
The History of Biochemistry at the University of Toronto

Dr. Marian Packham

Department of Biochemistry, University of Toronto

Over the years University Professor Emeritus Marian Packham has assumed the mantle of "Official Historian" of the Department of Biochemistry. Recently, she has taken on the task of writing a Departmental History and, on the occasion of the XIX International Union of Biochemistry & Molecular Congress which will take place in Toronto July, 2003, she has kindly provided an abridged version for inclusion in the Bulletin.



University Professor Emeritus Marian Packham

The Department of Biochemistry at the University of Toronto was founded in 1907-08, with Prof. Archibald Byron Macallum, who was head of the Physiology Department, as its first chairman. It was the first biochemistry department in Canada and one of the first in the world. Prof. Macallum is credited with the organization and extension of the Medical School at Toronto in the early 1900's and he was a strong

advocate for the construction (1902-1904) of the original Medical Building, on the third floor of which the Department of Biochemistry was housed for 60 years.

Macallum's research was influential in its time. He contributed to the knowledge of the localization of calcium, potassium and iron in plant and animal tissues by microchemical tests, and his comparisons of absolute and relative concentrations of the inorganic elements in sea-water and in the body fluids of many animals supported the concept of the origin of land animals from the sea. He received the unusual honour, for a Canadian, of election to Fellowship in the Royal Society of London. He was part of a small group who organized the American Society of Biological Chemists, was active on the executive of the Society and served as its president from 1911 to 1913 at the time when the Federation of American Societies of Experimental Biology was created.

Between 1919 and 1951, the Department had only two chairmen, Andrew Hunter (1919-1929) and Hardolph Wasteneys who had joined the Department in 1917. A Department of Zymology, formed in 1919 under Prof. Horace Speakman, merged with the Biochemistry Department in 1929.

In Andrew Hunter's time, biochemistry was mainly the servant of clinical medicine, with emphasis on chemical analysis of tissues, urine and blood in health and disease. His monograph on creatine and creatinine was a definitive work before the discovery of phosphocreatine.

Wasteneys (1929-1951) was interested in the synthesis of protein, before the days of tRNA, mRNA or ribosomes. His main collaborator in the field was Henry Borsook who worked with him during the 1920's. They investigated conditions that would reverse the proteolytic action of pepsin.

During the 1930's, Wasteneys brought a succession of professors from the U.K. for short terms. Among these was Guy Marrian whose work with his graduate students on the isolation and structure of estrogenic hormones received world-wide recognition. During World War II, many members of the Department were engaged in secret projects for the Department of National Defence, including work on BAL (British Anti-Lewisite), an antidote to mustard gas. In connection with the war effort, radioactive sulphur was used in the Department in 1941; these experiments were one of the earliest applications of the radioisotope technique that became a major tool in biochemical research.

Because of the depression of the 1930's and the war years, the Department grew very slowly and in 1950 there were only 5 professors on the staff. Nevertheless, by this time 75 Masters degrees and 59 Ph.D. degrees had been awarded and many of the graduates went on to professorial positions in the biochemistry departments and life science departments that were being established throughout Canada, the United States, and other countries. One of the earliest Ph.D. students in the Department of Zymology was Arthur Wynne who became a professor in Biochemistry upon the merger of Zymology with Biochemistry in 1929 and remained in the Department until his retirement in 1960, serving as Chair from 1951 to 1960. In 1958 he was elected as the first president of the Canadian Biochemical Society, which had been formed as a result of the deliberations of an unofficial committee chaired by Gordon Butler, at that time a professor of Biochemistry at Toronto.

Jeanne Manery Fisher was the first woman to achieve professorial status in the Department. In 1932 she graduated from the Biological and Medical Sciences course given by the Department of Biochemistry at the University of Toronto and after obtaining her Ph.D. in Physiology, and post graduate studies in the United States, she returned to the Department in Toronto in 1940. Although she carried heavy teaching responsibilities and established an active research program, prejudices against women academics prevailed and she was not appointed to the professorial staff until 1948. She maintained her research program until her

death in 1986, and achieved world wide recognition for her studies on electrolytes, during the development of this field from doubts about the reality of a true plasma membrane to the isolation from the membrane of the key molecule involved in transporting Na⁺ and K⁺ across cell walls. Very aware of the need to increase the visibility and participation of women in the Canadian Biochemical Society, she was instrumental in establishing its Equal Opportunities Committee in 1981. Following her death, the Society established the Jeanne Manery Fisher Lecturer Award to honour her memory.

