PARTNERSHIP FOR EXCELLENCE

Medicine at the University of Toronto and Academic Hospitals

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Partnership for Excellence

Medicine at the University of Toronto and Academic Hospitals

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In overarching respect and admiration for the men and women who people these pages, often renouncing the large incomes they might otherwise have obtained in favour of lives of science, dedication, and public service.

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1 Introduction

This book began life one day when I was lecturing to the medical students. "Stem cells were discovered at the University of Toronto," I said. "What!" They were incredulous and had no idea. This was a group of smart, alert medical students at the University of Toronto (U of T), and they were completely unaware of an important achievement of their faculty.

I realized that the story of medicine in Toronto was a story that needed to be told.

I was trained as a historian, not a physician. But I did go to medical school for two years, after I was already a full professor of history, because I had become interested in the history of medicine and realized that I did not have the knowledge required to study the subject properly. So I enrolled in all the basic medical science courses in the first two years of the medical curriculum and took all the exams – and finished in about the middle of my class.

So my approach in this book is that this is a powerful story and deserves to be told properly. And that means getting into the guts of all the departments and divisions of this sprawling faculty and its nine big research hospitals. (The list of affiliated hospitals appears on p. 746.) Many of these people have made important contributions to the international narrative, such as discovering stem cells. This means telling their stories as they deserve, through interviews and by consulting the archives and libraries in which the record of the past is stored.

Canadian hospital history is a coming field, and a picture of the transfer of resources from the private to the public sector is starting to emerge in many places in this country.[1] But this is not hospital history, even though the teaching hospitals of Toronto are a constant presence on these pages. It is the history of a single faculty in a sole university, which is to say that it is the history of a small group of people and their ideas. Even though such words as "program," "division," and "department" are almost too numerous to index, this book is basically a history of what these pioneers of Canadian medicine

thought and how they acted on their ideas. This kind of history has really not been done for medical schools. There are not a great number of histories of medical faculties, and they tend to be written more by favourite sons than by trained historians.[2] So I wish I could say, "Thus, I add to the body of knowledge about faculties." But there is no such body of knowledge, or rather, there is a great deal of knowledge about how these things have evolved elsewhere, but it has not yet been codified. Nobody can say how the evolution of molecular medicine in Toronto conformed to, or departed from, that in other Canadian institutions because no one yet has the sampling of studies that would make the construction of a historiographical tradition possible.[3] Instead, what are featured here are stories, and I shall be at pains to ground them in wider traditions in the pages that follow.

I will state right at the beginning that the faculty and affiliated teaching hospitals of the University of Toronto have become the dominant force in Canadian medicine and an international powerhouse. Why is that? This has happened for two reasons. One is that the University of Toronto is the sole medical school for eight major teaching hospitals. The academic physicians and scientists of these hospitals are all cross-appointed to university departments, and the faculty's students learn and work in the hospitals. This is like a string of locomotives hooked together, and as they pull forward, their force – in terms of bringing large amounts of intellectual energy to important scientific problems – has been enormous. In North American medicine, though there are other brilliant centres, nothing else quite like this exists.

Knox Ritchie, an Irishman, said this about his decision to join the Department of Obstetrics and Gynaecology at Mount Sinai Hospital in 1984: "When you looked at the geography, and the powerhouse Toronto potentially was – it wasn't yet, but it could be, if you looked at these teaching hospitals all sitting opposite each other on Ambulance Alley here. You look at Sick Kids, Toronto General, Mount Sinai. Princess Margaret wasn't there, yet, but it was Sinai that influenced them to come to that site. All of them with research institutes. And you walked up the street, and you had the basic sciences at the University just looking at you … I don't know of any other city in the world where it has that setup … It's unique. It makes Toronto what it is now."[4] So this combination of a major university with its basic sciences and the hospitals with all their brilliance made Toronto distinctive.

Second, the faculty has had a series of unusually gifted leaders to help yoke the locomotives together. This is quite a remarkable story because initially the leaders of the faculty – and this included a number who became world-class scientists – were farm boys from little towns in Ontario. Most were of Scottish Presbyterian stock. The second generation of leaders, who appeared in the 1960s and 1970s, were largely Jewish and of urban origin. This is one of the most remarkable stories in Canadian medicine. But it was these successive generations of leaders that helped outfit the scientists with lab space and funds and,

more importantly, inculcated a general research culture in the faculty and the hospitals.

The main theme of this book, as we shall see, is a story of two pivots: a pivot in the life of the faculty from education to research and a pivot in academic vision from the United Kingdom to the United States. These are pivots that happened not just in Toronto but throughout Canadian medicine and constitute one of the major narrative arcs of the twentieth century.

Now many of these stories are real triumphs of the human spirit, models for leaders of the future to reflect upon, and I realize that in telling them I risk jeers of "hagiography!" (Yet the faculty on occasion had feet of clay – particularly in its treatment of women and Jews – and this too will come out.) But one keeps in mind how modest were the material rewards for research those days. The early 1950s were not a profitable time for academic physicians in Toronto. Community doctors earned adequate incomes because they saw paying patients all day. But academic doctors were poorly remunerated for their hospital service and often had a difficult time getting private practices going, despite the prestige of a hospital appointment. It took Barney Berris, who had graduated in 1944, ten years as an academic physician to scrape together enough money to buy a modest bungalow in North York. He said later, "Although I was happy that I was in academic medicine, it was sometimes disconcerting to hear about these doctors' expensive trips, the large homes that they were buying and the private clubs they were joining."[5]

Most of the big stories in Canadian medicine are not well known, these included. Why is that? I asked James Till, the co-discoverer with Ernest McCulloch of stem cells at the University of Toronto in 1960, why he had never written an autobiography. Till, who came from a Saskatchewan farm family, replied, "My father was a very modest man. He's deceased some time ago, but I admired him greatly, and he came from the British tradition that you didn't blow your own horn, that was bad taste. I think I'm still affected by that tradition."[6] As readers will discover, the whole medical faculty at Toronto was once much affected by that tradition.

There is in the Canadian academic character a reserve that comes directly from the United Kingdom, from Oxbridge and Edinburgh, if one will. In British academic life, self-praise has always been considered inappropriate. The British have always had a horror of self-promotion, of trumpeting one's triumphs. There is no doubt that, just as many characteristics of Canadian academic life before the 1970s were derived from the United Kingdom – this may no longer be true – a reluctance to sing one's own praise has been similarly inherited. When Bill Bigelow, the originator of hypothermia (operating at low body temperatures) in heart surgery, set out to tell his story in 1984, he called it "a uniquely Canadian story and there is some unawareness of this on the part of many Canadians … The powerful United States news media and the large-circulation magazines seriously influence Canadian thinking. They naturally feature the

American component of any medical advance, [while Canadians remain] insufficiently aware of the input of their scientists."[7]

Dean Catharine Whiteside noted this reticence somewhat ruefully in 2006: in the external reviews of many departments, "our academic units are generally regarded as outstanding and often considered not just the best in Canada, but many are recognized among the few top-ranked programs in the world. Nevertheless, I often hear the same message from non-Canadian reviewers and candidates for leadership positions: we are not doing a very good job at communicating our accomplishments. Our education programs are not as well known as they should be. Our researchers and their discoveries are not publicized enough … In short, we have over achieved and under sold."[8] This book is not an attempt to redress that balance, and the same reticence that restrains my colleagues from boosterism makes me squirm as well at the history of superlatives. There is none of that in here. But I do give credit where it is due, and this is not hagiography.

A big story makes for a long book. Too long? I take the time needed to delve into the lives of these scientists and clinicians, to find out who they were, and to document in detail their accomplishments – so that praise and blame alike will have a factual base. I know that at a certain point some readers may weary of having to navigate, for example, the history of the Department of Anatomy. Yet anatomy was once the queen of the medical sciences! One cannot understand how medicine has pivoted from the study of lesions to biochemistry to molecular genetics without following the rise – and fall – of the Department of Anatomy. The faculty has many departments; they all have their own stories, and all flood into the great narrative river of leadership and research that is medical progress.

Absorbing though it is to bring things up to the present, writing history requires some distance. For this book, the narrative stops around the year 2000, on the threshold of molecular medicine and a new millennium.

The cost of the research for this book was funded by a grant from the Dean's Office. Yet no one has looked over my shoulder and the text, the stories, and the conclusions are entirely of my own choosing. This is in no sense an official history. But it is a compelling history, and those who read the following pages cannot fail to be moved at the difference that medical science has made in the betterment of the lives of Canadians and of people everywhere.

2 At the Corner of College and University

For many years Toronto was considered a kind of dull Puritan enclave, of which American poet John Dos Passos said in 1917 to a friend, "So you've been to Toronto – don't you think it's a beastly place? Toronto on a Sunday morning … I have been there – and I admit, that I loathe it."[1] The city was once considered unpromising and uninspiring, the province of Ontario a sleepy hinterland, in which narrow-mindedness was cradled in the arms of parochialism.

When in March 1909 American educator Abraham Flexner visited Toronto on behalf of the Carnegie Foundation, as part of a continent-wide assessment of the quality of medical schools, he found that "[t]he laboratories are in point of construction and equipment among the best on the continent. Increasing attention has recently been devoted to the cultivation of research." Given his devastating indictments of many other medical schools of the day – isolated from university life, proprietary in nature, and uninterested in research – this was praise indeed. "The school has recently perfected a very intimate relationship with the new Toronto General Hospital," Flexner wrote – this in contrast to many rival faculties that had the most tenuous of hospital connections and little opportunity to teach the medical students at first hand about disease and treatment. Flexner said that the faculty "obtains complete control of the clinical advantages of some 500 beds. Students have free access to all wards, clinical laboratory, [and] dispensary."[2] Clearly in 1909 Toronto worked well, too, classed among the top medical schools of the continent.

A hundred years later Toronto is still among the top medical schools in North America. In terms of enrolment, it is in fact the largest and has been so for decades. In 1950 a somewhat bemused Dean Joseph MacFarlane reported to the faculty, "The school now has the doubtful distinction of being the largest medical undergraduate training centre on the continent."[3]

In understanding how Toronto grew, several themes will appear. One is research. The Faculty of Medicine reached a position of excellence if not size by

emphasizing from the get-go science as the underpinning of the art of medicine and, from the 1960s on, by emphasizing research as the expression of the scientific method. Why was research so important? In an interview with a student newspaper in 1987, Fred Lowy, who had become dean of medicine seven years previously, said, "Our primary purpose was to turn out superb health professionals, and ultimately to improve health care for the people of Canada."

