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Résumé de l'article

Le département de biochimie de l'université McGill a ouvert ses portes près d'un siècle après la création de l'école de médecine. Les racines du département, toutefois, plongent jusqu'au tout début de l'école de médecine en 1829. Parce que plusieurs membres fondateurs de l'école de médecine reçurent leur formation à Edimbourg, le programme de formation médicale porte la marque de l'école d'Edimbourg — particulièrement l'accent placé sur la formation en chimie et la recherche fondamentale. Cette étude du développement d'un département universitaire est structurée autour des changements de direction et décrit comment les activités scientifiques, pédagogiques et administratives du département étaient influencées par les habiletés et les dispositions de ceux qui en assumaient la direction. Elle explique comment la croissance des instituts de recherche externes influençait l'évolution du département et donne quelques contributions notables de ses membres.

A Sixty-Year Evolution of Biochemistry at McGill University

ROSE JOHNSTONE[1]

Résumé: Le département de biochimie de l'université McGill a ouvert ses portes près d'un siècle après la création de l'école de médecine. Les racines du département, toutefois, plongent jusqu'au tout début de l'école de médecine en 1829. Parce que plusieurs membres fondateurs de l'école de médecine reçurent leur formation à Édimbourg, le programme de formation médicale porte la marque de l'école d'Édimbourg — particulièrement l'accent placé sur la formation en chimie et la recherche fondamentale. Cette étude du développement d'un département universitaire est structurée autour des changements de direction et décrit comment les activités scientifiques, pédagogiques et administratives du département étaient influencées par les habiletés et les dispositions de ceux qui en assumaient la direction. Elle explique comment la croissance des instituts de recherche externes influençait l'évolution du département et donne quelques contributions notables de ses membres.

Abstract: The Department of Biochemistry at McGill University was inaugurated close to a century after the Medical School was founded. The roots of the Department, however, can be found at the very beginning of the Medical School in 1829. Because several of the founding faculty members of the Medical School were educated in Edinburgh, McGill's early medical program bore the imprint of the Edinburgh school—particularly in the importance placed on instruction in chemistry and on basic research. This survey of the development of a university department is structured on the succession of department chairs, and describes how the Department's scientific, pedagogical, and administrative activities were influenced by the particular abilities and dispositions of the individuals who were at the helm. It explains how the growth of external research institutes influenced the Department's evolution, and cites some of the noteworthy contributions of its members.

As a discipline, biochemistry is an infant compared to chemistry, physics or anatomy. The baby has grown into a giant and has become a major discipline taught to science and medical students. The continuous output of new findings is shaping new medication and new treatments for man and beast. Because of its youth, individuals still alive today may have seen the dawn and growth of the discipline in their own lifetimes.

1 It is with gratitude that I acknowledge the help of the McGill University Archives, in particular Gordon Burr and Johanne Pelletier, its Chief Archivist and Director, respectively. Their help in providing important sources of information was invaluable. Thanks are also due to Pamela Miller of the Osler Library of the Faculty of Medicine of McGill University and to my friend and colleague T.L. Sourkes, who provided information from his personal papers and his vast storehouse of memory. Thanks are also due to Dr. Donald Douglas, who provided his personal documents about the McGill–Montreal General Hospital Research Institute, and to Marian Packham of the University of Toronto, for sharing her manuscript on the University of Toronto's Department of Biochemistry. This summary of the history of biochemistry at McGill was undertaken at the suggestion of the incumbent Chair of Biochemistry, Prof. David Thomas. I enjoyed the task and I hope the product will give him further insight into the Department that he has undertaken to lead into the twenty-first century.

Chemists of an earlier era observed that the same organic compounds, such as urea, already known to be made by living organisms, could be made without the aid of cells in a test tube. Such knowledge suggested that organic compounds derived from living forms did not possess a "vital" force or unique chemical properties and that chemical analysis could be used to distinguish between "the normal and the abnormal state." Thus, knowledge of chemistry and botany (as a source of potential drugs) were deemed important to provide medical students with better tools with which to pursue their profession. This practice led eventually to the establishment of biochemistry as a fundamental discipline for all students of medicine.

Early Beginnings of Biochemistry at McGill

At McGill, the Department of Biochemistry has its roots in classes and laboratories to teach chemistry to students enrolled in medicine. The University's records show that the Department of Chemistry arose not to train chemists, but to provide basic chemical knowledge to physicians in training. The emphasis on knowledge of chemistry for medical students at McGill is tied to the Scottish education of its earliest instructors, like A. F. Holmes, who trained for medicine in Edinburgh and recognized the importance and usefulness of chemical knowledge in the practice of the profession.[2]

Although "The University of McGill College" was officially launched in March 1821, the College had no physical presence, but was an empty farm with five designated professors. All but one of the five were Anglican clergymen. McGill's official charter had given it the right to establish an institution of higher learning and to grant degrees. However, no students had presented themselves for advanced education. At the same time, in the small Protestant community of Montreal, another organization, The Montreal Medical Institution, was trying to provide medical training to a group of students, but lacked an approved charter to formalize or recognize the training.

Prior to 1815, a hospital to serve the general public had been established in Montreal, largely to cope with the influx of English speaking and Protestant immigrants. This hospital eventually grew into the Montreal General Hospital, which flourishes to the present day. During the 1820s, a program to train new physicians was inaugurated under the name "The Montreal Medical Institution."[3] The need for formal recognition for this training was evident to the group of physicians in charge,

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2 Joseph Hanaway and Richard Cruess, *McGill Medicine*, vol. 1, *The First Half Century, 1829–1885* (Montreal: McGill Queen's University Press, 1996), 16–34; 54–56.

3 Hanaway and Cruess; Stanley B. Frost, *History of McGill University*, vol. 1 (Montreal: McGill Queen's University Press, 1980), 47–67.

who had been trained in Edinburgh, Scotland. Two of this group of four, Andrew F. Holmes and John Stephenson, were natives of Montreal. When they returned to Montreal after their studies, they were eager to teach and to introduce basic sciences, such as chemistry and botany, into the curriculum. The medical training program at Edinburgh had been one of the first to introduce these basic sciences, as well as the importance of experimental and theoretical approaches in chemistry, to the treatment of medical problems. In the previous century, William Cullen and Joseph Black had laid the groundwork for the study of chemistry in the medical schools at Edinburgh and Glasgow and they were instrumental in bringing these centers to the height of medical practice in the United Kingdom.[4] The education at Scottish schools differed from many of the period, where medical education was (a) largely by apprenticeship and (b) carried out with little provision made for courses in science or experimentation.

Application for a Provincial Charter by the Montreal Medical Institution to become a recognized school to train physicians was denied because the requesting body was not authorized to grant degrees.[5] Since this group of forward-looking physicians was determined to form a centre of education in medicine, they turned to the newly established McGill College to suggest that the Montreal Medical Institution become the College's first faculty. This proposal served both sides well, since one needed a bona fide educational facility with real students and the other needed an organization with the authority to grant degrees. The medical men were appointed to the staff of McGill College and given academic titles. Thus, the Faculty of Medicine, established in 1824, became the first teaching unit of the "University of McGill College" as well as the first medical school in Canada. By this action, the basis for the importance of basic science training in medicine was present at the beginnings of the first medical school in Canada.[6]

The late 1800s were a period of rapid growth of universities throughout North America, and McGill was no exception. In 1883, registrations in the Faculty of Medicine still exceeded registrations in all other faculties. By 1885, the annual report of the Faculty of Medicine indicated that enlarged facilities were being developed for the 275–300 students expected to register in Medicine in the coming year, making it by far the largest academic unit on campus. In the fall of 1885, when William Osler (distinguished alumnus, and former faculty member and Chairman) visited the University, the growth in Medicine had not reached the level

4 Arthur L. Donovan, *Philosophical Chemistry in the Scottish Enlightenment: The Doctrines and Discoveries of William Cullen and Joseph Black* (Edinburgh: University Press, 1975).

5 Frost.

6 Ibid.

predicted.[7] But new buildings for Arts & Applied Science and Chemistry had been erected. The popularity of University education, as distinct from direct training for a profession, had grown by giant leaps, and by 1886 the enrollment in Arts had become twice that in Medicine.

The University was expanding rapidly, with ever-greater numbers of young people seeking to expand their knowledge and opportunities for careers. Practical Science at this time was being offered to medical students and science students alike, under the same roof and by the same instructors. Some aspects of the fledgling University's life were already forming a pattern, namely, the chronic shortage of money. With every year, or almost so, the deficit increased. The financial needs kept outpacing the income! In those years, grants from government sources were virtually non-existent at McGill, and the majority of the income came from benefactors such as members of the Board of Governors, and student fees. The inability to hire or keep staff for lack of funds had already become a common thread in the annual reports of the University during the decade between 1889 and 1890. This financial shortage perpetuated the need to continue teaching science and medical students under the same roof and by the same cadre of instructors.

Finding a Home for the First Faculty

In 1823 (nearly 100 years before the Department of Biochemistry appeared on the scene) the Montreal Medical Institution was situated at 20 St. James Street. In 1845, the now Faculty of Medicine of McGill College moved to the campus. This move was very unpopular with staff and students alike but had been made to economize, and this overrode the inconvenience. The distance between the hospital and the classrooms was inconvenient at best, and in the harsh Montreal winters it created hazards and hardships for both staff and student. Despite the move, the Faculty of Medicine got neither the space it required, nor additional funding. Expenses continued to outrun income. In addition, the non-medical faculty of McGill College was unenthusiastic about sharing quarters with dissecting rooms, even though provisions had been made to isolate the activities of the medical faculty, especially anatomy and dissection.[8] The Faculty of Medicine remained in the Arts Building, as a unit of McGill College, until 1851. At that time, still dissatisfied, Medicine moved from the campus to Coté Street in downtown Montreal.[9] Thus in 1851, the non-clinical arm of Medicine returned to a site closer to the hospital itself.

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7 Stanley B. Frost, *History of McGill University*, vol. 2 (Montreal: McGill Queen's University Press, 1980), 282.

8 Frost, vol. 1, 131–144.

9 This street was destroyed while building the first Convention Centre in Montreal in the latter part

Other factors also contributed to the move away from the campus. A second, competing, medical training program had been established in Montreal. The new school, which would eventually become the Faculty of Medicine at the University of Montreal, offered clinical and non-clinical education at more convenient locations, and the attraction of McGill's Faculty of Medicine began to wane and fewer students applied.[10]

The move away from the McGill campus was not permanent. After 21 years on Coté Street, the teaching of non-clinical subjects was relocated to a site near the current James Administration Building. This new home lasted only a little over 25 years, being destroyed by fire in the early 1900s.[11] The classic Strathcona Building was erected in 1911 at an uphill site on the campus near Pine Avenue.[12] Fortunately, the land had been purchased much earlier, expressly for McGill's expansion, with funds donated by the then Chancellor, Lord Strathcona. That building remained home to Medicine for about half a century. The Strathcona Building stands today amid new facilities for genomics and proteomics. Until 1964, it housed the administrative offices and classrooms of the Faculty of Medicine as well as the medical libraries.

Biochemistry Appears in the Curriculum

Medical education at McGill has the firm imprint of the pattern set at the medical school at Edinburgh.[13] From the first, instruction in chemistry at McGill was a core undertaking. The first person to offer a course in chemistry (as well as in pharmacy and botany) was A. F. Holmes himself. Currently, the University's highest recognition for a graduating medical student is the Holmes Gold Medal, named in his honour.

Although there were several instructors in chemistry since the school's inception, the first full time instructor of chemistry, who during his career was renamed a "biochemist," was Robert Fulford Ruttan (1856–1930). A graduate of McGill in medicine, with an interest and extensive training in chemistry, he had begun instructing students in chemistry during his medical training. As a student, he had been a Gold Medallist in Chemistry. Following a "stage" in Germany, a practice common for many serious chemistry students in his day, he became a lecturer in practical chemistry in the Faculty of Medicine in 1887. Although ap-

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of the twentieth century. Hanaway and Cruess.

10 Hanaway and Cruess; Frost, vol. 1, 131–144.

11 A remaining portion of the burned-out first medical building also remains on campus, having been incorporated into the first Biology Building and subsequently into the James Administration Building.

12 Frost, vol. 2, 83.

13 Hanaway and Cruess.

pointed in Medicine, he taught non-medical and medical students alike since at the time no differentiation was made between the courses taught to the different groups of students. By 1891, he was promoted to Professor of Chemistry as well as Associate Professor of Medicine, a rapid rise in the ranks, indicative of his contribution to the school. He is reputed to have been a person of enormous energy as well as highly sociable. He belonged to many prestigious social clubs and was an active sportsman.[14] With time, he became increasingly involved in chemistry per se rather than in medicine, notwithstanding his continuing role as Registrar of the medical school.

During his professional evolution, Ruttan's title changed. In 1907, his new appointment read "Professor of Biological Chemistry and Organic Chemistry." This is coincident with the appearance of the term "biochemistry" to describe the study of the chemical events in living systems, introduced into the lexicon a few years earlier by the German researcher in this new field, Carl Neuberger. In his new position, Ruttan was expected to integrate the work being done in chemistry, now a rapidly growing department at McGill, with the analytical chemical work being done in the Faculty of Medicine, analyzing samples obtained from both human and other animal sources for a variety of chemical constituents, including lipids.[15]

Ruttan's scientific interests included the analysis of water contaminants. He analyzed samples provided by various public bodies and reported on the quality of the water supply. His major interest, however, was in the study of the solubility of fatty acids and in the characterization of "bog lipids," for which he acquired a reputation. With time, his centre of activity was physically distanced from the Faculty of Medicine, moving closer to the Department of Chemistry. His appointment as joint Professor of Chemistry and Biochemistry was intended to help develop a unified teaching program for both chemistry and medical students. To achieve this end, some specialized courses were introduced for the medical students, but the majority of courses were open to all interested students.

It was during Ruttan's tenure as head of Chemistry and Amalgamated Services in 1904 that the Montreal Medical Institution became an official and integral part of McGill University. Since 1824, chronic shortage of resources had fostered the collegial agreements between the Montreal Medical Institution and McGill University to share staff and facilities.

