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“Engineering Education at Loyola College, Sir George Williams and Concordia Universities”

by H.J. McQueen. F.D. Hamblin and S. Matulis

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WORKING PAPER 11/1997

ENGINEERING EDUCATION AT
LOYOLA COLLEGE, SIR GEORGE WILLIAMS AND CONCORDIA UNIVERSITIES

by

H.J. McQueen, F.D. Hamblin and S. Matulis

May 1997

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Abstract

This paper traces its origins to the Second CSME History Committee Seminar held in 1992 at Concordia University, Montréal, at which Stan Matulis presented a paper on engineering education at Loyola College and Hugh McQueen a paper by Doug Hamblin and himself on the development of mechanical engineering education at Sir George Williams and Concordia Universities. The McQueen-Hamblin paper later became the basis for an essay "Mechanical Engineering at Concordia University: A Quarter Century of Expansion" that appeared in the CSME's 25th Anniversary Commemorative Volume From Steam to Space..., which was published in late 1996. However, the Editor of this Working Paper Series felt, and Hugh McQueen agreed, that the Loyola material should be published more or less as originally presented, with some additions by McQueen, along with the original McQueen-Hamblin presentation, since they contain useful information not included in the essay.

The Loyola material - which is more in the form of a 'memoir' - begins on page 1. It first discusses the historical background of the College and its Faculty of Science, moving from there to the steps taken to accommodate veterans returning from World War II and the subsequent growth of the College. It then discusses the pre-engineering courses and their development into a Faculty of Engineering and full degree courses. It ends with the rather abrupt merger of the College with Sir George Williams University to form Concordia.

The Concordia material, which begins on page 7, discusses the pre-engineering program at Sir George Williams (SGW) and its evolution into a separate Faculty of Engineering, the beginnings of the Department of Mechanical Engineering, and the merger with Loyola. The Department, which came into existence in 1964, was the base from which the Concordia ME Department was formed. This material then goes into some detail on the development of the mechanical undergraduate and graduate programs, student projects, teaching staff and research, much of which has been presented in tabular form. The Figures and Tables have not, however, been updated beyond the early 1990s and, for a discussion of events and developments since then, the reader should refer to the McQueen-Hamblin essay in the CSME Commemorative Volume.

The Tables and Figures appear at the end of the paper. They are listed on page 14 (along with the single Note) and begin on page 15.

About the Authors

Hugh J. McQueen received a BSc degree from Loyola College, followed by a BEng in metallurgical engineering from McGill and a PhD from the University of Notre Dame in Indiana. Before joining the staff at Concordia in 1968, he conducted research at CANMET and taught at

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Ecole Polytechnique. He is now Professor of Materials and Manufacturing in the Department of Mechanical Engineering and has served one term as Chairman. Hugh has a special interest in the history of technology and - maintaining the liberal education he received at Loyola - has been the principal organizer of the required program in Social Aspects of Engineering. He will retire from Concordia on 1 January 1998. He is a member of the CSME History Committee.

F. Douglas Hamblin was educated and received his industrial training in Britain, where he worked as an engineer in the aircraft industry. Coming to Canada in 1958, he began his academic career in the Department of Mechanical Engineering at the University of Saskatchewan, moving to Sir George Williams University in 1967. He has served as Assistant and Associate Dean of Engineering at Concordia and established the University's Office of Institutional Research. He is one of the few Canadians holding the title of European Engineer. He retired from Concordia in 1996.

Stanley Matulis served in World War II with the Black Watch Regiment of Canada and was wounded in action. On returning to Canada and civilian life, he completed high school and entered Loyola in 1949 under the Veteran's Assistance Plan, graduating in 1954. He subsequently graduated in metallurgical engineering from McGill and worked for many years as a metallurgist with the Dominion Engineering Company in Montréal. He then joined Pratt & Whitney Canada, from which firm he retired a few years ago.

About the Working Paper Series

In June 1991, the Board of Directors of CSME agreed that its History Committee should be responsible for the production of a series of Working Papers on topics related to the history of engineering generally and to the mechanical discipline in particular. The Papers may or may not be authored by members of the Committee or the Society. They may also be published later, in whole or in part, in other vehicles, but this cannot be done without the expressed permission of the Canadian Society for Mechanical Engineering. The Papers will have limited initial distribution, but CSME Headquarters in Ottawa will maintain a supply for distribution on request.

The opinions expressed in the Working Papers are those of the authors and are not necessarily shared by the Society.

ENGINEERING STUDIES AT LOYOLA

by Stan Matulis and Hugh McQueen

A Little History

Loyola College, in west end Montréal, was incorporated by the Fathers of the Society of Jesus of the Canadian Province (The Jesuits) through an Act of the Quebec Legislature on 2 February 1889. The early degrees were granted by Université Laval in Québec, and later ones by the Université de Montréal when the College became autonomous.