Lowy asked rhetorically, "How is this done?" What made an institution first class, he said, "was the quality of its teachers and the quality of its students … Good students are attracted by good teachers. Students, particularly at the graduate level, contribute tremendously to the intellectual climate." And it was the capacity to conduct world-changing research that attracted good people to a place such as the University of Toronto. Lowy said, "Research is the creation of new knowledge – the conquering of our frontier. That is what makes it challenging. And the brightest people need to be challenged … There is a spirit of inquiry that prevails in contrast to merely passing on what was known and thought to be true in the past. People who teach in a strong research atmosphere are also preparing students for what is going to be discovered tomorrow, and ultimately this has a positive effect on patient care at the hospital and clinical levels."[4]

Research became the motor of the story. From the very beginning the Faculty of Medicine in Toronto was determinedly based upon science. But only in the 1960s did the enterprise begin to swell with the battalions of investigators and scads of dollars that laboratory research in particular demands. There was a wrenching change from the medicine of yore, dominated by gentleman-scholars who celebrated their achievements in tails at festive annual dinners, to the casual young men and women in running shoes and open-necked shirts of the lab world. "The prospect of the future leaves one alternating between elation and panic," said "Kager" Wightman in 1967, who was head of the Department of Medicine and something of an old boy himself, though a very nice one.[5]

But even though research animates the story, it is not the sole theme. As pointed out earlier, Toronto is a success because it is the only large city in North America to have many teaching hospitals but only one medical school. As a faculty report said in 1993, "No other metropolitan area in North America with a population over two million has only one medical school. The Toronto Academic Health Science Complex has nine fully affiliated teaching hospitals and serves as a major referral centre not only for Ontario but for Canada and North America."[6] "The striking feature of the University of Toronto, Faculty of Medicine," said Wendy Levinson, chair of medicine, in 2004, "is the single medical school in a large and multicultural city. Many cities of comparable size in North America have up to six medical schools competing for patients, trainees and faculty. In contrast, we have a network of multiple strong hospitals … all sharing the same Faculty of Medicine, Dean and Department structure."[7] (The Department of Medicine means internal medicine and medical specialty

disciplines; the Faculty of Medicine is, of course, all the departments together.) The hospitals brought a mix of individual excellences; the university offered top-notch students, trainees, and world-class scientists and clinicians. The faculty would concentrate not just an enormous amount of academic brainpower in these hospitals but a uniquely large and medically interesting patient population as well.

Standing at the corner of College Street and University Avenue today opens in every direction a vast perspective of hospitals and medical buildings that reaches, in fact, far beyond the line of sight to St Michael's Hospital on the east side, Sunnybrook Hospital to the north, and the Centre for Addiction and Mental Health's 27-acre campus to the south; the perspective opens farther north to the large suburban Baycrest, an academic health science centre focused on aging, and west to the Toronto Western Hospital of the University Health Network on Bathurst Street. It is a big scene, in other words. Dean David Naylor said in 2004, "The 'campus' for the Faculty of Medicine includes not only the academic area of the University but also the teaching hospitals and a wide variety of community clinics and agencies."[8] Thousands of clinicians and scientists work in these buildings. There were in 2004, for example, more than 400 full-time and 300 part-time faculty members in the Department of Medicine alone. It is one of the largest health-care complexes in the world.

Does size matter? This is where the hospitals enter the story, contributing their legions of clinicians and investigators at the research foundations to the faculty's core departments. As Eliot Phillipson, chair of medicine, said in 2000, "Good scientists do not like to work in isolation, but rather prefer to be where the action is … Their ultimate success will be determined more by 'the people they talk to,' than by fiscal and physical resources beyond their needs." For this reason Toronto had, in Phillipson's view, a "research environment" comparable to the best in the world.[9] Louis Siminovitch was one of the faculty's top scientists. He had studied in Paris at the Pasteur Institute and introduced molecular biology to the University of Toronto; in short, he was a figure of immense eminence. Siminovitch echoed Phillipson's comments about the importance of having coffee with smart people, telling President David Naylor in 2008, "We have underestimated, or more exactly, not understood the critical importance of collegiality. Naturally having been brought up at the Pasteur and the OCI [Ontario Cancer Institute], I have seen the enormous benefits of appropriate environments, fostered, of course, by leadership at the top."[10] So rubbing shoulders at the corner of College and University was crucial.

The changes that bring this narrative to the corner of College and University were massive. What others accompany the journey to this intersection?

One is the pivot from British to American medical styles. At the beginning, the faculty was massively turned towards the United Kingdom, and many of its barons were of Scottish origin. And a certain British style, now long lost on both sides of the Atlantic, tended to value teaching in small groups, even one-on-one

teaching, as the essence of training new physicians. The emphasis was on clinical care. Research, if it existed at all, was decidedly secondary. Contrast this with a hard-charging American style that sees the function of a Faculty of Medicine as generating new knowledge. Toronto shifts from the one to the other. In the early 1950s, Dean Joseph MacFarlane, unsettled by the tsunami of new techniques and treatments engulfing medicine, said, "This school has tried to hold an even balance between the constantly changing and more complicated methods of laboratory investigation, and the system of bedside teaching and theatre clinics with emphasis on the careful taking of history and painstaking physical examination. There are so many human ills that cannot be measured by any laboratory calculation. The student of medicine has much to gain from sound clinicians who still practice the art of medicine."[11] Yes, indeed, the art of medicine. The phrase sounds almost old-fashioned today in the hi-tech blur of international science. Internist Jack Laidlaw likes to talk about "the care of the patient that has the disease," as opposed to the "care of the disease," meaning understanding the factors in the patient's life that might influence the course of the disease.[12] In the fusty, Presbyterian Toronto of yore, the clinicians of the faculty did believe in the tradition of hands-on, personalized care; they believed in the importance of history taking and the clinical examination, as opposed to the interpretation of lab results – and that will emerge on many pages of this history.

One hesitates to introduce an administrative theme this early in the story, and yet it is an important one. One of the seminal events in the life of the faculty and the hospitals was the transition from a part-time to a full-time faculty that occurred during the 1960s and early 1970s at the same time that the medical school underwent a great expansion. Early in the 1960s, most senior clinicians still had private offices and appeared in the hospitals to supervise the residents in public clinics and to teach. The introduction of the Medical Care Act in 1966 changed all this because the federal government paid half of most hospital and physician services, making possible the appointment of clinicians who were full-time in the hospitals. Senior clinicians thus became hospital-based.

The faculty itself remained, however, department-based. One of the characteristics of the Toronto system is the ironclad dominance of the academic department, both in the basic sciences and in clinical medicine. "Institutional autonomy is a strong feature of this medical school," said one outside assessor in 1979.[13] Why is this interesting? Because the alternative is, as Dean Chute put it in 1969 as the faculty was convulsing about its governance, "a structure composed of the basic science departments and several hospitals."[14] A distinctive feature of the Toronto system is the presence of several large and powerful general teaching hospitals – at the outset the Toronto General Hospital (known as "The General" or TGH), the Toronto Western Hospital, and St Michael's Hospital. Under some circumstances, these hospitals could have swallowed the clinical departments, leaving the faculty with only a basic science

rump. Yet this didn't happen because of the determination of a series of deans to maintain the university department structure, even in the hospitals. "[Dean Chute] expressed a preference for general Faculty committees rather than committees whose members represent hospitals. The former preserve the concept of a medical school which is primarily an academic community."[15] Chute and his fellow deans appreciated that progress in research is enhanced in the context of an academic community, not in the bustle of the hospital ward.

By the beginning of the twenty-first century, it was the medical faculty that took the lead in enhancing the institutional partnership. Yet the hospitals had by no means been effaced. As Naylor, Peter Singer (head of the Joint Centre for Bioethics), and Lorraine Ferris (an administrative leader in the university's relations with the hospitals) put it in 2004, "The partnership respects the lead roles of the university in education, the hospitals in clinical care, and the overlapping nature of responsibility for research." Like Washington University and the Barnes-Jewish Hospital in St Louis, the U of T had adopted a model in which the university and the hospitals were governed more or less separately, their collaboration codified in a partnership agreement. For full-time clinical faculty, only 7 percent of their earnings came from the university, the rest from practice plans and from the hospitals. What gave the faculty its leverage? Hospital posts required university appointments, and the university facilitated the kind of stability that hospitals and practice plans all required for the smooth operation of a very large "academic health sciences complex."[16]

There is another overarching theme in this story: that of the tension between service and research. It, too, is a constant thread that runs through the history of the faculty's members and through the story of their students as well. For the clinicians of the teaching hospitals, the great tension was between their commitment as clinical teachers – demonstrating methods of examination and clinical findings to their young nestlings – and demands on their time as researchers. This same tension appeared historically in the experience of the students as well, who were in the 1960s and after torn between the desire of the research-oriented faculty to prepare them for careers as investigators and the desire of the community-oriented faculty to make them sensitive to social issues and caring in the face of human distress. Individual students will make their own choices given these options. Yet this tension is very much reflected in the curriculum: whether it is science-based or community-based. Even today it has not been entirely resolved. "This tension is a fundamental part of medical practice which spans generations," said Robert Byrick, former head of anaesthesia. "It will never be resolved because it is so fundamental to medicine. A balance is needed for individual practitioners, and for curriculum and for faculties – therefore this tension is a good experience for students as they need to cope with the challenge throughout their career."[17] This conflict between the demands of science and those of community involvement will persist on many pages of this volume.

In the background of this story are the dramatic changes that swept across medicine and its underlying sciences from the late nineteenth century onwards, changes that accelerated after the Second World War and that are almost overwhelming today with the rapidity of their advance. As William Boyd, professor of pathology in the Faculty of Medicine, said in the eighth edition of his *Textbook of Pathology* in 1970 – worldwide a trusted companion for medical students – "The student should be provided with a stream of knowledge, not a stagnant pool from which to drink. For the picture of disease is changing before our very eyes. Old diseases are passing away as the result of prevention and the assaults of modern therapy, but new ones are continually taking their place, including those that are the result of the well-meant but injudicious use of drugs. The inn that shelters for the night is not the journey's end."[18] Indeed not, and as the present author sits at the keyboard in 2012, in the new century and the new millennium, this account of the history of this distinguished faculty is also just a way station, and the future journey will demand its own authors.

3 An Afternoon in October 1903

At the opening ceremonies of the Medical Building in 1903: It was natural that we should endeavour to secure the presence here of some of the leading men of the larger and older institutions of learning … from the Mother Land.

President James Loudon[1]

The "New Laboratories"

In 1902 there were still several medical schools in Toronto, which made little sense. Late that year it was finally agreed, after fifteen years of intense wrangling between the two major rivals, that the medical school of Trinity University should be amalgamated into the Faculty of Medicine of the University of Toronto. After the new union was consummated in the summer of 1903, it seemed a good idea to schedule a celebration, together with a ceremony marking completion of the new medical building after two years' construction – the faculty's first building on the university campus since Dean Bulmer Nicol's 1850 medical building was "set in a pine grove on the east bank of Taddle Creek," long since vacated.[2] The celebration was scheduled for 1 October 1903. It was intended to be – and was – a splendid honorary occasion; a number of the big names in the international world of medical science had been summoned to Toronto for the event.

Charles Sherrington, Holt Professor of Physiology at the University of Liverpool, delivered the inaugural address. Students of neuroscience recognize Sherrington as the discoverer of the nervous integration of the body; he accepted the chair of physiology at Oxford ten years later and shared (with E.D. Adrian) the Nobel Prize for physiology/medicine in 1932.