Gordon Butler was a professor in the Department for 12 years (1947-1959) and with his 19 graduate students initiated and carried out a ground-breaking research program on what was then known as thymus nucleic acid. According to TIBS (4, June, N124) their contributions included introduction of the light-scattering method for measuring the molecular weights of DNA molecules; introduction of the 'SDS method' as a general procedure for preparing DNA; introduction of a method for effecting a quantitative conversion of DNA to its constituent 5'-deoxyribonucleotides; discovery that there are enzymes that can degrade DNA by an 'exo' action at the termini of polynucleotide chains; definitive characterization of 2-deoxy-D-ribose as the sole sugar component of DNA; and introduction of the gel-electrophoresis approach for separating nucleate-associated proteins.

Charles Hanes joined the Department in 1951 and chaired it from 1960 to 1965. During his term, money became available to add 9 new professors to the core staff and to appoint 3 part-time tutors for the laboratory classes. He was responsible for introducing the procedure of appointing the Departmental chairman for a 5 year term (renewable once) instead of the chairmanship being a "life sentence".

Before coming to the Department, Hanes had become well known for his discovery and initial characterization of plant phosphorylases and had been involved in the development of paper chromatography for the separation of phosphoric esters. In Toronto, he refined this technique and

applied it to the separation of amino acids and peptides. In his laboratory, diverse products of transpeptidation were characterized and quantitated, kinetic studies were carried out of sucrose phosphorylase and alcohol dehydrogenase, and elastase was used to investigate the structure of elastin. Hanes' first two graduate students in Toronto were George Connell and Gordon Dixon, both of whom produced Ph.D. theses on transpeptidation reactions, later joined the professorial staff of the Department, and then went on to more and more illustrious achievements. When they were in the Department, their research on the chemistry of haptoglobulins and immunoglobulins led to the development (with Oliver Smithies) of the technique of starch gel electrophoresis which was widely used for many years.

In addition to his research program on the structure and function of antibodies and enzymes, George Connell chaired the Department from 1965 to 1970, held major administrative positions at the University of Toronto, was president of the University of Western Ontario from 1977 to 1983, and president of the University of Toronto from 1984 to 1990. Upon his retirement, generous donations were made to establish a lectureship in his name to support a visiting lecturer each month.

The 1960's were good years, with funding for a new Medical Sciences Building, completed in 1968, new equipment, and new staff. As the members of the Department moved into the fifth floor of the new building, there were few regrets to leaving behind the cockroaches, mice, mercury in the cracks between the floor boards from the van Slyke equipment, inadequate cold rooms, and lack of air conditioning. Space was also available for the members of the core Department who had had laboratories in a building on Spadina Avenue. The professorial staff was expanded by introducing the practices of giving cross-appointments to members of other departments such as the Banting and Best Department of Medical Research, and of making honorary appointments of some members of the research institutes, particularly at the Hospital for Sick Children. As a result, the graduate student population increased enormously, to

70 students in 1970. Fearing that there would not be positions for the anticipated large numbers of new biochemists since the graduate student population at other Canadian universities was also expanding, the graduate students persuaded the department to limit each professor to no more than 2 graduate students at any one time (previously, 5 or 6 had been the norm). However, this restriction lasted for only a few years.

In the early 1970's, undergraduate instruction in biochemistry for Arts and Science students was greatly increased to include students in disciplines other than biochemistry, as well as larger numbers of biochemistry specialist students. The Department continued its teaching responsibilities for medical students, and took major roles in a new 'systems' curriculum introduced at this time.

G. Ronald Williams chaired the Department from 1970 to 1977 and later continued the involvement of Toronto biochemists in major administrative roles as Principal of Scarborough College. During his chairmanship, research blossomed and on 3 occasions, members of the Department received Canadian Biochemical Society Ayerst (Merck-Frosst) awards. In response to the student unrest of the 1960's, a Departmental Constitution was written, a Departmental Council with broad representation was established, and a graduate student organization was set up to co-ordinate graduate student activities in the Department. This Biochemistry Graduate Students Union (BGSU) is very active to-day, coordinating the student seminars and organizing social events.

In the 1970's, there were 27 appointments to the professorial staff, 8 of these to the core Department, but during Keith Dorrington's chairmanship (1977-1982) repeated cuts of the Departmental budget almost eliminated new appointments to the core. Dorrington's work after joining the Department in 1970 focussed on the structure and function of immunoglobulins and resulted in an Ayerst award in 1977. He was another biochemist with administrative talents and served as Vice Provost, Health Sciences and Associate Dean, Basic Sciences, in the Faculty of Medicine.

