendations. A summary of this work was included in the CAE's *Engineering Issues,* No. 7, of March 1998.

In 1996, CAE Fellow Thomas Brzustowski was appointed president of NSERC. In 1997, three Fellows of the Academy were appointed to the newly established Canadian Foundation for Innovation, and, as noted above, Keith Brimacombe was named to its founding presidency.

The Academy has worked closely with CCPE (now Engineers Canada) and its associations, less so with EIC and ACEC. In 2000, a Task Force of Fellows was set up to address some of the issues involving the interaction of the profession with the general public. A draft report was prepared, which was later shortened and appeared in 2002 as one on *Protecting the Public and the Environment – A Responsibility of the Canadian Professional Engineers.* This Task Force also produced a second report on professional competence, which supplemented a report on competence published six years earlier.

Energy and climate change have been continuing concerns of the Academy, and especially since 2000. For example, a Working Group set up that year published a report two years later, dealing particularly with long-term energy supply and its environmental impact.

Beginning in 2006 with the work of the Energy Pathways Task Force, the Academy made major contributions to the study of Canada's future as the generator and user of energy. A group of eight sponsoring organizations also supported the project. Michael Charles has written in his *Historical Update (2002-2012)*:

> ...over the period from 2006…we have the series of reports on energy issues generated under the leadership of Clem Bowman and Richard Marceau based on a number of workshops involving many members of the Academy and extensive consultation outside the Academy. The Energy Pathways Task Force issued its Phase I report in 2007. It outlined "national technology projects" on gasification of fossil fuels…
>
> The follow-on Canada Power Grid Task Force developed the case for expanded electricity grid connections in order to meet the nation's long-term needs. In its 2010 report it emphasized improved access for wind and solar energy sources, and enhanced capacity for energy storage…
>
> Arising out of the work of these Task Forces the notion of Canada as an energy superpower emerged, with the potential engineering projects deemed necessary likened to the major infrastructure projects which have built and sustained Canada since its very beginning.

The Energy Pathways Task Force work under the leadership of Clement Bowman and Richard Marceau was completed by 2016 and the reports published.

In 2010, an MOU was signed by the Academy, the Trottier Family Foundation (to which Lorne Trottier, an Academy Fellow, belonged) and the David Suzuki Foundation to establish the Trottier Energy Futures Project (TEFP). This Trottier-financed, CAE-Suzuki Foundation partnership's purpose was to study the problems involved in reducing GHG emissions in Canada by 80% by 2050. Its work included contributions by several CAE Fellows, led by Lorne Trottier, Peter Robinson and John Leggat, with the participation of project staff and consultants. It was managed latterly by the Academy. Over the years, it examined both medium- and long-term energy use, analyzed the problems and issues involved, and issued several reference documents and reports. The TEFP work was finished in 2016. To help publicize its findings, CAE past president John Leggat presented a lecture in Montréal in March 2016. The results influenced the work of (federal) Environment and Climate Change Canada. In 2017, the Academy and the Conference Board of Canada began a follow-up, economic impact study. Earlier, in 2013, TEFP had received an award for innovation from Bayer Canada.

Back to 2009….CAETS held its biennial Convocation in Canada, at Calgary. The meeting was chaired by CAETS President John Leggat and the technical theme, chosen by CAE, was *Our Heritage of Natural*

Resources – Management and Sustainability. Also in 2009, CAE signed a cooperation agreement with the Indian Academy of Engineering. In 2011 a delegation from the Chinese Academy of Engineering was hosted by the CAE in Ottawa. And in 2012 CAE co-hosted a technical workshop on clean coal technologies with the Indian National Academy of Engineering.

In December 2011, the Council of Canadian Academies, on behalf of its three member academies, issued *A Statement of Common Understanding* to "guide their future collaboration" and to ensure that their intellectual resources would be mutually supportive.

In April 2013, a four-person CAE Task Force was appointed to examine Engineering in Canada's Northern Oceans and, in particular, to study the development of the resources of these oceans taking account of sovereignty, environmental protection, climate change, transportation and human safety, to identify technology gaps and objectives and to address them. A preliminary report was presented at the annual meeting at St. John's in 2014. The final report was submitted in 2016.

In May 2010, CAE Fellows Richard Marceau and Michael Ball appeared before the Senate Standing Committee on Energy, the Environment and Natural Resources, which was involved in developing a study *Towards a Canadian Sustainable Energy Strategy.*

Recent appearances before Committees of the House of Commons have included one by then president Richard Marceau, before the Standing Committee on Industry, Science and Technology, in February 2013. Jeanette Southwood appeared before the Standing Committee on the Status of Women in 2017.