William Henry Welch, the great pathologist, and William Osler, possibly the most famous physician in the Western world at the time, came up from Johns

Hopkins University in Baltimore. Osler was an Ontario boy, born in Bond Head, who had begun his medical career at the Toronto School of Medicine (TSM) after a year in divinity at Trinity College in 1867, forsaking both in 1870 for McGill; he then went on to Europe, the United States, and ultimately became a Regius professor and baronet at Oxford. He was evidently fond of Toronto and had previously attended the opening of the Biology Building in 1889. (He would later throw a special luncheon for all the professors of medicine in the United Kingdom in honour of Duncan Graham, who had in 1919 just become the first full-time professor of medicine in the British Empire.[3])

The great Harvard physiologist Henry Pickering Bowditch (some of whose main contributions were written in German) was invited up from Boston. He did not personally attend but provided a speech, read by a deputy, on a very interesting straw that was blowing in the wind: medicine was becoming a laboratory science. "Whereas thirty years ago Anatomy and Chemistry were the only departments of medicine in which laboratory methods were in use, we have now laboratories of physiology, pathology, pharmacology, hygiene, bacteriology and surgery, while anatomy has greatly extended the scope of laboratory work by including the allied sciences of histology and embryology, and Chemistry has become to a large extent the handmaiden of clinical medicine."[4] A hundred years later, not only would individual departments and divisions have their own laboratories, but individual clinicians as well. In the new millennium after 2000, the pathway from basic science to clinical medicine, which passed via the intermediate stage of "translational research," was thus expected to begin in the laboratory and climb upwards towards usefulness from there.

Lewellys Barker, also born and raised in Ontario – he was a medical graduate of the University of Toronto in 1890 – had come up from Chicago, where he was teaching at Rush Medical College. But Barker, whose parents evidently intended to name him Lewellyn but an *s* was mistaken for an *n*, would shortly forsake Chicago for Hopkins and initiate a brilliant medical career.

There were medical stars from Michigan and McGill, Harvard and the University of Pennsylvania. Oh, it was a splendid afternoon. Osler spoke that evening. On the next day, October 2, all the luminaries received honorary degrees. And that evening Dean Reeve, who was feeling distinctly unwell with a high fever throughout, mustered his forces enough to hold a great dinner.[5]

Richard Andrews Reeve, born in 1842 in Toronto and "of Yorkshire stock," was a medical graduate of Queen's University in 1865. Professor of ophthalmology and otology at the University of Toronto, he was "the first 'Specialist' appointed to the Toronto General Hospital, whose staff he joined in 1872," covering the entire eye, ear, nose, and throat range.[6] He also taught ophthalmology and otology at the Toronto School of Medicine, and when the faculty reopened for business in 1887 he was indeed one of the professors, becoming dean in 1896. It was in 1903 that Reeve orchestrated the union with Trinity Medical College, "in consequence of which," said his eulogist in 1919, "the number of students

greatly increased. The harmonizing of the views of these two groups of students required great patience, and much tact."[7]

So on that October afternoon, Dean Reeve, though feeling unwell, could look back on a task well done.

Who else spoke? There was Goldwin Smith, former Regius Professor of History at Oxford, who lived in Toronto and whose orations had adorned Toronto medicine for many of his "fourscore years." Smith delivered a stricture upon medical officiousness. "He admonished them not to prolong the agony of departure when the final summons came to join the innumerable caravan that moves to the pale realms of shade, and quoted with much feeling the words of Kent in Lear:

> 'Vex not his ghost: Oh, let him pass; he hates him
> That would upon the rack of this tough world
> Stretch him out longer.'"[8]

Thus it was an auspicious occasion, at a time when the international centre of gravity of medicine was just beginning to tip from German-speaking Europe to the Anglo-Saxon world. Of course the Holocaust would complete this tilt, as the Jewish clinicians and scientists who had been the glory of German medicine were either murdered or driven into emigration. But supremacy in medicine was just beginning to tip westward. It was, after all, at the University of Toronto and not Heidelberg that insulin was discovered in 1921. Yet on that October afternoon in 1903 Lewellys Barker "strongly advocated the view that every medical student should be able to read French and German."[9] Sixty years later he would be thought to have spoken in jest.

The medical building itself, called at the time the "New Laboratories," was a marvel of technology. It was built on the "unit system of laboratory" that Harvard's George Minot – who shared a Nobel Prize in 1934 for curing pernicious anemia with liver extract – had proposed: movable partitions could make the laboratories larger or smaller, accommodating classes of different sizes. In the opening ceremony on October 1, President James Loudon of the university "accepted the care of the buildings from the hands of the Chairman of the Board of Trustees and assured him that the Medical Faculty would use the buildings for the advancement of Medical science in a manner that will enhance the reputation of the University and redound to the benefit of the public."[10]

William Feasby, clinician and historian, describes the "many-windowed structure" of the new medical building. "Its cupolas standing high to match the central tower of the practical sciences building, its façade staring blankly across the main campus towards stately University College, it was indeed an imposing sight. There could be no doubt in anyone's mind that medical training was going to advance in Toronto."[11] (Just as a sad little footnote: many years later, in 1966 when the new Medical Sciences Building was about to be erected on the

site of the demolished Medical Building, Dean Hamilton noted scornfully that "the buildings being replaced are without distinction."[12])

President Loudon did touch upon an issue that had agitated the spirits in the past and that would be on people's minds for the next century to come: "There is just one point further to which I wish to refer very briefly, the question of State aid to the teaching of medicine. Old prejudices die hard. The old doctrine of prejudice, of no aid to the students of a lucrative profession, has been reiterated so often since the middle of the last century in Ontario that it may seem almost like heresy to dispute it. But, is the profession after all so very lucrative? (Applause). There are some prizes, it is true; but is the average of wealth in the profession above that of a comfortable living?" The answer was no, he said.[13]

Loudon concluded his talk by pointing out, "We are now entering upon an important forward movement in the work. The federation of Trinity with the University of Toronto is practically assured (applause) and on the strength of this the amalgamated medical faculties begin to-day [October 1] their work in this building. (Loud applause) Medical education through this step enters upon a new and higher stage of development and the future is full of hope (applause)."[14]

The university gymnasium, where the ceremonies were held, echoed with applause on October 1 and 2. But when William Keen, the professor of surgery at Jefferson Medical College in Philadelphia and author of the standard surgical textbook *Keen's System of Surgery*, addressed the special convocation intended for granting the honorary degrees on October 2, there was soon a reflective silence; it was a kind of silence that would echo across the rest of the new century as well. He was discussing the need for government aid to the medical schools. "The profits on the formerly wasted coal tar products [the basis of organic chemistry] alone have more than repaid Germany all her vast grants to her chemical laboratories in which the methods of utilizing this waste were discovered," he said. "And the pre-eminence of Germany in medical research has been maintained by similar expenditures upon her medical schools. Why should not the familiar label 'Made in Germany' be replaced by 'Made in Canada'?"[15] Interestingly, the founders of the faculty did not see German medicine as a model for Canadian. Alexander McPhedran said a few years later that they rejected the "German system" of medical education, which sought to educate well only the elite. "The object aimed at in the reorganization of the faculty was to make it possible … to train all who are graduated as safe and efficient physicians, able to meet any emergency, medical or surgical, promptly when time is of vital importance to the patient without waiting for the service of an expert, a matter of utmost importance in remote districts."[16]

The year 1903 was a big year. In the spring commencement, ninety-nine medical students graduated. Among the students marching in that procession there were some as yet unheralded stars. William Edward Gallie, later professor of surgery, was in the file. "Gallie has changed – heavens, how he has grown!"

mocked the students' yearbook. Next to a photo of a square-jawed young Gallie funned the editors, "For a young man of Ed's individuality, the search for a vocation was no perplexity, desiring above all things the life of a student … Gallie has always taken a decided interest in athletics, his prowess in hockey as Barrie's crack cover-point being noteworthy."[17] (Gallie came from Barrie, Ontario.)

Near Gallie in the line of graduates would have been John Gerald FitzGerald, who "enjoys the distinction of being the youngest man in the class." (FitzGerald, born in 1882, was seventeen when he began medicine in 1899.) "We venture to say that his later years will find him enjoying the esteem and confidence of a goodly number of both the sick and well."[18] This prediction was spot on, given that FitzGerald became dean of medicine in 1932 and travelled the world on behalf of the Rockefeller Foundation yet died, as seen later, in tragedy.

In addition to the dean, the post-1887 faculty had the position of secretary, whose job was partly to produce the annual budget. Adam Wright, an obstetrician, was the first, succeeded in 1893 by James Brebner, a non-physician, for a brief year; then in 1894 Alexander Primrose became secretary and would remain so until 1918, just before he assumed the deanship in 1920.

On that October afternoon in 1903, Primrose was thus professor of anatomy and secretary of the faculty. The early deans – William Aikins from 1887 to 1893,[19] Uzziel Ogden from 1893 to 1896, and Richard Andrews Reeve from 1896 to 1908 – would have marched at the head of the commencement procession. Yet all were basically men of the nineteenth century and none a notable figure. Primrose, by contrast, was a person of the future. He would be dean from 1920 to 1932, but even before then he did his utmost to steer the Faculty of Medicine in the direction of science. He was born in Pictou, Nova Scotia, in 1861, into a family with tea-planting interests in India that Primrose was intended to pursue. Yet an accident with a horse intervened. "I was kicked into surgery," he used to say. His broken leg was treated by the surgeon John Stewart of Halifax, a leading light of his day. Said fellow surgeon Robert Harris in a eulogy, "Alexander Primrose's contact with John Stewart opened his eyes to a vision – the world of surgery – which must have been fascinating indeed to any young man in the days when the whole world of medicine was being revolutionized by antisepsis," of which Stewart was a leading apostle.[20]

Like Stewart and many young men in the Maritimes, "Primmy" studied in Edinburgh, where he earned a bachelor of medicine degree in 1886 (an MB was later in Canada rebaptized as an "MD," or doctor of medicine); he interned at Middlesex Hospital in London, qualified MRCS (member of the Royal College of Surgeons) in England in 1888, then in September of that year returned to Canada to take up his new post as assistant demonstrator in anatomy at the University of Toronto, delivering lectures on topographical anatomy "in the brick building on the corner of Gerrard and Sackville Streets," where the teaching facilities of the faculty were situated from 1887 in succession to the Toronto School of Medicine.[21] In 1896 he became professor

of anatomy, during which time he apparently initiated the Toronto anatomy teaching tradition of drawing on the blackboard with both hands simultaneously. In 1897 he became associate professor of surgery and was promoted in 1918 to professor of surgery, which post he occupied until his retirement in 1932. He was also secretary of the Faculty Council from 1894 to 1918. Later he would be dean of medicine from 1920 to 1932 – when people tended to call him "Prim" rather than "Primmy" – but in the earlier years he functioned as a behind-the-scenes power broker and historian of the faculty. At his retirement in 1932, President Sir Robert Alexander Falconer, who himself retired that year, said of Primrose, "He has been to me an officer on whom I could lean, a friend to whom I could talk with intimacy, an evenly balanced gentleman – he happened fortunately to be freer from his practice than others and therefore he could do almost the work of a full time Dean and he gave his whole soul to the work."[22]

Why might Primrose be remembered? At his retirement in 1932 the author of the tribute to him in Faculty Council thought it might be that "[t]he great traditions of the Edinburgh School of Medicine which he brought to this university have left an impress for good that is quite inestimable."[23] The impress of Scotland upon the U of T in those years was palpable.