In July of 1979, the XIth International Congress of Biochemistry was held in Toronto with 7500 scientists in attendance. The 75th anniversary of the founding of the Department was held in 1983 during Marian Packham's term as Acting Chair. The activities included a symposium, an Open House, and a banquet in Hart House at which Dr. Thomas Jukes (Ph.D. 1933) was the keynote speaker. The 320 registrants, many of them former students, came from across Canada and the United States.

Harry Schachter became chair in 1984 for a 5-year term. He had been Gordon Dixon's first graduate student in Toronto and had been immediately appointed to the core professorial staff upon completion of his Ph.D. in 1964. Well before becoming chair he had gained international recognition for his studies of the complex structures of the oligosaccharides of glycoproteins. As an emeritus professor of Biochemistry, he continues his active research program at the Hospital for Sick Children where he moved in 1976 and, for a number of years, chaired the Division of Biochemical Research.

A recurring theme in the Department's history is the choice of members from our core for major administrative roles elsewhere in the University; some of these have been mentioned earlier. In 1989, for example, George Connell was President of the University, G. Ronald Williams was Principal of Scarborough College, Robert Painter was Provost and Vice Chancellor of Trinity College, and Anders Bennick was Chairman of the Graduate Department of Dentistry.

From 1989 to 1991, search committees were repeatedly unsuccessful in attracting a chair from outside the University of Toronto while William Thompson served capably as Acting Chair. During this time, the Protein Engineering Network of Centres of Excellence (PENCE) was set up and Toronto became one of the four academic centres participating in it. Professors Emil Pai and Harry Schachter became co-leaders with 9 professors in Biochemistry participating. A protein crystallography centre was established in the Department, also under the direction of Emil Pai.

In 1991, Peter Lewis, who had joined the Department in 1974, was chosen as Chair. He served two terms, during which major changes were made in staff and in the focus of the research being carried out. The hiring frenzy of the 1960's inevitably resulted in a large number of retirements in the 1990's – 9 professors from the core department and 5 status-only and cross-appointed professors. Despite base budget cuts, the department was able to recruit 8 core department primary appointees and 9 status only or cross-appointed members, bringing the present total to 55, with 20 of these based on the campus. Credit for this renewal into a vigorous and youthful department belongs to Peter Lewis who was exceptionally active in finding opportunities for growth and arranging joint appointments with sister departments. In 1993, the installation of a 600MHZ NMR instrument in the Medical Sciences Building facilitated the research of newly recruited Julie Forman-Kay and Lewis Kay. Faculty "Retreats" in 1993 and 1998 ensured that all members of the Department participated in planning. Decisions made during this time resulted in at least half of the departmental members focusing their research activities on proteins, including structure determination, dynamics, in vitro and in vivo folding, proteomics, and structure-function studies. A highly-rated Collaborative Program in Biomolecular Structure has been set up involving 25 investigators from four departments. This program is designed to provide a stimulating training environment for Ph.D. students and serve as a forum to foster interactions among the participating research groups. The three focus groups are Protein Crystallography, NMR, and Protein Folding.

In 1998, a new multi-departmental program in Proteomics and Bioinformatics (P&B), with Peter Lewis as director, was initiated. Some of the new members of the Department of Biochemistry were hired through this program.

The present Chair, Reinhart Reithmeier, began his term in July of 2002, taking over a Department filled with enthusiastic, award-winning researchers and teachers. Instruction is provided for the education of students in the Faculties of Medicine, Arts and Science and the School of Graduate Studies.

The annual enrolment in all these courses exceeds 1800 students. Biochemistry courses for undergraduate students in the Life Sciences are offered during the second, third and fourth years; courses on special topics are available to graduate students.

The Department is geographically diverse with faculty based in the Medical Sciences Building, the Research Institute at the Hospital for Sick Children, the Banting and Best Department of Medical Research, and several other sites, including the University of Toronto at Mississauga and at Scarborough.

Many members of the Department have received prestigious awards for their research. Fifteen of them were or are Fellows of the Royal Society of Canada. Among them is David MacLennan of the Banting and Best Department of Medical Research who has been an active cross-appointed member of the Department since 1980; his long list of prizes includes appointment in 2002 as an Officer of the Order of Canada for the investigations in his laboratory of how normal sarcoplasmic reticulum proteins carry out their functions of calcium transport, sequestration and release and how mutant forms cause abnormalities or disease.

It remains for later historians to document the impressive achievements that our younger members are in the midst of accomplishing. As we approach our 100th anniversary, we look forward to an even greater future for the Department of Biochemistry in the Faculty of Medicine at the University of Toronto.