

Engineering Education and Research in Montreal: Social Constraints and Opportunities

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FRENCH-CANADIAN engineering education at the École polytechnique and English-Canadian engineering education at McGill University did not develop in the same way. To understand this situation we must bear in mind the history of the two main linguistic communities of Canada, and we must also accept that social groups are seldom homogeneous but rather are composed of a number of different and often conflicting sub-groups which try to shape the future of their community according to their particular point of view. It is this essential diversity of views and "attitudes" which exists in every society that makes it difficult to explain behaviour as a consequence of a single overriding *mentalité*.¹ There has been and continues to be more than one "attitude" towards industrialisation and technical education among French Canadians, as well as among English-speaking Canadians.²

For instance, the statement made in 1902 by Mgr L. A. Paquet suggesting that French Canadians leave "feverish mercantilism" and "vulgar naturalism" to others in order to seek higher goals, does not represent the only view on economic matters at the time among French Canadians. For example, Errol Bouchette in the preceding year, published a manifesto entitled *Emparons-nous de l'industrie* in which he stressed the importance of economic development for the future of French Canadians. The period from 1896 to 1913 was marked by a rapid expansion of the industrial sector of the province of Quebec, and some of Bouchette's arguments were indeed accepted by the provincial government which, in 1907, created technical schools in the major cities of the province and the École des hautes études commerciales in Montreal.³

To understand why French-Canadian and English-Canadian engineering education in Montreal were for a time so different, we must take into account the structure of the educational system of the province, the dominant role played by the Roman Catholic clergy within it, as well as the position of French Canadians within the economic structure of Quebec and Canada. These aspects complement Professor Rabkin's and Miss Levi-

¹ See, e.g., Rabkin, Y. M. and Lévi-Lloyd, A., "Technology and Two Cultures: One Hundred Years of Engineering Education in Montreal", *Minerva*, XXII (Spring 1984), p. 72.

² On *mentalité*, see Le Goff, J. and Nora, Pierre (eds), *Faire de l'histoire; Nouveaux objets* (Paris: Gallimard, 1974), pp. 76-94.

³ The quotation of Paquet is in Rabkin, Y. and Levi-Lloyd, A., "Technology and Two Cultures", *op. cit.*, p. 73. See also Linteau, P. A., Durocher, R. and Robert, J. C., *Histoire du Québec contemporain: De la Confédération à la crise* (Montreal: Boréal Express, 1979), pp. 75-137.

Lloyd's analysis of the two strands of technological education in Quebec which deals primarily with cultural factors.

Two Communities: Two School Systems

Following the defeat of the French garrison in 1759, Quebec became a British colony. In the years that followed the remaining French colonists became socially and culturally distinct from the ever increasing numbers of English-speaking immigrants from the British Isles. The pronounced differences between the two communities as well as the numerous points of contention were described in Lord Durham's Report of 1839 which suggested the union of Lower and Upper Canada as a means of accelerating the assimilation of the French Canadians. The plan never worked and by the middle of the century, any governmental action in the domain of education had to take into account the interests of the two major linguistic groups settled in the province.

In 1871, French Canadians formed about 78 per cent of the population of the province of Quebec. English-speaking Canadians, composed of Irish, English and Scottish immigrants, accounted for the remainder.⁴ The French Canadians were largely of the Catholic faith and the clergy played a central role in the life of the community, monopolising all levels of the education of Roman Catholics. The religious affiliation of English-speaking Canadians was naturally more diversified but after years of debate and six major schools acts between 1845 and 1869, an agreement was reached which resulted in the creation of a Council of Public Instruction composed of two distinct and independent committees, one Protestant and one Roman Catholic. Conceived on a religious basis, the school system was in fact also separated along linguistic lines. In 1875, the office of minister of public instruction, created in 1867, was abolished in favour of a politically neutral superintendent of education—to the great satisfaction of the Roman Catholic clergy—but the council itself and its two committees survived unchanged until 1964 when a minister of education was reinstated despite the opposition of the clergy. Though the division along religious lines was not without problems for minorities like Jews or English-speaking Roman Catholics, it nonetheless established the rule that the government was bound to subsidise each school system at least proportionately to its share of the population.⁵

In addition to the statutory subsidies, the government also took care to maintain a balance in its additional investments in education. In 1856, for example, it created three *Écoles normales* to train elementary school teachers. One was affiliated with the Catholic Université Laval in Quebec, and one with the Protestant McGill University in Montreal. For the

⁴ Linteau, P. A., et al., *Histoire du Québec*, op. cit., p. 56.