On that October evening in 1903, the ceremonies ended when the faculty entertained over a hundred guests at a sit-down dinner in the university dining hall, and James H. Richardson, "the sole survivor of the faculty of 1853," gave the evening a rather wistful close: "He referred very pathetically to the history of the early days and concluded his interesting reminiscences by thanking God that he had lived to see not only the restoration of the Medical Faculty and the good work it had accomplished in the last seventeen years, but also the final triumph of the unification of Medical teaching in the University."[24]

Oh, really?

A Glance Backward

The traditional medical school organization was laid down when its sole function was to train undergraduate medical students.[25]

Dean A. Lawrence Chute, 1968

The University of King's College Medical School, the forerunner of the Faculty of Medicine, opened its doors in 1843. It was an intimate little affair. James Richardson, one of the first two medical graduates (the other being a chap named Lyons) later recalled, "During the session of 1843–44, I was the sole regular attendant on Professor [William] Beaumont's lectures [on surgery], delivered in the old Parliament Buildings, and at his kind suggestion I would draw up my chair beside his, in front of the fireplace, while he read his carefully prepared lecture."[26]

The first dean of the medical faculty was William Bulmer Nicol, professor of botany and materia medica in the University of King's College from 1843 until its reconstitution as the University of Toronto in 1849. He and four other King's medical professors in 1844 were the first to be cross-appointed to the Toronto Hospital.[27] Nicol was appointed dean in 1850, administering his office for three years. William Canniff remembered Nicol's "kindly face" among his medical board examiners in 1854, along with "his high ability … In the diagnosis and prognosis of disease he was almost unequaled, certainly not excelled. In his bearing towards his confreres he was a model; as a professional friend he was the soul of honour."[28]

Growth was rapid. Through the Baldwin Act of 1849, King's College passed from the control of the Anglican Church and became the University of Toronto. Richardson continued, "The prosperity of the Medical department was phenomenal. In 1852–53 no less than sixty students were enrolled as attendants in my class, and the same success attended the other chairs … The dissecting room – the lecture theatres, were large and commodious – the [anatomical] museum was being built up. Everything was progressing most favourably, when suddenly a blow was struck which annihilated the Medical Faculty, and left the University of Toronto without one for about thirty years."[29]

In 1853 the United Provinces of Canada legislature, on the alleged grounds that popular sentiment opposed "state aid for a lucrative profession," abolished the fledgling medical and law schools as teaching faculties, leaving the university with simply an examining role in those fields for conferring degrees.[30] In reality, the act stemmed from a complex political intrigue, the details of which Richardson explained in his letter to President Loudon but that will be passed over here.[31]

Between the 1850s and 1880s a variety of private medical schools flourished in Toronto.[32] As historian Charles Godfrey shows, at one point in the 1870s and 1880s, there were four: the Toronto School of Medicine, the Trinity Medical School, the Victoria University Medical Department, and the Women's Medical College.[33]

The Toronto School of Medicine itself, the immediate forebear of the faculty and founded by John Rolph, was a pretty punk affair. The reading list for its students included "homeopathic text-books." The University of Toronto gave the exams, and the university would grant an MD degree upon completion of a thesis "upon some Medical Subject," one year after the MB or bachelor of medicine, the basic medical degree in Canada and the United Kingdom.[34]

The very existence of these private medical schools constituted a lobby against re-establishing the university Faculty of Medicine, as one history of the Medical Faculty put it, "on the ground that the State through the University should not engage in the teaching of professional subjects, which, it was also claimed, should also be left to private enterprise." This unusual doctrine did not prevail elsewhere and resulted in "disastrous consequences" for the provision of

medical services to the population of Ontario in these bleak years, as diplomas "were sold to candidates who had little or no training, professional or otherwise, and who consequently were unable to pass the required examinations."[35] (One result was the establishment in 1861 of a regulatory board that would, with the advent of Confederation in 1867, become the College of Physicians and Surgeons of Ontario. Medical historians R.D. Gidney and W.P.J. Millar write that the main difference between Canadian and American medical education in these years "was the establishment of superordinate licensing and examining boards with the power to determine standards of medical education and to make these standards the sine qua non of the license to practice."[36])

Among these private medical schools, however, one did stand out for something other than financial recompense to its founders and sometimes public benefit. That was the Women's Medical College, founded in 1883 "to enable women to secure a medical education to prepare them for work in the Foreign Mission Field and elsewhere."[37] The Women's Suffrage Club of Toronto had held a meeting to which various male dignitaries were invited, in the thought that they might lead the effort to found a medical institution for women. The Board of Trustees included, among others, a lawyer, James Beatty, as chair, as well as Mrs James Gooderham (distillery fortune) and Mrs John Harvie. The trustees purchased a house at 227 Sumach Street for $1,400, and the formal opening of the Women's Medical College occurred on 1 October 1883.[38] The faculty included many later stalwarts of the Faculty of Medicine as well as one woman, Augusta Stowe Gullen, the demonstrator of anatomy, who herself had just graduated in 1883 from Trinity Medical College in Toronto (Gullen is known as the first woman to graduate from a Canadian medical school. The daughter of Emily Stowe, the first woman to practice medicine in Canada, Augusta Stowe was married to Trinity classmate John B. Gullen; husband and wife both had practices at 461 Spadina Avenue.) During the first session, three women attended, two of them graduating in 1887. Michael Barrett, the inaugural dean, died in that year, and Alexander McPhedran – later head of medicine in the Faculty of Medicine of the University of Toronto – succeeded him.

From the viewpoint of exams, the college was affiliated with Trinity Medical College. In 1890 the Women's Medical College moved along the street to a larger facility at 291 Sumach and also became connected with the University of Toronto, students having the option of trying the examinations of both institutions. Another women's medical college had been founded in Kingston, Ontario, and in 1895 the Women's Medical College amalgamated with it, becoming the Ontario Medical College for Women.

In 1896 Emma Skinner-Gordon, who had just graduated from the Ontario Medical College for Women, "founded the first outpatient clinic for women, staffed by women doctors," according to the official history of women medical graduates of the U of T, on Sackville Street in connection with the Medical College for Women (the outpatient clinic moved to 18 Seaton Street in 1906).[39] Two

years later, in 1898 a dispensary, or clinic, devoted to women and staffed by Jennie Gray and Ida Lynd opened in the basement of the college. This became the nucleus of the Women's College Hospital (see pp. 561–577).

By 1906, a total of 112 women had graduated from the college, "including," as the student yearbook of the University of Toronto said, "23 who are Medical Missionaries in Persia, India, Ceylon, China, Japan, and amongst the Indians in our own North-West Territories." The yearbook further observed, "The College was founded to meet the need for Medical education for women … This movement really owed its origin to the feeling of Professors of the Faculty of Medicine in the University of Toronto that, although women were entitled to medical education, it was not advisable, perhaps not possible – at least, at that time – to give it to them in the University Medical Classes along with men." Yet these delicate male sensibilities evidently crumbled over time. In 1905 a government commission on the reorganization of the University of Toronto stipulated that the university should "provide for the medical education of women," and in 1906 in response to a recommendation of the Royal Commission on the university, the Women's Medical College was absorbed by the Faculty of Medicine of the university.[40] Jennie Smillie was one of the female medical students who had entered the Women's Medical College in 1906 (it was, as stated, officially the Ontario Medical College for Women, yet people continued to call it by its former name). She graduated with the rest of the medical class in 1909 and expressed the keenness with which this pioneering generation of young female physicians approached their mission: "We had girls from three different continents, yet in one respect we were all alike, we were all thirsting for knowledge: that thirst was the tie which bound us together, and we rejoiced in the hope that it would be satiated at this great fount of learning … How proudly we walked the hospitals with our stethoscopes and thermometers!"[41]

Thus the first generation of women physicians entered the world of medical practice. One of these early women medical graduates noted of the alumnae, "Some have become eminent, others have shown good ability, and all have done credit to themselves and honour to the sincerity, ability, and culture of the Dean and Faculty of their Alma Mater."[42]

The time between the end of the first Faculty of Medicine in 1853 and the reconstitution of the second in 1887 was a parlous period in the history of medicine in Ontario. In these years "not more than one in ten of the practitioners of medicine in this Province owed their degree to the University of Toronto," as one observer in the Faculty of Medicine wrote in 1903. Between 1853 and the reestablishment of the faculty in 1887, only 370 students, who had studied in the private medical schools or elsewhere, passed the medical exams of the university (which, as noted, continued to examine but not to teach). In 1881–2, the university senate raised the standard of requirements in the examinations, causing a great reduction in the number of successful candidates. There were fears that

the province might run out of physicians, and in 1886 negotiations began to re-establish the university Medical Faculty.[43]

Not only from the viewpoint of medical practice but from that of science as well were these private medical schools handicapped because they couldn't afford "microscopes and laboratory equipment for chemistry and physiology experiments," as historian Marianne Fedunkiw puts it: "Not having equipment for the emerging laboratory loosened schools' competitive grip on students. This, coupled with growing interest in the science of medicine brought back by graduates studying in Germany, led to the general feeling that Canadian medical schools were falling behind."[44] Primrose noted in an unpublished 1904 review meant for the president's eyes, "The schools were unable to train the students in the sciences because … they were unable to provide the extensive equipment and the necessary staff … required in modern scientific laboratories for efficient teaching. The only reasonable solution for the problem seemed to be the establishment of a teaching faculty in Medicine in the provincial university."[45]

In Ontario, the University Federation Act of 1887 brought the Medical Faculty of the University of Toronto back to life. The university would assimilate the private Toronto School of Medicine on the condition that "the new medical school would not be a financial drain on the slender resources of the university."[46] Primrose said, "The undergraduate class at once began with some two hundred and fifty students, and once more the University was in full control of medical teaching."[47]

In 1887 the medical students ferried back and forth between the university buildings, where the basic sciences of biology, chemistry, and physiology were taught, and the former building of the Toronto School of Medicine, located on Gerrard Street some distance away, opposite the pre-1913 Toronto General Hospital, "where anatomy and the clinical subjects were taught."[48]