The Université de Montréal controlled a network of colleges that emphasized philosophy and theology and were not involved in science - wanting no part of such materialistic studies! Loyola, on the other hand, in the mid-30s and early-40s, appreciated that science-trained people were 'the coming thing' in North America. The administration of the Université created some difficulties, discouraging Loyola's drive towards the sciences. But perseverance won out; Loyola was finally authorized to set up a Faculty of Science to grant slightly modified degrees, showing that the science graduate had won a Baccalaureum in Scientiis from Collegium Loyolaeum, Universitas Montis Regii.

Start of the Faculty of Science: 1943-53

Loyola's Faculty of Science started courses in the fall of 1943, giving honours chemistry, mathematics and physics as well as a pre-engineering in civil, mechanical, electrical, mining, metallurgical and engineering physics. Metallurgy was dropped after several years, but restarted in 1962. The pre-engineering graduates - although the parchment said simply 'BSc' - were ready to enter the fourth year of McGill's five-year engineering program. The entrance arrangements between the two institutions were unique; that is, no qualifying exams were required. This 'gentlemen's agreement' was no doubt based on McGill's recognition of the high scholastic standards of the Jesuits, especially Dr. Hugh McPhee SJ (physics) and Dr. Eric O'Connor SJ (mathematics), who were the academic linch-pins of the Science Faculty.

The campus paper Loyola News wrote up a minor heading in its 29 September 1947 issue, "News of Last Year's Loyola Grads":

Last year was an eventful one for Loyola since it produced its first graduating class in science.

Of this group, Messrs. Danaher, Flanagan, Harvey, Fauteaux, Kennedy and Leahy entered the Faculty of Engineering at McGill. These

'illustrious six' created a milestone for Loyola.

The Canadian Forces Veterans at Loyola College

Let's look particularly at 1945: The war with Germany was over in May and the Japanese capitulated in August. Within a few months, Canadian servicemen were coming home by the thousands every week. When they reached Canadian shores another name was given to them - the 'Canadian Veteran.' A ministry in Ottawa called the Department of Veterans Affairs (DVA) was created to help ease the demobilized servicemen onto 'civvy street' through a gratuity fund known as the Re-establishment Credit. The grant to a veteran, which depended on his length of service, could take several forms: a simple monthly allowance or lump sum to refurbish his home with furniture and appliances, to start a business, or to buy land to build a house. As an alternative, he could go to university, trade or technical school; for every month of service, the veteran qualified for one month of university training - that is, tuition and a \$60.00 allowance, \$90.00 if married.

McGill was swamped with veterans, forcing it to set up first year facilities at a former RCAF base at St. Jean, Quebec - which was named Dawson College. In response to a DVA approach to become involved, the 'Making Space' program resulted in the Central Building at Loyola going up by two more stories, ready for the opening of the school year in 1947. Shrewd people these Jesuits! Not only did they get their magnificent English collegiate gothic building finished, they further tried to capitalize on the influx of veterans by converting the Central Building's gymnasium into six temporary classrooms. But these were not to be used; the veterans did not come in the numbers expected, and many only wanted a 'refresher course' that was meant to prepare them for entry to the first-year at another college. In the Loyola News for 21 December 1945, a reporter asked veteran 'Rocky' Durocher what he thought of Loyola after his first three months. His reply was:

I have learned to like Loyola very much; however, it is not easy to say how many of us (the refreshers) will continue their studies at Loyola. It will depend largely on the courses they intend to follow, and upon their age. Quite a few of us will enter Dawson for engineering after our studies here, mainly because of its year-round course, (which) will save us several years. For the younger fellows, a year or so doesn't matter much, but those of us who are older, and for some of the boys who are married and have children, it counts for a great deal. (But) it is reasonable to suppose that quite a few of our class will stay on at Loyola.

Of the 117 veterans attending Loyola at Christmas 1947, 50 were 'refreshers' and 67 were taking actual college courses. But it came

to pass that 'Rocky' Durocher guessed correctly: some stayed, some left for other institutions. By the time Stan Matulis came to Loyola for the 1949-50 session (under the same vets plan), one could count the veterans on the fingers of one hand. The following year they were all gone, other than Stan. Many veterans successfully went through Loyola's pre-engineering studies and continued at other institutions, but primarily at McGill University, for their engineering degrees. Their enrollment had encouraged the completion of the principal campus building, which provided much needed space to further enhance engineering at Loyola.

The Years in Pre-Engineering

Hugh McQueen arrived at Loyola for the 1951-52 session. Like many aspiring engineers, Stan and Hugh were enthusiastic about the science and mathematics courses taught principally by Jesuits. But Hugh had trouble in an advanced math course - taught by Father O'Connor. It began at 1 pm and, when he fell asleep, he was very noticeable in a class of three!

It may be hard for many to believe, but Stan and Hugh appreciated the theology and philosophy courses, both at that time and even more in later life. They are also grateful to Father Drummond for his 'facts of life' biology course. They both played 'suicidal' floor hockey for the Science Faculty in the basement of the Central Building. Stan did very well in ice hockey and intercollegiate football. They were both executives of the Science Club and conducted an unsuccessful campaign for permission to break with tradition by having a Loyola pin that said "Science Faculty." Their activity of choice was the Loyola Contingent of the Canadian Officers' Training Corps, which had its offices, classrooms and lounge in the northwest corner of the old hockey arena (now the physical plant building). This Unit can trace its roots to World War I and the Irish Canadian Rangers, whose flags presently hang in the chapel. The COTC provided excellent leadership training, and well-paying summer jobs. Although Stan was in the Service Corps and Hugh in the Corps of Engineers, both spent the summer of 1954 with the Canadian NATO contingent in Germany.

