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*by Bob Alden, Professor Emeritus,
McMaster University*

Great Expectations, Great Achievements

The Creation of IEEE Canada

This story is quintessentially Canadian, heavily influenced by our neighbours to our south, unable to agree among ourselves, but tortuously progressing to a made-in-Canada solution that is unique and works very well. This is the first of a series of articles that highlight historical accomplishments that relate to the IEEE sphere of influence.

Of the 382,000 IEEE members worldwide, 16,000 plus live in Canada and we Canadians have a unique situation within IEEE.

IEEE Canada is a Canadian entity within two organizations, IEEE Inc. incorporated in the United States with a worldwide mandate in the advancement of technology, and the Engineering Institute of Canada with a mandate across all branches of engineering in Canada. This situation has formally existed since 1995 and is a marked change from the situation in 1969 as described by Gordon Slemon in the next page. I begin with his assessment of the early days (pre-1970) of engineering organizations in Canada.

1.0 The Early Days in Canada: 1887 to 1969

The Canadian Society of Civil Engineers (which at that time implied non-Military Engineers) was formed in 1887 and became the Engineering Institute of Canada (EIC) in 1918. On three occasions, in 1925, 1935 and 1953, the EIC attempted to unify all engineering disciplines in Canada under its umbrella but none of these attempts was successful. EIC also attempted unsuccessfully to merge with the professional regulatory bodies and with the Canadian Council of Professional Engineers.

There were branches of the American Institute of Electrical Engineers (AIEE) in Canada starting in 1903 and branches of the Institute of Radio Engineers (IRE) from 1925. Branches of the UK-based Institution of Electrical Engineers (IEE) have operated in Canada since about 1958. [Note: the IEE merged with the Institution of Incorporated Engineers (IIE) in 2006 to form the Institution of Engineering and Technology (IET)]. In 1963 the AIEE and IRE merged to form the Institute of Electrical and Electronics Engineers (IEEE).

By 1969 the memberships in these organizations were about 8000 for IEEE Region 7, 1200 for IEE and about 2000 for the Electrical,

Communications and Automation Divisions of EIC. Very few belonged to more than one of these bodies. Each had an argument for exclusive terrain.

- EIC felt that it was the historic Canadian society deserving of the support of all Canadian engineers.
- IEE policy had been to recognize EIC as the national organization in Canada. It refrained from establishing branches here until 1958. The Canadian IEE membership was largely immigrants from UK or from the former British Empire. Their branches were successfully maintaining the link with UK and providing personal interaction.
- IEEE members generally felt that they were receiving the services that they valued from their well-established IEEE publications, conferences and sections. They felt that EIC was dominated by civil engineers.

There was a limited amount of local cooperation among the societies, usually accompanied by a degree of mutual antagonism. At the same time the fragmentation of the Canadian electrical community was deplored by many and there was a growing mood of nationalism in the country.

It was with this background that a number of interested individuals held an informal meeting at the International Electronics Conference in Toronto in September 1969. Three models were discussed:

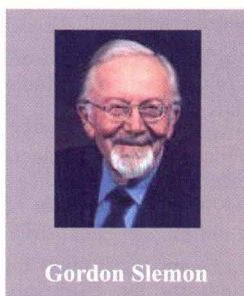
- an independent Canadian Society of Electrical Engineers,
- a more autonomous IEEE Region 7, and
- an EIC-constituent Canadian Society of Electrical Engineers.

It was an omen of things to come that the support for these three models was almost evenly divided at that meeting.

Acronyms used for Organization and Publication Names

AIEE	American Institute of Electrical Engineers
EIC	Engineering Institute of Canada
CEEJ	Canadian Electrical Engineering Journal
CJECE	Canadian Journal of Electrical and Computer Eng.
CSEE	Canadian Society for Electrical Engineering
CSECE	Canadian Society for Electrical and Computer Eng.
ICR	IEEE Canadian Review
ICF	IEEE Canadian Foundation
IEEE	Institute of Electrical and Electronics Engineers
IRE	Institute of Radio Engineers

2.0 The Committee & Birth of CSEE: 1970 to 1973



Gordon Slemon

During this time frame, a "steering committee" emerged and a series of about 20 meetings in Toronto and elsewhere was held. Initially the intent was to attempt to rationalize and coordinate the activities of EIC, IEE and IEEE. When the EIC decided in Oct. 1972 to create its own constituent society CSEE, the steering committee morphed into a CSEE-IEEE Joint Committee. The steering committee was initiated in 1969 by Gord Slemon. He was

About IEEE Canada

IEEE Canada (Region 7) is the Canadian arm of IEEE, as well as the constituent society of the Engineering Institute of Canada (EIC) for the technical fields of electrical, electronics and computer engineering. While both organizations provide educational services and products, IEEE provides technical information through its member societies and EIC focuses on the professional component. By bringing together both entities, IEEE Canada can provide its members with quality information on the latest technology and important networking opportunities.

Early Milestones of AIEE/IRE/IEEE History in Canada

1884	AIEE* formed in Philadelphia, USA
1887	Canadian Society of Civil Engineers (CSCE) formed
1901	Marconi's first transatlantic wireless reception in St. John's, Newfoundland
1903	AIEE Toronto Section formed at the Engineers Club in Toronto
1912	IRE** formed by merging the Society of Wireless Telegraph Engineers and the Wireless Institute
1912	CSCE becomes the Engineering Institute of Canada (EIC)
1921	AIEE District 10 (Canada) formed
1925	IRE Canadian Section formed at Canadian General Electric in Toronto
1944	Ralph Hackbush becomes first Canadian to be IRE Vice President
1957	John Henderson becomes first Canadian to be IRE President
1963	IEEE Region 7 created out of AIEE District 10 (Canada) and IRE Region 8 (Canada) during the merger of AIEE and IRE
1972	Bob Tanner becomes first Canadian to be IEEE President
1976	CSEE formed
1990	CSEE renamed CSECE
1995	IEEE Region 7 and CSECE merge to form IEEE Canada