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14 "Ruttan, Robert Fulford," in *American Men of Science*, 2 ed., edited by James Mckeen Cattell (New York: Science Press, 1910), 405; Gordon Young, *The Development of Biochemistry in Canada* (Toronto: University of Toronto Press, 1976), 9–10; A.B. Macallum, "Robert Fulford Ruttan," in *Proceedings and Transactions of the Royal Society of Canada*, Volume XXIV, (Ottawa: The Royal Society of Canada, 1930), pp. vii–ix.

15 "Ruttan, Robert Fulford," in *American Men of Science*, 2 ed.

Robert Fulford Ruttan (centre) and laboratory colleagues, circa 1894

Despite the fact that the Faculty of Medicine was a faculty of the University, the two had operated largely independently, particularly with respect to finances. After 1904, when the two institutions formally merged, cooperation and integration no doubt became more streamlined.

While Ruttan was Registrar, his focus on teaching and research was drawn to the rapidly growing chemistry department. In 1906, due to his efforts, a graduate training program was introduced into Chemistry, making research an important mandate of this department.[16] Reports of the Dean of Medicine and Chair of Chemistry to the Board of Governors during this time suggest that the development of biochemistry as a separate discipline in the medical sciences was not on the agenda.[17] Furthermore, it is safe to conclude from the annual reports that the scientific and research interests of the growing numbers of the Department of Chemistry did not have a significant focus in the medical or biological aspects of chemistry and were more aligned with basic aspects of the major branches of chemistry, both theoretical and practical. This tradition has largely, but not exclusively, characterized the Department of Chemistry at McGill, which retains its reputation as a major and prominent chemistry department on the Canadian scene.

A significant exception to the overall emphasis in the Department of Chemistry was the appointment of V. J. Harding as Lecturer in 1911, followed by Assistant and Associate Professor in 1913 and 1917 respectively.[18] Harding was an accomplished organic chemist, but had also shown interest in biochemical studies. He had worked with A. Harden on the action of enzymes on hexose-phosphates. At McGill, he taught both organic and physiological chemistry and had become involved in research in pathological chemistry with clinicians in obstetrics and gynecology. He offered an optional course to medical students who had shown an aptitude for chemistry and an interest in current developments in physiological chemistry, that is, biochemistry. His interest in obstetrics and the complications of toxemias of pregnancy continued after he left McGill to take up a position at the University of Toronto. He was one of the original movers for the creation of the biochemical section of the Canadian Chemical Association and the first president of the Toronto Biochemical Society.[19]

While the Department of Chemistry was expanding the realm of non-medical chemical education and training, new curriculum require-

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16 Frost, vol. 2, 82.

17 Principal's report on the upcoming changes in the organization of Chemical Education at McGill University with respect to the new responsibilities for Robert Ruttan, Annual Report of McGill University, 1910–1911, p. 7, McGill University Archives.

18 Victor J. Harding, "Obituaries," *The Biochemical Journal* XXIX (1935): 1–4; Young, 10.

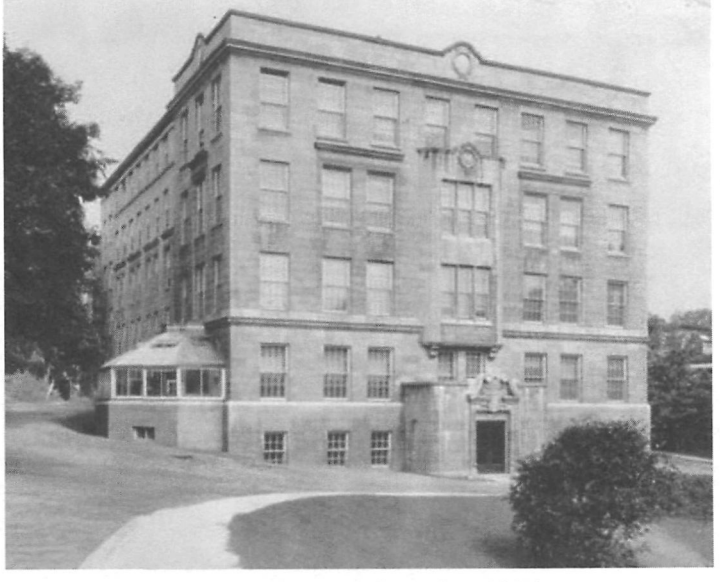
19 Ibid.

ments were being introduced by the medical faculty as prerequisites for a degree in medicine. Medical students would now be required to have courses in biochemistry, pharmacology and pathology, as required by the Accreditation Boards, in addition to the four years of medicine. This required the establishment of new facilities. A new building plan was approved to house the aforementioned basic sciences, a move which led to the further separation of the interests of chemistry from those of the basic sciences of medicine.

During Ruttan's tenure at McGill, a significant shift in the make-up of the student body in the medical faculty was heralded by a motion (moved by Ruttan himself) in 1918 that women be admitted to study medicine at McGill. The first woman (Maude Abbott) graduated in 1922.[20]

Biochemistry Becomes a New Department in the Faculty of Medicine

A new Biology Building (the present but refurbished James Administration Building), housing the first Department of Biochemistry, was erected in 1920. The site was near that of the first Medical Building, which had burned down in the early 1900s. From 1920 until 1964, the Departments of Physiology, Biochemistry, Pharmacology, Botany, Genetics and Zoology shared this facility. For the first time, the Department of Chemistry had no administrative link with teaching students in the Faculty of Medicine.



The Biology Building, circa 1925

20 Frost, vol. 2, 176.

The new biochemistry laboratory in the Biology Building, circa 1920

The Macallum Years (1920–1928)

The first Chairman named to the new Department was Archibald Byron Macallum (1858–1934). Like Ruttan, he hailed from Ontario and had established a distinguished reputation in research and administration locally as well as internationally before coming to McGill. His major research work was behind him when he took up the Chair in 1920, at age 62. At the time of his arrival, the Departments of Physiology, Anatomy and Pharmacology were already well established.

Macallum's career covered a wide landscape, moving from schoolteacher to biologist (Ph.D. from Johns Hopkins in 1888) and physician (M.D. from University of Toronto in 1910). There does not appear to be any indication that he actually practiced medicine extensively in the sense of treating patients. He carried out research in both the United States (at Harvard) and in the United Kingdom (at the Lister Institute and the Royal Cancer Hospital). Upon returning to Toronto in 1891, he was named Professor and Chair of Physiology. He was named Professor of Biochemistry when that department was established in 1908. He maintained this position until 1917.[21]

Macallum was deeply involved in basic research. His major scientific work was the determination of the inorganic ion composition in cells relative to that in sea waters. His studies emphasized the fact that the proportions of Na, K, Ca, and Mg in invertebrates are extraordinarily like sea water, supporting the notion that life originated in the seas.[22] He explored cytological micro methods to detect intracellular inorganic ions, an approach which may have given rise to some anomalous results, such as absence of K+ in nerve cell axons or dendrites.

He is credited with restructuring and expanding both the Faculty of Medicine as well as the Department of Biochemistry at the University of Toronto during his chairmanship. He left Toronto with a mandate to organize the first national scientific research and advisory body, the National Research Council (NRC) and became its first Chairman. He spent nearly three years in that capacity. He was at the forefront of the efforts to convince the political powers of the need for such a body. Without doubt, this activity changed the complexion of scientific re-

21 "Macallum, Archibald Byron," in *American Men of Science*, 2 ed., edited by James Mckeen Cattell (New York: Science Press, 1910), 293; "Macallum, Archibald B.," in *Obituary Notices of Fellows of the Royal Society* (London) 1 (1932–1935): 287–291

22 Archibald B. Macallum, "The Inorganic Composition of the Blood in Vertebrates and Invertebrates and its Origin," *Proceedings of the Royal Society of London Series B* 82 (1910): 604–624; Archibald B. Macallum, "The Inorganic Composition of the Blood in Vertebrates," *Chemical Abstracts* 5 (1911): 111.

search and funding of science in Canada, as the NRC continues to play a major role in Canada's scientific enterprise.

At the age of 62 in 1920, he acknowledged that he was glad to return to academia and took up the position of the first Chairman of Biochemistry at McGill. When he appeared on the scene at McGill, instruction to medical students became completely separated from that in chemistry both physically (at different sites) and academically (with different curricula). The old formula practiced in the Ruttan years came to an end. The instruction of the Chemical Basis of Medicine now became the full responsibility of the new department under Macallum. As Ruttan's tenure had seen the dawn of a graduate training program in chemistry, so under Macallum's aegis was graduate training in biochemistry initiated. However, the numbers of graduate students in biochemistry were smaller than those in sister departments such as Physiology, Experimental Medicine or Chemistry.[23]

Macallum's active research was largely in the past. He carried the major responsibility for teaching the large class of medical students, leaving less time for intensive research. He did, however, seek promising new candidates to foster the growth of his young Department. For instance, in the early 1920s Macallum was considering James B. Sumner as a candidate.[24] Sumner became a household name in biochemical circles in later years as he was the first to succeed to crystallize a protein, the enzyme urease.[25] However, that attempt to recruit Sumner failed and S. W. Bliss was recruited from the Harvard Biochemical Laboratory in 1925. He stayed but five years before returning to the USA.

Even from this cursory review, it is clear that during his life Macallum had a major influence on the direction of medical research and administration in Toronto, Montreal and in Canada and that the scientific community today still benefits from his achievements. He received many honours for distinguished service on several fronts. He was the first graduate of the University of Toronto to be elected a Fellow of the Royal Society of London. As well, he became a Fellow of the Royal Society of Canada and of Glasgow. Beyond his undisputed organizational abilities and foresight, he was a tireless researcher and dedicated to his work.[26]

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23 Data compiled from the annual reports of 1925–1930 from the Departments and Faculties reporting to the Faculty of Graduate Studies and Research at McGill University. The data were selected for the basic sciences in the Faculty of Medicine. Annual Reports of McGill University, McGill University Archives.

24 Livingston Farrad to A.B. Macallum, 26 May 1924, Biochemistry Applicants, Faculty of Medicine (RG2, container 62, file 1066), McGill University Archives.

25 It is interesting to note that one individual who wrote on Sumner's behalf did not judge Sumner's research to hold particular significance (ibid.). Despite this lukewarm assessment, Sumner was later awarded the Nobel Prize for the crystallization of urease.

The fact that one of this country's preeminent scientists and teachers held a Chair at McGill enhanced the image of this school in North America as well as in Europe. Yet, despite his contributions to science and a life-long career of teaching, the Carnegie Foundation refused to provide him with the pension that it made available to academics who had devoted their lives to academia. During Macallum's lifetime, pensions were not yet part of the general employment benefits. Thus, the availability of special funds for retirement income was highly prized by the academic community. The grounds for the refusal lay in the fact that Macallum had resigned from the University of Toronto to take up a position external to academia, to direct the National Research Council of Canada. This kept him away from academia for over two years. Despite long detailed letters to the Carnegie Foundation to plead for reinstatement to the list of academics eligible for this pension, he was refused. He states in a letter written in 1922 to the Principal of McGill, "It is a hardship that after thirty-one years of university life and nine additional years of teaching I should be denied a pension simply because of such interpretation."[27] The records do not show whether McGill provided a pension. Not even the most eminent were free from the slings and arrows of outrageous fortune.

The Collip Years (1928–1941)

After a tenure of eight years, Macallum retired at 70 and returned to Ontario, near his family. A third Ontarian, James Bertram Collip (1892–1965), came to Montreal to head the Department. The end of the 1920s shepherded in an intense period of growth in biochemistry as a discipline, and by the early 1930s biochemistry was becoming a leading discipline in the biological sciences. This was the age of discovery of the urea and citric acid cycles, two central reaction sequences which have become fundamental to appreciating the basic cyclical nature of the metabolic activity of all cells. It was the era of the establishment of the intermediates of glycolysis, the time of discovery of electron transport and the first time a virus, the tobacco mosaic virus, was crystallized. There were also spectacular developments in endocrinology. Besides insulin, a pituitary growth hormone was recognized, testosterone was isolated

26 "Macallum, Archibald Byron," in *American Men of Science*; "Macallum, Archibald B.," in *Obituary Notices of Fellows of the Royal Society.*

27 Archibald B. Macallum to Principal Sir Arthur Currie, 13 Dec. 1922, records of the Department of Biochemistry, Faculty of Medicine (RG2, container 67, file 1260), McGill University Archives. Macallum pursued his objective to obtain a pension form the Carnegie Foundation until his final retirement in 1928. Although he had support from the Principal and from the President of the University of Saskatchewan (who was a member of the Carnegie Board of Directors), Macallum's efforts ultimately came to nought.

from the testes and hormones were isolated from the adrenal and parathyroid glands. As well, pituitary regulators of hormone secretion (adrenocorticotrophin) were being isolated from mammalian tissues.

Collip had already become a prominent figure in endocrinology prior to taking up the Chair at McGill in1928.[28] His contribution had already been recognized as fundamental to the isolation and purification of insulin. During his tenure as Chair of Biochemistry, the Department would achieve international prominence. But a number of departmental problems that surfaced in later years have their origins in events that evolved during this most productive period in the Department's history.

Collip and Insulin

Before he reached the age of 30, Collip had made a major contribution to the isolation of insulin in a form suitable for human use. He had been a student of Macallum's at the University of Toronto and had obtained his Ph.D. under Macallum in 1916. There is little doubt that the older man had high regard for his younger associate. At the time Macallum came to McGill, Collip became Chair of the Department of Biochemistry at the University of Alberta. Within a span of four years, he had risen from a junior position to become Chairman. When he returned to the University of Toronto a few years later, to spend a sabbatical period working with Macleod, the Chair of Physiology at Toronto, he was encouraged to collaborate with Banting and Best in their work on the isolation of insulin. Although an active preparation had been obtained by Banting, it was not sufficiently pure to use on patients. Adequate purification had eluded the team in Toronto but was of utmost importance for use in humans, since the available preparations had unpleasant side effects. History records their success! Collip's most direct contribution was to assess the concentration of ethyl alcohol which kept insulin in solution, but precipitated other proteins. The original formula used by Banting and Best was 65% ethanol, a concentration at which insulin stayed in solution but also left other proteins in solution, which caused abscesses at the site of injection. Collip found that at 80% ethanol much of the contamination was lost, but insulin remained soluble. At 95% ethanol, insulin was precipitated out. Collip's flair for purification, his meticulous nature and methodical attention to details, remained with him throughout his productive career. When the Nobel Prize was awarded to Banting and

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28 Richard L. Noble, "Memories of James Bertram Collip," *Canadian Medical Association Journal* 93 (1965): 1356–1364; Young, *The Development of Biochemistry in Canada*, 16–18.