The years from 1949 to 1954 were great years at Loyola because, when Stan and Hugh were in pre-engineering, Father McPhee taught them math and physics. He was a shy, gentle man but, when his face reddened, you knew he was upset. Father O'Connor also taught math. He was, by reputation, one of North America's best mathematicians. They always held him in awe, until the day he told them he enjoyed watching animated cartoons - although he quickly qualified this remark by adding, "But only because they remind me of human weakness - its frailty and dumbness!"

They thought that the best professor - ever - was Frank Guadagni,

a metallurgical engineer from McGill who had graduated in 1937 and had won the British Association Medal. 'Guadink,' as the students liked to call him, taught engineering drawing and design and just about everything of an engineering nature; he was a well-liked teacher. In the spring of 1954, 14 students graduated and, that fall, entered McGill's Faculty of Engineering.

The Developing Years: 1955-1973

The situation at Loyola remained generally static until 1959, when 'rumblings' of change were heard from McGill. The revision of McGill's engineering curriculum forced changes in Loyola's freshmen year program. For admission to its degree courses, McGill began putting more emphasis on the individual student's record and did away with the 'blanket basis' that had been the rule up until then. Also, additional changes to McGill's policy and curriculum were being made frequently and Loyola was finding it increasingly difficult to provide its students with the necessary courses. And McGill's overcrowded facilities could at any time put a stop to the advanced entry arrangements. So the logical step was for Loyola to strike out on its own, so that the engineering students would be able to get their degrees from Loyola without recourse to other institutions.

About 1960 a committee headed by Dr. A.S. Yalcin produced a comprehensive report on Loyola's further development. Many of his recommendations were put into effect with respect to staff, space, lab facilities and curriculum; but what was most gratifying was his proposal to maintain the traditional humanities, which were the outstanding features of the program that Stan and Hugh followed. But, much to their disappointment, the session of 1965-66 showed a radical elimination of much of the philosophy and theology. Yalcin's report projected that the engineering student body would reach 250 by 1965-66; the optimum capacity of the facilities was 230. However, this figure was quite a bit off the mark. Even by 1972 the engineering enrollment had only reached 134.

Based on Yalcin's report, the engineering program was rapidly developed with the addition of staff and laboratory space. But about this time Loyola and another institution, Sir George Williams University (SGW), were both having difficulty providing the necessary courses. In order to overcome this, the head of engineering at Loyola - David McDougall - and his counterpart at SGW - Jack Bordan - initiated a system of 'course sharing' - that is, Loyola students went to SGW, and vice-versa. This could be considered a sort of precursor to the merger between the two institutions that was to occur in the mid-70s. McDougall has commented further, "When Loyola re-established the metallurgy course around 1962, they gave me - a geologist - the teaching job. It seemed that I was always only one chapter ahead of the students. I was getting apprehensive about this role in engineering and soon

asked for someone more qualified to take over the job as Faculty Head." Perhaps David McDougall was being somewhat modest about his knowledge of metallurgy! Around 1964, McGill's Assistant Dean of Engineering - George Joly, highly regarded in Montréal's engineering community - was persuaded to take on the senior job at Loyola's Engineering Faculty. Freed from his engineering responsibilities, McDougall was very willing to go back to run Loyola's Geology Department.

When Joly was appointed Chairman and Associate Dean of the Faculty of Engineering, he recruited qualified people for the various engineering disciplines - chemical, civil, electrical and mechanical. He rallied the Corporation of Engineers of Quebec to Loyola's side. This important body accepted his invitation to inspect and approve both the engineering laboratories and curriculum - which it did. The 1964-65 school session ended with the reaching of this important milestone. One can imagine the Loyola News running the following headline:

FIRST BSc ENGINEERING DEGREES AWARDED AT LOYOLA IN
CHEMICAL, CIVIL, ELECTRICAL AND MECHANICAL

For the first time, graduating students were pleased to read the suffix 'Engineering' after the letters 'BSc' on parchments that still had the blue seal of the Université de Montréal.

The Last Years at Loyola

During the latter part of the 60s, engineering courses were enhanced, and faculty augmented. In 1971-72, the 'day student' population broke the 4000-mark (for the College as a whole). In 1973, separate departments for civil, electrical and mechanical engineering were established.

But during this period dark, ominous clouds were hovering over the College. In 1968, when the Union Nationale was running the provincial government, Loyola was asked to send a delegation to a meeting with the Minister of Education. This high-ranking group was ushered into the office of the Minister who, without much small talk, opened a folder and read off pretty close to the following:

1. All existing Loyola equipment, libraries, labs, etc. are to be dispersed throughout the university system.
2. The students are to be transferred to other universities.
3. The Jesuits can do anything they want with their property.