William Thomas Aikins was the first dean of the refounded faculty. He was born in 1827 on a farm near Cookstown, Ontario, to a Northern Irish family who had come to Ontario via the United States. He attended John Rolph's Toronto School of Medicine from 1847 to 1849, then sought further training in surgery at the renowned Jefferson Medical College in Philadelphia, receiving an MD in 1850.[49] Aikins then returned to Toronto as John Rolph's partner in private practice. At Rolph's school from the early 1850s, Aikins lectured in anatomy and became a kind of general factotum and leading figure in the vicissitudes of Toronto medicine in the subsequent years. He agitated for the refoundation of the Faculty of Medicine and, having retired from his post at the Toronto General Hospital in 1880, in 1887 became the first dean of the new Faculty of Medicine. (He then lost the reelection in 1893.)[50] According to his biographer Charles Harris, Aikins was the product of a stern Calvinist upbringing. "His alleged lack of humour, like his beard, was a concession to Victorianism … When he died in 1897 it was said of him, 'He put a watch on the door of his lips, his words were

few and seasoned with grace.'"[51] This is a reminder of the Scottish Presbyterian ethic in which this faculty, and many of its early figures, had marinated.[52]

Under Aikins, rapid changes began in undergraduate medical education. Charles Godfrey, an Aikins biographer, writes, "While microscopy had been taught in a superficial manner [at the Toronto School of Medicine], now first year students learned the use of the instrument. Instruction in physiology and chemistry, previously lectured in a theoretical manner, was now taught in a laboratory and the students were required to perform experiments." Students were encouraged to relate this knowledge to pathology. The anatomists of the faculty imported into the dissecting room the methods used in Britain. "Clinical instruction doubled over the first three years and included more teaching in pathology and demonstrations of biopsies and their relation to the sick patient."[53] This was the beginning of the changes over which Abraham Flexner was to wax enthusiastic in 1910: "The laboratories and equipment [are] among the best on the continent."[54]

The hallmark of the faculty's refoundation in 1887 was science. Two years later the Biological Building was opened, and at the inauguration ceremony, as university historian Martin Friedland points out, all agreed that "the future of medicine lay in science."[55] The great science of the day was physiology, the term itself a kind of global description of the patient antemortem. Medical historian Pauline Mazumdar says of the understanding of "physiology" in those days, "In the hospital it explained the condition of the patient; in the school, [physiology explained] the anatomy [of] the cadaver."[56]

Ramsay Wright, though not a physician, was among the scientific fixtures of the faculty.[57] He held the chair of biology and physiology from 1887 to 1892, and when in 1892 Wright's student Archibald B. Macallum became professor of physiology, Wright continued to profess biology until 1912. An influential figure through external contacts such as Osler and Newell Martin, Wright also steered Toronto – and through his students a good deal of North American medicine – "towards the research ideal," as Gidney and Millar put it.[58] On that October afternoon in 1903, Osler referred especially to "the great work which Professor Ramsay Wright had done for the cause of scientific Medical education in Ontario."[59]

Macallum himself was a farm boy from eastern Ontario who turned into "a man of striking appearance and forceful personality, slender but over six feet in height, with a beard, moustache, and a leonine head."[60] He studied as an undergraduate at Toronto and later received a PhD from the newly founded Johns Hopkins University in 1888; there he was a student of the Englishman Henry Newell Martin, the first physiologist at Hopkins. Macallum also obtained an MB from the University of Toronto in 1890. At the refoundation of the faculty, Macallum became the instructor in physiology, a subject that he had already begun in 1885 to teach to the students of the Toronto School of Medicine. He later wrote, "In Canada the advancement of the science [of physiology] began

in 1885 when the writer, a student of Henry Newell Martin introduced in the teaching of medical students the modernized type of physiology, all under the influence of R. Ramsay Wright, an outstanding exponent of Biology in the University of Toronto."[61]

Macallum was primus inter pares of a small group of Wright's former students who drilled the spirit of science into medical undergraduates. Others included James McMurrich, the chair of anatomy, and John J. Mackenzie, the professor of pathology. "Both of them," pathological chemist John Bereford Leathes observes, "like Macallum [were] biologists before, as an after-thought they had studied medicine; a nucleus was formed for the band of Scots whose fighting leader was Macallum." Leathes continues, "On the clinical side they could count on the enlightened support of Alexander McPhedran, professor of medicine, and of Irving Cameron, professor of surgery, and in a few years this company completely transformed the medical school, gave it new ideals and built it on a sound foundation of biological science."[62]

In 1889 the new Biological Building was built on campus as a facility of the Faculty of Arts, although medical students attended the lectures in physiology. In 1891 the Museum Wing was added to the Biological Building, and on the top floor the medical students unofficially were instructed on dissections.[63] This led to public embarrassment for the university when the building's residential neighbours objected to human dissections – specifically contrary to the official agreement of its uses. Dean Walter Geikie of Trinity Medical School, which did not receive government grants for its facilities, also complained to the provincial government. The deception was apparent from the medical faculty's claim in its promotional recruitment advertisements of 1889 to 1892 that "[t]eaching of Anatomy [takes place] in the lecture room, dissection room … of the Medical College." President Wilson admitted privately to Chancellor Blake that "Dr. Geikie's statement could not be contradicted, so I said nothing about it."[64] Vice Chancellor Mulock mounted a spirited defence of the broad public interest while personally absorbing responsibility for the misunderstanding. The *Calendar* of the university for 1892–3 could then openly declare, "In the new Biological Building every facility is now provided for practical training in Biology and Physiology. The advantages of the well equipped Faculty of Arts are now available for the students in the Faculty of Medicine. The results cannot fail to elevate the standard of medical education in Ontario."[65]

Laboratory facilities for the students were available by the mid-1890s at the Toronto General Hospital: "The Faculty has in the General Hospital a laboratory for clinical pathology and chemistry, which has been furnished with microscopes and all apparatus required for the examination of all pathological fluids and specimens."[66] Lectures and demonstrations for the first- and second-year students took place at the university "and in the Anatomical Department in the west wing of the Biological Building." Third- and fourth-year lectures and demos took place in the TSM building of the Faculty of Medicine "on the corner of Gerrard and

Sackville streets, opposite the Toronto General Hospital."[67] Happy memories of the old Gerrard Street building were few. "The ancient pile looked dingy, smelled horribly and was ventilated like a tomb," said the med students.[68]

How demanding the first-year meds found the lectures! Fresh from high school in their little Ontario towns, they encountered Alexander Primrose lecturing in 1902 in anatomy:

> "Our first lecture – Anatomy, how shall I describe it? How vast and deep the subject seemed to our verdant minds! Dr Primrose left no doubt as to the importance of the osseous structure, and exhorted us not to forget the skin and superficial fascia. His drawings on the board were to us productions of a Raphael or Rembrandt. The display of color in the drawings, picturing each muscle, nerve or artery in a new hue was lavishly chameleonic, for hardly was our sketch finished when it vanished to be replaced by another of still more gaudy iridescence. Could it be that we had to worry and scratch our heads about the Torcular Herophyli or the Sustentaculum Tali? We had never heard the family physician say anything about these."[69]

The faculty was turning into a scientific heavyweight. Edward Gallie, later professor of surgery who began his studies at U of T in 1899, said, "Most of the teachers were on a fulltime basis and were members of departments in the Arts Faculty. A.B. Macallum and Ramsay Wright were outstanding. In Anatomy Alexander Primrose held full sway, and I never think of those days without thinking what a superb lecturer and demonstrator he was … It was this development that made it impossible for Trinity to compete with our School."[70] Trinity's merger with the faculty in 1903 was thus ineluctable.

Under the four-year program then in force, the class that graduated in 1903 had enrolled in 1899. The student yearbook sighed expansively, with tongue in cheek, "The Fall of 1899 was a memorable one. It saw the advent of an epoch in the history of the Medical Faculty … Dr. Primrose looked aghast as one after the other of the long line filed in, and each declared his intention of enlisting under the glorious red, white and black [the colours of the faculty]. Never before had such a throng found its way to the Biolog [Biological Building; the new Medical Building had not yet been built]."[71]

The Way Ahead

In those sunny days before the First World War, everything smacked of progress and growth. In 1906 control of the university was transferred from the provincial government to a Board of Governors. In 1907 Robert Falconer, a deeply literate Nova Scotia Presbyterian cleric educated at Edinburgh, became president, and wide horizons beckoned.

But there was one problem: financing a modern Faculty of Medicine on income derived almost solely from student tuition. "The only source of [operating]

income of the Faculty of Medicine," said Primrose in 1905, "is from the fees received from students for tuition." And although that might be adequate for the paltry salaries the professors received (most lived from the income of their private practices), it was inadequate to finance research. "The Faculty of Medicine of the State Institution cannot advance as it should do if there were no relief forthcoming from the Provincial Government. It is felt that the members of the Faculty of Medicine of the Provincial University have done perhaps more than their duty in paying such large amounts for equipment in the past and it is desirable that a rearrangement of the financial relations of the Faculty to the University should be made." Everywhere else in the Atlantic community, Primrose said, "the provision of research laboratories" was the wave of the future. It was similarly essential in Ontario "if this country is to keep abreast of the advances made in scientific medicine elsewhere." Surgery, for example, required research laboratories. "But [as well] research laboratories should be provided in such Departments as Pathology and Bacteriology, Physiology, Anatomy and Public Health … It is quite impossible with the present state of our finances to carry on research work to the extent reasonably to be expected from the Faculty of Medicine of the State University."[72]

This, too, was a theme that would echo down the halls of ivy across the next hundred years.

4 Getting Going

In the first third of the twentieth century, Canadians, as a colonial people, had a model before them of all that was excellent and wonderful – and that model was not the United States. It was England and – for the large contingent of physicians born here but with Scottish blood in them – Scotland. (One observer called attention in 1923, amid laughter, to "the dangers of having too many Scotsmen on the University faculty."[1]) When in 1934 President Cody wished to conjure up a model polity, it was not to "our Canadian democracy" that he referred but to "our British democracy."[2]

The faculty emulated the British model. After clinicians received the bachelor of medicine (MB) degree in Toronto, those with academic aspirations would almost certainly train a year or two further, in the hospitals of London, Oxford, and Cambridge. Of the class that graduated in 1905, four years later, one-third had already done postgraduate work in England or Europe.[3] And when departments wished to make truly stellar professorial appointments that would garner them more international visibility, it was not – as later – to the United States that they reached but to the United Kingdom. (Similarly, when UK institutions wished to appoint the best of the international ranch, they often reached to Canada, or as in the case of William Osler, who left Johns Hopkins for Oxford, to the Canadian-born.) It is wonderful that in 1909, when the Toronto General Hospital (TGH) wished to acknowledge the contributions of its ex-interns ("house staff") who had moved on in life, it summoned them back to an annual dinner and awarded the scientifically most promising of them a "gold-headed cane." "It is expected that the cane will be made in London, England, and will be patterned after the celebrated gold-headed cane of medical history, which is now in the possession of the Royal College of Physicians of London, England."[4] The story is either cringe-inducing, as evidence of colonial toadery, or endearing, as a sign of a powerful transatlantic connection from which these young Canadian physicians drew strength and knowledge. One recalls, however, that the traffic

went two ways. It wasn't just a bunch of grateful colonials waving Union Jacks and gawking at Westminster. Plenty of Brits were happy to come to Toronto for their "BTA" qualification (been to America). British-born Barrie Fairley, who joined the Department of Anesthesia at the Toronto General Hospital in 1955, said, "Toronto at that time was a tremendously attractive medical centre for a young British doctor to visit or work. In the UK we had all been brought up on textbooks by such authors as Best and Taylor (Physiology), Grant (Anatomy), and Boyd (Pathology) and the overall quality of medicine was extremely high."[5]

In any event, it is impossible to understand the unfolding story without knowing the Mother Country is clucking in the background.