John Henderson
First Canadian IRE President

*American Institute of Electrical Engineers
** Institute of Radio Engineers

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A 25-YEAR HISTORY OF IEEE CANADA

appointed as intersociety relations chair for IEEE Region 7, CSEE and IEE, and he was elected chair of the steering committee. He worked tirelessly throughout these 20 or so meetings and beyond (to the late 80s) to encourage cooperation among the "competitors". These meetings included those of the steering committee as well as meetings with IEE, EIC, IEEE Region 7 and the IEEE leadership. I will come back to the role of the IEEE leadership in decentralizing the IEEE structure later on. It is fair to say that EIC was interested in promoting the Canadian entity and that virtually all IEEE members were satisfied to retain their IEEE services. One of Gordon Slemon's key contributions was in keeping the various organizations aware of the fact that a problem did exist—a non-trivial problem with the constantly changing membership of volunteer committees.

IEEE Canada History

In 1969, there were three technical organizations with a focus on electrical engineering in Canada: IEEE, which included 31 technical groups spanning a wide range of interests and 10 regions across the world; the Engineering Institute of Canada (EIC), which had members in various disciplines including civil and electrical engineering; and the Institution of Electrical Engineers (IEE), a licensing body for British electrical engineers. Despite obvious interest in the field, there was no single Canadian organization for electrical engineering.

According to Bob Alden, IEEE Vice President of Regional Activities, 1990-1991, it took 25 years of hard work from dedicated individuals for IEEE Canada, which serves as both Region 7 of a decentralized IEEE and a member society of EIC, to be formed in 1995.

Two such individuals, Bob Tanner, IEEE Region 7 Director, 1968, IEEE President, 1972; and Bill Thomson, IEEE Region 7 Director, 1970-1971, were pivotal in creating the environment for the future IEEE Canada. Tanner's contribution was as the principal author of the first IEEE long-range planning report, while Thomson obtained important funding for the startup of the first IEEE Region 7 office. George Armitage, who served as Manager for the original office in Thornhill, Ontario, also made important efforts to realize the vision of IEEE Canada. Alden, who served as IEEE



Guglielmo Marconi (left), a pioneer in wireless telephony, with his assistant George Kemp.

Region 7 Director, 1988-1989, oversaw the official naming of IEEE Canada and the publishing of the region's magazine, IEEE Canadian Review.

In 1995, the Canadian Society of Electrical and Computer Engineering (CSECE), previously the Canadian Society of Civil Engineering (CSCE), joined with IEEE Region 7 and officially formed IEEE Canada in order to better serve the needs of engineering professionals across Canada.



Marconi workers at Signal Hill in St. John's, Newfoundland, with antenna kite for transatlantic signal.

A 25-YEAR HISTORY OF IEEE CANADA

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3.0 The Doldrums: 1974 to 1987

I choose this title only to emphasize that very little happened on the transitional journey to IEEE Canada except that both CSEE and IEEE Region 7 continued on their separate ways. CSEE started officially in 1976 with first president Tom Pavlasek and produced its own journal CEEJ in the same year with George Holbrook as its first editor and funding from NRC (the National Research Council) as well as a start-up grant from IEEC Inc (now the IEEE Canadian Foundation). IEEE Region 7 and its 20 Sections continued to provide excellent services for its members. In many cases IEEE Section meetings were offered as being "joint" with the fledgling CSEE.

4.0 The Shaping of the Merger: 1988 to 1994

Both "competitors" (IEEE Region 7 and CSEE) started to develop specific strengths that led, in the early 1990s, to the state where a merger was desirable by all sides.

These developments are about long-term dedicated volunteer commitment. Many volunteers, working for both organizations, dedicated to improving their profession—in this case, from an organization and service perspective. The leadership comes from those elected to serve as CSEE President or IEEE Region 7 Director, supplemented in large measure by countless additional volunteers who provide the actual member services.

CSEE, CSECE Presidents

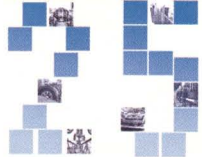
1994	Tony Eastham
1992, 93	Jean-Rémi Giroux
1990, 91	John Plant
1988, 89	Cam Blachford
1986, 87	Mo El-Hawary
1983, 84, 85	Tas Venetsanopoulos
1981, 82	Dinkar Mukhedkar
1978, 79, 80	Chuck Campling
1977	Colin diCenzo
1976	Tom Pavlasek

IEEE Regional Directors (1968-1995)

1994-1995	Ray Findlay, (2002 IEEE President)
1992-1993	Vijay Bhargava
1990-1991	Tony Eastham
1988-1989	Bob Alden
1986-1987	Gord English
1984-1985	Wally Read (1996 IEEE President)
1982-1983	Fred Heath
1980-1981	Jean-Jacques Archambault
1978-1979	Ted Glass
1976-1977	Frank Creed
1974-1975	George Sinclair
1972-1973	Doug Hinton
1970-1971	Bill Thompson
1968-1969	Bob Tanner (1972 IEEE President)

I have the privilege to have known all of the volunteers noted in the two lists of volunteer leaders. It is interesting to observe that all (both lists) are dedicated IEEE volunteers—serving their profession in one organization or the other. This fact suggests that eventually the merger will occur—if it is the right thing to do. These are part of our IEEE family.

For the rest of this part of the story, I write it as a personal account of my volunteer family's efforts to do the right thing. I hope it will tell the story of how things were at that time and how we collectively worked to improve member services and develop our Canadian solution.