4. Faculty members will have to fend for themselves.

The delegation was stunned. One of the Loyola people commented, "This is rather sudden - when does it come into effect?" The Minister then said, "There will be a public press conference tomorrow restating what I have just told you. You are requested not to discuss this meeting until it is public knowledge."

The uproar was immediate and strong: the English papers ran three-inch headlines: LOYOLA CLOSES. Not only the press, but English radio and TV raised quite a fuss.

Gratifying editorials in the French press - Le Devoir and La Presse - also supported Loyola. Le Devoir stated, "You can't close Loyola - it's been here so long that it is part of Quebec." Public opinion was so strongly in favour of Loyola that the government relented, with comments like this: "We have had further meetings on the subject. You will have to make arrangements to live within the present university organization. How you do it we don't know, and we don't care." The College gained a reprieve, but even SGW, with its Charter, was seriously threatened. These events forced Loyola and SGW into preliminary negotiations for some kind of association.

In its objective - to maintain its academic traditions - the Loyola administration pursued every avenue while struggling with inadequate funding. Finally, in 1974, there arrived the most important year for Sir George Williams University and Loyola College. They merged to form Concordia University. The Loyola Faculty of Engineering was absorbed into the SGW Faculty with its accredited program. So in 1976-77 the last BSc Engineering class graduated from the former Loyola engineering program.

MECHANICAL ENGINEERING AT CONCORDIA UNIVERSITY

by Hugh McQueen and Doug Hamblin

Introduction

In 1993, on the 25th anniversary of the first graduating class in 1968, the Department of Mechanical Engineering at Concordia University in Montréal awarded 65 BEng, 7 MAsc and 4 PhD degrees.

This Department came into existence in 1964, with the transformation of the SGW certificate program into the Engineering Faculty (Tables 1a, 1b and 2). When the first engineers graduated in 1968, the postgraduate program was inaugurated. Both programs underwent continual modification and addition, as listed in Tables 3 and 4. In 1975, the Department was enriched by staff from Loyola College (Tables 1a, 1b and 2) upon its unification with Sir George Williams University into Concordia University. During the period from 1965 to 1993, there has been continuous growth in the number of professors (Table 2 and Figure 1a), in the number of (all engineering) students graduating (Figure 1b), and in the quantity of research funds (Figure 2). There are now four research centres based in the Department (Table 5). The recognition of the faculty members by technical societies (Table 6) has been matched by the successes in competitions entered by the students (Table 7).

Roots in Sir George Williams University, Loyola College

In preparation for the returning veterans, a pre-engineering curriculum was introduced (Table 1b) as an important part of the BSc program at Loyola College, as has been noted in the Matulis/McQueen paper above. The pre-engineering certificate program at SGW (founded 1926, Charter granted 1948) was inaugurated in 1954. For the most part, students from these programs completed their BEng studies by attending McGill University for two years. This continued until the early 60s, when the McGill program underwent major reorganization. The Loyola College Faculty of Engineering under Dean George Joly never received academic accreditation because of opposition from the Université de Montréal (which held the Charter), although it was recognized by the Corporation (now the Order) of Engineers of Quebec. The Engineering Faculty at SGW, under Dean Jack Bordan, came into operation in 1966 when the Hall Building - on de Maisonneuve Boulevard in downtown Montréal - containing the laboratories was opened. At both institutions, the development of staff (Table 2) and of laboratories was gradual, in association with the growth of the student body, to which the funding available was proportional.

In setting up the Faculty at SGW, it was decided to have only three disciplines for which there was considerable demand and to leave

till later the smaller departments in which there was excess capacity in the province. While the Faculty lacked the aura of comprehensiveness, it did gain strength by concentrating its efforts. The reasonableness of this scheme became apparent a few years later, in 1973, when Opération Science Appliquée of the provincial Ministry of Education defined 50 graduates per year as the healthy minimum and obliged the older universities to amalgamate small departments. To provide the service courses, such as materials science, usually presented by small departments, specialists were included in the Mechanical Department, which led to closer integration into one of the options - in this case, design and production.

Undoubtedly the engineering schools at Loyola and Sir George Williams, founded within two years of one another, were in competition, but Loyola was disadvantaged by inadequate government funding and the inability to initiate graduate studies and associated research. Upon the merger of Loyola and SGW in 1974, the SGW program was maintained because it was accredited. Dean Joly of Loyola became an Associate Dean with responsibility for engineering activities at the Loyola Campus of Concordia. The professors, with the exception of retirees, became valued members of the amalgamated Department (Table 2, see 1975). The Loyola program was wound down so that the last BSc (Eng.) students graduated in 1975. However, one section of students followed the first year of the Concordia program at Loyola until 1982. Research labs - notably in solar energy and heat pumps - have continued there.

The Bachelor of Engineering Program

This program of studies for mechanical engineering was set up to meet the requirements of the Canadian (Engineering) Accreditation Board with the minimum distribution in mathematics and physical sciences (25%), engineering sciences (25%), design (25%) and complementary studies (12.5%), with the remainder being devoted to electives. At the centre was the engineering core, which all students followed for two years in the full-time stream, but could also be taken in four years in the evening. The unifying courses were those in physical systems, which considered fundamental relationships found in electrical and mechanical systems. Building upon this was the departmental core, which included basic mechanical engineering science and design. To complete the program, there were electives either in more advanced or more applied courses in these subjects. Because of the paucity of staff (when the program began), there was a limited number of electives, which became loosely grouped into five options.