Macleod for their achievements, the latter shared his prize money with Collip.

Collip at McGill

When Collip returned to Edmonton after his sabbatical to resume his chairmanship, his philosophy about the objectives of research in the biological sciences had been profoundly changed. He had become convinced that biochemistry should be pursued in the interests of medical practice. He ceased to work on projects which were an outgrowth of his Ph.D. work with Macallum. He became medically qualified and undertook projects which had direct importance to human health. Governed by these views, he began to concentrate on the isolation and purification of endocrine secretions. He successfully isolated parathyroid hormone, showed its involvement in calcium metabolism and continued to isolate, quantify, standardize and develop assays for the hormones that were being isolated by his own associates as well as others.

By the late 1920s, Collip had acquired more than local recognition. After his success in Toronto, he received an offer from the Mayo Clinic at Rochester, Minnesota, to join a group in experimental medicine. A second offer came from McGill University to succeed Macallum as head of the Department of Biochemistry. No doubt with the support and encouragement of his former mentor, Collip took up the Chair at McGill in 1928. Even today, in a world moving at a much more rapid pace, having held Chairs at two different schools by the age of 35 would be considered extraordinary.

During Collip's tenure, names that have lived on at McGill appeared on the University's roster, and areas of research with a similar legacy evolved in the University's laboratories. Outstanding scholars became associated with the Faculty and the Department of Biochemistry. D. L. Thomson joined the Department in 1928, fresh from his Ph.D. at Cambridge. By 1932, he was promoted to Associate Professor, and Full Professor status came in 1936. Hans Selye, with a Ph.D. from Prague, joined as Lecturer in the same year. J. S. L. Browne became the first candidate to be awarded a Ph.D. degree under Collip's supervision. While taking his Ph.D. training, Browne identified estriol in the placenta. In the course of time, Browne would help to found a Department of Investigative Medicine, head a center for research in steroid hormones and become an outstanding international figure. Abraham Neufeld joined the staff as Lecturer in 1939 but spent most of his academic career at the University of Western Ontario as a clinical chemist.

Collip's Department also expanded classroom instruction to non-medical undergraduates who were entering courses and laboratories in

Collip (far right) and faculty circa 1930. Second from left, Leonard I. Pugsley; third from left, Gwen Toby; sixth from left, David L. Thomson. Second from right, John S. L. Browne; third from right, Hans Selye.

the Faculty of Medicine (Histology and Embryology; Physiology; Biochemistry; and Bacteriology) in larger numbers. Some of these had in the past been restricted to medical students. The influx of students in these areas, and especially biochemistry, strained the existing facilities. In an annual report in the mid 1930s, Collip stressed that teaching and supervision were made extremely difficult and he pressured the University to provide more space and resources.

Teaching biochemistry to undergraduates in Arts and Science was a relative novelty on the North American continent. The medical school of the University of Toronto had introduced a joint physiology-biochemistry undergraduate program when Macallum had headed the department there. It appears likely that Collip had continued this tradition. Both men had had extensive training in biology and biochemistry prior to becoming physicians and perpetuated this approach when they became responsible for undergraduate education. However, in the United States, biochemistry was taught and continued to be taught, for many years to come, as a discipline offered only to medical and graduate students. Most Canadian universities have adopted the McGill–Toronto model. Thus, although biochemistry departments were officially part of the faculties of medicine, courses were offered to science students and specialized undergraduate programs in the discipline were developed. This educational approach has remained a distinguishing feature of Canadian medical schools. Since these programs were developed in medical schools, the syllabus continued to emphasize the human (or mammalian) condition.

The first of Collip's students graduated with advanced degrees biochemistry in 1931. Among the early Ph.D. recipients was Evelyn Anderson, the first female student to graduate with a Ph.D. from the program in biochemistry. In contrast with the physical sciences, graduate studies in biochemistry attracted women from the very earliest periods. At least three women were in graduate training between 1930 and 1936.

Research Activity in the Department under Collip

During Collip's tenure, the Department achieved outstanding international recognition. The scientific output of the relatively small number of individuals was impressive, with some 212 publications in a period of 11 years. More significant than the weight of paper, however, is the nature of the discoveries made. The lively scientific life in the Department under Collip is recorded in an annual report of 1933–34.[29]

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29 A report from Dean of Medicine (Meakins) on the activities of the basic science departments in the Faculty of Medicine, Annual Report of McGill University, 1933–1934, McGill University Archives.

Collip and his graduate students Browne, Anderson and Pugsley had obtained a water-soluble derivative from human placenta (Emmenin), which was successfully used as an estrogen supplement. It was marketed by the Ayerst Pharmaceutical Company in Canada, and garnered attention and money for the research program. Emmenin was later identified as an estriol conjugate. The first report on the isolation of adrenocorticotrophic hormone (ACTH), was published,[30] in addition to the purification other pituitary hormones. Judging by the names on the many papers published, there was extensive collaboration between the members of the Department of Biochemistry and those of other departments, such as Anatomy and Physiology, many of which were involved in the studies of several different hormones.

During those years of intensive research in the Department, Hans Selye published his classic paper on adaptation to stress and the crucial role played by corticosteroids. Selye's skills as a histologist, along with his surgical skills, had been a valuable contribution to much of the ongoing work with hormones: visualizing their efficacy, specificity and the effect of removal of the organs involved. In time, Selye's work gained international prominence in the exploration of the role of corticosteroids in responding to stress. It should not be surprising to learn that these two highly gifted and ambitious scientists (Collip and Selye) did not see eye to eye, especially after Selye asserted independent credit for his observation on the role of the adrenal steroids in an animal under stress.[31] Comments from a few individuals who knew both protagonists confirm their extreme antipathy.

Nonetheless, this testy relationship did not diminish the vibrant scientific life in the Department at that time. Even when viewed after more than half a century, the lively scientific environment under Collip remains palpable. The continuous discoveries must have created an enthusiasm that permeated the Department. The research achieved international renown and many students and visitors were attracted to participate in the research work.

The Gilman Cheney Chair

Collip was the first recipient of The Gilman Cheney Chair. In the late 1930s, McGill received a bequest under the will of William Gilman Cheney "for the establishment of a Chair or Chairs in the name of my dear father, the late Gilman Cheney, the annual revenue whereof to be

30 James B. Collip, Evelyn Anderson, and D. L. Thomson, "The Adrenotropic Hormone of the Anterior Pituitary Lobe," *Lancet* 222 (1933): 347–348.

31 Hans Selye, "Thymus and Adrenals in the Response of the Organism to Injuries and Intoxication," *British Journal of Experimental Pathology* XVII (1936): 234–248.

applied to the interests of the Medical Faculty of the said College." In April 1937, Collip was appointed to the Gilman Cheney Chair of Biochemistry.

But Collip had ambitions other than running a teaching department. He made it clear to the University that he wanted to develop a research institute devoted to endocrinology. When his request to rename the Department to Biochemistry and Endocrinology was not approved, he proposed to step down from the Chair and become the director of an institute dedicated to endocrinology. Such a unit had been promised to him by the University at an earlier date. At the height of his prominence and success, he felt the time was right to shift the direction of his career. The Institute for Endocrinology was established in 1941 and Collip became Professor of Endocrinology, with the title "Gilman Cheney Professor of Endocrinology." The income from the fund was removed from the Biochemistry Department to help finance the new Institute of Endocrinology. The new unit moved to the Royal Victoria Hospital, vacating the space allotted to Biochemistry in the Biology Building. With the move went all the major equipment. With one sweep, Biochemistry was emptied of both staff and stuff, leaving a bone-bare department for the next Chair of Biochemistry.

The world situation and the Second World War disrupted many of Collip's personal plans. Like many scientists and academics, Collip became involved with Canada's war effort and worked on projects deemed important to solve urgent problems, and his endocrinological research momentum fell victim to the war effort. After the war, the momentum of the field that had energized him failed to be revived, and he left McGill and full time research to become Dean of Medicine at the University of Western Ontario. The research institute that Collip founded was dissolved in 1947, and the income and the Chair reverted to Biochemistry.[32]

From Principal James's correspondence at the time, the suspicion arises that an additional factor prompted Collip's decision to leave McGill.[33] Collip had been overlooked in the appointment of a new Dean of Graduate Studies. His junior colleague, David Landsborough Thomson, by then the incumbent Chair of Biochemistry, was appointed Dean

32 Principal F. Cyril James to B. Collip, 22 April 1947, Records regarding Endocrinology (RG2, container 136, file 3881), McGill University Archives. This file also contains correspondence indicating that on 3 March 1947, Collip was still negotiating with Alan Bronfman for a new Institute at Macdonald College. On 21 April, he accepted the offer from the University of Western Ontario to become its Dean of Medicine.

33 Principal James to Chancellor Sir E.W. Beattie, 7 June 1942, Records of Graduate Studies and Research (RG2, container 104, file 2831), McGill University Archives. D.L. Thomson is appointed Dean of Graduate Studies. Additional correspondence clearly indicates that Collip wanted the position to reflect his seniority. See also James to Collip, 7 July 1942.

in 1942. The Principal and the Chancellor selected Thomson as the better candidate, even though the Principal had admitted to the Chancellor that Collip would feel slighted by having the appointment go to his junior associate. Earlier, Collip had briefly held the position of "acting Dean" and had written at the end of his brief tenure that he had "enjoyed the position." To what extent the lack of recognition by the senior administration affected Collip's decision to leave McGill remains moot. The coincidence is striking, but there is no one left for verification. Like his predecessor Macallum, Collip returned to the heartland of Ontario. His research took a back seat as he dealt with the issues exercising Deans.

The Thomson Years (1941–1957): The Winds Change

History tells us that the fate of kingdoms can change dramatically with a change in the heads of state. The same phenomenon, of course, occurs with any institution. The evolution of the Department markedly changed pace, and the Department lost its "place in the sun" under Collip's successor, David Landsborough Thomson (1901–1964). Thompson had been one of the Department's active participants from the earliest days of Collip's appointment. Thomson had arrived in Canada in 1928, a young man fresh from his studies for the Ph.D. degree at the Biochemical Laboratory at Cambridge. From the published work emerging from the Department prior to the Second World War, it is clear that he had been an active contributor to the research work, as his name appears as a co-author on many of the publications of the group. When Collip left to direct his new institute in 1941, Thomson was made Chair of the Department.

Earlier biographies suggest that Thomson was the main author of the publications during Collip's era.[34] Thomson himself was not deeply involved in hands-on laboratory work. The record shows that he guided relatively few students to graduate degrees: four to the M.Sc. and one to the Ph.D. All were registered prior to 1946. Moreover, one of these students, who later achieved eminence in her field, Dame Brigitta Askonas, was registered for the degree with Thomson as director but actually worked under the direction of an investigator outside the Department. It is not clear whether some of the other of Thomson's students also had daily supervision from investigators who were neither members of the Department, nor had recognized associations with the Department. Another student was registered under the joint supervision of Thomson with a faculty member of a different department. Thom-

34 Young, *The Development of Biochemistry in Canada*, 11.

son's appetite to train students was evidently well below Collip's. Thomson's many talents lay elsewhere, and even included writing books. He published a popular book on cytology, *The Life of the Cell*, and a mystery story based on a murder in the laboratory.[35] No one recalls an active Thomson research laboratory.[36] This practice of "farming out" graduate students persisted for many years, long past Thomson's era, until guidelines were established that required Departmental approval to supervise graduate students.

During the period of the Second World War, while Collip held the Chair but was engaged in Canada's war effort, much of the departmental responsibility was shouldered by Thomson. When Collip left to direct his new institute, Thomson was a natural successor to the Chair. Anyone familiar with biochemistry at McGill during the forties and fifties will, at the mere mention of Thomson's name, likely produce a positive and effusive response. Thomson became a legend with students primarily because his classes were not just a cut, but a mile, above the norm. Without a doubt, those who encountered Thomson were awed by the man's ability to share his knowledge in a lucid and captivating manner. His interests in science and culture were exceptionally broad and, according to those who knew him, he retained much of what he read. Moreover, he had a gift in the ability to explain new ideas in a thought-provoking as well as entertaining manner. Thomson continued to be the principal lecturer for all students in science and medicine and enthralled numerous classes of students for nearly 20 years, well into the 1950s. No other instructor in Biochemistry created the same excitement and enthusiasm for this subject at McGill. Many undergraduates became enticed to study biochemistry as a result of Thomson's lectures. In the pamphlet "McGill Medical Luminaries" he is described as having "a distinctive and arresting personality without rival at McGill."[37]

But Thomson did not show a passionate interest in hands-on research. With Collip out of the picture, Thomson's personal involvement in research lost its anchor and he came to have scarce direct contact with "wet research" or with the training of graduate students. He maintained a lively but detached interest in the great expansion occurring in his discipline. This lack of direct involvement in expanding the frontiers of knowledge stands in stark contrast to both Macallum's and Collip's

35 David L. Thomson, *The Life of the Cell* (London: Butterworth Press, 1928); Thomas L. Davidson, *The Murder in the Laboratory* (New York: EP Dutton & Co., 1929).

36 Personal communications of the author with a number of former graduate students who trained during the early Thomson years.

37 Edward H. Bensley, *McGill Medical Luminaries*, Osler Library Studies in the History of Medicine, no. 1 (Montreal: Osler Library, McGill University, 1990).

philosophy. In the era when biochemistry was becoming a discipline with a major impact in the world of science, the absence of an active research program contributed to erosion of the Department's stature.

By his writings on scientific and social issues, Thomson tried to influence his contemporaries on the importance of the "Academic Life" and freedom of expression. For example, in a letter to Principal James in 1945, he objected to a "presumed" regulation of the Board of Governors that staff could not engage in political activity.[38] Such a ruling had to be publicly declared or disclaimed, if not true, he insisted. However, it is not clear from this letter whether he was an active advocate of freedom of expression in an era when paternalism at the University was more the norm than at present.