⁵ The real situation was in fact more complex; *ibid.*, pp. 242–245. See also Audet, Louis-Philippe, *Histoire du Conseil de l'Instruction Publique* (Montreal: Léméac, 1964).

Catholics of Montreal, there was a third school, the École normale Jacques Cartier. Each of these schools received an equal yearly grant.⁶ More than 60 years later, in 1920, when the Université de Montréal was created and received a government grant of one million dollars, a similar grant was accorded to McGill and Laval. Government intervention was always made in a linguistic and religious climate that not only defined the rules for statutory subventions but also forced successive governments to distribute any additional investment in education in a way that would not upset any of the two main communities of the province. The situation created by the adoption of a dual school system was summarised by L. P. Audet in 1970:

The separation of the education system of Quebec into two distinct divisions had advantages and drawbacks. Duality favoured the autonomy of each group and protected each against assimilation by the other, but it also emphasized a harmful isolation, doubtless unforeseen when the system was set up in 1875.⁷

Industrialisation and the Need for Practical Education

At the beginning in the 1850s, stimulated by the development of railways, a new interest in civil engineering in particular and practical education in general emerged in Canada. This first wave of industrialisation raised questions as to the importance of scientific and practical training across Canada. At McGill University, for example, a visitation report from the Royal Institution for the Advancement of Learning for the year 1848 noted that the curriculum was no longer adapted to a commercial centre such as Montreal, and drew attention to the absence of courses in agricultural chemistry and civil engineering.⁸ These new demands ultimately led to a reform of the institution's charter and to the appointment of John William Dawson as principal in 1855. Two years later a programme of civil engineering was offered to students of McGill. Sir Edmund Head, governor-general of New-Brunswick, stimulated the creation of similar courses as early as 1854 at King's College, Fredericton, although a complete programme came only in 1859 with the provincial government's creation of the University of New Brunswick. In Ontario, there was a similar evolution and, starting in 1857, a programme of civil engineering was offered by the University of Toronto. The same year, the provincial government created a Lower and an Upper Canada Board of Arts and Manufactures in order to offer technical courses to workers.⁹

⁶ Labarrère-Paulé, André, *Les instituteurs laïques au Canada français: 1836-1900* (Quebec: Presses de l'Université Laval, 1965), pp. 197-214.

⁷ Wilson, J. Donald, Stamp, Robert M. and Audet, Louis-Philippe, *Canadian Education: A History* (Scarborough: Prentice-Hall, 1970), p. 348.

⁸ Frost, Stanley B., *McGill University: For the Advancement of Learning, Vol. 1: 1801-1895* (Montreal: McGill-Queen's University Press, 1980), p. 174.

⁹ Young, C. R., *Early Engineering Education at Toronto 1851-1919* (Toronto: University of Toronto Press, 1958); Beard, A. F., "The History of Engineering Education at the University of New-Brunswick", in *The University of New-Brunswick Memorial Volume* (Fredericton: New Brunswick University Press, 1950), pp. 75-86; Charland, Jean-Pierre,

In French Canada, the criticisms of the reformers centred around the lack of practical education in the *collèges classiques*. The curriculum of these church-controlled institutions was tailored to the preparation of prospective priests, doctors and lawyers.¹⁰ There was no place for the more practically minded students, and liberal newspapers like *Le Pays* regularly criticised the lack of scientific training and the excess of Greek and Latin in the curriculum of the *collèges*. They also deplored the monopoly of the Catholic clergy at all levels of education which, they said, rendered difficult any reform of the system.¹¹ Secondary and university education were not included in the mandate of the Council of Public Instruction so that the clergy had no account to give of its activities in these sectors.