The program was founded on the most advanced curriculum concepts of the 1960s, without the need to maintain any traditions from the pre-war era. Moreover, there were no laboratories based on ancient

or heavy equipment. In 1971 the elective courses were organized into three options which, in 1981, underwent slight changes in name (Table 3). Two new options have been added; however, one was transformed into the separate industrial engineering program in 1992.

Also in 1971, the program was completely revised to receive graduates of the network of Collèges d'enseignement général et professionnel (CEGEPs), which included the final year of high school and the first year of university. The provincial Ministry of Education also required that the new program be limited to 120 credits and be completed within three years. It had also to mesh with a set of CEGEP course descriptions, although the amount the students would have grasped by the time they reached Concordia was unknown. The three-year program was extremely strenuous, but McGill's program was that length and it was necessary to compete for the better students. At the same time a four-year schedule was also offered. Meshing the two schedules with due consideration for prerequisites was quite a feat since most courses were taught only once a year because of staff limitations. In reality, many students signed up in the three-year program but, through course failures, ended up in a three-and-a-half- to four-year program. The University continued to offer the courses transferred to the CEGEPs for students admitted to engineering with certain omissions in their background because they: came from outside the province; had completed CEGEP but had not followed the correct program; or were mature students who had never gone to a CEGEP.

While the Department avoided many transitions by starting with modern equipment, it did see some. The slide rule was phased out in favour of electronic calculators. Now the majority of students have their personal computers and manipulate complex CAD/CAM programs. Graph preparation is now done almost entirely by computer. The Gestetner 'multiplying machine' has given way to the photocopier with both laser and colour facilities.

The Department operated on a credit system with pass and fail in individual subjects. But a problem arose with a small number of students who were scraping by with many D grades. A grade point average with minimum requirements of a C- average was introduced in 1972, which meant that after one or two D's the student had to repeat D as well as F courses. The new system greatly improved the quality of the final year and graduating students.

The number of graduates in mechanical engineering has risen from 20 to 85 per year, with some large fluctuations (Figure 1a). In terms of the fraction of the total Faculty graduates, this discipline has remained fairly constant at one-third. It is possible that saturation was reached around 1990, but this has been hidden by the year-to-year variations. Based on a four-year program, one may estimate an enrollment growth from 80 to 320. In the same period the professors increased from 10 to 30 (Table 2), so that the

student-to-faculty ratio has grown from 8 to 11.

The undergraduate program could not operate without support staff. In 1993 there were five graduate engineers charged with laboratory instruction and development, assisted by around 20 part-time graduate student demonstrators. Seven technical staff members ensured that the laboratory equipment was maintained and improved. In addition, the Department had access to a machine shop staffed by a foreman and four craftsmen who spent more than half their time on mechanical engineering projects and the remainder on work for the rest of the Faculty.

Development of the Teaching and Research Staff

The chronological appointment of professors is presented in Table 2. It occurred in spurts, as growth was permitted by the Ministry of Education. From Figure 1a it can be seen that the overall growth was fairly linear from 1965 to 1985, when saturation appeared. Of the entire list, only two have not held doctorates. The separate list of short-term appointments in the lower half of Table 2 shows that three of four of the staff have remained for the long haul. This confirms that the Department was found to be a collegial place where individual contributions could be made.

The development of the Department did not depend on any one man. However, it was blessed by chairmen (M.P. du Plessis, 1969-71 and 1973-76; H.J. McQueen, 1971-72; T.S. Sankar, 1976-87; and M.O.M. Osman, 1987-93) who encouraged the growth of every member, both in curricular and research areas. The electives and the graduate courses (Table 4) reflected the interests of the individuals.

An important aspect of the development of the Department was the self-direction, high motivation and friendly cooperation of the professors; personal ambition was coupled with concern for the reputation of the Department. Within the framework of the Accreditation Board's requirements and the options outlined above, the professors proposed course outlines and associated laboratories that were integrated by the curriculum committee and the departmental council. In retrospect, each professor seems to have been truly inspired by training new members of the profession to the highest possible standards within his field.

The Department gradually developed an integrated system of undergraduate core teaching and laboratories, specialized courses, research programs funded by government agencies, industrial consulting and research contracts. In association with this, there evolved a spirit and system of evaluation and motivation of the students that led to high performance in a variety of international student design competitions (Table 7), and a good reputation with employers.

With regard to research, the youth and recent graduate training of almost all of the professors were advantages, but the absence of equipment was a serious drawback. Faculty members were successful in obtaining NRC or NSERC individual operating grants and formed groups to obtain equipment grants. It was clear that pooling individual efforts and developing complementary research would be advantageous for the groups. When the Quebec government introduced a granting program that was directed towards groups of professors and graduate students (FCAR), the Department was able to form teams that were successful in the first competition, and repeatedly until recent years. Some researchers were left out, but they found collaboration externally - for example, in the group that Professor McQueen helped to form with colleagues from the Department of Metallurgy at McGill and the electron microscopy laboratory at Ecole Polytechnique.