My involvement with engineering organizations began in a typical small way in 1958 as a student member of both the AIEE and the IRE, and increased in 1971 when I was drafted as my employer's representative on the local IEEE section executive committee. One of my first assignments was to run a technical training program, which I mistakenly thought was to educate my fellow IEEE members. After proposing a naive program which would likely lose money, I was very directly instructed that my objective was to produce a training program for non-members that local industry would want to support so that the program surplus would enable the section to fund the newsletter (which in those days involved the postal service) and other member benefit activities. I learned quickly and my revised plan met with executive committee approval and did the job! The next year, I was "promoted" to section vice-chair and had the opportunity to attend my first region committee meeting, representing my section chair who was unable to attend.

4.1 Decentralizing IEEE

That 1973 IEEE Region 7 meeting of all section chairs and other volunteers (Doug Hinton was the Director) was held in New York City at the IEEE headquarters in the United Engineering Centre (opposite the United Nations building) and run by very nice Americans who were the IEEE headquarters staff. While these folks were very welcoming and competent, in my view they were not particularly interested in Canadian activities other than we were number 7 out of 10 regions and the focus seemed to be on the first six (the U.S. regions). There seemed to be a lot of U.S. politics and viewpoints, including discussions about the creation of a United States Activities Board. While the meeting location and staff approach indicated a very centralized IEEE operation, I came to realize that the IEEE was changing, due to a number of dedicated volunteers—especially some with Canadian ties.



Robert Tanner

Two of these Canadians were pivotal in creating the environment for the future IEEE Canada: Bob Tanner (who served as Region 7 Director in 1968 and 1969, then as IEEE Secretary in 1970, IEEE Vice President in 1971, and IEEE President in 1972); along with Bill Thompson (who succeeded Bob as Region 7 Director for 1970 and 1971). Bob Tanner was the principal author of the first IEEE long range planning report. It spelled out an evolution for IEEE regions to become self governing. Bob provided the concept and Bill provided the mechanism. Bill Thompson

obtained special funding for the startup of an office in Region 7—this was one of two such experiments, the other was in Los Angeles in Region 6.



Canadian Office

Bill hired George Armitage as the manager who set up the office at 7061 Yonge Street in Thornhill, Ontario (just north of the North York boundary) where it existed for twenty two years. The physical office closed in 1993 and was replaced in 1994 by a virtual office run by Cathie Lowell using the various electronic/internet services which were emerging at that time.

The decentralization of IEEE and the creation of the Canadian Office were, in my view, the basis for the Canadian entity we know today.

George hired an assistant, first Ila Worsdale, then Dorothy Millman, to be in the office and began a process of visiting sections and giving technical training courses—the content for these courses was in white three-ring binders with the name "IEEE Canada" on the cover—together with a blue IEEE logo on the left and a red maple leaf on the right. This was the first time that I saw the "IEEE Canada" concept in existence. The Canadian Office created a physical focus for a distinctly Canadian operation. At the end of 1983 both George and Dorothy retired and Fred Heath (1982-83 Region 7 Director) became the office manager (from 1984-87), with Pam Woodrow hired to replace Dorothy. At that time a major office activity was selling IEEE Standards and Sandy Artinger was hired to help



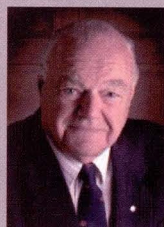
George Armitage

with this venture—which was profitable for the office and convenient for Canadian members and companies until IEEE changed its way of distributing standards in the early 90s. When Fred Heath retired at the end of 1987, I promoted Pam to be Manager of Canadian Member Services. As part of that mandate, Pam became very involved with supporting Student Branches—attendance at the annual Student Branch Workshop was the highest in those years. Shown below is a photo I took of Pam Woodrow with Hazel Scott (Regional Student Representative) and Gerald Karam (Student Activities Coordinator), taken in the office in 1988.



Pam Woodrow, Hazel Scott and Gerald Karam

It was also the time that other Canadians were attempting to rationalize the desire for the Engineering Institute of Canada to develop a meaningful component in Electrical and Electronics Engineering. Gordon Slemon has accurately documented the frustrations from the absence of any Canadian EE society (due to the success of the AIEE and IRE activity in Canada since the very beginning of the electrical and electronics industries), followed by the creation of a Canadian Society within EIC that had lots of nationality but little membership.



Wally Read

During the 70s and early 80s I was active as an IEEE volunteer, moving from section to region interests, and then to my technical society, learning about the various ways and idiosyncrasies of IEEE governance. During that time I participated in the IEEE Region 7-CSEE working group (from the perspective of believing that Region 7 must become the Canadian society) and observed the startup of the CSEE in 1976 along with its Journal, which was initially subsidized by NRC (the National Research Council of Canada). In the early 80s I was

out of regional activities and active on the administrative committee (now the governing board) of the IEEE Power Engineering Society.

1984 was the IEEE Centennial year, marked by then Region 7 Director Wallace S. (Wally) Read's decision to celebrate the centennial by commissioning and publishing a book to commemorate the achievements of the Electrical Industry in Canada over the past 100 years and longer. Harry Prevey, a long-time Toronto Section volunteer was the editor.



Electricity
The Magic Medium
L'électricité
cette prodigieuse énergie
IEEE Canadian Region

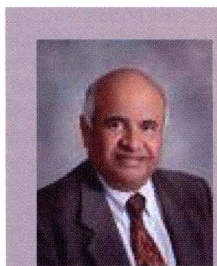
Centennial Book

In 1986 I was surprised to be asked by Wally Read to become a candidate for Region 7 Director, and even more surprised when I won the election. As the director-elect in 1987, I was fortunate to have Gordon English as my current director—he gave me a lot of freedom and responsibility, and being based in Vancouver often assigned me tasks in the eastern part of our region. This was the year in which I thought about how to make Region 7 into IEEE Canada. Since I followed my two-year term as

regional director with a two-year term as IEEE vice-president for regional activities, I was able to complete or assist on some of the actions we started at that time.

