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The Origins of Mechanical Engineering Education in Canada

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Introduction

There are conflicting claims to the establishment of Mechanical Engineering as a discipline in Canadian Universities. The School of Practical Science of the University of Toronto is sometimes credited with the honour of establishing the first program in Mechanical Engineering in Canada, although, as we shall see, there is reason to doubt that claim. We have several choices on which to base the claim for being first: the claim could originate as a result of giving a course of lectures, the establishment of a program leading to a diploma or the first degree program, the establishment of a department, the founding of a chair to teach the subject, or the first use of the designation Mechanical Engineering. In addition to the University of Toronto, the claimants include McGill University, which announced the first first degree program in Mechanical Engineering in 1871; or École Polytechnique, founded in 1873 as a general engineering school. In what follows, I shall only consider as contenders those schools which are still in the business. We will thus rule out Albert College in Belleville, which established a program in Civil Engineering about 1857, the University of Halifax, a short-lived experiment (1876-81) to unite all the universities in Halifax in the last quarter of the last century, and Regiopolis College, which came and went in Kingston, Ontario. Not considered in depth either is the Royal Military College in Kingston, which was founded by an Act of Parliament in 1874 somewhat along the model of West Point Academy in the United States. It was clear from the outset that the program was aimed as much at civilian life as the military. As a result, it proved to be popular, an average of twenty students a year entering between 1876 and 1890. Diplomas were issued for successful completion of the four year program in Civil Engineering. However, it was noted that the program would equip the graduate for work in other disciplines. RMC did not, however, become a degree granting institution in the various disciplines until about 1962.

We should also keep in mind that there were profound changes south of the border which influenced education in Canada. British technical education within the higher education format was singularly lacking. The French model was perhaps the best system during the early part of the Nineteenth Century, and the system that the most influence on, for example, West Point, the first US engineering school. The first public institution of any consequence was Rensselaer, founded in 1828 after the French model, and awarding its first Civil Engineering degree in 1835. Mechanical Engineering was first offered at Polytechnique College of the State of Pennsylvania in 1854, at Yale in 1863, M.I.T. from its founding in 1865, Worcester Free Institute in 1868, and at Stevens Institute in 1871, all before any schools established the discipline in Canada. The history and growth of the United States as an economic power in the Nineteenth Century was due in part to its technical supremacy. Britain, and the rest of the Commonwealth, although competitive in the first half of the century, lost the momentum during the second half. Part of the problem was a rather unhealthy dependence on the raw resources of the colonies, without due regard to manufacturing and industry. By the last quarter of the century, Germany had also surpassed Britain's technical capability.

The origins for this state of affairs for Canada lay partly with her dependency on Britain, and the strong hold that Britain exerted, especially during the mid-century. This was manifested in the Anglican stranglehold on all public education, making it a copy of the British system, which eschewed practical education in universities. It wasn't until the rise of dialectical materialism and the publication of the Origin of Species, by Darwin in 1859, that public opinion began to change. But the schools were very slow to follow. Consequently, in Canada, there was a great reticence to include engineering as part of university curricula. There were some moves at King's College, New

Brunswick and at the University of Toronto, both around the half century. But a catalyst was needed. That proved to be agitation on the part of the public against the universities. Nowhere was that more obvious than in New Brunswick.

The First Engineering Instruction

Sir Edmund Walker Head was appointed Lieutenant Governor of the Province of New Brunswick in 1848. It was very clear early in Head's tenure that King's College, the provincial university, was in great danger of losing the province's support, having long ago lost the public confidence. Head thought one way to save the college was to make the instruction more practical so that it might have more appeal for the populace. Accordingly, in 1853, he sought, and was granted, leave to appoint a commission of inquiry into the affairs of the college. His first appointment was J. William Dawson, the Superintendent of Education for Nova Scotia, whom he had met a few years earlier. Head's introduction to Dawson was effected by Sir Charles Lyell, whose friendship with Dawson had extended over the previous several years¹. Dawson was a geologist and naturalist and most importantly, from the political standpoint, a Presbyterian. For his next choice, Head chose the Reverend Dr. Egerton Ryerson, Superintendent General of Education for Upper Canada. Ryerson was a most dynamic and fiery opponent of any denominational domination of higher education. He was a Methodist who had taken on the fight to release Upper Canadian education from Anglican domination, and had waged a personal battle both in Upper Canada and England, which eventually unseated the powerful Bishop Strachan from his position of influence. It may have been coincidence that Head chose Ryerson, but it was more likely an overt political appointment designed to palliate the Methodists in opposition to the College. J.H. Gray, the influential member for Saint John, and who was one of the moderates in the House, was chosen as Chairman. The other two members were John Saunders, an alumnus of King's College, and a member of the Legislative Council, and James Brown, who was a member of the House of Assembly. The report, when it was finally submitted, was a model for future generations to aim at, as to practicality, political expediency, liberality and genuine concern for education attainment. It was, in fact, so much ahead of its time, and its executioners so clerically unbiased, that it could not stand much chance of immediate implementation, except for some few parts. The report contained a proposed act of amendment which would have provided for degrees in arts, law and medicine, as well as diplomas in Civil Engineering, land surveying, agriculture, commerce and navigation; it would have put the university governance in the hands of a Senate comprised of a Rector appointed by the Lieutenant-Governor, and eight senators, to serve terms of three years each on a rotational basis. A complete curriculum was drawn up for each of the diploma courses, and a schedule of salaries, with provision for hiring of special lecturers in engineering, agriculture, commerce and modern languages.