As noted above, the postgraduate student program was begun after the first class graduated in 1968 and attracted external students by offering all courses in the evening. In response to NSERC's efforts to ensure that maximum public benefit for the research dollar, the professors threw themselves into graduate training, conference presentations and journal publications. In accordance with the trend towards aligning academic research more closely with national industrial objectives, many faculty members developed industrial consulting into research contracts and collaboration grants. The growth of funding is reported in Figure 2.

From the beginning it was agreed that the research emphases of the Department would be on mechanical systems and fluid controls. Both teams advanced rapidly and developed into larger and renowned research centres. Their evolution, their spread into related areas, and the development of new teams has been presented in Table 5. Thermo fluid power began to develop in the early 1980s, and became a research centre in computational fluid dynamics in 1990. In manufacturing and materials, a small but strong group has persisted over 25 years in the hot working of metals with emphasis on stainless steels (with Atlas Steels, Tracy, Quebec) and on aluminum alloys and composites (with Alcan). Research in composite materials and structures began in 1976 and grew into a research centre in 1993. In the last decade, new initiatives were developed in biomedical and industrial engineering. Lastly, a research centre for computer-aided vehicle engineering has been established.

The external funding associated with this research effort has been shown in Figure 2. The Faculty of Engineering and Computer Science (as it now is) has grown more rapidly than any other within the University and has recently attracted almost half of its total grant funding. The Department of Mechanical Engineering's two million dollars per year represents more than one-quarter of the Faculty total. All of the long-term faculty members hold NSERC Operating Grants. For more than a decade, there has been four active FCAR research teams (Table 5).

The faculty members have distinguished themselves over the years (Table 6). Many have served as Montréal chapter chairpersons or as national officers of their technical societies. Seven have been elected Fellows by their societies. Five have received awards for teaching. There has been one (NSERC) Steacie Fellow, and one winner of an Alexander Humboldt Award.

The Department suffered a great tragedy with the fatal shooting at the University of Professor Jaan Saber in August 1992. V.I. Fabrikant, who was responsible for this tragedy, had been a member of the Department for 13 years. But under the leadership of Professors Osman, Krepec and Hoa, the Department has applied itself vigorously to the task of recovery, assisted by formal enquiries that have helped to restore its reputation.(1)

Graduate Studies

As noted above, this program was started in 1968 - the year of graduation of the first BEng candidates at SGW. The first MEng and PhD degrees were awarded in 1971. Since then, the numbers have increased to about 15 MEng and 5 PhD per year (Figure 1a). Such growth is consistent with the rises in the number of professors (Figure 1a), research areas (Table 5), and funding (Figure 2).

The areas of study and the number of courses offered in each are presented in Table 4. Occasional name changes are shown, with their point of introduction indicated by the position. Many areas reached saturation about 1974, but new specialties were introduced more recently, such as aeronautics, which is a joint program with Ecole Polytechnique and McGill, and composite materials in 1994. The totals and the offerings in the engineering core reached saturation in the late 1980s. The total offerings in other departments are indicated and show that computer science started in 1973 and building studies in 1976. Specialized courses in other departments are often sought by mechanical engineering graduate students.

The Mechanical Engineering Department has faced particularly heavy teaching responsibilities in the first year in the evening; this problem is being alleviated with the help of part-time lecturers. The graduate program is also taught in the evening (every professor teaches one evening course), so that there would be opportunities for engineers from industry to follow a professional master's degree program. Mature engineers from industry are encouraged to offer courses in their specialties and to collaborate in special research projects; they are given recognition for this by appointments as adjunct assistant or associate professors (Table 2). Such people have been of great benefit to the Department, bringing valuable industrial inputs.

Student Projects and Awards

Creativity is often most effectively motivated by enthusiasm. Much superior to courses is the challenge of a contest in which students have an opportunity to find solutions to technical problems that are currently relevant to society. The contest activity goes beyond conceptual design, permitting the student to get 'hands-on' experience of advanced technologies.

National societies have set up a variety of contests over recent decades. Concordia students have risen to the challenge in numerous cases, as listed in Table 7. Such competitions are not of the quick, adrenaline-exciting type, but ones that demand perseverance and ability to conceive based on sound engineering knowledge and design principles. Competitions are often with similar teams from schools remote from Montréal, so that the quality of the educational foundations are being tested as much as personal initiative and collective synergism. The faculty advisors deserve recognition for their role in helping to define the scope of the project initially, and occasionally giving technical advice. They also contribute by removing procedural roadblocks by suggesting industrial mentors, and occasionally by resolving conflicts or rekindling enthusiasm.

The list of successes (Table 7) shows that the graduates of the Mechanical Department at Concordia have developed an engineering capability that compares well with the best universities in North America. It shows that undergraduate training has not been given a low priority at Concordia compared with research and publication.