However difficult any reform towards a more practical course of study might have been, sciences were in fact not excluded from the programme.¹² The curriculum leading to the *baccalauréat ès arts* at Université Laval, the only French-Canadian University—a property of the Petit Séminaire and thus of the Catholic clergy—was based on the French model and did not neglect the sciences. There were two separate final examinations, one devoted to the classics and one to the sciences—algebra, geometry, physics, geology, zoology and biology. To obtain the *baccalauréat ès arts* a student had to obtain at least 60 per cent in each examination. Until the 1870s, this degree was essentially equivalent to the BA of Toronto and McGill Universities which also had restricted liberal arts programmes.¹³

The cleavage within the French-Canadian community was not between scientific education on the one hand and humanistic or religious education on the other but, rather, between science as general culture—as conceived in the *collèges classiques*—and applied science viewed as a complement of industrial activity. These opposing conceptions of the role of scientific education are clearly visible in the two reports prepared in 1880 by the Commission on Arts, Science and Letters of the National Convention of the Société Saint-Jean-Baptiste. One report, outlining the position of the clergy, was presented by abbé Joseph-Clovis-Kemner Laflamme, professor of physics and geology at Université Laval. The other report was read by Charles Baillargé, engineer of the city of Quebec and the architect who designed the Université Laval and the federal parliament in Ottawa.

Histoire de l'enseignement technique et professionnel (Quebec: Institut Québécois de recherche sur la culture, 1982).

¹⁰ Galarneau, Claude, *Les collèges classiques au Canada français* (Montreal: Fides, 1978).

¹¹ Bernard, Jean-Paul, *Les rouges: libéralisme, nationalisme et anticléricalisme au milieu du XIX^e siècle* (Montreal: Presses de l'Université du Québec, 1971), pp. 126–128; see also Eid, Nadia Fahmy, *Le clergé et le pouvoir au Québec: une analyse de l'idéologie ultramontaine au milieu du XIX^e siècle* (Montreal: Hurtubise, 1978).

¹² According to Rabkin, J. and Levi-Lloyd, A., "Technology and Two Cultures", *op. cit.*, p. 72: "knowledge meant [for French Canadians] a commitment to the humanities from which science, let alone applied science, would be firmly excluded."

¹³ Jarrell, Richard A., "L'ultramontanisme et la science au Canada français", in Fournier, M., Gingras, Y. and Keel, Oth (eds), *Sciences et médecine au Québec: perspectives sociohistoriques* (Quebec: IQRC, 1987), pp. 41–68.

Laflamme never mentioned the existence of the École polytechnique and insisted that the teaching of science in the *collèges classiques* did not require any major revisions, for the purpose of the *collèges* was to give students a general culture to prepare them to engage in a profession, and not to train specialists in any given scientific domain.¹⁴ The few civil engineers needed could be sent to Europe for training. This solution would cost less than the establishment of an engineering school in the province. By contrast, Baillargé insisted on pride in the students trained at the French-Canadian engineering school—the École polytechnique—and also stressed the importance of appointing competent teachers capable of teaching pure and applied sciences. Laflamme did not address this issue of the competence of teachers, though liberal newspapers and members of parliament had often remarked that “clergymen can give an excellent literary education, but they are less prepared to give a practical education”.¹⁵ Baillargé concluded his defence of practical education on a polemical tone: “less Greek, less Latin, more physics, mechanics, chemistry and technology and we will succeed.”¹⁶

The conflict between these two opposing points of view on the role of science in education remained latent until the 1920s when a second wave of industrialisation of the province gave rise to another debate on the place of science in the curriculum of the *collèges classiques*.¹⁷

Though interest in engineering education emerged in Canada in the 1850s, the sudden cessation of railway construction in 1860 hindered its development until the 1870s when a more stable demand for civil and mining engineers arose. At McGill, for example, the programme was closed in 1861, after having produced about a dozen engineers, and reopened only ten years later when, according to Principal Dawson, the times were “particularly favourable in consequence of the present activity in mines, railways and other scientific enterprises in this country”.¹⁸

Dawson's efforts to reanimate a programme of engineering education at McGill started around 1868 when he presented the government of Quebec with an elaborate report in order to obtain money for the development of courses in civil and mining engineering.¹⁹ The provincial government was not reluctant to assist McGill financially. In fact, the views of the prime minister, Pierre-Joseph-Olivier Chauveau, were similar to those of Principal Dawson whom he knew well.²⁰ From 1855 to 1867,

¹⁴ Chouinard, H.-H.-J.-B., *Fête nationale des Canadiens-français de Québec* (Quebec, 1881), pp. 421–426. The École polytechnique was created in 1873.