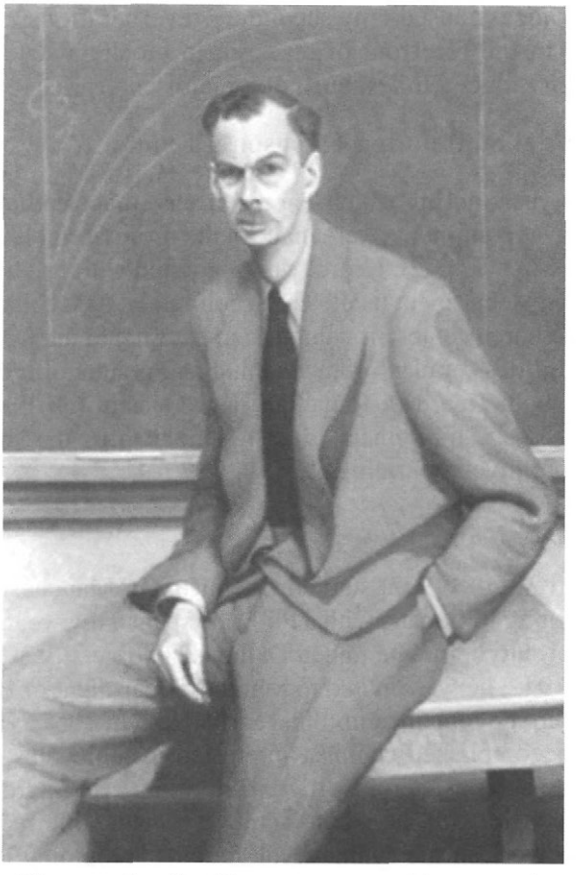
On providing adequate research time to faculty, he stated that "researchers should not be overwhelmed with teaching duties." He also wanted to encourage graduate students to teach undergraduates as a means of getting new knowledge to the younger generation at a time when the University staff had dwindled and the student population had expanded. Quoting from a 1945 paper he gave on university research, he wrote, "Basic research is as chancy as rain—but it's what provides water for the reservoir." His words ring true to the present. At a symposium on industry and university research, he said, "Industry acts in a short-sighted way when it tempts a man capable of really fundamental research into some narrow branch of applied science."[39] Thus, despite his lack of direct participation in science exploration after he assumed the Chair, his sentiments on its importance never wavered, but his actions failed to follow.

Thomson maintained a prominent profile in the University, sat on important federal government committees involved in science policy and funding and acted as an advisor (particularly on nutrition) to government agencies. At McGill, as well as holding the Chair of Biochemistry (1941) he assumed the position of Dean of Graduate Studies (1942), and in 1955, he also became Vice-Principal of the University. He wore three hats at once.

In the post-war period, there was a surge forward in research and development in the area called "metabolic biochemistry." This was the era of separation of cellular constituents and the attribution of particular functions to the various cellular organelles. Isotopes were introduced into metabolic research and overturned long-held concepts. The first

38 D.L. Thomson, "On Coordination of Research in Canada," presented at the Meeting of the Chemical Institute of Canada, 6 June 1945, and correspondence with Principal James on the presentation, 11 May 1945, Records of Graduate Studies and Research (RG2, container 104, file 2831), McGill University Archives.

39 Ibid.



Thomson in a familiar pose, captured in a portrait by Frederick B. Taylor, 1953

textbook dedicated to the idea of constant turnover and replacement in biochemistry was published.[40] The more typical texts of the era categorized the chemical reactions occurring in biological systems, but did not emphasize the constant replacement and turnover of even apparently stable macromolecules.

This was also the era when DNA was recognized as the substance that carried genetic information and when its base complementarity was demonstrated. By 1953, the model of the double helix of DNA was proposed and biochemical research was providing new understanding of the chemistry of all living things. But at McGill, notwithstanding Thomson's philosophy on the importance of basic research, these major

40 Ernest Baldwin, *Dynamic Aspects of Biochemistry* (Cambridge, England: Cambridge University Press, 1947).

scientific advances caused only secondary reverberations. From being a major centre in the forefront of research in biochemistry, the Department had been reduced to a suburb of a major enterprise.

The Professorial Staff during Thomson's Tenure

In the sixteen years during which Thomson served as head of the Department, two new appointments were made at the professorial level. Only one of these professors, R. D. H. Heard, was appointed with full time responsibility to the core department itself. The second, J. H. Quastel, came on staff to develop a research center off campus and external to the Department but with responsibilities for classroom teaching and graduate student training. Coincidently, both Heard (a Canadian) and Quastel (an Englishman by birth), were 1851 Exhibitioners, British scholarships that had provided their means for university training.[41]

R. D. H. Heard

R. D. H. Heard (1908–1957) studied Chemistry in Manchester, England, and upon returning to Canada with a Ph.D. he spent a few years conducting research in Toronto before he joined Dalhousie University as an Assistant Professor. In 1942, he was invited to join the Department of Biochemistry at McGill, where he remained until his early death in 1957.[42] Heard was a talented and accomplished chemist, interested in molecules of high biological potency such as steroids, thyroid hormones and adrenergic compounds. While at McGill, he would achieve considerable recognition for his pioneering work in the synthesis of steroids containing radiolabelled isotopes. Several of Heard's graduate students became successful scientists working in industry and academia.

J. H. Quastel

Judah H. Quastel (1899–1987) was enticed to emigrate from the UK in 1948.[43] Thomson and Quastel had known one another as young men, both having been students with Sir Frederick Gowland Hopkins at Cambridge. By the time Quastel came to McGill, he had already made a substantial impact in the world of biochemistry. Quastel had been the youngest person to become a Fellow of King's College, Cambridge and

41 An attempt to recruit Charles Hanes, a Canadian trained in Britain, failed. Hanes eventually landed on the academic staff of the Department of Biochemistry at the University of Toronto.

42 Young, *The Development of Biochemistry in Canada*, 11–12.

43 Frank C. Mackintosh and Theodore L. Sourkes, "Judah Hersh Quastel," *Biographical Memoirs of Fellows of the Royal Society* (London) 36 (1990): 381–418; Judah H. Quastel, "A Brief Autobiography," *Bulletin of the Canadian Society of Biochemistry* XVIII (1991): 13–34; Judah H. Quastel, "Fifty Years of Biochemistry," *Canadian Journal of Biochemistry* 52 (1974): 71–82.

was a Fellow of the Royal Society of London before immigrating to Canada. He had introduced the first specific competitive inhibitor (a term he coined) of an enzyme reaction, using malonate to inhibit succinate dehydrogenase of respiring bacteria. He had achieved international stature and recognition for having performed a number of fundamental and seminal studies such as the demonstration of ß-oxidation of fatty acids and devising assays for detecting phenylpyruvate in urine. Phenylpyruvate in the blood stream can be responsible for mental retardation and its detection in urine is now used as a diagnostic test for phenylkenonuria in infants (a genetic condition that Quastel is credited with naming). The expression of the disease may be avoided by early dietary control.

One of Quastel's major studies had been bacterial respiration and fermentation and he had shown that the highly stable dicarboxylic acid, succinate, was rapidly and readily oxidized by microorganisms to fumarate and then to pyruvate. These studies complemented those of H. A. Krebs on the elucidation of the citric acid cycle (also known as the Krebs' tricarboxylic acid cycle), in which the oxidation of succinate to pyruvate via fumarate is a key reaction sequence in the cycle. The citric acid cycle maintains central importance in cell biology as the metabolic process by which many living organisms abstract energy from respiration and convert it to adenosine triphosphate (ATP), this being the most common form of energy transfer used by all living species. In addition, and no less important, this reaction sequence provides key organic intermediates for synthetic purposes in the cell.

Orville Denstedt

The third professional member of the Department was Orville Denstedt (1899–1975). He, along with Thomson, had been on staff during the Collip era. In fact, Denstedt, a former student of Collip's, had stayed on in the Department after obtaining his Ph.D. Denstedt remained a faithful and beloved member of the Department until his retirement in 1967. He was probably the best-loved person in the Department over many years because of the kindness and the consideration he showed everyone who crossed his path.

Thus by 1948 there were three professorial positions in the core Department (and one major figure external to the core) to teach both medical and science undergraduates and to direct graduate students.

Research and Teaching in the Core Department 1941–1957

Under Thomson, the Department remained in the Biology Building, where it had been located under Macallum and Collip. It occupied the whole of the third floor, which included a part of the pre-1920 building

that had been spared by the fire, housing primarily the main lecture theatre. By the mid-1940s, the building had lost its gloss, as little renovation had been done during twenty-some years despite the heavy daily traffic. The joint Botany and Zoology Library was on the ground floor, but the Medical and Osler Libraries were in the Strathcona Medical Building. The three biology departments (Botany, Zoology and Genetics) were located on the first and second stories and the upper two floors were occupied by Physiology and Pharmacology respectively. A single small elevator was available for staff only: students were relegated to the stairs.

There were only two research laboratories in the core Department, Heard's and Denstedt's, which faced each other on the east and west sides of the long hall. Heard's students were involved in synthesizing steroids and this group made the first labelled steroids, using radioiodine and later carbon 14. Tissue localization and metabolism of the steroids were carried out for some years with the collaboration of the Department of Anatomy, where great strides were being made with radioautography of tissue sections to localize radiolabelled compounds. Among the graduate students who obtained Ph.D.'s with Heard and went on to establish international reputations in biochemistry are Bernard Belleau, Judith Cohen-Saffran (credited with the synthesis of the first labelled steroid), Samuel Solomon, Kenneth Roberts, and Claire Yates. Belleau became a leading expert in Canada in medicinal chemistry, with novel approaches to designer drugs. Solomon became the Director of the Endocrine Laboratories at the Royal Victoria Hospital, with international recognition for his achievements in endocrinology of steroid hormones. Another student, Marcel Chaput, achieved local fame in a different way: in subsequent years, he became one of the early activists in the Quebec Independence movement.

On Denstedt's side of the hall, the research was devoted to studies of red cell preservation and metabolism. Some of the earliest studies on the metabolic activity of mammalian and avian red cells were undertaken in this laboratory. Blood preservation became a vital concern particularly during wartime, since it was needed for heterologous blood transfusions near the battlefield.[44] Denstedt was among the pioneers in this activity and continued to study the properties and metabolic activity of the red cells themselves and to find optimal conditions for their

44 During the Spanish civil war and later during the Chinese civil war, Norman Bethune (a local left-leaning physician working at the front at both of these conflicts) had shown the importance of using blood transfusions directly on the battlefield. Bethune gained the lifelong adoration from the Chinese for his commitment to their revolution, for his surgical skills and for the fact that many lives were saved by on-site transfusions. The life-saving importance of having blood available impressed Denstedt to study ways and means to improve blood storage.

preservation. Denstedt's laboratory carried out much of the pioneering work in this area in addition to fundamental studies on the red cells themselves. For example, the early work on respiration in avian red cells and young mammalian red cells, as well as the control of their glycolytic pathways, were studied in Denstedt's lab.

Among Denstedt's students to achieve recognition and prominence were Spyridon Alivasatos, Rhoda Blostein (Na/K ATPase), Dave Rubinstein (avian red cell respiration and lipoproteins), Paul Ottolenghi, Hanna Pappius (brain swelling), Ken McKearns, Bruce Sells and Murray Saffran (regulation of corticosteroid secretion).

The third laboratory on the floor was the major undergraduate teaching lab, occupying the width of the floor. Every medical student and the majority of biochemistry and physiology undergraduates passed through that lab. The old wing of the building, also housed a small laboratory for the advanced undergraduate students specializing in biochemistry. The major risk to students in that lab was from exposure to mercury! There were constant mercury spills from the use of the old Ostwald manometer. When the manometer was broken (not infrequently), it was nigh on impossible to clean up the mercury, given the spaces between the slats in the worn wooden floors! Other occupants of the aging building were the rats (other than the caged variety) that romped around the floor at night.

In the post-war years, the building as a whole had a dusty, musty, smell except for the pleasant and bright library on the ground floor. Biochemistry's domain had an aspect of a former time—well worn and run down.

Thomson's Priorities

In addition to his frank lack of direct participation in the research activities of the Department, the Chair with commitments to the University as a whole, had little time or interest to foster the development of the Department's physical resources, or to give guidance in seeking research funds to improve and modernize the research equipment. Only on the intellectual level did Thompson maintain an interest in the ongoing research.

The annual reports of the University make it plain that the University has had a chronic history of budget deficits from the very beginning. In retrospect, it becomes evident that few of the modest resources available were directed by the Dean of Graduate Studies (Thomson) to his home department. From personal memories of the changes made to laboratory facilities in the building shared by Biochemistry and Botany, it appears that more money for modernization was applied to Botany

than to Biochemistry, although the changes were modest at best. No doubt, the Chair of Botany could apply more leverage to the Dean of Graduate Studies than could the Chair of Biochemistry! One cannot help but ask whether having a Chairman who wore several hats did not work against the interests of his own Department. Just prior to stepping down from the chairmanship, Thomson admitted to the incoming Chair that the Department had been neglected for years.

It is commonly assumed that during the early post-war years there was negligible growth or development anywhere in the University. Obviously the years of war were not periods of expansion at McGill or elsewhere. However, some departments, such as Chemistry, showed growth and an increase of their staff. New undergraduate and graduate programs were evolved during the war years and the immediate postwar years in Chemistry at McGill.[45] While it is true that the real expansion of facilities and staff were still a decade away, not all biology departments fared equally badly during this period. The annual reports indicate that departments like Microbiology, Physiology and Biology were expanding staff and facilities to an extent not evident in Biochemistry. For example, in the twelve years from 1943–44 to 1955–56, a total of 56 faculty were hired in the Departments of Biochemistry, Physiology, Anatomy, Bacteriology and Biology (Biology includes Botany, Zoology and Genetics). Of the new appointments, Biology acquired twenty; Bacteriology, sixteen; Physiology, eight; and Anatomy, six. Biochemistry acquired two, plus an additional two part-time members, each hired to teach a single course. By the mid-1950s, Thomson, Denstedt and Heard comprised the core, with Quastel the fourth member external to the core. (See Appendix for staff lists over a sixty year period.)

Like Biochemistry at McGill, the Biochemistry Department at the University of Toronto also had a single Chairman for a long stretch of time (1929–1951) and it grew slowly during the years of the Great Depression and the Second World War. Nonetheless, by 1950, there were five members of the core department and the Chairman, Hardolph Wasteneys, hired several distinguished scientists such as Guy Marrian and Gordon Butler to join the department. Between 1930 and 1950, a total of 134 M.Sc. and Ph.D. degrees were awarded.[46] At McGill, the number of degrees during the same years was 56, nineteen of which had been awarded during Collip's tenure. These numbers show the disparity

45 Leo Yaffe, "History of the Department of Chemistry, McGill University," an address to the James McGill Historical Society, 13 April 1978.