4.2 The Building Blocks

In 1988 I had the opportunity to meet with Cam Blachford, whose role as CSEE President coincided with mine as IEEE Region 7 Director. It was an historic meeting between two stubborn volunteers with two different points of view—likely one of the best examples of the rivalry that Gordon Slemon so accurately describes. We both left that meeting determined to promote our separate agendas, but we also were very much aware of the weaknesses inherent in the two organizations.



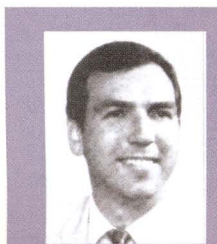
Vijay Bhargava

I believe that Cam decided to stop competing for sections and their activities, since CSEE did not seem able to increase its membership significantly above its initial core EIC member count, and instead focus on the Journal and a mechanism for covering the cost. Fortunately for CSEE, Vijay Bhargava decided to create the Canadian Conference on Electrical and Computer Engineering and run it in his unique way so that it generated the annual surplus needed to subsidize the Journal—urgently needed since NRC had phased out its initial financial support. Vijay

was also the creator of the CSEE logo that later became part of the IEEE Canada logo.

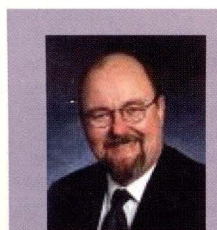
It was clear to me that if IEEE Region 7 was to evolve into a truly Canadian organization we needed more than an office which acted as a buffer between Canadian members and the American IEEE staff. We decided to formally use the name IEEE Canada and create a magazine, the *IEEE Canadian Review*, designed and published in Canada as a member benefit. The name “IEEE Canada” was proposed as an alternate name for “IEEE Region 7”, passed at the annual regional meeting, and subsequently and successfully submitted to the IEEE Regional Activities Board and the IEEE Executive Committee for their approval. We created business cards and letterhead with the new name and logo and used them in future correspondence with IEEE boards and staff. Shortly afterwards, the IEEE USA letterhead appeared. At that point, I knew that our new name would stay.

I had known Richard Marceau as an enthusiastic IEEE volunteer in the Montréal section, who was primarily involved with producing technical publications for conferences sponsored by



Richard Marceau

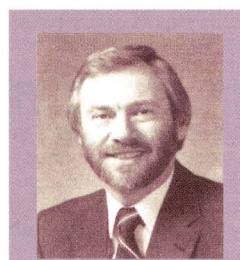
Montréal Conférences Inc. (MCI). I enlisted his support and he became the first editor of the fledgling magazine, the *IEEE Canadian Review—La Revue canadienne de l'IEEE*. Our first issue was published in September 1988 with a special grant from IEEC Inc. This was the Toronto-based corporation that organized a trade show and conference under various names—initially the “IRE Canadian Electronics Conference” in 1955, and later “Electronicom”. This regional conference ran in alternate years to MCI’s Montech.



Miro Forest

About this time, and with the demise of these regional conferences in Toronto, Montreal and across the United States, I broached the concept of evolving IEEC Inc. (with its 30 plus year history of supporting IEEE activities in Canada) into the IEEE Canadian Foundation. The original name proposed was IEEE Canada Foundation but that was rejected by the government approval body. The legal process culminated in Revenue Canada granting a charitable foundation status in 1994. Miro Forest, the last president of IEEC Inc., and the first president of the IEEE Canadian

Foundation, was the driving force in this long and often frustrating legal process, involving many government oversight bodies, for transforming IEEC Inc. into the ICF. Later and over a two-year period starting in 2002, discussions between the directors of MCI and the IEEE Canadian Foundation culminated with the joining of resources (MCI contributed funds and experienced bilingual volunteers) that enabled the IEEE Canadian Foundation to offer bilingual services.



Bob Alden

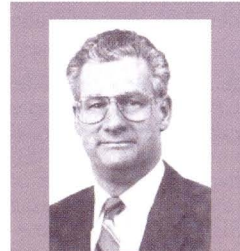
In the March 1989 issue (#3) of the *IEEE Canadian Review*, my director’s column was entitled “*A Single Canadian Electrical Engineering Society: An Achievable Goal?*” I ended that article with: *Can we conceive of an IEEE Canada which is viewed by IEEE as Region 7; and, for example, by the Engineering Institute of Canada and the Canadian Council of Professional Engineers as the Canadian Society of IEEE? One technical Society, with appropriate ties transnationally within IEEE, and nationally within Canada. I believe this to be an achievable goal! Let’s make it a reality.*

As the outgoing Director in 1989, it was my responsibility to nominate candidates for Region 7 Director-Elect. Vijay Bhargava was one of my nominees and the winner in the subsequent election. While we had often apparently been in opposition, he for CSEE, me for IEEE, he was clearly a volunteer leader of very high quality. Tony Eastham had succeeded me as Director, and together they set the stage for a renewed look at formally combining the two societies.

4.3 The Stage is Set for a Successful Merger

CSEE had been renamed in 1990 to CSECE (as had the journal from CEEJ to CJECE). The stage was now set. Both organizations had non-competing complimentary assets: CSECE was the constituent society of EIC and had a journal and a conference; the IEEE entity was Region 7 of IEEE with 20 sections, 60 student branches, 14,000 members, a magazine, a developing foundation, and legal title to the name IEEE Canada (and an acceptance of that name within IEEE). When Tony was the Region 7 Director, John Plant was the CSECE president (and a former IEEE Central Canada Council chair), so they began the discussions that Vijay Bhargava and Ray Findlay concluded.

In the Fall of 1991 Region 7 Director-Elect, Vijay Bhargava, established a “Blue Ribbon Committee” consisting of outgoing Region 7 Director Tony Eastham and outgoing CSECE president John Plant. This committee was charged with reviewing the relationship between IEEE Region 7 and CSECE and preparing a discussion paper to be considered by both organizations.