Certificates, Diplomas and Degrees

Although the final report of the commission², was not tendered until December 28, 1854, Head convinced the legislature and the college authorities that practical instruction should be undertaken immediately. Consequently, the first regular course of instruction in engineering in British North America began on the fifteenth of February, 1854. Thomas McMahon Cregan, an engineer engaged on the survey of the European and North American Railway, was employed by the British firm of Jackson, Peto, Brassey and Company which had contracted for some of the work in New Brunswick. At the behest Head, Cregan began teaching that day to a class of twenty-six students. Cregan gave his lectures at King's College, that great stone structure which was to become the nucleus of the University of New Brunswick. Offering such a course was a daring experiment for its time. It was a desperate attempt by Head to preserve the college against the rising tide of those who would have it closed. A significant proportion of the population of the province were increasingly hostile to the Tory appointees who had so long held control of the province. King's

College, seen as a part of the Tory empire, stood as an obvious target for the popular faction. There were some who felt that the College should offer a more practical curriculum. The curriculum should include details of telegraph and railway construction, or agricultural principles: others felt it should be closed. In a letter to the Sir Charles Lyell, Head speculated on ways the College could be turned to more use: "The elements of science and natural history, as applied to arts and manufactures, including agriculture, the theory of shipbuilding or navigation, mensuration, surveying, and civil engineering, all these might be offered as being immediately and practically useful in enabling a boy to earn his own bread." Head had his way. Students were given preparatory lectures by Dr. James Robb, the Professor of Chemistry and Natural History, and William Brydone Jack, Professor of Mathematics and Natural Philosophy. The course of lectures in Civil Engineering were advertised in the Royal Gazette in a letter dated 1 December, 1853, and signed by Charles Fisher, the College registrar.

Cregan's course was a curiosity in the annals of Engineering education in Canada because it was given more out of political necessity than any other reason. And when the political crisis had passed, the course itself was not repeated, although provision was made in the College to teach Engineering as a regular part of the curriculum. Cregan, though asked by Head to continue, was not able to do so because he was in poor health at the time. There is a copy of a certificate given to one of the participants, Henry George Clopper Ketchum, at the end of the winter session of the course³.

In preparation for Cregan's course of instruction, William Brydone Jack, professor of mathematics and natural philosophy, and James Robb, the professor of chemistry and natural history, implemented the following course of lectures in the fall term of 1853⁴.

By Professor Jack

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| <p>I. Algebra:- on Monday and Wednesday</p> | <p style="text-align: right;">at 10 a.m.</p> <p>Geometry:- on Tuesday and Thursday</p> |
| <p>II. Solution of geometrical problems by algebra:
Construction of algebraic expressions; and analytic geometry:- on Monday, Tuesday and Thursday</p> | <p style="text-align: right;">at 11 a.m.</p> |
| <p>III. Pneumatics, including the properties of fluids in general, and their application to the construction of the air pump, diving bell, barometer, suction and force pump, fire engine, steam engine, etc.;</p> <p>the relations of air to heat and moisture; and the production and propagation of sound:- on Wednesday and Friday at noon</p> | |
| <p>VI. Astronomy, descriptive and practical, by special appointment.</p> | |

By Professor Robb

Course of Chemistry, with its applications to Art and Industry

Matter and Force: Weighing and Measuring.

Heat: Expansion, contraction, temperature, fusion, latent heat, evaporation, boiling, steam,

conduction, convection, radiation, incandescence, phosphorescence, combustion.
 Light: Theory, spectrum, photography.
 Electricity: Galvanism, thermo-electricity.
 Magnetism: Electro-magnetism, magnet electricity.
 Chemical affinity: Composition of bodies,
 elements and compounds, nomenclature, laws of combination, equivalents, symbols,
 formulae, analysis, qualitative and quantitative.
 Inorganic Chemistry: History of non-metallic elements
 and their acids, etc.;
 History of the metals and their compounds;
 Metallurgy.
 Organic Chemistry: Elements of the organic world;
 History of vegetable principles and products;
 History of animal principles and products;
 Metamorphoses of the organic elements:
 on Monday, Tuesday, Wednesday, Thursday and Friday at 1 p.m.