46 Marian Packham, comments on the history of the Department of Biochemistry, University of Toronto, personal communication with author, April 2003.

in the academic life in two sister departments in major cities in Eastern Canada in this period. On the brighter side, many of McGill's biochemistry students, despite the odds, managed to conduct research to sustain the flow of new information from its few research facilities.

The overwhelming administrative load carried by Thomson had serious consequences on his health. So much so that his physician wrote Principal James in 1957 to request that Thomson be given a year's leave of absence to regain his strength.[47] By the time Thomson returned to full-time work and resigned from the Chair in 1958–1959, the stature of the core department had shrunk on the international stage, and was a shadow compared to that of the late 1930s.

Quastel's Research Institute

Biochemistry, as a growing discipline, fared better in units outside the core Department. When Quastel was appointed Professor in the Department of Biochemistry in 1948, he developed its largest single training unit: the McGill–Montreal General Hospital Research Institute. It was physically housed in another building a few minutes' walk away from the Department and operated quite independently of the core. No equipment was shared by the two units, and in fact there was relatively little day to day interaction between the graduate students working in the Biology Building and those working at "the Institute" directed by Quastel.

The Institute was housed (literally) in the former family home of the Morgan family, the owners of Morgan's Department Store (later The Bay). The home had been donated to McGill in association with the Montreal General Hospital and had become a research institute bearing the name of both. It was situated at 3619 University Street, almost directly opposite the Strathcona Building. The building had been intended as a research centre for Hans Selye. However Selye had left McGill to join the faculty at the Université de Montréal, and by 1946 the house was being used as a student residence, not a laboratory.

In later years, when Quastel had become fully established at that site, he tried to interest the Morgan family in supporting the Institute financially by showing them the "wonderful way" that the old family mansion was being used. The visit by the members of the family was a disaster! The family, particularly the matriarch, was appalled by the transformation of the beautiful structure, the ornate ceilings and solid oak floors, into a four-storey laboratory. "Look what's happened to the Library!" was overheard as a comment. Perhaps they should have been shown the

47 Physician's letter to F.C. James regarding Thomson's health, 5 Sept. 1957, Records of the Department of Biochemistry, Faculty of Medicine (RG2 container 242, file 7295), McGill University Archives.

sturdy ropes attached to the front windows on the upper floors to be used as fire escapes!

Quastel Becomes the Director of the McGill–MGH Research Institute

When Quastel had accepted the invitation to relocate to McGill from England (or more rightly, Wales), it had been with the encouragement of D. L. Thomson and I. M. Rabinowitch, a forward-looking clinical researcher and physician at the Montreal General Hospital. Rabinowitch considered it important to develop an institute for cell metabolism to provide better fundamental understanding of medical problems. Rabinowitch had participated in the Department's work since Macallum's era, lecturing in pathological chemistry as early as 1923. The University and the Montreal General Hospital had accepted Rabinowitch's proposal to launch a research institute with three components, cell metabolism (with Quastel at the helm), organic chemistry (particularly carbohydrate chemistry, headed by S. Baker, a local organic chemist), and a unit for "atomic" chemistry (radioisotopes), supervised by Donald E. Douglas. Rabinowitch was the Institute's official director from afar. Within a short time after Quastel's arrival, however, Quastel (who never assumed he was an equal among equals) took over full direction of the Institute. By 1949, Rabinowitch had resigned from his official position partly due to health problems and partly because he and Quastel did not share a common view on the research undertakings and management of the new Institute. While both Baker and Douglas remained at the Institute for some years, neither had university appointments or responsibility for training students: both were officially employed by the Montreal General Hospital. The pair maintained a somewhat independent existence, with Douglas becoming the "isotope marshal" exercising tight control over the use of isotopes in the building in the era when the use of isotopes of carbon and tritium were becoming popular reagents in biological experiments. Students and researchers of the time can never wipe out the memories of the white cloth "booties" and the special lab coats that had to be donned to enter the basement, the "radioactive centre," to carry out experiments using any amount of radiolabelled isotope of whatever nature (mostly carbon 14).

In 1955, the Institute became fully part of McGill. The ties with the Montreal General Hospital were officially severed and both Douglas and Baker left the Institute, thus leaving Quastel as the only senior figure.[48] Quastel (known as "Q") was a highly ambitious man of considerable

[48] Donald D. Douglas, personal account of the origins of the McGill University–Montreal General Hospital Research Institute, 1948–1956. Personal communication with author.

scientific talent, and had already achieved prominent international status and recognition. Although certain areas of scientific research held greater appeal for him than others, he had a very broad interest in biochemistry as a whole. He was driven by the desire to make a major scientific contribution, one that could be of direct relevance to the treatment of human disease. However, the Institute had no primary focus on any particular disease or metabolic dysfunction. The result was that the research projects undertaken were as varied as the people working on them.

The majority of the researchers were graduate students. At the time Quastel arrived in Canada, young men and women were leaving military service and entering Canadian universities in large numbers, supported by government subsidies to continue their studies. Several of the first graduate students under Q's aegis were men rather than boys when they entered graduate school. This created a more mission-oriented environment. Coupled with Q's vision and ambition, projects were undertaken over a very broad field of biological research—from soil research to brain research. Drawing on Quastel's wartime experience at the Rothamsted Agricultural Centre in Wales, where he used soil perfusion to develop drugs to control the growth of mono-and dicotyledons differentially, researchers at the Institute devised a technique to study intestinal perfusion and the transport of sugars and ions across the small intestine in vitro. This was one of the earliest attempts to study absorption of nutrients across the intestinal wall outside of the whole animal.

Some of the individuals who obtained their Ph.D. degrees at the Institute and went on to develop independent scientific careers in university, government or industrial laboratories include Rolf Hochster, Peter Scholefield (who had accompanied Quastel from Wales), John Colter (later Chair of Biochemistry at University of Alberta), Walter Darlington, William Parenchyk, Beatrice Braganca, Shail Sharma (later Chair of Biochemistry at the All India Institute for Medical Research in New Delhi), Don Kushner, C. P. Sung, Annette Herscovics, John H. Spencer (later Chairman at Queen's University), Peter Faulkner (highly regarded scientist in insect biochemistry) Carol Prives (a leader in T-antigen research at Columbia University), Joav Prives, Emi Riklis, Maurice Brossard (later Chair of Biochemistry at Laval University), Nicole Begin-Heick (later Chair at the University of Ottawa), Joseph Ilan, and Rose Mamelak Johnstone (later Chair of Biochemistry at McGill, and the author of this article). This list, like the others cited here, is far from complete.[49]

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49 A complete listing of all successful Masters and Ph.D. Degree Candidates (1925–2002) is available from the Department of Biochemistry at McGill University. The document includes thesis

Because of Quastel's scientific stature, the laboratory also attracted many visitors for short- and long-term stays. Some of the visitors and post-doctoral fellows who worked for extended periods at the Institute and enriched the research environment include: Emmanuel Margoliash from the US, Choseki Furusaka from Japan, Leonard Zatman from the UK, Mabel and Lowell Hokin from the UK and the US, and Murray Fraser from UK and Canada, and many other short term visitors.

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This contact with visiting scientists was an asset to students training with Quastel, as a source of both intellectual enrichment and personal and professional broadening of horizons. However, it provided little to the rest of the Department of Biochemistry because there was so little interaction between the two units, not even regular joint seminars or group meetings. The Chair of the Department did not intervene to foster intellectual exchange between the Institute and the core research laboratories. Q himself may have approved of this relative estrangement. He was very protective of any new discoveries in his group until the data were published. This sentiment tended to discourage intellectual exchange between students and even visitors, unless he guided the interaction. The style was clearly centralized and radial, so that all information had to flow through Q to assure that any interesting finding would be exploited in a direction he deemed likeliest to make a significant impact. Of course, it was impossible to prevent all exchanges of scientific findings between researchers, but lines of communication were minimal. In later years, when some of the Institute staff had acquired responsibility for the daily supervision of students, the rigid centralization broke down.

Compared to major institutions in the rapidly expanding field of biochemistry, Q's labs probably fell well short of the top ten training environments in North America. However, the critical mass was greater and the environment more stimulating at the Institute than that it was the core Department. The impact that Quastel's Institute had on the graduate training program of the Department of Biochemistry is evident from a comparison of the number of student fellowships held by stu-

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title, thesis supervisor and the year in which the degree was awarded.

dents training with Quastel with that by other faculty members in the Department over a period of years (Table 1).

Table 1
Graduate Student Training Scholarships in Three McGill Departments
1947–1951

Department	1947	1948	1949	1950	1951
Anatomy	3		6	3	6
Bacteriology	3	2	2	3	5
Biochemistry	3	9 (5)	12 (9)	9 (7)	10 (5)

The numbers in parentheses refer to the number of student awards made to students under Quastel's supervision.

One aspect of training in both the core Department and the Institute that stood the successful participants in good stead in developing their careers was the absolute requirement to become self-sufficient, resourceful and independent. For many years, the majority of registered graduate students in Biochemistry were actually trained in the many laboratories, including the Institute, spread over the McGill University / Hospital complex. These laboratories had little direct interaction, intervention, or supervision from the administrative core of the Department. Q's unit was somewhat more closely tied to the central Department as a consequence of the personal interaction between Quastel and Thomson, as well as the fact that Quastel and several members of his research group had Departmental appointments and participated in the undergraduate teaching activities. The growth of "branch plant" training centers, when the core Department's growth was stunted, continued to undermine the status of the core Department as a valuable asset to the University.

Elliott and the Neurological Institute

Shortly before Quastel had set up his research unit with (loose) ties to the Department of Biochemistry, another independent biochemical research unit had been established at the Montreal Neurological Institute. This unit had a more defined mission: to study problems of the brain, especially as they pertain to the treatment of brain trauma. The first head of biochemical (or neurochemical) research at the Montreal Neurological Institute was K. A. C. Elliott, who had been recruited by

Herbert Jasper and Wilder Penfield, leading clinicians at the Neurological Institute, to run a biochemistry research laboratory.[50] Following a five-year period spent in Philadelphia doing research on brain metabolism at a psychiatric hospital, Elliott arrived in Montreal in 1945. Like Quastel and Thomson, he had studied for a Ph.D. degree in biochemistry at Cambridge, also under Sir Frederick Gowland Hopkins ("Hoppy"), the father of British biochemistry. Thus, when Quastel joined the McGill Faculty in 1948, the three major lights of biochemistry were ex-students of Hopkins from Cambridge.

Elliott was given a titular appointment in Biochemistry but maintained only an informal association with the Department until late into the 1950s. He gave an occasional lecture to undergraduate classes, trained graduate students registered in Biochemistry, and had a collegial relationship with Quastel. Since there were practically no graduate courses as such, students, both graduate and undergraduate, were expected to attend occasional seminars in special areas to expand their vistas in the field. In this way, some undergraduates might have encountered Elliott as a member of the Department of Biochemistry.

A significant number of graduate students studying neurochemistry at the Montreal Neurological Institute were registered in the Department of Biochemistry, although (as with the students in training under Quastel) they remained remote from the core Department. Elliott's students, like the others in the laboratories around the campus, had a nominal interaction with those in the core Department. For practical purposes, they were in separate worlds in their daily interactions.

Elliott's arrival at the Montreal Neurological Institute (the "Neuro") launched several areas of research, including an in-depth study of brain swelling, a problem that sometimes occurred after brain surgery or brain injury with which the medical staff often struggled. The studies that Elliott, with his colleague Hanna Pappius, carried out differentiated between true swelling and traumatic edema, the latter being uptake of fluid into the extracellular space. This distinction was essential for appropriate treatment.

Ernst Florey joined the lab at the Neuro in 1954. Prior to coming to McGill, Florey, while working in the US, had noted that a mammalian brain extract exhibited inhibitory activity on the stretch receptor of the crayfish. Together with other collaborators, Elliott's team at the Neuro identified this factor as gamma amino butyric acid and showed its inhibitory action in the mammalian nervous system. It was the first

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50 Kenneth A.C. Elliott, "An Unorthodox Career," *Bulletin of the Canadian Biochemical Society* XVII (1980): 12–25; Herbert Jasper, "The Saga of K.A.C. Elliott and GABA," *Neurochemistry Research* 9 (1984): 449–460.

natural neuro-inhibitory substance isolated from nervous tissue to be chemically identified.[51] Later work led to an examination of the blood brain barrier with respect to amino acid uptake.[52]

Thomson's Era Ends

In 1958, Thomson gave up the Chair in Biochemistry, but retained his two other posts. Fortune was not on his side. Just three years after he relinquished the Chair, Thomson slipped on a patch of ice and suffered a brain hemorrhage. His condition became more complicated when the bleeding could not be stanched because of an unsuspected clotting defect. He never fully recovered from the accident, surviving in an incapacitated state until 1964. At the memorial service in his honour, comments lamenting the absence of young students at the assembly were overheard. By then, some eight to ten years had passed since Thomson had captivated students with his lectures. There were few young students around who remembered the "legendary" Thomson. When he died in 1964, the flow of letters from Principal James's office, the Senate and the Administration gave vivid testimony to the deep affection and profound regard in which he was held by the senior administration. His colleagues missed the engaging raconteur with the brilliant mind.

Notwithstanding this high regard, in a seventeen year span in the Chair, during a time when biochemistry as a discipline had blossomed to become a major area of scientific endeavor, the Department at McGill had suffered from intense undernourishment. Given the man's stature and by all reports his brilliance, what prevented him from keeping the light of excellence alive in the Department? Clearly there were many factors, including shortages of funds and personnel during the years of war, distraction by other more pressing wartime and post-war commitments, the demands of administrative work in addition to the heavy teaching load. However, there is good reason to think that the heart of the matter lay elsewhere, namely in Thomson's total lack of personal involvement in research work. He had no research enterprise of his own or even a continuing collaboration with anyone else. He understood fully the importance of research, but did not view it as a function that required his personal attention. Nor did he undertake to give guidance to the other members of the small Department. This distance, and the inadequate commitment to the philosophy that basic research needs fostering within the core of a science department itself,

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51 Kenneth A.C. Elliott and Howard Florey, "Factor I—Inhibitory Factor from Brain," *Journal of Neurochemistry* 1 (1956):181–191.