Tony Eastham

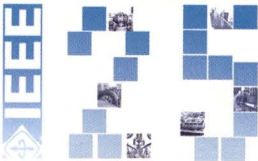
They identified three options: maintain separate organizations with no common activities; develop collaboration and engage in cooperative programs and ventures; and, amalgamate to form a single organization. Their recommendation was for amalgamation.

At the spring 1992 meetings of both organizations, the amalgamation proposal was presented and approved in principle—subject to financial and operational plans being developed. To inform the memberships, Tony and John prepared an article “IEEE Region 7 and CSECE—is a merger desirable and feasible?” for the fall 1992 issue (#14) of the *IEEE Canadian Review (ICR)*.



John Plant

In January 1993 Vijay appointed a working group for the amalgamation of IEEE Region 7 and CSECE consisting of Tony Eastham, John Plant, Bob Alden and Ray Findlay. In February 1993, the proposal was presented to the IEEE Transnational Committee (TC) and the IEEE Regional Activities Board (RAB); the following motion was passed “TC, RAB welcomes



and supports the initiative to merge IEEE Region 7 with the CSECE and urges IEEE to work with CSECE towards determining ways and means to bring about this merger by January 1, 1994."

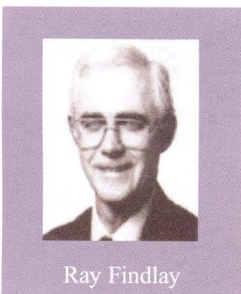
In May 1993 draft bylaws and a draft budget for 1994 were presented and approved at the IEEE Region 7 meeting in St. John's. It was agreed to hold discussion in all Section committees, and to inform and seek approval by the IEEE Region 7 membership in the next ICR. In August 1993 the IEEE Executive Committee and the IEEE Board of Directors approved this process.

In November 1993, a special CSECE Annual General Meeting approved that CSECE would be dissolved and its assets transferred to IEEE Canada on the condition that the membership of IEEE Region 7 and the IEEE Board of Directors approve the merger. In consulting the membership, the fall 1993 ICR (#17) carried an article "IEEE Canada—the decision is yours" containing the background, the process, the features and budget, and a ballot to approve the merger. By the end of 1993 both IEEE Region 7 and CSECE had approved the merger.

The start of 1994 saw both organizations operating in complete collaboration pending the remaining approvals

- IEEE Region 7 Director Ray Findlay was also the IEEE representative on the CSECE board
- CSECE President Tony Eastham was also vice-chair of IEEE Region 7
- Louis-André Poulin was Treasurer of both organizations

At the May 1994 Region 7 meeting in Ottawa, the modified draft bylaws were approved and forwarded to the IEEE board with a request to approve the formation of IEEE Canada and recognize the new organization as Region 7 of the IEEE.



Ray Findlay

With the fall 1994 IEEE election ballot mailing, a ballot for the merger was included. Following a positive vote, the merger was approved by the IEEE Board of Directors at its November 1994 meeting, with Ray Findlay (IEEE Region 7 Director) making the presentation and convincing the Board of the merits of the merger. As of January 1, 1995—IEEE Canada formally exists and Ray Findlay becomes the first IEEE Canada President.

5.0 Merger Achieved: 1995

In 1995 we all won with a unique Canadian solution to the need to develop a single appropriate organization for electrical and computer engineering professionals in Canada.

In terms of current operation in Canada, IEEE Canada is the name of the organization. IEEE Canada is governed by a Board of Directors whose chair is the President of IEEE Canada. There are no longer any regional meetings. All 20 Canadian IEEE Section chairs are Directors of IEEE Canada. The official logo of IEEE Canada is shown here and consists of the IEEE logo on the left and the CSECE logo on the right—representing the official 1995 merger that was approved by IEEE and with the blessing of EIC. The form of the new logo follows the precedent set by the merger of AIEE and IRE in 1963, wherein the IEEE logo contains elements of both predecessor organizations' logos.



IEEE Canada is one of (currently) 12 constituent societies within the EIC. EIC does not have individual members as such but members of its constituent societies may be elected EIC Fellows or be awarded EIC Medals. The IEEE Canada President is a director of the EIC and attends the EIC Board meetings held twice each year. The IEEE Canada Awards

and Recognition Committee Chair is a member of the EIC Honours, Awards, and Fellowships Committee.

When IEEE Canada is represented at IEEE Board meetings, our president attends as the Region 7 Director. All IEEE members in Canada are full members of IEEE and any technical societies and councils they elect to join.

Acknowledgements

I would like to express my thanks to the many volunteers and IEEE staff members who have assisted me in the gathering of historical material over many years. I must single out a few of these: Gordon Slemmon—whose words I have used in Section 1 and elsewhere; Mary Ann Hoffman—former IEEE staff member in Regional Activities and the History Center; George Armitage—the first office manager and long time volunteer treasurer of IEEC Inc. who introduced me to the name IEEE Canada in 1972; Cathie Lowell—the IEEE Canada Administrator; and, legendary IEEE volunteers Ray Findlay and Vijay Bhargava. There are many other superb volunteers who have contributed to the IEEE, both here in Canada and worldwide, but I have tried to focus on those who have contributed directly to the creation of IEEE Canada. Much of the material used for this article is archived on the IEEE Canada website—select the "history" link on the left hand side of the home page. The back issues of the *IEEE Canadian Review* record many events and personalities of historical interest, these are also archived on the IEEE Canada website—select the "Review" link at the top of the home page.

About the Author



Robert T.H. (Bob) Alden retired from McMaster University in Hamilton, Ontario as Professor Emeritus, after a 32-year career in which he was the founding director of the Power Research Laboratory and published 85 papers, 35 of them in fully refereed journals. He is a licensed professional engineer in Ontario, Canada, a Fellow of the Engineering Institute of Canada and a Life Fellow of IEEE.