Over the past few years, a fair number of CAE Fellows have been elected or appointed to influential positions in Canada. Examples include: Tom Jenkins elected Chancellor of the University of Waterloo in 2014; Gilles Patry appointed chair of the Canadian Foundation for Innovation in 2016; Molly Shoichet appointed the Province of Ontario's government first chief scientist in 2017 (however, the following year the government changed and the appointment was withdrawn); and Alan Winter appointed British Columbia's first Innovation Commissioner in 2018.

During 2016, the Academy was part of the CAETS Energy Task Force that completed a major report on engineering opportunities arising from a lower carbon economy. And in November 2016, CAE, with the Bowman Centre for Sustainable Energy and the Canadian Society of Senior Engineers, held the first annual Richard Marceau Energy Symposium. A second symposium was held in October, 2017.

In 2016, representatives of the three Academies of the CCA met to discuss the development of closer working relationships between them. That year also, and in order to increase its visibility in its mission as a public affairs participant, the Academy began a series of conference co-sponsorships with the Conference Board of Canada and the Institute for Research in Public Policy. The results of these conferences were usually reported in CBC and IRPP publications.

In August 2016, in a *Fellows in the News* section of the CAE Newsletter, the following statement appeared:

> We have recently argued with a number of parties, including the Council of Canadian Academies and Innovation, Science and Economic Development Canada, that "innovation" doesn't stop at original scientific discovery.

In 2017, the Academy hosted a meeting with representatives of the Mexican Academy of Engineering. And in that year, also, CAE members provided advice to the UK Royal Academy of Engineering during the enquiry into the disastrous Grenfell Tower fire. In 2018, CAE hosted a meeting with the president of the Chinese Academy of Science and another with senior members of the Royal Society of New Zealand. In September 2017, CAE became a nominating partner for the Governor General's Innovation Awards.

In May 2018, the Academy partnered with the Conference Board of Canada in sponsoring a conference on *Reshaping Energy 2018: Today and Tomorrow.*

Publications and Reports:

Since 1991 the Academy has published over 30 stand-alone reports and books that reflect its studies and concerns, and will continue to do so. Between 1991 and 2003, CAE also published a series of short reports by individual authors or by Task Forces on *Engineering Issues.* The first of these was by Donald R. Stanley on *Managing the Environment – the Engineering Challenge.*

The Academy published its first regular, bilingual membership *Newsletter* during the summer of 1987, and has continued to do so ever since. It has been redesigned several times but has always covered news, newsflashes, news releases, Fellows in the News, recent appointments, obituaries, activities of interest, and meeting schedules, as well as noting current activities of its partner organizations in and beyond the engineering profession. Since 2015, it has been a '10 issues-a-year' electronic publication.

Dennis Poussart, a Fellow of the Academy and a professor at Université Laval, created its first Academy web page in 1996 (www.acad-eng-gen.ca) and was webmaster until 2000, when the University of Ottawa became responsible. A new website developed by the CAE office was launched in 2008. In 2012, the Academy began its association with the electronic media through *Facebook, Twitter* and *Linkedin.* By 2013, internal communications within the Academy were solely electronic. In January 2014, the Academy announced that it had launched an updated website (www.cae-acg.ca), which would make possible the electronic payment of fees, a searchable members' list, and event registration.

Articles and papers by Fellows on Academy-related topics have also been published elsewhere over the years, and are too numerous to mention here. An example would be the op-ed piece by Academy president Ruth and Conference Board of Canada CEO Muzyka on follow-up to the Trottier Energy Futures Report that appeared in the Ottawa/Québec edition of the *Globe & Mail* on 31 May 2017.

To sum up very, very briefly…

The Canadian Academy of Engineering is an independent, self-governing, non-profit organization established in 1987 to serve the nation in matters of engineering concern.

From the CAE *Directory of Fellows, 2014/2015*:

> Given the essential importance of engineering to the prosperity of Canada and the quality of life of Canadians, the mission of the Canadian Academy of Engineering is to assemble a cadre of Fellows elected from among Canada's most experienced and distinguished engineers, and to make their collective expertise available to Canada at the national as well as the local levels, both in response to requests and invitations and at the initiative of CAE itself. This is done through advice to governments and to institutions, participation in strategic studies and consultations, studies initiated by the CAE, communication to the public, and other means as appropriate.

…and in the words of Academy past-president Douglas Ruth:

> …if you stand on a street corner in any city in the world and turn through 360 degrees, everything you see has been touched by engineering. Yet we are the profession that "hides in plain view" – the general public and our leaders have scant appreciation of what we contribute to their standard of living. Now is the time for us, engineers, to take our place among the influencers of how our society develops.

The Canadian Academy of Engineering stands ready to help make this happen. Its Fellows are committed to ensuring that their expertise is applied to the benefit of all Canadians.

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Andrew H. (Drew) Wilson, FCAE

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