¹⁵ Laframboise, Maurice, *Débats de l'Assemblée législative du Québec*, 6 December, 1876. See also *Le Pays*, 20 June 1868, 20 August 1868.

¹⁶ Chouinard, H.-H.-J.-B., *Fête nationale*, *op. cit.*, p. 436.

¹⁷ Galarneau, Claude, *Les collèges classiques*, *op. cit.*, p. 221–228.

¹⁸ Cited by Young, C. R., *Early Engineering Education*, *op. cit.*, p. 24.

¹⁹ Maheux, A., “P. J. O. Chauveau, promoteur des sciences”, *Mémoires de la Société royale du Canada*, 4th series, Vol. I (1963), p. 91.

²⁰ Dawson, J. William, *Fifty Years of Work in Canada* (London: Bailantyne, Hanson, 1901).

Chauveau had been superintendent of education in Lower Canada. From 1867 to 1873 he was prime minister and also assumed the role of minister of public instruction. As such, he was well aware of the importance of practical education for the economic development of the province. In 1866, for instance, he had toured several European countries to study their systems of education. Upon his return, he had worked towards improving the teaching of agriculture and engineering.²¹ In his first annual report as minister of public instruction, he had stressed the importance of "giving to the new Province of Quebec a school system adapted to the needs of the times and able to prepare the youth to the tasks of the future".²² Chauveau had in mind schools of commerce, of applied science and courses in agricultural science.

It was in this context that Dawson asked for financial aid. By agreeing to give McGill \$1,000, however, Chauveau was bound to make a similar offer to the Université Laval. Though Chauveau pressed Laval to establish courses in engineering, the rector of the university, Mgr Thomas-Étienne Hamel—himself a professor of physics—refused the offer. The Catholic clergy feared that this subsidised programme would prepare the way for ultimate governmental control of the university which belonged to the Petit Séminaire. The clergy was already fearful of Chauveau who, in 1867, had created the ministry of public instruction which they saw as a threat to their authority and monopoly in matters of education. For example, Mgr Larocque, a member of the Council of Public Instruction, explained at the provincial council of bishops, held in 1868, that the creation of commercial or technical schools "would divert students from the colleges and thus diminish the number of ecclesiastic vocations".²³ Moreover, the creation of these schools would diminish educational funds going to the *collèges classiques*.²⁴

The possibility of reform was also limited by the fact that the government was not in a position to invest much money in education. The first task was then to develop an agricultural policy based on the colonisation of new territories in order to counteract the emigration of French Canadians to the United States.²⁵ In these circumstances, the presence of the clergy in education was a way in which the government could save money. Taken together, these factors explain why neither the clergy nor the government could easily agree to make any major change in the educational system, even though the prime minister himself was convinced that major reforms were needed.

²¹ Audet, L. P., "P.-J.-O. Chauveau, ministre de l'Instruction publique, 1867-1873", *Mémoires de la Société royale du Canada*, 4th series, Vol. 5, 1967, pp. 171-184.

²² *Ibid.*, p. 184.

²³ Cited by Grisé, J., *Les conciles provinciaux de Québec et l'Église canadienne 1854-1886*. PhD thesis, Université de Montréal, 1962, p. 110.

²⁴ Heap, R., *L'Église, l'État et l'éducation au Québec: 1875-1898*, PhD thesis, McGill University, 1978, p. 70.

²⁵ Hunt, K. D., *The Ministry of Public Instruction in Quebec 1867-1875*, PhD thesis, McGill University, 1964.