By T.McMahon Cregan⁵

Civil Engineering; including an explanation of the construction and uses of logarithms, sines, tangents, trigonometrical formulae, resolution of plane triangles, methods of surveying with the theodolite and circumferentor; the construction, use and adjustment of the instruments used by engineers; levelling; method of determining the best route for railways; computation of the quantities of land and earth-work required for the execution of the works; horsepower of machinery, method of setting out railway curves and sidewidths, calculation of gradients and theory of inclined planes, superelevation of rails, composition and resolution of forces, calculation of strains and pressures, strength of materials, theory and practice of timber and iron framing; viaducts and bridges; on three days in the week, with instruction to the Field on Saturday, and as often as may be expedient.

All elements of a curriculum for "Railway Engineering" were included in these courses, encompassing Civil Engineering, Mechanical Engineering and Electrical Engineering, as they were known at that date.

Dawson and McGill

In 1854 Sir Edmund Head was appointed Governor-General of Canada. This position carried with it the responsibility to act as Visitor to McGill College in Montreal. The College Council, at the suggestion of Head, appointed William Dawson as Principal of McGill College. The appointment was unique at the time: Dawson was the first colonial to be appointed to such a position in Canada. Over the next half century, Dawson (Sir J. William Dawson) proceeded to justify Head's good opinion of him, moulding McGill into the foremost science-based university in Canada. In his inaugural speech in November⁶, 1855, Dawson announced a course of Civil Engineering lectures (to be given by Thomas C. Keefer). In the speech, he announced plans to establish ..". special courses, each to extend over two years, and to entitle the student, on examination, to a certificate, or diploma."

"A course of Civil Engineering. This will embrace English Literature, Mathematics, Natural Philosophy, Chemistry, Geology and Mineralogy, Surveying and Civil Engineering, including the construction of machinery. Such a course will be exceedingly serviceable, not only to all young men about to enter on the profession of Civil Engineering, but to many others more or less closely

connected with the public works of the Province. In this department of Engineering we hope to enlist the talents of one of your Civil Engineers whose name is favourably known wherever the public works of Canada have been heard of."

To obtain the Civil Engineering Diploma, students had to matriculate in arts, attending classes in mathematics, English literature, French, chemistry, natural philosophy, geology and mineralogy. In this respect, the course was little different from the diploma course at King's that Dawson had helped implement. Dawson's speech drew heavily on his work with the Commission at King's and quoted heavily from correspondence in the matter.

The prospectus for the following year (1856) announced a course of Civil Engineering⁷ "accessible to matriculated students in the third or fourth year." Dawson himself taught agricultural chemistry and natural philosophy, while Robert Crawford, C.E. was Professor of Road and Railway Engineering. Crawford was succeeded the following year by Mark J. Hamilton, C.E. Over the next several years there were a number of diplomas awarded. The first graduate of the diploma course was Oliver Gooding⁸ who completed the course in 1858. The year 1859 saw the successful completion of three more graduates and in the following year, there were five graduates. The success of this diploma program continued largely unabated until 1864, when it disappeared for a period of seven years, re-emerging in 1871. Fifteen students had completed the course up to the time of its disappearance from the calendar.

In 1871, Dawson, fearing that an engineering program was about to begin in Toronto, convinced the Board to support applied science at McGill. The Department of Practical Science was formed in the fall of that year with a new lecturer in Civil Engineering⁹. The department became the Department of Applied Science, and in 1875, the Faculty of Applied Science. At the same time, provision was made to award the degrees of B.A.Sc. and M.A.Sc. in Civil Engineering, Mining and Assaying, Mechanical Engineering, and Practical Chemistry. By 1878 the Faculty of Applied Science at McGill had been formed with four departments; civil, mechanical, mining engineering and practical chemistry. The first graduates in the engineering program were announced two years later, in 1873¹⁰. These were the first full engineering degree programs in engineering in Canada. The first graduate in mechanical engineering of which there is any record was William Graham (B.A.Sc., 1884), who went on to practise in the United States¹¹. Graham is the first graduate of a bachelor's degree program in Mechanical Engineering Canada.