Conclusions

During the first quarter century, the Department of Mechanical Engineering (first at Sir George Williams and then at Concordia) has grown in numbers of undergraduate and graduate students and teaching staff. Examination of the curriculum, research funding and output, and student activities show that this development has been vigorous. Now in a period of slower, more mature development, the Department appears poised to progress dynamically, although it has been jarred by recent tragic events.

Note

(1) Hugh McQueen has written a paper called Tragedy and Turmoil, 1992-1995 describing in some detail the tragedy itself, its aftermath, and the process of recovery. Copies of it can be obtained from him at the Department of Mechanical Engineering, Concordia University.

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TABLE 1a: HISTORY OF SIR GEORGE WILLIAMS AND CONCORDIA UNIVERSITY

1873	Adult Education Courses Montreal YMCA (always included French courses)		
1913	YMCA Business School (high school and practical courses)		
1926	Sir George Williams College named		
1929	Senior Matriculation Students		
1932	Day Classes Inaugurated		
1936-37	First Graduation class: 8 B.A., 2 B.Sc., 1 B.Comm.		
1948	Sir George Williams College (Quebec Charter)		
1953	Study Committee for Engineering (L.Austin Wright, Gen. Sec. EIC)		
1954	Department of Engineering Chairman - J. Bordan		
1956	Norris Building (library)		
1958	Certificate Program in Engineering: Mechanical, Electrical, Chemical, Civil		
1959	First Graduates in Engineering		
1959	Sir George Williams University (revised charter)		
1964	Faculty of Engineering - Dean J. Bordan until 1970		
1966	Faculties of Arts, Commerce and Science		
1968	Hall Building Opened		
	First Graduates B.Engineering (total 48, ME 19)		
	Department of Mechanical Engineering - Chair, M.P. du Plessis		
	Departments of Civil and Electrical Engineering		
1968	Graduate Program Commences		
1970	Dean J.C. Callaghan until 1977		
	First M.Eng. and D. Eng. degrees awarded		
	Social Aspects of Engineering; founding coordinator: H.J. McQueen		
1971	Eng. Program adapted for first CECEP graduates		
	ME options: 1. Thermal fluid power; 2. Design, Production; 3. Electro-mech. Systems;		
1973	Dept. Computer Science (jointly Engr. & Science)		
1975	Concordia University (SGWU unites with Loyola)		
	1976 Dept. of Building Engineering		
	1977 Dean: M.N. Swamy until 1992		
	1981 ME options: 3. Systems & Control; 4. Industrial Eng. [ME 8 Prof.+ 10 A./P]		
	1985 Faculty of Engineering & Computer Science		
	1987 Joint Aeronautical M.Eng. Program; Quebec Uni. + Industry		
	1990 M.A.Sc. introduced for thesis option		
	1992 Industrial Engineering Program inaugurated; [ME, 10P+16A/P]		
	1995 IE Program accredited, First 2 graduates		

TABLE 1b: HISTORY OF LOYOLA COLLEGE AND ENGINEERING STUDIES

- 1899 Loyola College incorporated in the Quebec legislature by the Society of Jesus (Jesuits) Canadian Province
 B.A. degrees granted within frame work of "Colleges Classiques de Université de Laval
- 1919 B.A. degrees granted by Université de Montréal which had just been founded
- 1938 Science courses offered permitting graduates to enter McGill 4yr program (after senior matriculation)
- 1943 Faculty of Science instituted with options in Mechanical Engineering and 5 other disciplines
 Graduates assured automatic admission to 3rd year of McGill 4 yr program (later 4th year of 5 yr program)
 Dean, Dr. Hugh McPhee, S.J. physics, Dr. Eric O'Connor (SJ) Mathematics, F. Gaudagne engineering drawing
 and design
- 1945 Veterans returned, 67 in university courses, 50 in refresher courses
- 1947 First B.Sc. graduation, 6 in engineering options
 Main building raised 2 floors to final height
- 1948 Faculty of Commerce
- 1948 F. Guadagni (B.Eng. metal., McGill 1937) professor of engineering drawing and design (died 1964)
- 1957 Certificate Program in Engineering, 3 yrs.
- 1959 McGill modernizes its curriculum, accepts students on individual basis
- 1960 Yalcin report on Loyola's future, projects 250 engineers by 1966
- 1960-63 D. MacDougal geologist heads engineering dept.
 Engineering laboratories added
- 1964 Faculty of Engineering, Dean George Joly (former Assistant Dean of Eng. McGill)
- 1965 B.Sc. (Engineering) 4 yr. program (compared to 5 yrs at McGill)
 Options in Mechanical, Electrical, Chemical, Civil
- 1966 First graduating class, however some graduates in 1964 and 1965
- 1968 Loyola closure announced by Ministry of Education
- 1969 University parallel program introduced until 1974 providing courses as in newly instituted but
 incomplete English CEGEPS (colleges of general and professional education)
- 1971 Induction of first CEGEP graduates, 130 engineering students, total students 4000
- 1972 Operations Science Appliquées recommends closure of Engineering Faculty
- 1972-73 Departments of Mechanical, Electrical, Civil Engineering (ME, 4 Faculty)
- 1974 Merger with Sir George Williams Faculty of Engineering
- 1977 Last B.Sc. (Eng) students graduate
- 1989 Discontinuation of Loyola section for first year Engineering