Hospitals

Just as the Faculty of Medicine was rising on campus, the hospitals themselves were in the whirlwind of change from hospices to therapeutic institutions. Toronto belonged to a much bigger picture of change in the nature of general hospitals all across Atlantic civilization. Previously, hospitals had been the last refuge of those who had no other place to go, the terminally ill who had no families, the aged, and the destitute. They had been refuges, not treatment centres. Such were the changes that swept over surgery in the 1880s and after, as the new principles of antiseptic and aseptic surgery made major operations possible, that hospitals rapidly became places where the sick could be cured. The progress in drug therapeutics was somewhat less dramatic but perceptible: a flood of analgesics and anesthetics reached the marketplace that promised the relief of pain and sedation for the distressed. Hospital birth became sought out instead of home birth because anesthesia eased the pain of labour – and quick surgical interventions could save the baby's life in case of a complication. Finally, there were big changes in the clinical investigation with the introduction of the ophthalmoscope and the blood pressure cuff late in the century and the X-ray in 1896.

Toronto was not resistant to these trends. As TGH superintendent John Nelson Elliott Brown pointed out in 1905, "Up to within a comparatively recent period the services of the hospital were sought for by those only who, as the result of poverty, or accident, were unable to receive medical aid under other auspices. The popular sentiment, therefore, toward the hospital, was one of timidity rather than of confidence." Under such circumstances, few save the desperate sought out hospital care. "Today," Brown continued, "all this is changed. Owing to the remarkable advance in all departments of medical science, and also to the wider dissemination of general knowledge, the popular attitude toward the hospital has undergone a great transformation. In contrast with former time hospital aid is now sought for by rich and poor alike, not only for the graver, but for many of the minor ailments."[6]

Superintendent Brown emphasized the research role of the hospitals as well as healing. The hospital must "do all in its power to add to the general stock

of medical knowledge. Inasmuch as humanity generally is benefited by such additions, it may be said that [research] is scarcely less important than [treatment]. In order that a hospital may fulfill this part of its functions, it cannot be too strongly emphasized that its requirements will be much greater than if it confined itself solely to the routine care of the sick."[7] Here sounds strongly a note that will accompany this book throughout: research as a shared mission of hospitals and faculty.

Primrose

In 1920 Alexander Primrose succeeded Charles K. Clarke as dean of the faculty. Because the deanship was then still a part-time job, he continued as professor of surgery. A native of Pictou, Nova Scotia, born into a family of Scottish origin, Primrose studied medicine at the historic University of Edinburgh (birthplace of modern medicine late in the eighteenth century), earning an MB in 1886. He interned at the Middlesex Hospital in London, migrating to Canada in 1889. He was professor of anatomy in Toronto from 1892 to 1906, followed by tenure as associate professor, then professor of clinical surgery until his retirement at the end of 1931. During the First World War he served alongside Duncan Graham and J.J. Mackenzie with the University of Toronto Base Hospital at Salonika in Greece. He was on staff at both TGH and the Hospital for Sick Children. As secretary of the faculty from 1894 to 1918, he belonged to that core group of clinicians and academics who constituted the institutional memory of the faculty.

As dean, Primrose radiated good will and optimism. In his Christmas message in 1926 he said, "The immediate future is full of promise for further development. In the Faculty of Medicine we have received large bequests of money which have enabled us to plan expansion on a scale hitherto impossible."[8] He reflected pride in the faculty and believed, not necessarily incorrectly, that "[t]he student graduating from the University of Toronto possesses qualifications unsurpassed in English speaking countries."[9]

Medicine

The Department of Medicine is the soul of a teaching hospital. Referred to often as "internal medicine," the Department of Medicine embraces the diagnosis and pharmaceutical treatment of just about everything that can go wrong with the body, except the organs of reproduction and the head and neck. From the very beginning in 1887, Toronto had professors of medicine and the teaching hospitals had dedicated Departments of Medicine.

The first important lecturer on clinical medicine was Alexander McPhedran. He was born in 1847 in Halton County, Ontario, where he completed his high school education and taught for some years in the public schools. In 1873 he enrolled in the Toronto School of Medicine, was said to have a brilliant course

as a student, and graduated with a MB in 1876. He received an appointment in 1885 at the Hospital for Sick Children and later at St Michael's Hospital and TGH. In 1887, at the refounding of the faculty, McPhedran was a lecturer on clinical medicine; he became associate professor in 1898. In 1900 Graham died and McPhedran succeeded him as professor and head of the Department of Medicine, stepping down in 1919. As Dean FitzGerald said on the occasion of McPhedran's passing in 1935, "[He] was a great physician and one of the most distinguished clinician teachers of his time. There can be little doubt that he exercised a greater influence than any other on the minds of the students of his day. He was clear, sharp and incisive. His clinical lectures were models of lucidity and comprehensiveness … No former student of Professor McPhedran will ever cease to be grateful to him for the part he played in their professional training."[10] McPhedran railed against the tiny sums available to the Department of Medicine to encourage clinical investigation and created a small fund with this purpose in view. "After his retirement the Board of Governors of the University supplemented this fund and established the Alexander McPhedran Research Fellowship in Clinical Medicine."[11]

The Eaton Gift, and Duncan Graham Becomes Professor of Medicine

The professors were all practicing physicians until Duncan Graham became the first full-time professor of medicine in 1919 and Clarence L. Starr the first full-time professor of surgery in 1921.

Flash back for a moment to 1903, the year in which Edward Gallie, later professor of surgery, graduated from medical school. He recalled a system of clinical training that was virtually nonexistent: a total of seventeen internships for the entire city, no postgraduate training in any specialty, mobs of medical students surging in and out of operating rooms, searching for shards of surgical learning and spreading microbes in great clouds. It was at this point that Joseph Flavelle, the packing-house magnate, became chairman of the Board of Trustees of the Toronto General Hospital and resolved to change things. Flavelle decided, first, in Gallie's words, "that a new General Hospital must be built somewhere in the neighbourhood of the University, and that it must be closely linked with the University for teaching purposes and for scientific investigations; second, that henceforth the character of services rendered or work accomplished should form the only basis for claims to appointment or promotion on the staff."[12] The new Toronto General Hospital was relocated to College Street in 1913 and the stage set for reform.

The reorganization that Flavelle desired was somewhat delayed owing to circumstances, but in 1919 a gift from the Eaton family created the faculty's first full-time professorship, and Duncan Graham – whatever ill might be said about his medical ideas or his personal style – is entitled to enormous credit for

remedying the catastrophic situation that Gallie encountered upon graduating in 1903. How did this happen?

When Alexander McPhedran retired as professor of medicine in 1919, William Goldie, an internist, is said to have taken up the torch to have the professorship of medicine become a "full-time" position (a concept then all the rage in North American medicine), meaning that academic clinicians should have salaries rather than living from the fees of their clinical practices, in order to devote themselves to teaching and research. (Full-timers would also not be permitted to accept fees by way of moonlighting.) Goldie, born in Ayr, Ontario, in 1873, the son of a flour miller, had graduated as silver medalist in medicine at the University of Toronto in 1896 and taught in the Department of Pathology and Bacteriology before joining the Department of Medicine. He became physician-in-charge of infectious diseases at the children's hospital, until retiring from the post in 1911 after a reorganization. From 1913 to 1919 Goldie directed the outpatient service of the Toronto General Hospital (with time out for overseas duty in 1918–19). Goldie was among the most influential members of the faculty in these early days, and Edward Gallie remembers that "the man to whom we owe eternal gratitude, not only for amalgamation [with Trinity] but also for the most important organizational advances that have been made since that time, is William Goldie," who used the question-and-answer method in teaching. "His method was new, and to some of us, such as John Oille, quite thrilling." "Without doubt he was the father of our present School."[13]

Thus, at the end of the First World War, Goldie found himself contemplating the deficient organization of the Department of Medicine. When the chair of medicine became vacant, Goldie apparently persuaded President Sir Robert Falconer that the position should be full time. Then it became necessary to drum up a full-time salary. Having convinced the president, Goldie had to find the means to accomplish his idea. According to one source, "Fortunately, two of [Goldie's] patients were Sir John Eaton … and his wife Flora, a former nurse." Eaton apparently turned the funds over to Goldie, saying, "Here's the money. You do what you like with it."[14]

In 1918 while in England, Goldie set out to find someone suitable, meeting young Duncan Graham, a U of T medical graduate in 1905 and at the time at the No. 4 General Hospital in Basingstoke. Given his background in laboratory medicine, Graham was a bit of a surprising choice, yet he had demonstrated administrative competency at the Basingstoke hospital and argued for "the basic sciences as the basis of good medical practice." Here the model was Johns Hopkins University, where the system of medical education that Osler had helped install was based on a thorough knowledge of physiology and pathology and on "the teaching hospital [as] an integral part of the university with full time professors," as Graham's eulogist put it. "In looking for a new Professor of Medicine at Toronto, the University was influenced by this new type of

medical education in which the professor would be primarily a teacher and not a busy consultant."[15]

Thus, Goldie wrote to Eaton of Graham, "He is not only respected but liked even though he is an exacting task-master." Indeed. At the personal level, Graham was not the most endearing of men. Said Helen "Nell" Farquharson, Ray Farquharson's daughter, who had known Graham in the latter days of his career, "Duncan Graham frightened people. He was very severe, very autocratic … Most staff people, I think, were a bit intimidated by him." Unlike his cousin the bulky surgeon Roscoe Graham, Duncan "was sort of a little person, but rather gruff, and his word was law." In reviewing a book about Graham, one of his students, Arthur Squires, who seems on the whole rather well disposed to his former professor, nonetheless describes Graham as "ruthless."[16]

Graham may have elicited this sense of unease in people because he was something of a racist and quite uninhibited about displaying it. In 1923 at a meeting of the Faculty Council, "Professor Graham asked if some steps could be taken to exclude coloured students from the medical course, owing to the difficulty in providing for their clinical instruction." The faculty did not vote on the matter.[17] (For Graham's attitudes towards Jews, see chapter 22.)

Duncan Graham was born near Ivan in Ontario in 1882 and may have owed some of his less winning characteristics to an unforgiving father in childhood. As his eulogist comments, "His mother died while he was fairly young and I am sure residents have often wondered whether his father pounced on young Duncan for a wrong observation or an illogical conclusion in the same way that Professor Graham would demolish the feeble arguments of a resident presenting a patient at rounds."