Sir William Dawson's principalship of McGill University began in the fall of 1855 when he was 35 years old and continued until his resignation in 1893. Sir William forged the destiny of a small college: by sheer dint of his own forceful personality he transformed the college into a great university. The transformation is all the greater if one remembers that Dawson held no University degree until after his appointment. To the end of his life he opposed the Darwinian concept of evolution, being a staunch fundamentalist Presbyterian. In spite of his personal feelings he made McGill a haven for learning in the sciences decrying the concentration of others on the arts, and concentrating instead on scientific and practical curricula. Under his direction engineering flourished.

Montreal was also the scene for formation of the Canadian Society of Civil Engineers, forerunner of the Engineering Institute of Canada, in 1887, with 288 members, among them Hurd Peters, the first graduate of UNB in engineering (1854). McGill University, quite naturally enough served as hostess for the meetings of the society, and there is every evidence that the students of McGill took every opportunity to rub shoulders with the Great Canadian Engineers of the era: Sir Sandford Fleming, Thomas C. Keefer, Kivas Tully, and Sir Casimir Gzowski, to mention but a few. The greatest of Canadian engineering accomplishments were presented in talks at society meetings. There were on average about twelve presentations a year in those early days, and the McGill Engineering students came to adopt almost a proprietorial attitude to the proceedings.

Although the University of New Brunswick demands first recognition for the teaching of engineering at a University in Canada, and continuing the instruction with the most meagre of resources and especially with very few faculty, McGill University deserves just recognition as the great innovator of engineering education in this country.

École Polytechnique¹²

The situation for French-speaking Canada was even more difficult in terms of technical education than for English-speaking Canada. The political and social structure in Quebec did not make the emergence of technical education a priority, even though the government attempted to encourage the enterprise. Until well after the turn of the century, most French-speaking engineers were educated in English at McGill, even though both engineering units were founded within a few years of each other. However, for the last quarter of the century, McGill held sway over every other engineering school in the country.

École Polytechnique lays claim to being one of the oldest engineering schools in the country¹⁴. It was established in 1873 on a site now covered over by the Place des Arts in Montreal. Classes began in January, 1874 on the first floor of l'École du Plateau. The program, opening in 1874 under the direction of the first principal, M. Urgel-Eugène Archambault, was carefully conceived to be a general introduction to the principles of engineering, incorporating basics of Civil Engineering, Mining and Metallurgy, metalworking and industrial production techniques. Although the faculty, consisting originally of Archambault, and Charles Pfister, joined the following year by William Haynes and Emile Balet, showed the utmost dedication and enthusiasm, only Pfister had any real engineering experience, and none had the academic qualifications of any of the faculty at the other schools of engineering. At the outset the course was intended to be of four years' duration, the first graduands, emerging in 1877, consisting of a class of five civil engineering students. Initially commissioned as l'École des Sciences Appliquées aux Arts et à l'Industrie, École Polytechnique changed its name to the present one in 1875. Over the next several years there were few graduates in the school, although many casual students. Although Mechanical Engineering was taught as an integral part of the curriculum, it was not a specialty, and no diplomas were awarded in it for many years after the founding of the school. A specialist year was offered beginning about 1940. However, discipline-specific programs were not available until the middle of the following decade.

The precarious state of finances for the fledgling institution hindered development. Since the profession was not recognized in the French community, and there were no statutes governing it, the diploma had no legal value. It was some years before this obstacle could be overcome. However, by the start of the first world war, École Polytechnique was among the top four engineering institutions in the country, the others being Queens, McGill and Toronto. In 1908 there were 172 registrants, with 24 degrees awarded.

In 1876, the school was accorded some status by the Quebec government by way of accommodation on a similar basis to the universities. By 1887 it was decided that affiliation with a chartered institution might prove to be of mutual benefit, and provide a basis for a degree program. Hence, in that year, École Polytechnique was affiliated with Laval University, an arrangement which was continued until 1920 when the school became aligned with the Université de Montréal instead. Since then, the latter arrangement has continued, with a move to a shared campus in 1955. However, l'École Polytechnique was established as financially independent from other institutions and has remained so up until the modern development of the school.

Doings at Toronto

King's College, Upper Canada, had been transformed into the non-sectarian University of Toronto by the Baldwin Act of 1849, by which provision was also made to establish a chair in Civil Engineering¹³. No attempt was made to fill the chair until 1851, when the position was advertised as available¹⁴. No appointment was made to this post, even though Toronto dates the founding of its engineering school from 1851. The university senate made provision for a curriculum in Civil Engineering in April, 1855¹⁵, possibly at the suggestion of the Visitor, Governor-General Sir Edmund Head. However, no Civil Engineering course was even advertised in Toronto until 1857¹⁶. The first student did not enter the course until 1859. Since no appointment was ever made to the Chair of Civil Engineering, the course never did achieve any measure of popularity. Seven students did embark upon the two year diploma course in Toronto, the first, F.G. Robertson, graduating in 1861, the next being W.G. Bellairs in 1862, and G.C. Brown in 1867: there were only seven diplomates in the entire history of the course. The diploma course was effectively terminated in 1878, with the inauguration of SPS.