His IEEE volunteer service includes the following. He is currently President of the IEEE Canadian Foundation and a Director of the IEEE Foundation. He has just completed a three-year term as the Awards and Recognition Chair of IEEE Canada and is the Publications Chair of the IEEE Toronto Section. He served as IEEE Vice President for Regional Activities in 1990 -1991, Director of IEEE (Region 7) in 1988-1989, Secretary of the IEEE Power Engineering Society in 1980-1981, Chair of the Hamilton Section in 1974 - 75. He was the IEEE Canada Webmaster in 2002 - 2006 and founding chair of the Toronto Section Life Members Committee in 2002. Between 1992 and 2002 he wrote 75 articles in IEEE's *The Institute* as a regular column entitled "Traveling the information highway with Bob Alden."

He has received several IEEE awards: 2002 IEEE Haraden Pratt Award "For outstanding and sustained leadership in many areas of the IEEE especially in the use of electronic communication"; 2000 IEEE Third Millennium Medal "In recognition and appreciation of valued services and outstanding contributions"; 1999 William W. Middleton Distinguished Service Award "For challenging IEEE volunteers and staff to maximize their use of electronic communications in all IEEE activities"; 1999 IEEE Canada's Outstanding Service Award "For outstanding service as Region 7 Director and for pioneering efforts in establishing the *IEEE Canadian Review*, the IEEE Canadian Foundation and IEEE Canada"; 1992 IEEE Larry K. Wilson Transnational Award "For exceptional leadership in the promotion of electronic mail worldwide and promoting IEEE as a leader in the use of communications technology"; and, 1984 IEEE Centennial Medal "For extraordinary achievement", nominated by the IEEE Hamilton Section.

The External Cardiac Pacemaker

A Canadian Invention and an IEEE Milestone

By Visda Vokhshoori, IEEE Toronto Section

1.0 Introduction

"There was no intent to sit down and develop a pacemaker. As so often happens, one piece of research spins off into something else." These are Dr. Jack Hopps' words from his 1984 interview with panelists of CBC quiz show "Front Page Challenge". [1]

The development of the external cardiac pacemaker came about through Dr. Hopps assisting Toronto-based Dr. Wilfred Bigelow in studies related to hypothermia and surgery. The doctors realized that one of the problems was to keep the heart beating in the cold state. So they developed a technique to stimulate the heart, to keep it going.

In 1950, Dr. John Hopps designed the first catheter electrode for cardiac simulation. Hopps' Pacemaker-Defibrillator, a reconstruction of which is



seen in Figure 1, operated with a vacuum tube design. About a decade later transistors replaced the vacuum tube. This resulted in considerable decrease in the size of the pacemaker. Overtime, advancements in semiconductor and battery technology have helped develop an implantable pacemaker in humans.

Figure 1: Reconstruction of the Hopps pacemaker prototype. Photo courtesy of George Szarka, whose reconstruction of the above, along with a replica of the Hyman pacemaker, helped medical historians understand and chronicle the various stages of development that have led to the modern implantable pacemaker. Mr. Szarka painstakingly pieced together the circuitry and form of the Hopps prototype from patent filings, photographs and scientific papers.

2.0 The Pump

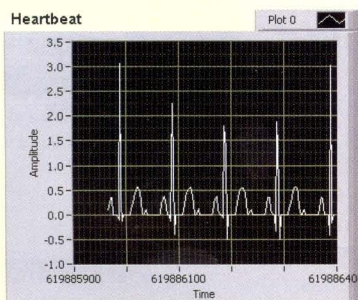


Figure 2: In the cardiac cycle's four stages upper and lower chambers contract then rest.

and contract. It is a four-part cycle consisting of contraction (systole) and rest (diastole) of upper and lower chambers. A heartbeat may seem like a simple event repeated over and over. As simple as it may seem, it is in fact a series of very complicated and precisely coordinated events that take place inside and around your heart. When the cycles are precisely timed, the heart is able to pump very effectively.

As you can see in figure [2], there are four parts in each cardiac cycle. The first peak indicates the start of the electrical impulse generated by the heart's natural pacemaker, sinoatrial (SA node). This area, (P wave), is smooth and positive and usually lasts less than 0.12 seconds. This is followed by a valley-peak-valley, otherwise known as QRS complex. QRS complex, in simple terms, is the definite indicator of a heartbeat. During the 0.04-0.12 seconds that it takes, the ventricles depolarize. From the bottom of the valley to the onset of the next peak, no electrical activity is recorded, hence the flat line. However, during this period the ventricles are contracting. The last part, T wave, represents repolarization or recovery of the ventricles. At times the natural pacemaker may be defective, causing the heartbeat to be too fast, too slow, or irregular. The artificial pacemaker helps the heart to beat in regular rhythm. [2]

3.0 Pacemakers prior to Hopps

Beginning in the eighteenth century, physicians realized that electrical stimulation could cause muscles to contract—and they knew perfectly well that the heart was a muscle. Charles Kite recommended electrical discharges to the chest for resuscitation in "An Essay Upon the Recovery of the Apparently Dead", (London, 1788). Kite's invention was more of a precursor to defibrillation, than to pacing.

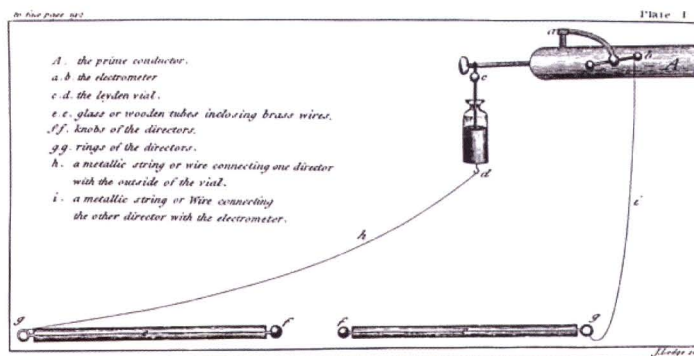


Figure 3: Leyden jar capacitor & attached electrodes for cardiac resuscitation.