Despite the attitude of the Université Laval towards the provincial government, the project of a school of engineering for French Canadians was not abandoned. Chauveau's successor as prime minister and minister of public instruction, Gédéon Ouimet, stressed the importance of creating a school of practical sciences for French Canadians. In his first report as minister, he noted that Chauveau had so far failed in his attempts, but was confident he would soon be able to create such an engineering school.²⁶ The École polytechnique finally opened its doors in Montreal in January 1874 as a corporation of the province. Two years later it was incorporated as a university.²⁷ The first five graduates received their diplomas signed by the superintendent of public instruction in June 1877.²⁸

Notwithstanding those promoting applied science, the École polytechnique long had difficulty in recruiting students. This situation arose in part from the fact that potential recruits were in the *collèges classiques*, which were first of all seminaries with a curriculum aimed at the education of future priests. These private institutions would not willingly transform their programme to prepare students to attend the École polytechnique since the teaching of science in the *collèges* was conceived as a necessary part of a general education and culture. Moreover, the teachers—priests who were graduates of these *collèges*—could hardly foster interest in engineering. This dominant conception of a classical education was not peculiar to Quebec—it was also at work in England and France during the second half of the nineteenth century.²⁹

At the turn of the century, the director of the École polytechnique, E. Balète, wrote to the archbishop of Montreal asking him to suggest to all the directors of the *collèges* that they send a few of their students to the École polytechnique. Knowing the traditional nationalism of the Catholic

²⁶ *Rapport du ministre de l'instruction publique de la Province de Québec, 1872–73 et une partie de 1874* (Quebec, 1874), p. ix.

²⁷ The decision to grant university status to the École polytechnique was opposed by Dawson and his colleagues at McGill in view of the low academic level the ministry had initially envisaged for the school.

²⁸ Audet, L. P., "La fondation de l'École Polytechnique de Montréal", *Cahier des Dix*, XXX (1965), pp. 149–191. Professor Rabkin's and Miss Lévi-Lloyd's account of the circumstances surrounding the creation of the École polytechnique is very confusing. They mention that "in anticipation of the provincial government's plan to develop engineering at the École polytechnique, McGill's board of governors suggested the expansion of their own school of engineering to serve both the French- and English-speaking communities" of the province, "Technology and Two Cultures", *op. cit.*, p. 70). There could hardly have been any such "anticipation" for the document containing the suggestion dates from 1876 whereas the École polytechnique was created in 1873. They confuse the document of 1876 with a document of 1871. It is this last document that was sent by Chauveau to the rector of Laval University and not the one referred to by the authors, which dates from 1876 and which is linked to the university status accorded to the École. For more details on these points, see Collins, Peter, *Notes on the Centenary of the Faculty of Engineering of McGill University: Its Origins and Growth* (Montreal: McGill University, 1972), p. 9; Maheux, A., "P. J. O. Chaveau", *op. cit.*, p. 91.

²⁹ Shinn, Terry, *L'École polytechnique: Savoir scientifique et pouvoir social. 1794–1914* (Paris: Presses de la Fondation nationale des sciences politiques, 1980); Sanderson, Michael (ed.), *The Universities in the Nineteenth Century* (London: Routledge & Kegan Paul, 1972).

clergy, Balète insisted that "the extreme scarcity of the student body contrasts singularly with the situation existing in an English Faculty of this city where there are hundreds of students".³⁰ Mgr Paul Bruchési accordingly sent a circular letter to the directors of the *collèges classiques* of his diocese. In calling the École polytechnique to their attention, he was convinced he was acting "in the interests of French Canadians". He suggested that professors orient "those students who are not destined to the liberal professions" towards the École polytechnique. In sending "one or two students" every year, the professors would further "the cause of the influence of French Canadians in careers too often closed to its youth".³¹

Though the official approval of the goals of the École polytechnique by the archbishop of Montreal might have helped in the recruitment of students, a more important factor limiting the size of the student body was the poor prospect for employment of French Canadians. Most industries were in the hands of English-speaking Canadians and French Canadians anticipated difficulty in fitting into what they perceived as a "foreign" milieu. As the minister of public works observed in 1893:

The situation of our students at the École polytechnique is due to our social and economic state, nothing else. The big industries, and the large railway, water and lighting companies are, in general, in the hands of our compatriots who prefer to hire, and one cannot blame them, their nationals instead of others as competent and honorable as these others may be.³²

As late as 1933, Augustin Frigon—who had been director of the École polytechnique from 1923 to 1935—made a similar complaint.³³ The fact that, at the time, French-Canadian industrialists were few in number and weaker economically than their English-Canadian counterparts, not only had negative effects on the opportunities of the graduates for employment but also severely limited the expansion of the institution itself. Unable to find rich French Canadians to contribute to the endowment of the École polytechnique, the latter could survive only with government funds of which there were little to spare.³⁴ During the first ten years, the government contribution was limited to \$3,000 a year—about the salary Ernest Rutherford alone received at McGill in 1897—and was some \$6,000 from 1883 to 1903. Clearly, such a budget could hardly permit the appointment

³⁰ "Notice sur l'École Polytechnique de Montréal", 1899, Archives de l'École polytechnique de Montréal.