52 Kenneth A.C. Elliott, "An Unorthodox Career."

and not just in nearby research institutes, no doubt played a major role in the Department's decline. Active contribution to the expansion of knowledge provides both the excitement and sense of accomplishment to the members of the group which, in turn, are needed to sustain activity and continued development. In Thomson's own words, "it fills the reservoirs." Too late, at his retirement from the Chair, Thomson admitted in discussion with the newly designated Chairman, that the Department had fallen far behind other North American departments.

Lloyd Stevenson, the Dean of Medicine, wrote to Principal James at the time of Thomson's retirement and the start of the search for a new Chairman, "the personnel of the Department [of Biochemistry] is meager for the job it has to do...[These are] the chief reasons why suitable candidates [for the Chair] are hard to find...[It is] important to build a strong Department...If any Department can claim to give the measure of a contemporary Medical Faculty, it is this one." He also calls biochemistry "one of the departments linking Medicine to the rest of the University."[53]

The search was undertaken, but few serious scientists with high credentials were attracted by the University's offer. New money for extensive change and new staff were always in short supply and the Administration apparently did not regard the Department's status to be in sufficient critical need of renewal to provide the necessary resources, despite Stevenson's pleas.

For nearly twenty years, many students in Biochemistry had had supervisors without Departmental appointments, except perhaps honorary ones, and little Departmental involvement in their training. A good many of these graduates would in time become well known and even leading scientists and educators in Canada and abroad. It was, however, the research laboratories in which they trained, rather than the core Department, would become recognized as important research and training centres.

The Elliott Years (1958–1968)

After some months of unsuccessful search, Kenneth Allan Caldwell Elliott (1903–1986), already a faculty member on the staff of the Montreal Neurological Institute, let it be known that he might be interested in succeeding Thomson and taking on the duties of Chairman. This ended the search for a Chair. By 1958, Elliott had established an active, lively and productive research group at the Montreal Neurological Institute.

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53 Lloyd Stevenson to Principal James, 12 Aug. 1958, Records of the Department of Biochemistry, Faculty of Medicine (RG2, container 242, file 7295), McGill University Archives.

The work was highly regarded and both he and his colleague of some years, Hanna Pappius, were well recognized in the field of brain research. Shortly thereafter they were joined by Leon Wolfe, who had achieved independent recognition in phospholipid metabolism.

Elliott's appointment marked a major transition for the Department. He was the first Chair to have had no previous experience in university teaching, nor indeed did he have a personal interest in classroom teaching or in administration. For the first five or six years, he retained his personal office and research laboratories at the Neurological Institute. He relocated when the new facilities for the basic sciences were opened in the McIntyre Building in 1964. In the early years he directed the Department's administrative affairs from the old Biology Building, but maintained his research activities high up on the hill in the Neurological Institute, in his old labs, with his old colleagues and his old associates. It is possible that he never became fully aware of the inner workings of the Department and the hardships and shortages faced by the staff and students in the Biology Building during his early years. Elliott did recognize that the Department had been neglected and that no new life had been added to the core for many years. He also recognized that the major research labs and researchers were members of external units, to which the principal investigators had primary loyalty. Within a very short period, he began to recruit new staff, the first ones being graduates of the Department who were employed in local institutions.

The Department faced a very serious shortage of teachers, given its extensive teaching commitments. Thomson had been the mainstay of the whole teaching program at all levels and carried on at a reduced level until his accident. Elliott himself had never engaged in serious, day-in-day-out teaching of classes at any level, be it undergraduate, graduate or in the professional school. Setting exams, marking exams and confronting students' complaints about grading was tantamount to a foreign world. He was accustomed to lecturing at professional meetings, where the audience knew the background and was keen for new developments. Assembling data to liven up the fundamental concepts of biochemistry and to sustain the interest of large numbers (several hundred at a time!) of undergraduates was simply outside his realm of experience or appetite. Although he tried his hand at it briefly, teaching young nursing students, the suspicion remains that he was more charmed by the lively nurses-in-training than by attempting to instill in them a basic knowledge of the fundamentals of biochemistry. Clearly, he did not play a major teaching role nor set an example for the Department. He was fortunate, however, when he hired the first two new staff, David Rubinstein and Murray Saffran. Both had grown up in the Department as undergraduates and had obtained Ph.D.'s in Bio-

chemistry at McGill. Both were excellent instructors, who already had established research programs. Rubinstein had also obtained an M.D. Along with Esau Hosein, another McGill graduate, these three were the first new appointments in the Department since 1947. They became the principal instructors after Thomson's accident in 1961.

Departmental Management

Elliott's approach to running a biochemistry department was to give the staff a free hand in both classroom teaching and individual research, without attempting to orchestrate an overall, global educational philosophy or research program. He expressed confidence that the individuals he hired would know how and what to teach better than he did, perhaps because he was aware of his own shortcomings in the classroom sphere. In so doing, he gave the staff a sense of independence to execute their responsibilities with little supervision and without having to account to the Chair for changes in the syllabus. Since the staff generally took pride in the courses presented, the outcome, on the whole, was satisfactory.

The research areas continued to reflect the expertise and interest of the staff, with no involvement from the Chair. However, we all know that things do fall apart without some overview, and some courses eventually suffered from a failure to bring to the fore new ideas and scientific advances in a rapidly growing discipline. The graduate students probably were the most short-changed, given the complete absence of advanced courses for graduate students, which should have provided a window on new areas of investigation appearing on the horizon.

When it came to staff recruitment, Elliott did not focus on the development or expansion of specific areas in biochemistry (such as enzymology, nucleic acids, or membranes and lipids) and to seek appropriate candidates accordingly. After his first appointments of local individuals, he appointed several faculty members in diverse and unrelated fields, like plant biochemistry and bone calcification. He made no attempt to hire individuals with overlapping or complementary research interests with an eye to which interests might lead to internal collaborations or scientific interactions. More significantly, the external candidates were not required to visit the Department prior to being hired. A letter of reference and a generally suitable background seemed to suffice. Importantly, however, Elliott was convinced by his first new appointees that the absence of expertise in nucleic acids in the Department had to be rectified. Molecular biology was on the horizon and rising rapidly. Elliott looked no further than a recent Ph.D. graduate

with good credentials from the Department, John H. Spencer. Spencer had trained for his Ph.D. in Quastel's laboratory a few years earlier, had had postdoctoral training with E. Chargaff, at Columbia University in New York, and agreed to come on board. Research and teaching in nucleic acids were finally added to the Departmental program in the early 1960s. (Later in Elliott's tenure, Murray J. Fraser, a Canadian trained in England who had held positions in Winnipeg and Toronto, who also had expertise in nucleic acids and protein chemistry, joined the academic staff.)

Despite the long period of neglect, there was little, if any, financial support from the Department or from the University for the newcomers to launch their research programs. The new appointees had to find funding from external sources, even for the most minor equipment.

Elliott, in his brief autobiography for the Canadian Biochemical Society, wrote proudly that he managed to increase the staff "by stealth and cunning" beyond that available to him via normal channels. But, he admitted, the growth he achieved was less than that happening in other biochemistry departments in Canada.[54]

Elliott was aware that in the various hospitals associated with the University, there were many biochemistry-based laboratories (including his own). Each of the directors of these laboratories was anxious to recruit new graduate students from the undergraduate biochemistry student body at McGill. This cadre of students, especially the Honours students, had become familiar with the essence of biochemical laboratory work during their undergraduate years. The admission standards to the Honours program were high and the candidates could be interviewed at minimal expense to the potential supervisors. Directly or indirectly, Thomson had fostered the training of graduate students outside the core of the Department since there were few "inside" choices for the growing number of requests to pursue graduate studies. This practice continued for a few years under Elliott, until he must have realized that it was working against the interests of the enlarged group of full time members of the Department. Many of the brightest potential graduate students, especially those from the Honours program, were attracted to laboratories with better facilities, more research money and often higher stipends. There were no sources of funds to attract students from universities outside Montreal, except the small number who had won their own scholarships. Thus, the internal staff members struggled to find bright students and resources, in addition to playing a service and administrative role for the many external laboratories.

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54 Kenneth A.C. Elliott, "An Unorthodox Career."

To counter this tide, Elliott introduced a policy whereby a select group of established investigators in the complex of hospitals was given approval to train graduate students. Procedures and regulations were developed to establish Departmental standards for training as well as mechanisms to maintain the approved standards. Furthermore, new restrictions made it more difficult for graduate students to select research supervisors who did not have formal affiliation with the Department. The latter policy was viewed with some resentment by many of the researchers in the hospitals lacking such affiliation. However, in the end, it fostered the research programs in the Department itself. Concomitantly, it led to a weeding out of a number of unsuitable training environments which had cropped up over the years.

A New Physical Environment

The Department's self image underwent a major change when the new quarters were built and occupied in 1964. The Chair and the five full members of the Department all came under one roof in the new McIntyre Building, along with their respective research units. This was the first physical move for the Department since 1920 when the Biology Building had been erected to house all the basic biology departments in arts, science and medicine faculties. The new facilities housed units pertaining to the Faculty of Medicine only, which were for the first time in their history physically separate from the biology departments (Botany, Zoology and Genetics). The biology departments acquired separate facilities in the new Stewart Building at about the same time.

During the ten years of Elliott's administration, the Department took on the appearance of a cohesive unit, a structure typical of most university departments in North America. However, the growth of the Department was insufficient to erase the neglect of the earlier years and to bring the Department to a level of high visibility and modernity. Furthermore, its development was overshadowed by the rapid advances of the discipline elsewhere in North America and in particular, closer to home, at the University of Alberta. The modernization of the Department of Biochemistry at the University of Alberta led to the development of a leading center for the study of protein structure and enzymology.

In 1961, John Colter, who had obtained a Ph.D. (1951) at McGill under Quastel and had spent a decade in the US, returned to Alberta as Chair of Collip's old department. He revitalized the department of five or six members and undertook an extensive recruitment campaign with funds available from the Alberta Heritage Foundation as well as from the University. He convinced the University of the importance of bio-

chemistry and the value of investing in this rapidly growing field, a field which held great potential for deeper understanding of biology and for improvements in treating disease. In the next few years, a significant number of young researchers (particularly individuals originating from Western Canada with advanced training in the U.S.) were enticed to join the department, and the University of Alberta developed into a leader in biochemistry in Canada. Some of the individuals recruited in biochemistry at the University of Alberta at this time were L. Smillie, B. Sykes, C. Kay, V. Petkau, N. Madsen, William Bridger and William Parenchyk. The emphasis of the work was on the structural aspects of proteins. No such rapid change took place at McGill.

The Department of Biochemistry at the University of Toronto also went through a period of development at about this time. Charles Hanes, who had been invited to join McGill's department, had instead taken a position in Toronto, his former home. In 1960 he was appointed Chair and held the position for five years. During his short tenure, he appointed nine new members to the Department, more than doubling its cadre of scientist-teachers. In this group were several of Canada's most distinguished investigators, including G. H. Dixon, R. K. Murray, G. R. Williams, R. A. Anwar, T. Hofmann, H. Schachter, W. Thompson, J. T. Wong and W. A. Green. In contrast with the practice at McGill, at Toronto there were no cross-appointed members of the Department before 1965.[55] The dramatic change in staff and the renewed intensity of research activity at Toronto stand in sharp contrast to the changes in the Department of Biochemistry at McGill, where after the long drought, only four (M. Saffran, D. Rubinstein, and E. Hosein and J. H. Spencer), were hired in the first five years of Elliott's tenure.

Research Activity

The single most prominent piece of research associated with the Department of Biochemistry at McGill during this period (1958–68) was that undertaken by Murray Saffran on the secretion of corticosteroids and pituitary peptide hormones in vitro. Saffran had begun this research before he formally joined the Department, and continued to explore these problems using in vitro methods, leading to the recognition of secreted hypothalamic peptides. One of these he named corticotrophin releasing factor (CRF). It was secreted by the hypothalamus and triggered the release of corticotrophin (ACTH), which in turn stimulated

55 Marian Packham, comments on the history of the Department of Biochemistry, University of Toronto, personal communication with author, April 2003.
personal communication with author, April 2003.

the production and release of corticosteroids. Identified initially by its physiological action, CRF proved elusive to chemical identification until 1981, when W. Vale reported its chemical structure.[56] Schally, who had worked on the neural peptide project in Saffran's laboratory as a Ph.D. student, would in later years extend and refine his studies on neural peptides and chemically identify TRH and LH-RH, two other hypothalamic peptides. He had by then immigrated to the US to pursue the work begun at McGill. Down the road, he was awarded the Nobel Prize for the identification of hypothalamic peptides. The historical record shows, however, that Saffran's insight was the key to the recognition of the existence of neural peptides capable of stimulating the secretion from the anterior pituitary gland.[57]

The number of theses submitted between 1960 and1970 (total: 206; Ph.D.: 130) suggests that the scientific activity of the Department had begun to recover from its lassitude, but it was still far from trendsetting. At the time of Elliott's retirement in 1968, the number of full time academics had reached 13, but this included Quastel and Scholefield and all the faculty members on the staff of the newly established Cancer Research Center, about half of the total complement.

Closure of the McGill–Montreal General Hospital Research Institute

By 1968–69, Quastel and Scholefield each had separate research units, situated cheek-by-jowl on one floor of the new McIntyre Building. Both were operationally, but not administratively, part of the Department of Biochemistry. Quastel had had to give up his research Institute on University Street and now directed a small, post-retirement unit, bearing the old Institute's name, which occupied a segment of the floor. Scholefield, who had been the Associate Director of Q's unit, was named Director of the Cancer Research Center in 1965. The Cancer Center has since undergone many changes of Directors, and at the present time has close ties with the Department, even though they retain independent administrations and remain separate entities.

University regulations made retirement obligatory at age 65. Quastel was very unhappy with the forced retirement. He was not yet prepared to give up his research life and he succeeded in obtaining a post-retirement appointment at the University of British Columbia. His departure in 1968 led to the final closure of the McGill–Montreal General Hospital Research Institute, almost exactly twenty years since its creation.

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56 Murray Saffran, Andrew Schally, et al., "Stimulation of the Release of Corticotrophin by a Neurohypophysial Factor," *Endocrinology* 57 (1955): 439–444.

57 Murray Saffran, "Corticotrophin Releasing Factor: The Elusive Hormone," in *Pioneers in Neuroendocrine Research*, vol. 2 (New York: Plenum Press, 1978), 12–25.