A long and bitter battle ensued over the matter of technical education in Toronto, culminating in a commission of inquiry (1871) on the matter. Even then, it was not until 1880 before the University of Toronto regained control of technical education. Dr. Ryerson, who had served ably on the King's College Commission, was credited with the idea of establishing a "School of Technology" in Toronto, although he did not wish it to be associated with the University of Toronto because of the lengthy debates over secularization, and the lack of success of the Civil Engineering course at University College. (Ryerson was made a member of the University Senate and thus, quite likely to be well-informed on this matter). In 1871 the government proposed to establish a School of Technology. The scheme was vehemently opposed in the Legislature. The government was defeated in that year, with the result that the school was set up in downtown Toronto, primarily as a training centre for artisans in the old Mechanics Institute building.

The School of Technology began classes on 6 May, 1872 with three part time instructors, among them William Hodgson Ellis, Instructor in Chemistry and responsible for teaching Chemistry, Practical Geology and Mining. Ellis was also appointed to be Principal of the school. Thomas H. Heys was also hired to assist in the teaching of Chemistry and to take responsibility for Natural Philosophy. The third instructor was William Armstrong, a graduate in Civil Engineering from Dublin, who undertook to teach Applied Mechanics and Drawing. It soon became clear that something more was needed, and a motion was put to the Legislature to form a "School of Practical Science." This particular name appears to have been coined by Dawson in 1871, who had requested the establishment of such a school at McGill. The name was never used at McGill, although McGill's program began that same year.

The School of Practical Science continued as a school for artisans until 1877 when it was agreed to remove it to the campus of the university and to construct for it a new building. The following year the School was opened for the granting of diplomas in Engineering: Civil, Mechanical or Mining, Assaying and Mining Geology, and Analytical and Applied Chemistry, after three years of study. The faculty were listed as H.H. Croft, professor of chemistry; E.J. Chapman, Professor of Mineralogy and Geology; James Loudon, Professor of Natural Philosophy; John Galbraith, Professor of Engineering; R. Ramsay Wright, Professor of Biology; and W.H. Ellis as Assistant to the Professor of Chemistry. Admission was granted in the first year based upon practical experience. During the first two years the work was common to all branches, with the student choosing an option towards the end of the second year. Of the seven students enrolled in the first year, three opted to take the mechanical option, all previously engaged in work on the Northern Railway¹⁷. They became the first diplomates of the program in 1881. Although the school was primarily considered a school for artisans, these diplomates represent the first graduates in a Mechanical Engineering option in

Canada. Over the next several years, until 1887, there were no more than half a dozen graduates in all disciplines of the diploma program each year.

For the next six years there was some confusion between University College and the School of Practical Science as to which might be offering engineering. With the establishment of the Professional Degree in Civil Engineering in 1884, the controversy came to an end. The degree was only available in Civil Engineering upon the completion of at least three years of experience. All previous diploma or degree programs were repealed by the statute creating the degree. The University of Toronto Federation Act of 1887 transferred the science departments of University College to the university of Toronto, finally terminating instruction in Civil Engineering by University College. In the spring of 1889 provision was made for a second diploma program in Mechanical Engineering, including Electrical Engineering. However, the diploma would only be awarded after a further three years of practical experience in a prescribed engineering activity. In the spring of 1890 a more modern diploma program was established in five departments:

1. Civil Engineering.
2. Mechanical (and Electrical) Engineering.
3. Mining Engineering
4. Architecture.
5. Analytical and Applied Chemistry.

Eleven candidates were awarded the degree of B.A.Sc. in the first year it became available, 1893. However, it was not until the session of 1909 that provision was made to discontinue the three year diploma program. All students entering that year were required to do the four year degree program. Consequently there were no graduates in engineering at Toronto in 1912. The following year and thereafter all graduates were granted the degree of B.A.Sc. However, up until the reorganization of 1909, many students took only the first few years at Toronto, completing their work at McGill¹⁸.

By the time Toronto reorganized in 1909, the engineering programs had achieved enough prominence to match those of McGill. By 1911-12 Toronto had exceeded the enrolment at McGill, with Toronto at 793, McGill at 453, Queen's at 330, École Polytechnique at 151 (general engineering) and the University of New Brunswick at 80 (Mechanical Engineering was not established at UNB until after the Second World War). The only other degree programs at the time were at Manitoba (53, Mechanical Engineering was not established until the following year), and Nova Scotia Technical College¹⁹(32). The University of Alberta graduated its first degree recipients in the following year.