As mentioned, Graham graduated in medicine at the University of Toronto in 1905, then worked as a bacteriologist for the Ontario Board of Health; in 1906 he was placed in charge of the Pathological Laboratories at TGH. He also spent two years as a pathologist and physician to the Pittsburgh Sanatorium in Pittsburgh, Pennsylvania. This was followed by two years at London, Dresden, Heidelberg, and Vienna. He returned to Canada in 1911 as a lecturer in bacteriology at U of T, then returned to Berlin in 1913 for graduate work in internal medicine, forced to return, however, because of the outbreak of war. He went overseas in 1915, first to England, then to France, then to Salonika with the University of Toronto medical unit. He finished the war at Basingstoke, where Goldie encountered him.

Osler, now Regius Professor of Medicine at Oxford, got wind of Toronto's interest in Graham as a candidate for the professorship of medicine and took an active interest in the appointment, convening in 1918 a big dinner for Graham at Oxford and inviting "15 or 20 of the outstanding medical scientists and other scientists … This was a tremendous event that allowed Professor Graham to build up associations with outstanding [researchers] in England who later provided training posts for Dr. Graham's residents." Osler encouraged Graham to

accept the post, and it was possibly through Osler that Graham insisted "that the Professor of Medicine be the Physician-in-Chief as well. This was not the model in the English schools but was at Hopkins."[18] Graham, who already had studied extensively in the United States and on the Continent, was therefore not Anglophiliac in his thinking about medical training, not an adept of the English emphasis on close teaching rapport, but rather a fan of the American system – as manifest at Hopkins – that saw science as the basis of medical practice and the university teaching hospital as its locus.

In many ways, Hopkins had been the model for the new Toronto General Hospital; its image as a research university had guided the 1906 Royal Commission on the University of Toronto, and indeed Osler in 1906 had been invited to be president of U of T. Michael Bliss observes, "Hopkins was also the model for the full-time movement, which the Rockefeller people were pressing on everyone else, and that was almost certainly in the minds of the Torontonians and the Eatons by 1918."[19] So despite the many ways in which the faculty remained an appendage of London and Edinburgh, Graham was bent upon importing the Hopkins model and doing so with a relentlessness that changed forever teaching and research in internal medicine in Toronto.

In April 1919 Falconer announced that Graham would become the head of the medical clinic at TGH, effective 1 July 1919. Graham was not pleased at what he found. In scientific terms the Department of Medicine was somnolent. A 1920 report stated baldly, "Members of the Staff have devoted the greater portion of their available time to a thorough clinical and laboratory investigation of the patients on the Wards … and to teaching the large number of Students. Little or no time has been available for pure research."[20] Graham proceeded to chop away the dead wood, dismissing 40 percent of the existing staff and causing "a heated debate in the press and legislature."[21]

At this point the aforementioned Eaton gift came in handy. Sir John and Lady Eaton, who had acquired their fortune from the department store named after the Eaton family, decided in 1919 to make a charitable gift to the Faculty of Medicine of $25,000 per year for a period of twenty years. Of the $25,000, $5,000 was to go to pediatrics, a subunit of medicine; of the $20,000 to medicine, $10,000 would support the Eaton professor's salary. As Duncan Graham told university president Sidney Smith in 1946 (as the university struggled to reconstitute the paper trail of these events, hopeful of further grants – the original correspondence had all been discarded), "It was agreed that the rest of the fund should be used chiefly in the payment of salaries to promising young men joining the staff of the Department in order that they might devote their whole time for a few years to hospital work, teaching and research."[22] Interestingly, only in 1932 was the chair of medicine designated by the Board of Governors "the Sir John and Lady Eaton Chair of Medicine."[23]

Kager Wightman, later professor of medicine, had his own take on the Eaton grant: "The purpose of this gift was to provide the same kind of single-minded

devotion to the development of the Department and its scientific basis as had the earlier establishment of full-time professorships in the Departments of Pathology, Physiology etc. An effort was then made to recruit physicians who combined clinical skills with sufficient scientific training and experience to be able to interpret the advances of science to students and practitioners of medicine."[24] The emphasis here was not on research but on clinical care and medical education.

Just as a footnote: an agreement in 1946 between Lady Eaton and the Board of Governors placed the choice of incumbent of the chair in the hands of a committee of five members, two of whom were to be nominated by the Eaton Company, a perquisite that the university would later deny to other benefactors of named chairs.[25]

The Eaton grant greatly improved the laboratory situation at TGH. Graham later told Sidney Smith, "In 1919 the Department of Medicine had no laboratory facilities in the University or in the Toronto General Hospital for clinical research, and in the first ten years was dependent upon other departments in the University for laboratory facilities. After the establishment of three small medical laboratories on the medical wards of the hospital and [later new animal facilities in the Banting Institute] the clinical research programme of the department expanded. Until 1931 the budget of the department was more than adequate to meet its needs."[26] Perhaps in his enthusiasm to impress President Smith with the generosity of the Eatons, Graham neglected to mention a second grant of $20,000 that he and fellow internist John Oille had obtained from Mrs A.R. Clarke in 1921 "for the purpose of establishing a better Laboratory service in the Medical Wards of the Hospital." Two six-bed wards were closed to make room for the new laboratories.[27]

Before Graham's arrival at TGH in 1919, there had been four independent medical services under the direction of scientifically undistinguished but socially quite considerable figures such as – to use their wartime ranks – General John Taylor Fotheringham, Colonel Graham Chambers, and Major William Brown Thistle. In September 1919 Graham retired them all involuntarily and brought in his own crew. The former chieftains were really quite grumpy about this and sued.[28]

Graham later explained how he had reorganized the medical services of "The General": "Four clinicians were appointed as Ward Supervisors, and patients were segregated according to types of disease. Five clinicians specially qualified in laboratory methods … were appointed, and they devoted eight hours a day to necessary examinations of patients. The Outpatient Department was placed under clinicians specially qualified in general medicine. The majority of teachers in Clinical Medicine are in private practice, but have charge of a certain number of patients in the hospital and teach without salary from four to nine hours a week."[29] In the large public wards of TGH, care was free for the patients and the doctors worked without honoraria, making a living from the fees they

received from the patients in the private pavilion and from their private practices. At that point the General had 193 medical teaching beds, with 21 teachers and 250 students.

In 1921 the university decided to expand the full-time system. The small honoraria for clinical services were no longer to be paid to members of the Department of Medicine, or to other departments, "with the purpose of devoting part of the money to salaries for such of the staff in the Clinical Departments as are not dependent for their living upon private practice and are giving all or nearly all their time to the work of the University."[30] This was the beginning of what were later called practice plans, donating a percentage of billings to a department fund for teaching and research.

These events permit one to place Graham's tenure in perspective. He reorganized the Department of Medicine into a unified service capable of being science-driven. But he himself was not a scholarly giant. He bought into a number of the colossally wrong-headed ideas of his epoch, such as the notion that sites of "focal infection" in the gums or the bowel (always infected!) might produce symptoms of distant disease. "If focal infection is the primary cause of ill-health," Graham wrote in 1931, "and all foci of infection have been found and can be eradicated, one may expect that the patient's health will improve, and a cure or a marked amelioration of symptoms result."[31] This advice led to an orgy of sacrificial offerings of wisdom teeth and tonsils.

With the Eaton money, Graham brought on board a whole cohort of young physicians who would provide the scientific steel of the Department of Medicine and would be known as "Clinicians to the Toronto General Hospital." Goldie headed one of the divisions of the service, a post that he held until his retirement in 1928.[32]

Among the new recruits was Walter R. Campbell, born in 1890 in Port Robinson, Ontario, and a matriculant of St Catharines Collegiate Institute. He had earned a BA in sciences at U of T in 1911 and in 1912–13 trained in biochemistry under Macallum. As a medical student he was a member of the Society for Experimental Medicine, and when he graduated with an MB in 1915 he was keen to do scientific work.[33] Campbell was the uncle of obstetrician Jim Goodwin, and Goodwin recalled, "He was an absolutely brilliant man. The medical students used to call him 'Dynamite' because he was a very boring lecturer, but that was the only thing that was boring about him." (The 1947 Daffydil, the medical students' annual music-hall production, saluted Campbell thus: "Oh Dynamite your accents sweet are never loud and strong. / So we're going to help conclude them with this therapeutic song; / So if we call you 'Mumbles' it's because you've got a fault, / We think you ruined your vocal cords with iodized salt."[34])

Goodwin's father died early, and Walter Campbell took Jim Goodwin under his wing, especially after Goodwin fell ill for a time. "Walter would come over and sit by my bed and tell me stories about the old days. He had treated diabetic

mothers before insulin. It was a matter of keeping them alive – the babies would die like flies, and the mothers would die, too, they could die, and he was telling me how you would balance dietary input and exercise, to see them through this sort of thing. This was before insulin."[35]

Graham also brought Andrew Almon Fletcher into the Department of Medicine. Born in 1913 in Kingston, Ontario, in a university professor's family (his father held the chair of Latin at Queen's), Fletcher took one year of arts at the University of Toronto, then transferred into the five-year medicine program. He was president of his fifth-year class, graduating in 1913, and chose as his motto, "Story! God bless you! I have none to tell you, sir."[36] But shortly he would, just as Campbell, be part of the insulin story.

The Eaton grant, and then the Rockefeller grant just afterwards which created a full-time professor of surgery, banished with a stroke the educational chaos Gallie had encountered upon graduation in 1903. Gallie said, "These gentlemen [Starr in surgery, Graham in medicine, and Alan Brown in pediatrics] "began the gradual building up of their staffs and the promotion of education and research which has led to the wonderful prominence that this hospital [the Hospital for Sick Children] now occupies among the children's hospitals of the world."[37]

Surgery

In the late nineteenth century internationally, surgery replaced anatomical pathology as the queen of the medical sciences, the specialty leading the scientific advances. Surgeons, unlike physicians, had always been able to do useful things, such as limb amputations, managing haemorrhoids, and setting fractures. But with the discovery of the principle of surgical cleanliness (antisepsis and asepsis) and of anesthetics, surgery opened the way to the body's major cavities: abdomen, chest, and cranium. A royal road was trod upon that outdistanced all other specialties in delivering benefits to humankind. This happened ineluctably in Toronto as elsewhere.