Elliott's department, circa 1960. Back row, left to right: O. Denstedt, D. L. Thomson, R. Johnstone, K. A. C. Elliott, M. Saffran, W. Creaser, J. H. Quastel. Front row, left to right: D. Rubinstein, E. Hosein, P. Scholefield

The number of Ph.D.'s awarded by the Department during Quastel's twenty years as Director of the Institute was 201. Of the latter, 71 were obtained under Quastel's umbrella, indicating the major impact "Q" had had on the training program of the Department. No other single unit occupied an equivalent position.

Causes of Stagnation

At the time of Elliott's retirement from the chairmanship in 1968, the core Department comprised six full time academic appointments. The remaining seven had primary appointments in other units and did not answer first and foremost to the Chair. The scientific stature of the Department in Canada and North America was still below what it had enjoyed under Collip thirty years earlier. Its development was far short of that at either Toronto or Alberta (as indicated above).

Viewed with the telescopic enlargement of hindsight, the neglect of the Biochemistry Department for a period of more than 25 years (from 1941 to 1970) appears stark. The neglect was probably not deliberate, but of the individuals who had power to institute significant changes, few had sufficient vision of the implications of the developments that were changing the face of biochemistry and departments of biochemistry beyond the bounds of McGill. The ongoing extraordinary progress would catapult biochemistry and its younger sister, molecular biology, to the forefront of biology and experimental medicine by the end of the twentieth century. Today, research conducted in physiology, pharmacology, and anatomy or cell biology departments, as well as in the basic research conducted in many clinical departments, uses the tools and approaches that evolved principally in departments of biochemistry or molecular biology. This was simply not the case a half-century ago, where the tools of the trade were significantly different in these disciplines, each possessing distinct (though perhaps overlapping) experimental approaches.

Lloyd Stevenson, Dean of Medicine for a short period in the 1950s, had recognized the profound need to lift the sagging Department out of its doldrums. Whether the evolution of biochemistry at McGill would have been otherwise had Stevenson remained as Dean of Medicine is a question of little practical significance. After he left (to take up a Chair in the History of Medicine at Yale), there does not appear to have been a strong voice in the Faculty to overhaul and modernize the Department. Just as serious, however, was the absence of strong leadership in the Department itself. With its minimal staff, mostly in the junior ranks, there was no prominent figure to push for the profound changes needed. The wheel had too much rust to squeak to be oiled!

Undoubtedly, Elliott had the best intentions at heart for the Department. According to his own words, he loved being Chairman.[58] However, both his mindset and personality did not, and could not, provide the leadership required. He was not a person to take a stand against authority nor draw up a plan for a development program and do battle to achieve his goals. "By stealth and cunning" he managed to get an additional couple of staff members (over the original four approved hirings) after more than a decade with none. Some insight into his deference to authority may be gleaned from a brief correspondence with the Dean of Medicine requesting funds to cover a relatively minor over-expenditure (under $200). The letter was one of abject apology with a promise that it would not happen again.[59] Without condoning budget overruns, given that the University ended few years in the black, evidently financial administrators routinely overran their assigned budgets! At a time when the Department required substantial investment to overcome its neglect, Elliott, despite his goodwill and the pleasure he took in the position, could not be the force for change that was needed.

Contrast this attitude with the one described by L. Yaffe when he became Chairman of the Department of Chemistry at McGill.[60] When he took the position he expressed the view that his Department had fallen behind other major Departments in Canada since a number of retirements and deaths had depleted the ranks. In a 1978 report to the James McGill Society describing his department's history at McGill, Yaffe states, "I proposed a plan of expansion to the University and I must say with gratitude that the plan was accepted and we embarked on the expansion." The year was 1965 and within a period of five years, fifteen new, energetic staff members had been hired for the Department.[61]

Why was a decline in a basic science department of the Faculty of Medicine allowed to continue for so many years without any apparent intervention from the higher administrative body? To get some insight into this question, two former Deans of Medicine were interviewed and independently commented that the relationship between a department and the Faculty depended in large part on Dean's opinion of the Departmental Chair and the Chair's tenacity in lobbying for loosened purse strings. As might be expected, money to recruit new candidates, particularly to increase the number of staff positions, required considerable persuasion, even when the staff cohort was lean to the bone. Only a strong impetus for new recruits from the Departmental Chair, irrespective of the leanness of the Department, would catch the Dean's ear. One

58 Kenneth A.C. Elliott, "An Unorthodox Career."

59 Kenneth A.C. Elliott, letter to the Dean of Medicine, 1964. Personal communication with author.

60 Yaffe.

61 Ibid.

former Dean expressed the need to be convinced that a candidate for a non-replacement position would be expected to have a significant and distinctive impact on the Department, over and above the Department's assessment of its needs. Clearly, only a confident and persuasive Chair could fulfill that role.

Additionally, there was at the time no routine assessment of departments by independent observers, either external or internal to the University, to judge the need to upgrade a department that was lagging. Provided the teaching requirements of the Faculty of Medicine were met without carping criticisms from the medical students and the Dean's ear was not filled with buzzing complaints from individual members of the Department (which would alert the Dean to low "morale"), stagnation could roll on without interference. A Dean with a strong research bent would be sensitive to the level of competitive research money that the department attracted (relative to other similar departments) as well as to the number of scholarly publications contributed by the unit. A Dean who placed less emphasis on research might remain unaware that the department was slipping as a centre for advanced studies.

At all times, the foremost concern of the Faculty of Medicine was the instruction of the medical students. So long as that commitment was met and there was ample opportunity for research and advanced degree training in the greater medical community (i.e. the more clinical environments, where the research had greater visibility in the broader field of medicine) there was no major impetus to revive a wilting department. Only with the necessity to appoint a new Chair would there be a wind of change and the power of the wind would be measured in the new Chair's view of the Department's future.

Thus, the appointment of an individual with vision, drive, self-confidence and persuasive powers was essential to clear out the cobwebs after Thomson's tenure. Elliott, despite goodwill, already belonged to an earlier era and lacked several of these qualities, although he appreciated them in his colleagues. Notwithstanding his reputation in the neurosciences, the drive and ambition to create a fully modern department were lacking during the ten years of his leadership.

Martin Rodbell: The Chair Who Wasn't There

It took over two years before a new full time Chair was appointed after Elliott retired. Suitable candidates were not easy to find. The University's resources could never match those available south of the border, nor indeed those available in other parts of Canada. Several departmental insiders had aspirations for the Chair. The most senior contender would have been Murray Saffran. He had both the scientific stature and

the ability to run the Department. Indeed his name came up as a candidate at the time of Elliott's appointment, but his youth and inexperience at the time militated against him.[62] During the ten years that followed, Saffran became less attractive as a candidate for the Chair. He had spent at least five years overseeing the construction of the new McIntyre Building as Building Director and, having had less time to supervise his own laboratory, his research had faltered. His support from the academic community also faltered, perhaps because he had had to cross swords about the new building facilities with some of the individuals who were on the selection committee for the new Chair. There was also the feeling that it was time to search further afield. Now that modern facilities were available to attract external candidates, some of the obstacles facing the previous selection committee were believed to have been overcome. In the course of the two year search, two interim Chairs were appointed. Meanwhile, seeing better career opportunities, Saffran decided to take up a position as Chair at the Medical College of Ohio, in Toledo. He left Canada before a new Chair was appointed.

The appointment of a Chair in the Medical Faculty was (and is) in the hands of the Dean of Medicine and the committee appointed by him. In the choice of a Chair for a basic science department, a Dean of Medicine would want to carefully consider the kind of impact such an individual would have in interacting with other medical departments (particularly those involved in basic medical research under the general rubric of "biochemistry"). There were and are many such units alive and very active in the University's hospitals. Members of these medical research units were much closer to the Dean's ear and shared more common interests with the Dean than did the members of the Biochemistry Department who, with the exception of Rubinstein, were not medically trained or engaged in research closely aligned to medicine. The members of the Department were occupied primarily with non-clinical research and with teaching science students at the undergraduate and graduate levels. Although teaching the medical students was always of prime importance, it did not occupy the majority of teaching time.

The evidence suggests that the Dean was influenced by his medical colleagues on the selection committee. This committee recommended an excellent potential Chair of Biochemistry, Martin Rodbell. Rodbell was a well known researcher who had done very important work on the role of cyclic AMP in lipid metabolism, using isolated adipocytes. (Rodbell would later be awarded the Nobel Prize for his work.) His colleagues at the Montreal General Hospital knew him well and were

62 Dean M. McGregor to Principal Rocke Robertson, 30 May 1968, Records of the Faculty of Medicine (RG2, container 345, file 12716), McGill University Archives.

enthusiastic about the prospects of having such a prominent biochemist, with interests to complement some of their own, in the driving seat of a basic science department in the Faculty of Medicine. Rodbell came to visit the medical school, met with the Dean and members of the selection committee and accepted the Dean's offer before any formal contact or interview with the staff of the Biochemistry Department. The announcement of the appointment was made to the departmental staff only after the official acceptance.

To the majority of the departmental staff, Rodbell was an unknown quantity. One or two individuals had met him personally in the course of their professional work but no one knew him. Rodbell had spent the majority of his career as an investigator at the National Institutes of Health in the US. He had never coped with the problems of classroom instruction, the training of science undergraduates, or the unusual pattern of biochemical education in the majority of Canadian schools. In contrast to American medical schools, in Canada, biochemistry and physiology are taught to undergraduate science students, as well as to medical and dental students. A substantial component of staff teaching time is actually devoted to the nonprofessional students. Unlike American Medical schools, the majority of the staff draw their salaries from the University's budget and not from their research grants. Successful researchers at American medical schools may devote their entire careers to research, with minimal classroom teaching to either medical or graduate students and none to undergraduates in science programs. Although securing research funds and maintaining an active research program are essential for tenure and promotion at McGill and other Canadian schools, the University may question the justification for the position if there are no formal teaching responsibilities.

These details form part of the context for Rodbell's appointment and may help explain its fate.

After accepting the Dean's offer to Chair the Department, Rodbell called a meeting in the departmental library to explain his philosophy. It was the one and only time the Department as a whole met with him except for a formal seminar. By this time, the gossip machine had rolled along and all "knew" that Rodbell thought the level of research in the Department was mediocre or old fashioned. By the same channels, it was known that Rodbell felt too much time was being devoted to classroom work. These rumours may have caused a level of anxiety among the staff, since at that time a significant fraction of the staff was untenured, and a drastic change in policy could imply a threat to their futures. To revise the teaching structure to that prevalent in most American schools, many of the staff would become obsolete.

Rodbell's comments at the meeting confirmed what had been heard in the halls. As he was going into the particulars of his vision for the future of the Department, he outlined a whole new branch of "exciting" modern work to revitalize the Department. While Rodbell was emphasizing the excess effort spent in the classroom work and how he would hire new personnel with strong research commitments, there grew a palpable undercurrent of feeling among those present that the new plans were meant to satisfy a group with goals distinct from those of the current members of the Biochemistry Department. Suddenly, as if reading the minds of the collective, Rodbell said, "I am my own man. I don't intend to fire anyone, YET." The room became a silent tomb for a moment, before one or two outbursts of anger at the implied threat to the future of the staff. Shortly thereafter, with a chastened and depressed staff, the meeting broke up.

That was the last time any member of this group saw Rodbell in the Department. As far as the Biochemistry staff knew, he was due to begin the position formally in September, about five months down the road. When September came, the staff discovered that Rodbell had retracted his acceptance. No official reason was ever made public to the Department. Another interim Chair was appointed, and the search began again.

This experience had a sobering effect on the Department and eventually led to the greatest redevelopment and staff replacement since Collip's day. After two years without a permanent Chair, the Department's next decade would be a period of growth and stability. But during the coming decade the Department would lose the senior members who had been major figures during Elliott's mandate. Murray Saffran had already left for the Medical College of Ohio. David Rubinstein left to become Chair of Biochemistry at Dalhousie University in Halifax, Nova Scotia and John Spencer left to take the Chair of Biochemistry at Queen's University in Kingston, Ontario.

Graham's Era (1970–1980)

Following the Rodbell misadventure, the Department as a group became more aware of the events underlying the selection of a new Chair and of the individuals being nominated and interviewed. Several prospective Chairs presented themselves without a match being made until the arrival of Angus Graham (1915–). At the time of his appointment, the existing departmental staff had a basic idea about his background and his nature, since he was well known to colleagues in Toronto. Angus Graham's personality was completely different from Rodbell's or Elliott's. Although, in his heart of hearts, he also favored a highly research-oriented department and he had little interest in having the

staff spend too much time in the classroom, he quickly realized he was dealing with a long tradition of the Canadian experience. Graham, a Canadian from Ontario, had been living in the US for many years, had become an American citizen, and had spent the majority of his career in research centers. His last position in the US was at the Wistar Institute in Philadelphia, which was affiliated with the University of Pennsylvania. He himself had had his training in Canada and in Scotland, obtaining a Ph.D. degree from the University of Edinburgh in 1942 and a D.Sc. in Microbiology in 1952. He too, had had a distinguished career in the US and was well known internationally, particularly for establishing conditions for studying the in vitro replication of mammalian viruses. He was the first senior external appointee to the Department whose primary scientific interest was in virology and nucleic acids.[63]

Beyond his academic credentials, Graham had two personal qualities that contributed greatly to the support he obtained from the existing inner core of Elliott's Department. First, he had the ability to speak and interact with people at all levels on a par. He would speak with the janitor with the same civility as with the most senior academics. Second, Graham's self-confidence gave him the ability to accept criticism of his plans and proposals. Given the reasons why his ideas might not fly, Graham would rethink his position and reexamine his decisions. Unlike many people in management positions, he had the ability to reverse a decision publicly, without seeming to feel that his authority was being undermined. These characteristics made for a totally different style of operation, with much more consultation and exchange of views than had been the norm.

Like Rodbell, Graham also was determined to upgrade the level, quality and intensity of research work in the Department. With the departure of some staff members and the support of the Dean to hire new faculty, he had the opportunity to hire several young scientists more in line with his image of the academic researcher. Moreover, because areas of research which he considered timely and very important, such as immunochemistry, were absent from the Department, but had excellent practitioners in various research institutes around the University, he offered cross-appointments to four or five individuals with specific expertise in areas of importance to biochemistry. These individuals were not on the Departmental budget, but were to be treated as full time members of the Department with respect to offering courses, training graduate students and having a say in Departmental matters. The "Asso-

63 L. Prevec and A.F. Graham, "Retrovirus-specific ribosomes in infected L-cells," *Science* 154 (1966): 522–523.

ciate Members" continued on in the manner that had been introduced under Elliott (i.e. training students, participating in existing courses).