³¹ "Lettre circulaire de Mgr. L'Archevêque de Montréal aux Supérieurs des collèges de son Diocèse", 19 February 1899, Archives de l'École Polytechnique de Montréal. See also Ryan, W. F., *The Clergy and Economic Growth in Quebec* (Quebec: Presses de l'Université Laval, 1966), pp. 233–234.

³² Cited by Ryan, W. F., *The Clergy and Economic Growth*, op. cit., p. 233.

³³ Frigon, A., "Le Canadien français et l'industrie", *Revue trimestrielle canadienne*, XIX (March 1933), pp. 1–11.

³⁴ For a discussion of the causes of economic inferiority of French Canadians, see Durocher, René and Linteau, Paul-André (eds), *Le "retard" du Québec et l'infériorité économique des Canadiens français* (Montreal: Boréal Express, 1971); and Sales, Arnaud, *La bourgeoisie industrielle au Québec* (Montreal: Presses de l'université de Montréal, 1979).

of well-trained, full-time teachers or the purchase of elaborate scientific equipment for teaching and for research. During this period, students were trained mainly by part-time and often self-trained lecturers.³⁵ Only in 1905 did the École polytechnique finally emerge from its recurrent financial problems and secure sufficient funds to construct its own building. After 30 years of existence, it had trained 108 graduates, all in civil engineering; this was an average of 3.4 a year. Most of them found employment in federal, provincial and municipal services and only 5 per cent were employed in industry and commerce.³⁶

In contrast, English-speaking engineers graduating from McGill had no cultural or linguistic barriers to overcome and their market for employment extended across North America. In 1909, for instance, a survey showed that only one third of all engineering graduates of McGill were working in the province of Quebec. About 25 per cent were in Ontario, 18 per cent in the rest of Canada, 16 per cent in the United States and 10 per cent elsewhere.³⁷ This distribution also reflects the fact that a large portion of students were recruited from outside the province—about 50 per cent in 1914.³⁸ For religious and linguistic reasons, only a handful of French Canadians studied at McGill—fewer than 12 graduated in engineering between 1873 and 1893. In this context, it is understandable that in 1911, for example, 100 engineers graduated from McGill and only 35 from the École polytechnique, though ethnic considerations alone would have warranted the reverse;³⁹ with only one third of McGill graduates staying in Quebec, the two engineering schools of Montreal thus trained a similar number of engineers for the provincial market. While the engineers trained at the École polytechnique found employment in the civil service, those of McGill who practised in Quebec were recruited by the private sector (63 per cent in 1911).⁴⁰

Engineering grew rapidly at McGill not only because it was able to attract students from outside Quebec; it was also helped by the large endowments and gifts to the university from wealthy business entrepreneurs. William Macdonald, a rich tobacco manufacturer, alone gave a total of more than ten million dollars to the university. In 1890, he contributed

³⁵ Maurault, O., "L'École polytechnique de Montréal, 1873-1923", *Revue trimestrielle canadienne*, IX (December 1923), p. 346.

³⁶ "Mémoire de la corporation de l'École polytechnique de Montréal à la Commission royale d'enquête sur les problèmes constitutionnels", *Revue trimestrielle canadienne*, XL (Summer 1954), p. 31.

³⁷ *Graduates' Bulletin and List of Graduates in the Faculty of Applied Science*, No. 5, McGill University, Montreal (June 1911), p. 22.

³⁸ Tourigny, Paul, *Histoire comparée de la Faculté de génie de l'Université McGill et de l'École Polytechnique, 1920-1940*, MA thesis, University of Montreal, 1980, p. 17.

³⁹ Rabkin, Y. and Levi-Lloyd, A., "Technology and Two Cultures", *op. cit.*, p. 78.

⁴⁰ Only 8 per cent were working in the civil service; 13 per cent had academic positions and 16 per cent worked for railway companies—we cannot distinguish between private and governmental ones. Data compiled from *Graduates' Bulletin*, No. 7 (June 1912) McGill University, Montreal.