The early success of the School of Practical Science was due to the energy of John Galbraith, who took the first Chair of Civil Engineering in 1878. He had intended to enter Civil Engineering at McGill University but was dissuaded from so doing since "engineering was but a trade and a person might, after serving some apprenticeship, present himself for examination by the University examiners, and if his test proved satisfactory, he would be awarded a diploma." James Loudon also had significant effect on the early endeavours of the fledgling school, first as a lecturer in Natural Philosophy (Physics), 1872-5, then as a member of the Board, and finally as President of the University of Toronto.

Galbraith contributed boundlessly to the life of SPS, especially with the formation of the Engineering Society in the spring of 1885. He was its first President, and, incidentally, the only faculty member to be so honoured, each successor being a student. This society was a significant unifying force in the profession numbering amongst its accomplishments the dissemination of technical information through the organ of the Engineering Society bulletin.

Queen's

At Queen's, as at other schools, a program in Civil Engineering and Surveying was offered as early as 1865²⁰. There is no evidence that the course was ever given, even though there was a trend towards practical instruction. One of the reasons for the advertisement might have been that the eminent geologist Robert Bell, C.E., had joined the Faculty in 1864 to teach chemistry, geology and mineralogy. However, the man who probably had more than anyone else to do with the establishment of engineering at Queen's was Nathan Fellowes Dupuis, a mathematician, appointed in 1868 as Professor of Chemistry and Natural History. It was Dupuis who gave the opening address for the session at Queen's on 2 October, 1872, remarking²¹: "... it is not a matter of choice with us, whether we will have scientific teaching or not, but a matter of necessity ... if our universities will not make provision ..., schools of technology, established for the purpose, will." He had clearly an eye to the movements in that direction south of the border, and was also aware of the growing importance of the Mechanics Institutes which had sprung up across the country to fill a gap not addressed by anyone else. However, due to a disconcerting lack of funding it was several years before the need could be met.

Rev. George Munro Grant was appointed Principal of Queen's in 1877. He had long been an admirer of engineering works, especially those connected with the railway. Grant accompanied Sandford Fleming on the construction expedition for the Canadian Pacific Intercolonial Railways through the Rocky Mountains, acting as the Secretary for the expedition, and reporting its wonders in "Ocean to Ocean", published in 1873. Hence when Grant became Principal of Queen's University he had a long-standing friendship with some of Canada's finest engineers, and proceeded to exploit the relationship, especially with Fleming. In 1880, Grant induced Fleming to accept the appointment of Chancellor of Queen's, prompting Fleming to remark²²: "This is the strangest thing of my life. What made them elect a man to the highest position, who has never been in his life at college?"

Sometime in 1887 the Eastern Ontario communities began agitating for a school of mining. It was established in 1893 in association with Queen's to "...give a complete scientific education of both a theoretical and practical character to young men studying mining engineering and to provide theoretical and practical instruction in subjects pertaining to modern agriculture²³." The staff included Dr. William L. Goodwin, Professor of Chemistry, Willet G. Miller, Professor of Geology, and William Nicol in Mineralogy and Assaying. Professor Nathan F. Dupuis taught Mathematics. And here we find a curious development. The calendar for Queen's for the session 1894-5 announced the establishment of a new Faculty for instruction in: Chemistry and Mineralogy, Mechanical Engineering, Civil Engineering, Electrical Engineering, Mining Engineering, and Biology leading to Medicine. Dupuis was named as Dean of the new Faculty. All of the practical subjects were taught by instructors from the School of Mining, even though the degree of B.Sc. in the chosen discipline was granted from Queen's. The school opened with six staff and five students, awarding the first degrees in 1897.

There was a great deal of rancour in Toronto over the establishment of the School of Mining because of the provincial aid given to the school, the common epithet calling Queen's "a one horse institution¹⁹." In 1902, a degree program was established covering the disciplines of Chemistry, Mineralogy, Mechanical, Civil, Electrical and Mining Engineering²⁴. The School of Mining and the Faculty of Applied Science were not amalgamated until 1916.

