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DISSERTATION NOTES

Philip C. Enros

Editor's Note: From time to time, *Scientia Canadensis* will bring to the reader's attention important recently-completed dissertations.

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The most important characteristic of twentieth-century science is its utility. While the association of utility with science did not originate in this century—as Bacon, the early activities of the Royal Society and the Industrial Revolution all show—it was only around 1900 that science finally began to realize its promise. The result was one of the basic transformations in the pursuit of science. The 'technocratic reappraisal,' as Arnold Thackray has labelled this shift in the image and purpose of science, was a fully conscious realization that, through experts, science was the key to military power, national survival and the increase of wealth.

The best expression of the new attitude toward science at the turn of the century can be found in the emergence of formal R & D systems. Not only was there a strong movement promoting research in universities, but – and perhaps more significantly – there was a new interest in science by governments and a new value set on science by industry. Both dissertations under notice here deal with the growth of R & D, but in two different settings. McRae's work is a study of the diffusion of the new spirit of science into a professional, university faculty. Langford's examines the history of a chemical firm's efforts to harness science for profit. Both dissertations demonstrate that Canadian science, like science in other industrialized countries, was being transformed at the turn of this century.

McRae's work centres on the scientific curriculum in the Faculty of Medicine at the University of Toronto between 1880 and 1910. At the start of the period, Toronto did not have a medical faculty. By 1910 the medical laboratory facilities were, in the opinion of Abraham Flexner (who surveyed the quality of medical colleges in the United States and Canada)

among the best on the continent, and Toronto had become a centre for physiological and biochemical research. In not too many years those laboratories witnessed the discovery of insulin. This transformation is the subject of McRae's dissertation.

The key individual responsible for the scientific spirit in medicine at Toronto was Robert Ramsay Wright. Taking the chair in natural history, essentially a lecturing position, he made it into the 'centre of an active laboratory-based group of researchers, initiated into the research methods of the new experimental biology of Huxley and Foster.' (pp 315-16). The laboratory was a bridge between biology and medicine at Toronto. When a medical faculty was re-established at the university in 1887 (the first faculty had been abolished in 1853), its pre-clinical years, under Ramsay Wright's influence, became distinguished by a biological, research-oriented approach to medicine. This emphasis on teaching medicine scientifically was, for the time, somewhat unique to Toronto. McRae explains why neither McGill nor Queen's took this path.

The careers of graduates are one indicator of Toronto's successful innovation in medical education. McRae has a very interesting chapter (chapter 5) on the large number of individuals trained at Toronto in the 1890s and early 1900s who became influential biomedical scientists in the United States. Toronto, through a teaching program characterized by laboratory work, an emphasis on evolution, comparative studies of invertebrates and teaching fellows, turned out a product in great demand by American universities, but one that Canadian institutions were not able to take advantage of.

One individual who did remain in Canada was Archibald Byron Macallum. A pupil of Ramsay Wright's, he built on his teacher's efforts by developing a research school. McRae gives a good and particularly full account of Macallum's work in physiology and biochemistry.

McRae's dissertation ends with a brief review of the legacy of these crusaders for a scientific spirit. On the local scene, the number of faculty positions and research grew rapidly in the faculty of medicine. Their influence also extended to the organization of research in Canada, through their involvement in such institutions as the Biological Board of Canada, the Ontario Fisheries Research Laboratory, Connaught Laboratories and the National Research Council.

The subject of Langford's dissertation is Shawinigan Chemicals, 'a major, scientifically innovative chemical company, the only such company under Canadian ownership' (p 408). Her focus is on the role of innovation in the company's history. Four chapters form the heart of the dissertation.

They examine the period from the formation of the firm's parent, Shawinigan Water and Power, in 1898 to 1930; the Depression; the Second World War; and the time from the War to the company's dissolution in the 1970s. Imbedded in these chapters are a number of case studies of both product and process innovations, which Langford uses to illustrate characteristics of the company in the four periods. Among the many innovations she examines are the production of acetone from acetylene, Shawinigan acetylene black, polyvinyl resins and a loop reactor for continuous emulsion polymerization.

One other chapter (chapter 2) reviews theories of industrial innovation. These theories are presented merely as background; they are not developed in the body of the dissertation. However, there is one concept, that of Freeman, Clark and Soete's 'new technology systems,' which Langford favours in trying to sum up Shawinigan Chemical's experience.

Shawinigan Chemicals was formed in 1927 out of the Canada Carbide Company (its predecessor, Shawinigan Carbide, dates from 1901), the Canadian Electro Products Company (established 1915) and a number of smaller companies, all attracted to the area or stimulated by the availability of hydroelectric power due to the formation of the Shawinigan Water and Power Company. In terms of technological innovation, Shawinigan Chemicals' roots go back to T.L. Willson's discovery of a commercial process for making calcium carbide. But the major stimulus to the firm came from the need of the First World War for acetone. Canadian Electro Products was established then to develop a process for obtaining acetone from acetylene (itself produced from carbide). The history of innovation at Shawinigan Chemicals is, in terms of technology, the story of the various industrial chemicals produced from acetylene and its derivatives.

Contrary to what might be expected, the Depression witnessed a high rate of both process and product innovation within the company. This provided the basis for the company's prosperity after World War II. That war, unlike the first, did not open up a new line of innovative activity. Rather, it broadened the company's participation in existing technology. After the war, until about the 1960s, Shawinigan Chemicals enjoyed considerable financial success. There were, however, signs that all was not well. The company was unable to grow as fast as its competitors, and its technological expertise, based on calcium carbide, was being eroded by the emergence of a rival technological system, petrochemicals.

Langford offers a wide-ranging analysis of the demise of Shawinigan Chemicals in the 1960s and 1970s. Her explanation incorporates not only the shift to petrochemicals, but also social and political factors - strikes and nationalization of Shawinigan Water and Power Co. in 1963 - and

changes in ownership and management. I particularly liked her examination, although brief and tentative, of the relation between company strategy and R & D strategy. Here, for example, she looks at whether the firm could have survived as a chemical innovator if it had entered into petrochemical technology earlier.

It is commonplace within our community to lament the underdeveloped state of the history of Canadian science and technology. McRae's and Langford's dissertations are an encouraging sign that Canadian topics continue their appeal for our few doctoral students specializing in the history of science and technology. Moreover, it is satisfying to note that the two efforts are part of a growing body of doctoral dissertations on the emergence and growth of Canadian R & D. David Zimmerman, James Hull, Yves Gingras and Frances Anderson have recently completed theses in this area; Jennifer Hubbard and Allison Li have theses in progress.

Another common concern, also addressed by McRae's and Langford's works, is the neglect of science and technology by Canadian historians. Both dissertations are well-researched, exemplifying the kinds of sources available to researchers and how the material may be used. They also demonstrate the intellectual rewards that can result from studies of the Canadian R & D system. But in addition, McRae and Langford deal with two growing areas of Canadian history: higher education and business. Since their dissertations make definite contributions to these areas, they should cause other historians to take note of the merits of the history of science and technology.

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