\$400,000 for the construction of an engineering building, while in 1898 he donated \$280,000 for the chemistry and mining building. In comparison, the École polytechnique's only building cost \$105,000. A last and most telling example of the availability of financial support for McGill was the "million dollar campaign" launched in 1910 to reconstruct the engineering and medical buildings destroyed by fire in 1907: in five days, the university received one-and-a-half million dollars, 36 gifts being over \$1,000.⁴¹

These three major factors: the prospects of graduates for employment, the foreign origin of many students at McGill—a phenomenon also present in the history of medical schools in Quebec⁴²—and the scale of financial resources, help explain the fact that McGill engineering school produced, between 1877 and 1910, about five times the number of engineers as the École polytechnique.

The Institutional Basis of the Development of Research

The institutional and economic constraints and opportunities which shaped the two strands of the engineering education of French Canadians and English Canadians in Montreal, also account for the different rates of development of research at McGill and at the École polytechnique. Hence, the observation that at "McGill individual teachers were expected to take care of research, and research-related matters", while "the administration of the École took a more active hand in the encouragement of research",⁴³ does not attend to the institutional constraints that are always present in the development of scientific or engineering research in universities. Engagement in research is not only a matter of individual curiosity. It first presupposes an appropriate training such as could not be obtained in any Canadian university before the first decade of the twentieth century. The practice of research in universities is also affected by institutional structures and by the existence of mechanisms to decide whether or not to put necessary resources, such as time, space and money, at the disposal of departments and individuals; appropriate training and dispositions may be necessary conditions for the prosecution of research, but they are not sufficient.

At McGill, for instance, a major step towards the institutional provision for research was taken in 1906 with the creation of doctoral programmes. In 1897, Toronto had been the first Canadian university to adopt the German diploma for research. These programmes grew slowly until the First World War and produced only about one doctorate a year at McGill

⁴¹ *Graduates' Bulletin*, *op. cit.*, No. 6 (November 1911), pp. 5-6.

⁴² During the 1930s, for example, Americans accounted for 44 per cent of all enrolments in medicine at McGill. In the 1920s, only 25 per cent of all medical graduates of McGill but 60 per cent of those who originated from Quebec practised in the province. See Weisz, George, "The Geographical Origins and Destinations of Medical Graduates in Quebec, 1834-1939", *Social History/Histoire sociale* (forthcoming).

⁴³ Rabkin, Y. and Lévi-Lloyd, A., "Technology and Two Cultures", *op. cit.*, p. 81.

and two a year at Toronto, all disciplines included.⁴⁴ The growth in research, which prompted the creation in 1922 of faculties of graduate studies in these two institutions, was stimulated by the creation of the National Research Council of Canada in 1916. This federal institution made available fellowships for graduate students and grants-in-aids for professors, thus giving rise to the first systematic research system in Canada.⁴⁵

At the École polytechnique, the paucity of resources did not permit an emphasis on research. At this time, the first task was regarded as the improvement and diversification of the training of engineers by the appointment of better trained and full-time professors, instead of using part-time lecturers as was, for lack of funds, the usual practice until the 1920s. The diversification of training was important, since until 1943 the École polytechnique trained only civil engineers while McGill offered five different fields of specialisation.

The fact that the École lacked the resources to develop structures to help its teachers to engage in research does not mean that individual professors did not try to develop research projects on their own. In 1926, for example, Louis Bourgoïn, professor at the École polytechnique, received a grant of \$1,200 from the National Research Council of Canada to study the catalytic action of ultra-violet rays. In the same year, André V. Wendling, also of the École polytechnique, received \$2,000 from that body for research on the dielectric properties of ceramics.⁴⁶ While retaining his teaching duties, Wendling went on to obtain his doctorate in physics from McGill in 1937. Thus, individual initiatives existed at the École polytechnique as well as at McGill, but the financial problems faced by the former institution led its director to make a virtue out of necessity and to define a policy of excellence in teaching, convinced that research could be developed only when circumstances became more propitious.⁴⁷

By 1939, Armand Circé, the director of the École polytechnique, had become conscious that his institution, by neglecting research and by giving attention only to undergraduate teaching, had fallen short of an ideal of education according to which research was an important function of a university and of a school of engineering. Addressing a group of students, Circé acknowledged that greater efforts should be made to promote research, but only in so far as it did not encroach on the first responsibility

⁴⁴ Frost, Stanley B., *McGill University: For the Advancement of Learning. Vol. 2: 1895–1971* (Montreal: McGill–Queen's University Press, 1984), pp. 80–82.