Nova Scotia

In Nova Scotia, agitation for technical education had begun early in the last quarter of the Nineteenth Century. This culminated in a report published in 1882 advocating that a single school be given responsibility for developing engineering education²⁵, as the myriad small colleges could

not hope to compete effectively in resources with the schools in either Ontario or Quebec. It was several years before the government acted on the proposal. In the meantime, King's College (Nova Scotia) implemented a three year Civil Engineering program leading to the degree of B.Eng. Dalhousie claims to have implemented engineering instruction in 1891. However, it was not until 1902 that a program was established in Mining, followed two years later by one in Civil Engineering. The Faculty of Engineering ceased to exist in 1909 after passage of the Technical Education Act in 1907, creating Nova Scotia Technical College. Ernest Brydone-Jack, a graduate of UNB, was hired away from Manitoba to be the first Dean of the new faculty. From then on, students matriculating in all but Engineering Physics, did their final two years at "Tech." In fact, "Tech" was established as the engineering degree-granting institution for the province, taking students for the final two years, at the outset (1909) in the disciplines of Civil, Electrical, Mechanical or Mining Engineering. The first Mechanical Engineering Graduate appears to have been in 1910.

Points West

After the turn of the century there followed a spate of schools begun, no doubt, out of the growing sense of nationhood. The University of Manitoba appointed Ernest Brydone-Jack as Professor of Civil Engineering in 1907 to mark the beginning of teaching of engineering at that institution. Brydone-Jack, the son of William Brydone Jack, one of the first professors to implement practical instruction at a university (New Brunswick) had received his first university education at UNB (BA, 1891, with Civil Engineering courses, but did not take the diploma in CE) before continuing his studies at Rensselaer (C.E., 1894). Manitoba established Electrical and Mechanical programs quickly, in succession, in 1909, and 1913 respectively. With the appointment of W.C.Rowse as the Chair in Mechanical Engineering the following year, the program gained in stature, only to be interrupted during the war years as the student population declined drastically. Although the program led to a bachelor's degree, it extended over only three years²⁶.

The University of British Columbia program claims its beginnings in 1906 at the McGill University College of British Columbia under the guidance of Dr. Henry Marshall Tory²⁷. Tory, under the employ of McGill, established the school on a firm basis. Subsequently he was responsible for the establishment of the University of Alberta, along the same lines as McGill, as a non denominational University, and finally for the development of Carleton along the same lines. One way or another, The Universities of McGill and New Brunswick were directly or indirectly responsible for the development of science and engineering education in most universities in Canada.

The University of British Columbia was not established in its own right until 1908 with passage of an Act to establish the University of British Columbia. As might be expected, in a province growing as rapidly as British Columbia, the prime requirement was for competent Civil Engineers at the outset. For the first few years only two years of pre-engineering were offered at the Vancouver campus, the students proceeding to McGill to complete the degree. G.E.Piper was the first professor of Mechanical Engineering in 1907²⁸. Mechanical Engineering was not begun as a separate department until 1914, when Lawrence Killam was appointed as Professor of Mechanical Engineering and the first engineering degrees were not granted until 1919, the first regularly enrolled class graduating the following year. However, Growth was slow, hampered by a lack of space and facilities until well after the war, when the site at Point Grey was developed.

Alberta's first university had its origins in 1906, when an act of the legislature made way for it. Henry Marshall Tory was persuaded to accept the presidency the following year. he quickly appointed W.M.Edwards as lecturer in Civil Engineering. Edwards remained until 1918, when he died of the influenza epidemic that swept the country that year. Applied Science was established in 1913, with designation as a Faculty of Applied Science in 1921²⁹.

The School of Engineering at Saskatchewan was established in 1912. The school was founded around the Agricultural program, designed and implemented by A.R.Greig, a graduate of Mechanical Engineering from McGill. It began as a program in Mechanical Engineering, disguised as Civil Engineering, with four students. But in 1916 with the first graduating class in Civil Engineering, a temporary hiatus in the growth of the institution was experienced when the entire population of students and faculty went off to war. Resumption of the program in 1919 brought sixteen students, and the following year, an additional staff of seven. However, Civil Engineering was still the only full program, Mechanical and Electrical Engineering being offered as three-year introductions up until 1923. The first degree in Mechanical Engineering was awarded in the same year to T.S.McKechnie³⁰. However, up until 1929, only sixty students graduated in all disciplines of engineering³¹.

Comments

J. William Dawson had some of his ideas shaped by his experiences on the King's College (New Brunswick) commission of inquiry recommending the establishment of a Civil Engineering program. Dawson supported this endeavour very heavily. He had also the support of Head in these recommendations, as Head had advocated the implementation of a more practical curriculum and especially Civil Engineering and Agricultural Chemistry. By recommending the appointment of Dawson as the Principal of McGill, Head, probably more than any other individual, shaped the fortunes of Science and Engineering education in English-speaking Canada. The effects of Dawson's strong science approach, a radical departure from the secular institutions of the time was to form the nucleus for the University of British Columbia as well as the University of Alberta, shortly after the turn of the century. Together, they might be justly called the father's of engineering education in Canada.