The apparatus as shown in Figure 3 is from Kite's article. An electrostatic generator charges a Leyden jar capacitor, which can discharge its accumulated electrical energy through the electrodes below. Energy will build up until the voltage is high enough to jump the spark gap.

The idea of a "pacemaker" is attributed to Dr. Albert Hyman of New York. Hyman's apparatus, based on his notes of April 6, 1930 [4], included:

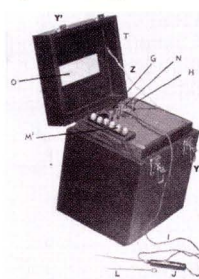


Figure 4: photo of Hyman's pacemaker.

- (1) a small source of electric current, i.e., a common flashlight battery;
- (2) an interrupter mechanism;
- (3) a timing device;
- (4) a method of regulating the duration of the injected current; and,
- (5) a suitable insulated needle to carry the current only to the right atrial area of the heart. The instrument would, of course, be easily portable, and small enough to fit into a doctor's bag.

Figure 5 shows a flow diagram of Hyman's pacemaker. The needed electrical current was supplied through winding the hand-crank attached to a spring motor, which drove a magneto-generator and produced the desired current. Each time this current came into contact with the disc interrupter an electrical surge passes to the needles and then to the heart.

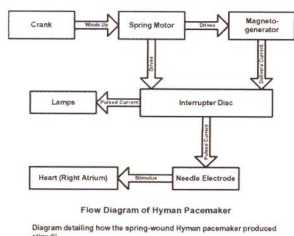


Figure 5: Flow Diagram of Hyman Pacemaker

4.0 Hopps' Pacemaker Circuit

The end of world war promised new beginnings. Interest in hypothermia began in that era when field surgery under cold conditions seemed to have better outcomes. Performing open heart surgery under hypothermic conditions was a logical extension, but the challenge was how to restart the heart should the cold stop it. Electrical stimulation of the heart's chambers was known to cause contraction—electronics could provide the sequencing.

In collaboration with Drs. Wildfred Bigelow and John Callahan, Hopps produced the first external cardiac pacemaker, including:



- (1) A stimulator-defibrillator;
- (2) A foot-pedal Micro Switch;
- (3) Two Electrodes/Foot pedals that allowed the surgeon to control flow of electricity while positioning electrodes by hand on either side of the heart. [5]

The pacemaker was large—30 cm long and several centimeters wide and high. The unit was powered by 60 Hz household current.

Figure 6: Dr. Hopps, testing a pacemaker

When transistors were invented Hopps' pacemaker idea was incorporated into a smaller unit. The first implantable pacemaker was invented in 1958.

Hopps' vacuum tube-based circuit can be seen in Figure 7; schematic provided courtesy of George Szarka.

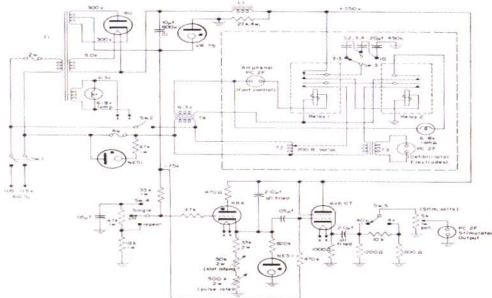


Figure 7: Schematic for the Hopps Pacemaker-Defibrillator, model #3.

5.0 Pacemaker Advancement

Today the pacemakers are small, compact, mini-computers that are implanted in human's body to keep heart beat in regular rhythm. The advancement in the battery design has made a tremendous difference in the life of a pacemaker. Unlike the first implanted pacemaker that lasted

Milestones in IEEE Canada History

IEEE Milestones in Electrical Engineering and Computing is a program of the IEEE History Committee to honor significant achievements in electrical, electronic and computer engineering, as well as the associated sciences. Milestones recognize technological innovation and excellence for the benefit of humanity found in unique products, services, seminal papers and patents. Each milestone honors a significant achievement that occurred at least 25 years ago in an area of technology represented in IEEE. To date, more than 75 milestones have been approved and dedicated around the world—10 of them in Canada.

IEEE Newfoundland-Labrador Section

- Landing of the Transatlantic Cable, 1866
- Reception of Transatlantic Radio Signal, 1901
- First Submarine Transatlantic Telephone Cable, 1956 (with Canadian Atlantic Section)



The Great Eastern landing the western end of the transatlantic cable.

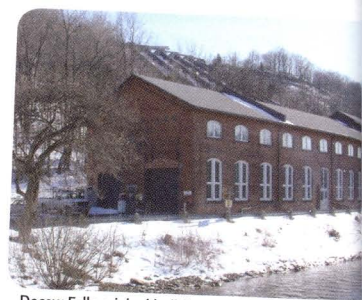
IEEE Newfoundland-Labrador Section

IEEE Ottawa Section

- Alouette-ISIS Satellite Program, 1962

IEEE Hamilton Section

- Decew Falls Hydroelectric Power Plant, 1898
- First Distant Speech Transmission in Canada, 1876



Decew Falls original building.

IEEE Hamilton Section

IEEE Winnipeg Section

- Nelson River HVDC Transmission System, 1972
- Pinawa Hydroelectric Power Plant, 1906

IEEE Montreal Section/ IEEE Quebec Section

- First 735 KV AC Transmission System, 1965

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A 25-YEAR HISTORY OF IEEE CANADA

only one day before the batteries conked out, today's pacemakers can last up to ten years.

The first major technological leap in implantable pacemakers occurred when pacemakers stopped just pacing the heart to a preset rhythm and started to offer more "intelligent" therapy.

Sensing is the function that allowed pacemakers to "listen" to the heart and literally record what the heart was doing on its own.