⁴⁵ Gingras, Y., "The Institutionalization of Scientific Research in Canadian Universities: The Case of Physics", *Canadian Historical Review*, LXVII (June 1986), pp. 181–194.

⁴⁶ "National Research Council: List of Research Grants to Individual Applicants", Public Archives of Canada, RG 77, Vol. 276, File A-A-2-14.

⁴⁷ For examples of complaints about the lack of resources for research, see Villeneuve, J. A., "Les ingénieurs électriciens à l'École Polytechnique", *Revue trimestrielle Canadienne*, XXV (June 1939), pp. 180–181.

of the École which remained undergraduate teaching.⁴⁸ Research was considered a remote objective, but the conjecture created by the Second World War accelerated the emergence of research at the École polytechnique by providing it with new funds and the opportunity to appoint its first experienced research worker.

On the eve of the invasion of Poland by Germany, Georges Welter, a Roman Catholic francophone born in Luxembourg, was still vice-director of the institute of metallurgy at the Instytutu Metalurgii i Metaloznawstwa Politechniki Warszawskiej—the polytechnic school of Warsaw. A productive research worker—he published more than 60 papers between 1921 and 1939—Welter left Poland the day before the invasion. Returning to his native country, he wrote to several institutions throughout the world in search of an appointment. One of these letters came into the hands of Georges Baril, dean of the faculty of sciences at Université de Montréal, who immediately sent it to his colleague Armand Circé—the École polytechnique was affiliated to but independent of the university. Convinced he had found the man who would “show the way and give appropriate directives so that others may follow him into the field of research”, Circé took the necessary step to appoint Welter from the spring of 1941.⁴⁹ The organisation of research was now in his hands and he rapidly set to work to purchase scientific instruments worth \$30,000 and to solicit funds. By 1945, he had already published several papers. In 1947, his laboratory became part of a group of research institutions linked to a private American body, the Welding Research Council. His growing reputation attracted attention to the École polytechnique and in 1948 he won the international medal given by the James F. Lincoln Arc Melting Foundation. More importantly, Welter rapidly recognised the importance of a programme to train students in research. After the war, he began supervising doctoral students—the first doctorate being awarded in 1947—and produced the first generation of research oriented French-Canadian engineers. The products of Welter’s work during the 1940s and 1950s led, in the 1960s, to an exponential growth of research, indicating a real “take-off”. Under the leadership of Julien Dubuc, who had done his doctorate under Welter, the École polytechnique was reorganised and a *Direction de la recherche* was created in order to give research a status equal to that of teaching.

Conclusion

The pattern of the emergence of research at the École polytechnique, and the role played by the institution in fostering its development, did not

⁴⁸ Circé, A., “Aperçus sur le développement et l’orientation de l’enseignement à Polytechnique”, *Revue trimestrielle Canadienne*, XXV (March 1939), pp. 17–32.

⁴⁹ A. Circé to J. Desy, 7 May 1940, Archives de l’École polytechnique.

differ basically from the pattern observed at McGill 60 years before.⁵⁰ In both cases, the first teachers interested in doing research came from England or Europe where they had received appropriate training and had acquired the necessary attitude. They trained Canadians in the practice and ethos of research in turn. The attitude which distinguished English-speaking Canadians from French-speaking ones in their participation in engineering and research was not unchanging and unchangeable. Opportunities for employment after training and the availability of financial resources to educational institutions were of great importance in constraining the choice of careers. French-Canadian culture and the dispositions associated with it were not uniform and rigid. Given the opportunities and the means, young French Canadians could be attracted into an engineering specialty or assimilated into the practice and ethos of research.

⁵⁰ For more details, see Desroches, J. M. and Gagnon, R., "Georges Welter et l'émergence de la recherche à l'École polytechnique de Montréal, 1939-1970", *Recherches sociographiques*, XXIV (January-April 1983), pp. 33-54.