Footnotes

1. Sir Charles Lyell was one of the great naturalists of the nineteenth century. Lyell first made Dawson's acquaintance during Lyell's North American tour of 1841-2. They communicated regularly thereafter, especially on geological matters. Head had previously appointed Dawson to serve on a Commission of Enquiry into Means to Make the College (King's College, N.B.) more Practicable, appointed at Lyell's suggestion in 1853. See also, for example, Richard A. Jarrell, "Science Education at the University of New Brunswick in the Nineteenth Century," *Acadiensis*, July, 1973.
2. Calendar of McGill University, 1858
3. Letter Books of H.G.C.Ketchum, University of New Brunswick Library, MG., H53.
4. University of New Brunswick Archives.
5. Royal Gazette, New Brunswick, 10 Dec., 1853.
6. J.W. Dawson: "On the Course of Collegiate Education, adapted to the circumstances of British America," Inaugural Discourse, November 1855, Montreal.
7. Prospectus of McGill University, 1856.
8. Calendar of McGill University, 1858
9. Stanley Foster Brice, *McGill University for the Advancement of Learning*, McGill-Queen's University Press, 1980, Vol. 1, p 274.
10. Graduates of McGill University corrected to July, 1909, Montreal, printed for the University by C.R.Corneil.
11. *ibid*, p 122.
12. There are several histories of the school, including: L'Ecole Polytechnique de Montreal, 1873-1948, par Olivier Maurault, and L'ecole Polytechnique de Montreal, par Olivier Maurault, in *Revue Trimestrielle Canadienne*, 1923, pp341-372. More recently Histoire de

- L'ecole Polytechnique de Montréal, Boréal, Montreal, 1991. See also "Engineering Education in Canada", in The Engineering Journal, September, 1962, which includes short histories of most of the engineering schools in Canada.
13. Robin S. Harris, A History of Higher Education in Canada 1663-1960, University of Toronto Press, 1976, p 168. Harris' work is a very substantial chronicle of events and trends in the Universities, and includes several sections on engineering education.
 14. A complete history of the establishment of the university can be found in The University of Toronto and Its Colleges, 1827-1906, The University Library, 1906.
 15. C.R. Young, Early Engineering Education at Toronto, 1851-1919; University of Toronto Press 1958, p. 14.
 16. Calendar, University College, MDCCCLVII-MDCCCLVIII, Henry Rowsell, Toronto.
 17. C.R.Young, op. cit., p. 67.
 18. For example, Herbert Bristol Dwight, who achieved some measure of success at M.I.T., began his Electrical Engineering program at Toronto, removed to McGill to finish, then returned to Hamilton to work for a time at Westinghouse. Subsequently he moved to Boston where he produced his remarkable mathematical tables.
 19. Harris, op.cit. p 628.
 20. Calendar of Queen's University, Session 1865-6.
 21. See Queen's University at Kingston, 1841-1941 by D.D. Calvin, p 205.
 22. "Time and Sandford Fleming", The Royal Bank of Canada Monthly Letter, Vol. 59, No. 8, Aug., 1978.
 23. A.L.Clark, The First Fifty Years: A History of the Science Faculty at Queen's University 1893-1943, Queen's University, 1943, p 9.
 24. Calendar of the School of Mining, Kingston, Ontario, Tenth Session, 1902-1903. The School of Mining existed side by side with Queen's in an informal arrangement, utilizing the same professors and laboratories. In 1897 the association was put on a more formal footing. However, it was not until 1916 that the mining school became a part of the university.
 25. Technical Education at Home and Abroad, by Professor J.G.MacGregor, Halifax, N.S., Herald Publishing Co., 1882, p21.
 26. W.L.Morton, One University, A History of the University of Manitoba, McClelland and Stewart, 1957, p 131.
 27. For a record of Tory's accomplishments as an educator, and founder of universities, see Henry Marshall Tory, Beloved Canadian, by e.A.Corbett, Ryerson Press, 1954.
 28. Tuum Est, A history of the University of British Columbia, Harry T.Logan, the University of British Columbia, 1958.
 29. The History of the University of Alberta, 1908-1958, John Macdonald, The University of Alberta, 1958.
 30. A complete history of the development of engineering at Saskatchewan can be found in Thorough, An Illustrated History of the College of Engineering, 1912-1982, R.H.Macdonald, Published by the College of Engineering, University of Saskatchewan, 1982.
 31. The First Fifty, Teaching, Research and Public Service at the University of Saskatchewan, 1909-1959, Carlyle King, McClelland and Stewart, 1959, p 39.