Pacemakers quickly adopted computer and microchip technology to add "brains," so that they were equipped to listen to the heart, "make a decision", and then pace or not. Modern pacemakers monitor every beat of the heart and "fill in the missing beats" when the heart does not beat as it

The story of one of IEEE's newest milestone—the first long-distance voice transmission—was recently published in *The Institute* (7 May 2008).

First Long-Distance Voice Transmission is Newest IEEE Milestone

By Willie D. Jones

The spot in Canada where the first long-distance voice transmission was received was honored recently with an IEEE Milestone in Electrical Engineering and Computing. A commemorative plaque was unveiled at the old telegraph office in Paris, Ont., where Alexander Graham Bell heard voice signals being sent through wires from the telegraph office in Brantford, 13 kilometers away.

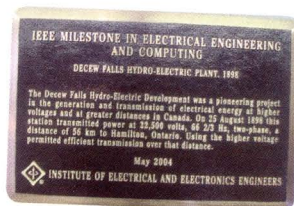
IEEE President Lewis Terman and IEEE Canada President Ferial El-Hawary were among the luminaries who joined members of the IEEE Hamilton Section for the 4 May unveiling. The ceremony coincided with the IEEE Region 7 (Canada) spring meeting in nearby Niagara Falls, Ont. A number of meeting attendees traveled to the site to help recognize the milestone.

The one-way transmission on 10 August 1876 was a giant leap forward, considering that previously Bell had been able to transmit voice signals only between rooms in a building. True telephony, with two-way voice transmission came a few months later.

"The most significant milestones are for things we take for granted today," says IEEE Member Chris Maryan, chair of the Hamilton Section. "Despite using it constantly, most of us don't even think about the effort that went into the development of the telephone in its infancy." Maryan notes that a lot of intermediate steps between Bell's initial experiments and the eventual commercialization of the telephone are lost to history.

"What we have here represents one of the more significant jumps in the technology," he says.

The Brantford-to-Paris call, which included a one-way conversation to Bell from his relatives and the voices of a choir singing in Brantford, took place over the telegraph network. The Paris site where the plaque is displayed was the local telegraph office at the time. The building has been rebuilt a number of times due to fires, most recently in 1901, and used for other purposes, but the site has always been remembered for its contribution to communications history, Maryan says.



For every Milestone, a bronze plaque commemorating the achievement is placed at an appropriate site.

A 25-YEAR HISTORY OF IEEE CANADA

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ought to. When nothing is needed, the pacemaker merely observes, content to be on stand-by.

Another major advancement in pacemakers occurred with the so-called transvenous lead. Transvenous means "through the vein", and lead is the standard term for the insulated wire that runs from the pacemaker (usually implanted in the upper chest) to the heart itself.

While remote patient monitoring is becoming increasingly sophisticated, pacemakers were actually some of the original devices to offer telemedicine. Even as far back as the 1980s, pacemaker patients could send information from home to their doctor's office over a regular telephone. That technology is still around today, although with some refinements. In fact, pacemakers were some of the very first devices to introduce the whole

concept of having a "check-up" with doctor and patient in two different locations!

The pacemaker business is still going strong. Millions of people all over the world have benefited and continue to benefit from this life-enhancing therapy.

6.0 Registration of the Pacemaker as an IEEE Milestone

Due to its significance and strong ties to the Toronto area, IEEE Toronto Section nominated Development of "First External Electronic Cardiac Pacemaker with Internal Electrodes for Continuous Clinical Use" as its first IEEE Milestone.

IEEE Toronto Section Milestone committee was comprised of: Pat Finnigan (SMIEEE), Inci McGreal, Ron Potts (Region 7 Life Members Coordinator), and Bert deKat (IEEE Hamilton Section). "We had a tremendous amount of help and support from IEEE Region 7 staff and the IEEE History Center, as well as the evaluation committee comprised of very senior, experienced, and supportive reviewers," says Pat Finnigan, who led the Milestone application to its successful conclusion.

On April 24, 2007, IEEE Toronto Section made its final submission for the Milestone. The submission was approved June 30, 2008, and the plaque unveiled September 26, 2009 at the Best Institute in downtown Toronto, where the research was performed.

7.0 References:

- [1] CBC Digital Archives, Broadcast on May 19, 1984, http://archives.cbc.ca/on_this_day/10/08/
- [2] Tom Kenny, *The Nuts and Bolts of Cardiac Pacing*, Chapter 1
- [3] Seymour Furman, MD, Early History of Cardiac Pacing and Defibrillation, *Indian Pacing Electrophysiology Journal*, 2002 Jan-Mar; 2(1): 2-3, <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1569902>
- [4] Maulik V Baxi, First Artificial Pacemaker, A Milestone in History of Cardiac electrostimulation, <http://www.asmj.net-firms.com/article0903.html>
- [5] Heart Rhythm Society, <http://www.hrsonline.org/News/ep-history/topics-in-depth/hymanspacemaker2.cfm#Problems>
- [6] Showcase of Canadian Engineering Achievement, IEEE Canada web site, http://www.ieee.ca/millennium/pacemaker/pacemaker_about.html
- [7] Jo Ann LeQuang, Pacemaker, Implantable Heart Technology Turns 50, <http://www.articlesbase.com/health-articles/happy-birthday-pacemaker-implantable-heart-technology-turns-50-495628.html>

About the Author

Currently a developer of the optimizing backend of the IBM XL compiler brand, Visda has been in IT for more than 10 years. She has spent her career since graduation from the EE Department of State University of New York, New Paltz, at four different groups, in two different countries with IBM. With each change, she has set the bar higher for herself, working on more complex set of computing problems. She obtained her MSEE from Columbia University, New York, in 2002. She is the PR Chair for IEEE Toronto "Hopps First External Pacemaker" Milestone Celebration.