Having spent many years engaged in viral research, Graham was familiar with the great advances being made in nucleic acid research and the ongoing revolution in molecular biology. He also recognized that this aspect of biological research was almost non-existent in the Department. He viewed most of the approaches to solving biological problems in the Department in 1970 as residues of a former era. Across North America, as well as in the leading European research laboratories, the experimental approaches still extant in the Department were being replaced with more powerful techniques.

Following his arrival, and the arrival shortly thereafter of several bright, ambitious and well trained new faculty members, there was a sense of turnaround of the general fortunes of this unit. Situated in a relatively new physical environment (the McIntyre Building), with new equipment (including that purchased with funds from multi-user departmental grants as well as individual research grants), and enjoying increased success in attracting operating research funding, the Department gained a new self-image. Within five or six years it began to be viewed as one of the leading biochemistry departments in Canada, a position it retains today. Biochemistry at McGill in the 1970s underwent a modernization similar to that of the University of Alberta in the 1960s. Where the study of nucleic acids, replication, and molecular aspects of protein synthesis had been unknown, these areas became predominant during Graham's ten years of tenure as Chair. The new faculty members who joined the core Department during this decade include Peter Braun, Stewart Millward, Walter Mushynski, Robert Mackenzie, Edward Meighen, David Denhardt, Nahum Sonenberg, and Kimon Angelides. More than half are still in the Department and have achieved considerable eminence in their fields.

Graham's Hiring Policy

Graham brought to the Department hiring practices common in American schools and perhaps in other parts of Canada, characterized by intensive external searches. In this period in Canada's history, there was loud public debate about the high percentage of non-Canadians (particularly Americans) being hired by Canadian universities, especially, but not exclusively, in humanities departments. The accusation would be countered by claims that there were insufficient numbers of Canadians with high calibre training to fill the university positions. Government bureaucrats in turn tended to question the wisdom of foreign appointees. Was public money invested to train Canadians for academic

work being wasted because the academic appointments at the universities were given to non-Canadians? Should there be restrictions on foreign hiring? New regulations were, in fact, adopted by the Department of Immigration during this period to try to restrict, without abolishing, foreign (primarily American) hiring.

Up to the period of Graham's tenure, selection of candidates for positions had been carried out with the knowledge and participation of only a few members of the Department. The selection of staff after Collip's era (and perhaps even in Collip's day) had been done by word of mouth among people who knew one another, or who were graduates of the Department, without any official consultation with the Departmental staff as a whole. It was not the practice to select from a short list of promising candidates. This tradition was inconsistent with Graham's experience of a more rigorous, investigative approach to appointing new staff at the institutions where he had worked.

Graham felt that there were many Canadians who had studied abroad, and who might prefer to return to Canada to develop their careers. In principle, he had no objection to foreign hires. But given the more exacting immigration requirements and his experience that many scientifically trained Canadians were abroad, particularly in the US, he made a deliberate effort to advertise positions widely in professional journals and to write to his many contacts in the US for recommendations for outstanding and promising young investigators, particularly expat Canadians. He invited these selected candidates to apply for the available positions. The Department at the University of Alberta had used a similar approach to rekindle the interest of western Canadians to return to Alberta.

The prospective candidates had to present themselves to the Department and describe their research achievements formally, so that all the staff, University-wide, acquired some insight into their abilities and interests. Furthermore, Graham explicitly looked to break the established trend of "inbred" hiring, that is, hiring staff educated only at McGill, with little experience outside the McGill fold. To a great extent, he was successful. Several highly skilled young investigators were hired who had trained at the major centers of biochemistry in the US. The pattern of hiring candidates sight-unseen or appointing born-and-bred McGill insiders was broken. Coupled with specific cross-appointments of staff from areas under-represented in the Department, Graham expanded the educational horizons of the graduate students with new courses as well as new areas for advanced research.

The Department grew in size and in the amount of research money that flowed in. The number of graduate students and postdoctoral fellows increased to hitherto unknown levels. Notably, this was also an era

of growth in biochemistry and molecular biology worldwide. Now McGill's Biochemistry Department began to appear more prominently at international venues of biochemists. At the end of Graham's tenure as Chair in 1980, McGill could claim to have become one of the two top biochemistry schools in Canada, based on the quality of the research output, the international stature of its staff and the success in raising competitive research funds. Clearly there had been a giant step forward. Furthermore, for the first time, formal classroom courses for graduate students were introduced rather than scattered lectures of "current topics" in addition to regular seminar series.

By and large, Graham had a "good nose" for hiring new staff. Despite the new participation of the whole department in the hiring decision, the ultimate voice was his. No one was asked to join without his support and he used his power (generally tactfully) to override disagreeing voices. Several of Graham's appointees have established international reputations for their work. These include Nahum Sonenberg, a leading authority on the initiation of protein synthesis whose work has identified several components of this complex process; Robert Mackenzie, who explored new aspects of folate metabolism and established that there is a mitochondrial form of methylene tetrahydrofolate dehydrogenase (an NAD-dependent bifunctional enzyme); Edward Meighen, who established the components of the bacterial luciferase pathway and its specific inducers; Peter Braun, whose work on myelinating enzymes and neuronal development are internationally known; and Walter Mushynski, who demonstrated the high phosphorylation level of neurofilaments.

But only rare individuals make exclusively perfect decisions. Two individuals who later became Nobel Laureates (Sidney Altman and Michael Smith) presented themselves as possible candidates for academic positions during his chairmanship. Both had already started the work that would later be recognized for the Prize. However, at the time of their visits to McGill, the potential of their work was not fully recognized. In science, predicting the significance and outcome of really new work eludes many of us. Who appreciated the potential for electricity or the telephone when they first came on the scene?

Graham's Legacy

When Graham approached the end of his ten-year term as Chair in 1980, the Department had finally shed the image of a neglected unit of a major Canadian university. With an increased budget from the Faculty of Medicine, Graham was able to recruit additional staff. Government funding for research, both for personnel and equipment, also expanded in this area. At its peak, the cadre of staff, including cross-appointees,

had reached twenty. These were imaginative investigators who tackled scientific problems of recognized merit and who were in a strong competitive position to obtain funding from external agencies.

The enhanced emphasis on research activity, coupled to the evident scientific research ability and dedication of the staff, led to a major increase in the flow of new scientific information. Money was available for the purchase major modern equipment. As usual with the availability of new technologies, new directions of research followed. More students sought admission for graduate work, and postdoctoral fellows appeared for the first time in decades. Any underused space was converted to research laboratory space, gradually diminishing the space available for dedicated undergraduate laboratories.

Staff "esprit" was high, and the quality of teaching, both undergraduate and graduate, had markedly improved. Graham himself participated in the teaching, especially of the youngest undergraduates, and maintained an interest in the nature of the course work and its execution by the staff. At the same time, he left the organization and the general course content to the wisdom of the instructors. Departmental meetings were infrequent, but when they were held, the staff did have the opportunity to voice opinions and criticisms.

Post Graham

Since its inception, the University had experienced periods of famine and periods of relative financial health. It is no surprise, then, that the period of expansion and renewal that the Department enjoyed in the early 1970s would not be sustained. Towards the end of the 1970s, at a time when external funds for fellowships were still available for graduate students and postdoctoral research, the University's financial situation experienced one of its periodic slumps. There were budget slashes across the board and little discretionary money to run a growing Department. A freeze was placed on hiring and no new facilities were built.

When Graham retired from the Chair, the notion that the Department as a whole should have a strong voice in its future had taken a secure hold. The question was then debated by the whole Department whether to approach the Dean of Medicine to seek an external candidate to replace Graham, or whether one of the more established, internal members would be willing to undertake the task. By then, three senior members had recently left to take up Chairs at other institutions. The Dean of Medicine was opposed to the idea of a rotating chairmanship, a practice popular in other areas, but not in the Faculty of Medicine. By common consent, the senior member of the Department with the highest scientific profile was David Denhardt. When he declined the position,

preferring to focus his career on his research interests, the lot fell to the author of this review.

Thus, this history ends with the Department of Biochemistry at McGill acquiring the first female "Chairman" in its history. The new Chair at McGill became the first to break the "male lineage" in Canadian biochemistry departments, and was among the first five in all of North America. With the same appointment, the Faculty of Medicine acquired the first female representative of its basic science departments at McGill, at a time when female admissions to Medicine were rising close to fifty percent. The evolution of the Department since 1980 waits to be assessed by future commentators, to judge whether its promise to become a leading school of biochemistry in Canada and internationally worldwide has been fulfilled. At present, let it suffice to say that the most recent publicly available records (1998) of research funding at this University show that nearly twenty years after Graham's appointment, this Department leads by a large margin the University's list in obtaining external funding for research.

Ode to an Administrator's Lot
Teaching, research, so they say,
Is a University's whole mainstay.
So why, oh why, is it our fate
Our time and imagination to dissipate?
We spend the day, if not the night
With yet another report to write.

Submitted with an Annual Report by R. M. Johnstone during her term as Chair of the Department of Biochemistry at McGill.

Biographical Note: Rose M. Johnstone Ph.D. FRSC is Emeritus Gilman Cheney Professor of Biochemistry at McGill University. She has been a full time member of the teaching and research staff of McGill's Department of Biochemistry since 1964. She obtained her Ph.D. degree from the same department, under J. H. Quastel, as a member of the McGill–Montreal General Hospital Research Institute. She has been the author or co-author of over 125 publications in scientific journals and books. Her scientific interests include the transport of small organic compounds across mammalian cell membranes as well reticulocyte maturation. A new organelle, the exosome, was identified in her laboratory and shown to be a mechanism for selective removal of specific plasma membrane proteins. She served as Chairman of the Department between 1980 and 1990. She also served as Treasurer of the Royal Society of Canada and is the recipient of The Queen's Silver Jubilee Medal. Her address is: Department of Biochemistry, McGill University, Rm 804, McIntyre Bldg, 3655 Sir Wm. Osler Promenade, Montreal, Quebec, H3G 1Y6. Email: <rose.johnstone@mcgill.ca>

Appendix

Faculty and Staff in Biochemistry at McGill, 1922–1976 (selected years)

1922–23
BIOCHEMISTRY AND PATHOLOGICAL CHEMISTRY
Professor – A. B. Macallum
Assistant Professor – George Eric Simpson
Demonstrator and John McCrae Scholar – J. F. Logan
Assistant Demonstrators – I. M. Rabinowitch, H. E. Eberts

1924–25
BIOCHEMISTRY AND PATHOLOGICAL CHEMISTRY
Professor – A. B. Macallum
Assistant Professor – J. F. Logan
Demonstrators – H. L. Cameron, J. C. Forbes
Lectures on Pathological Chemistry – E. H. Mason, I. M. Rabinowitch

1928–29
BIOCHEMISTRY AND PATHOLOGICAL CHEMISTRY
Professor – J. B. Collip
Associate Professor – S. W. Bliss
Lecturer – David L. Thomson
Lecturers on Pathological Chemistry – E. H. Mason, I. M. Rabinowitch
Demonstrator – S. A. Beatty

1929–30
BIOCHEMISTRY AND PATHOLOGICAL CHEMISTRY
Professor – J. B. Collip
Associate Professor – S. W. Bliss
Lecturer – David L. Thomson
Lecturers on Pathological Chemistry – E. H. Mason, I. M. Rabinowitch
Research Fellows – R. L. Kutz, J. S. L. Browne

1941–42
BIOCHEMISTRY
Professor – D. L. Thomson
Lecturer – O. F. Denstedt
Demonstrator – C. Gwen Toby

1948–49
BIOCHEMISTRY
Professors – D. L. Thomson, Chairman
J. H. Quastel
Associate Professors – O. F. Denstedt, R. D. H. Heard
Assistant Professor – K. A. C. Elliott
Sessional Lecturer – Judith Saffran
Demonstrator – Lucille Stewart

1958–59
BIOCHEMISTRY
Professors – D. L. Thomson, Chairman
J. H. Quastel
Associate Professors – O. F. Denstedt, K. A. C. Elliott
Assistant Professor – P. G. Scholefield
Sessional Lecturers – Esau Hosein, Margaret Purvis

1960–61
BIOCHEMISTRY
Professors – K. A. C. Elliott, Chairman
D. L. Thomson, J. H. Quastel
Associate Professors – O. F. Denstedt, M. Saffran
Assistant Professors – E. H. Creaser, E. A. Hosein, D. Rubinstein, P. G. Scholefield

1968–69
BIOCHEMISTRY
Professors – K. A. C. Elliott, Chairman
M. Saffran, P. G. Scholefield, S. Solomon
Associate Professors – M. J. Fraser, E. A. Hosein, Rose M. Johnstone, D. Rubinstein, J. H. Spencer, T. Wood
Assistant Professors – Eleanor M. Harpur, M. Manning, R. L. Momparler, A. R. Wasserman, T. Webb
Lecturers – Sally MacLachlan, M. R. Reesal

1976–77
DEPARTMENT OF BIOCHEMISTRY
Professors – A. F. Graham, Chairman
M. J. Fraser, E. A. Hosein, D. Rubinstein, S. Solomon, T. L. Sourkes, J. H. Spencer, L. S. Wolfe
Associate Professors – R. Blostein, P. E. Braun, D. T. Denhardt, R. M. Johsntone, A. R. Wasserman (on leave)
Assistant Professors – E. M. Harpur, R. E. MacKenzie, E. A. Meighen, S. Millward, W. Mushynski
Emeritus Professor – K. A. C. Elliott
Lecturer – M. R. Reesal
Research Associates – P. J. Dolphin, K. Harbers
Associate Members – M. K. Birmingham (Psychiatry), L. F. Congote (Exp. Medicine), J. Dupre (Exp. Medicine), D. Edward (Exp. Surgery), W. C. Galley (Chemistry), L. Goodfriend (Exp. Medicine), L. M. Jerry (Exp. Medicine), H. Pappius (Exp. Neurochemistry), J. F. Perdue (Lady Davis Institute), C. Scriver (Paediatrics), J. Shuster (Exp. Medicine)