TABLE 3. UNDERGRADUATE OPTIONS 1992

1. **Thermo Fluid and Propulsion Option** (initial name, Thermal Fluid Power) is concerned with heat and power generation and environmental control. It provides background in design and analysis of internal combustion engines, heat generators, heat transfer units and turbomachinery.
2. **Design and Manufacturing Option** (initial name, Design and Production) is concerned with the field of machine design and analysis and extends to manufacturing processes, CAD/CAM and Computer Integrated Manufacturing (CIM). It includes entire range of processing of metals, polymers and composites.
3. **Automation and Control Systems Option** (formerly, Electro-Mech. Systems) is concerned with basic principles of controls and automation of industrial processes and extends to adaptive control of machines and robot manipulators including Computer Numerical Control (CNC) of machine tools.
4. **Vehicle Engineering Option** (since 1991) is concerned with locomotion systems, the dynamics and stability of passenger and off-road ground vehicles, including suspension, structural mechanics, steering and controls.
5. **Industrial Engineering Option** (1981-94 then Industrial Engineering Program) is concerned with the design, organization, analysis and integration of people and industrial systems components in order to enhance effectiveness. These components include whole machines, transportation and conveyance elements, physical plant, organizational frameworks, schedules and budgets. Industrial Engineering Program inaugurated 1989 accredited, first graduates 1995.

TABLE 4: GRADUATE COURSE SPECIALIZATIONS

	Vibrations & Mechanics	Fluid Control Systems	Transport Processes	Metal Cutting Machine Tools (Material Science)	CORE Comput. Systems
1971	3	3	6	2 (2)	25
1975	Dynamics Vibrations Mechanical Systems		Thermo-Dynamics Heat Transfer	Machine Tools & Production (Materials Eng. & Processing)	
1981	7	8	10	7 (8)	40
1985 1987 1991	(Ground Vehicle) [Biomechanical]	Industrial Control Automation	(Aeronautics) [Aerospace]	Machine Design & Production* [*Composites]	
1991	7(2)[2]	11	7(11)[8]	7(7)[3]	47

	CORE	MECHANICAL	BUILDING	CIVIL	COMP. SCI.	ELECTRICAL
1991	47	65	40	28	41	55

TABLE 5

RESEARCH/PROGRAMS IN MECHANICAL ENGINEERING

MECHANICAL SYSTEMS	INDUSTRIAL CONTROL SYSTEMS	THERMO-FLUID POWER AND PROPULSION	MANUFACTURING AND MATERIALS
Vibrations 1968 T.S. Sankar M.O.M. Osman S. Sankar R.B. Bhat G.D. Xistris FCAR Team	Fluid Control 1968-80 M.P. du Plessis C. Kwok J. Svoboda R.M.H. Cheng FCAR Team	Heat and Mass Transfer 1970- S. Lin Solar Source, Heat Pumps 1978- S. Lin K.I. Krakow	Hot Working of Metals 1968- H.J. McQueen 1995- Center for Composites Composite Materials, Structures & Processing 1977- S.V. Hoa, S. Lin A.E. Blach FCAR Team
Rotor Dynamics T.S. Sankar R.B. Bhat	<u>Fluid Control Center</u> 1969-83 Low Cost Automation 1973-78 NRC Funding	<u>Center for Research on Computation and Application</u> 1991- (consortium Quebec Uni.) <u>Computational Fluid Dynamics Laboratory</u> 1975- W.G. Habashi	Pressure Vessels and Heat Exchangers A.E. Blach 1976- Flexible Manufacturing 1989- A.A. Bulgak
Machine Tool Dynamics Metal Cutting 1968- M.O.M. Osman T.S. Sankar V. Latinovic Reliability Diagnostics 1972 T.S. Sankar G.D. Xistris	<u>Center for Industrial Control</u> 1983- R.M.H. Cheng Fluid Power and Control Automated Guided Vehicle R.M.H Cheng Flight & Automobile Simulators J. Svoboda	Vortex Dynamics, Flow Instabilities G. Vattistas Fuel Controls for Combustion Engines 1979- T.H. Krepec Gas Dynamics & Shock Tubes 1976- R. Neemeh	Computer Integrated Manufacturing 1991- G. Abdou CAD CAM, Robotics A. Hemami V. Latinovic M.O.M. Osman
<u>Computer Aided Vehicle Engineering</u> <u>CONCAVE</u> 1986- S. Sankar T.S. Sankar MESSTQ A.K.W. Ahmed S. Rakheja V. Fabrikant FCAR Team	Robotics R. Rajagopalan Computer Integrated Manufacturing Centre 1986- (with John Abbott CEGEP & ICAM Technologies)	Coal Gasification '75-82 Spaceflight Propulsion 1975 Transient Gas Discharges 1984-88 A.J. Saber	Biomedical Engineering, Human Factors, Safety 1986- G.J. Gouw G. Vattistas A.J. Saber