The Department of Surgery was founded in 1887 by the dean of the faculty, William T. Aikins, who as professor of surgery directed surgical affairs for the next ten years.[38] At Aikins's death in 1897, Irving Heward Cameron, who had been professor of "clinical surgery" at the beginning of the department's history, became chair. Cameron was the son of a chief justice of the Court of Common Pleas of Ontario. He began as a law student, then took his MB in 1874 from the Toronto School of Medicine.[39] He achieved the fellowship of the Royal College of Surgeons in England before returning to Toronto. In England he "adopted Listerism, recently promulgated," as his biographer puts it. It is positive that he was an early adept of antiseptic principles in surgery. Less promisingly, "he remained an exponent of Lister's methods [spraying the operative field with phenol] long after others had been converted to asepticism." In Toronto,

Cameron was a student of Aikins, and after the refoundation of the faculty, in 1892 Cameron became professor of clinical surgery.[40] In a world of increasingly aseptic surgery (keeping microbes from reaching the wound) Cameron did not use gloves. "Yet the kindly healing of his operative wounds," said his eulogist, "and his own freedom from infections were ample evidence of the efficiency of the antiseptic method."[41]

The stamp of Britain upon him, Cameron's main contribution to the reorganization of the Toronto General Hospital that began in 1906 was to suggest changing its name to "The Toronto Royal Infirmary and University Hospital."[42] "Never operate," he counseled, "just to see what is inside," excluding the exploratory laparotomy.

In those days a different concept of the doctor-patient relationship prevailed. According to Cameron's eulogist C.W. Harris, "The story is told that the late Mr Timothy Eaton had fallen and injured his hip. Mr. Cameron [as he preferred to be addressed] was called in and during the course of his examination caused the patient pain; the latter understandably used his uninjured limb to violently push the doctor away. Mr Cameron went to the bottom of the room, picked up his hat and gloves, bowed and left the room."[43] A colleague then attended Mr Eaton. Cameron headed the department until his retirement in 1920.

Contemporaries would have ranked highly a third early surgeon, F.N.G. Starr. Frederic Newton Gisborne Starr, a Toronto School of Medicine graduate in 1889, joined the Faculty of Medicine in 1891 as a demonstrator in surgery after postgraduate study in England, Germany, and France. In 1923 he became professor of clinical surgery, retiring ten years later, for a total of over forty years of service. Starr much embodied the old school of medical instruction. On the occasion of his retirement in 1933 a colleague said, "He was more interested in teaching the craft as a master to apprentice than as a clinical or didactic lecturer. To the small groups of senior students, house surgeons and personal assistants about him, he was a teacher of the very highest order."[44]

One sees here coming alive a principle of medical education quite distinctive to Toronto and borrowed from the United Kingdom: the apprenticeship system of instruction in which small groups of trainees cluster about the master for one-on-one teaching. It was a tradition in which the master teachers were quite indifferent to research, and excellence in training was the desideratum. The system was dislodged with some difficulty by the wholesale rush to research in the 1960s.

One more name is important: George A. Peters, at the Hospital for Sick Children, in July 1899 made the first contribution of the Department of Surgery to the international scientific literature when he successfully transplanted the ureters into the rectum of a two-year-old child who had both an ectopic bladder and a procident rectum. "The occurrence of both in one subject makes the sufferer's life so unutterably miserable, and renders him so repulsive to his friends, that life without relief is well-nigh intolerable." Peters devised a method of

giving the infant some control over urination by finding a route for the transplantation of the ureters into the rectum outside the peritoneum (the incising of this protective layer of the abdomen, in those pre-antibiotic days, often led to catastrophic infections). "If thus converting the rectum into a cloaca," Peters wrote, "the patient can hold his urine even from one to three or five hours, he is surely in a much better position to take his part in life than he could possibly be with the best apology for a bladder that can be expected to result from any flap operation."[45] (A flap operation means raising a layer of tissue.) Gallie later wrote, "I saw some of these patients several years after their operations, completely changed from a condition of abject misery to one of comparatively happy childhood. They had gradually developed control of the rectum so that the urine could be retained for several hours, without mishap."[46] This initiated a long tradition of transplantation surgery in Toronto.

Peters himself, as so many of his colleagues, was shaped in the soil of small-town Ontario. Born in 1859 in Eramosa, he received an MB in 1886, a year before the refoundation of the faculty. He then studied in England and became the first Toronto surgeon to become "FRCS Eng." (Fellow of the Royal College of Surgeons of England).[47] He joined the Department of Surgery in 1892, serving until his early death in 1907. The procedure he perfected became known as the Lenden-Peters operation. Peters was also appointed to the General and enjoyed there a "brilliant career" in a wide variety of surgical treatments, among them the surgical removal of both lobes of the thyroid for exophthalmic goiter (which the Mayo brothers initiated and Peters introduced to Canada in 1904[48]); he also perfected in 1898 the making of easily removable plaster-of-Paris casts.[49]

Gallie remembered of Peters, "As a clinical teacher he was superb. One day he called me over to a child with a distended abdomen and asked me to put my stethoscope on the lower half of the abdomen and tell him what I heard. I listened for a while, expecting to hear intestinal gurgling, but before long became aware of the loud beating of the heart. Then he suggested that I listen for breath sounds and sure enough they were quite audible. This was 'Peters' sign' for general peritonitis."[50]

Peters died at age forty-seven of "angina pectoris," likely to have been a heart attack. Gallie said, "Even when he knew the end was approaching he dictated to his stenographer a description of the radiating pains of this dread disease as exemplified in his own case, and pointed out where they differed from the ordinarily accepted ideas. That is the kind of man he was."[51]

Around the time of the First World War, the organization of surgery at the Toronto General Hospital had become highly fragmented. In 1920 there were four different surgical services with 150 beds. There was a laboratory consisting of "a small room off two of the Surgical wards in which facilities are available for testing urine and making blood counts." If one wanted to do surgical research – which meant animal work – one needed go over to the Pathology Building.[52]

Yet change was coming. A donation from the Rockefeller Foundation announced on New Year's Day 1920 resulted in the appointment of a full-time professor of surgery. The Rockefeller Foundation envisioned the gift explicitly as a reward for Canada's participation in the First World War. The letter of transmittal said, "The Canadian people are our near neighbors. They are closely bound to us by ties of race, language and international friendship; and they have without stint sacrificed themselves, their youth and their resources, to the end that democracy might be saved and extended."[53] The grant served as a counterweight to the full-time professor of medicine, whom the Eatons had funded. In 1920 several Rockefeller executives undertook a tour of Canadian medical schools and found, "The most satisfactory school is the University of Toronto with McGill a close second."[54] In fact, McGill and Toronto received $1 million apiece from Rockefeller and among the uses to which Toronto put the money was the full-time professorship of surgery.

The faculty struck a committee, headed by Primrose, to consider the allocation among departments of the Rockefeller grant. In a working paper of 16 February 1920, the committee outlined the future organization of the Department of Surgery, recommending, "that there be one Head of the Department of Surgery … The Head of the Department shall have full control of the administration of the entire department in the University, hospitals and surgical laboratories [the Hospital for Sick Children, the Toronto Western Hospital, and St Michael's also had departments of surgery and some laboratories]. The Head of the Department should be in charge of surgical wards, out door and emergency departments of the Toronto General Hospital. This will necessitate doing away with separate surgical services and the establishment of a single surgical service in this hospital. All patients admitted to the public ward beds in the Hospital will be under the direct charge of the Head of the Department," who would also be the surgeon-in-chief at the Toronto General Hospital. "He shall have absolute control of matters in connection with teaching in all Hospitals granting privileges to the University." He would also have control of hiring. This coming professor might operate on some private patients, but only at TGH and for no more than three hours a day. "His mornings from nine to one must be devoted to his duties as Head of the Department."[55] The report could not have been clearer: the disorganization of the old system must be replaced by a Duncan Graham–style titan.

Two weeks later, on 1 March 1920, the committee recommended to the Faculty Council that in medicine, surgery, and obstetrics and gynecology, a single full-time head should be appointed who would organize undergraduate teaching effectively and provide "a system of training for the junior members of the staff which will in the course of a few years result in the production of well trained specialists who … may be chosen to fill senior positions on teaching staffs in this University or elsewhere." In each hospital there would be but a single service in surgery, medicine, and obstetrics-gynecology, led by a single powerful

figure who "will be chief and in control."[56] This was a system that had proved itself admirably at Johns Hopkins University and now would show equal merit at Toronto.

Who might be competent to fill such a post in surgery? Of these early figures, the only one to graduate from Toronto was Clarence L. Starr. Born in 1868, he finished his studies at U of T with an MB in 1890, then trained at the Hospital for Ruptured and Crippled Children in New York. In New York, he earned an MD from Bellevue Hospital Medical School, "from which," his eulogist tells, "his father had graduated twenty-five years before." Clarence Starr then studied in England and Germany, returning to Toronto in 1893 to begin practice. In 1894 he received a staff appointment at the Hospital for Sick Children. "Here he laid the foundation for the development of orthopaedic surgery." But the next year he left for the General and worked as first assistant to I.H. Cameron until 1911, when he found himself again back at the children's hospital, but this time as surgeon-in-chief. He served in England during the war, then upon his recall to Canada in 1918 was involved in organizing veterans hospitals. "It was largely as a result of his high qualities as an organizer and administrator of surgical services that he was appointed in 1921, Professor of Surgery in the University of Toronto and Surgeon-in-Chief at the Toronto General Hospital." At the General, as Cameron's successor, he reorganized the Department of Surgery.[57] His salary and other departmental expenses were paid by the annual $50,000 interest from the $1 million Rockefeller grant.[58]

As the new professor of surgery, Clarence Starr proceeded to clean house as Duncan Graham had done in medicine. Said a hostile account of events in 1921 in the medical press, "The general plan of reorganization … was that already adopted by the Department of Medicine, namely, one so-called 'full-time' professor endowed with very large powers of his staff, the policy of teaching and the care of patients in the wards and out-patient department of the General Hospital." The plan, the article said, had been conceived during absence on military duty of Professor Cameron. "The new professor of surgery, Clarence L. Starr, immediately set to work to reorganize his department, with the final result that … in Sept 1921 four men (all well-known surgeons long in the service of the hospital and the university), received notice of their retirement." They were Herbert A. Bruce, James A. Roberts, John McCollum, and Andrew Moorhead. "Two men over the statutory age-limit, the late Dr. [George Arthur] Bingham and the Dean of the Faculty, Dr. Primrose were retained."[59] (There followed a big protest on the part of those in medicine and surgery who had been let go, which I shall not follow in detail.[60]) Cameron, who had been in the Department of Surgery since 1887, was thus rather unceremoniously booted out.

Dean Primrose was beside himself with pleasure at the new Department of Surgery: "The existing organization has attracted widespread attention, many prominent teachers from abroad have visited our clinics and laboratories for the purpose of learning our methods and have been most favourably impressed.

Eulogistic references have appeared in the medical press in England."[61] Clearly, this was the acme of praise. But the reorganization of medicine and surgery into departments with a powerful full-time head was not received everywhere with applause, certainly not by the physicians who were discontinued as not up to speed. They protested and in October 1922 the provincial legislature set up a special committee to hold hearings on the changes. On 12 Jan. 1923, Starr testified "that when he first took office there were seven services not co-ordinated and since then there had been two reorganizations." Starr said, "I have no doubt that the present unit system is the best." He said there were staff conferences twice a month, "and each division knew the work of the other division." This was the system he had learned at the children's hospital.[62]

Powerful letters from respected authorities in favour of the changes were weighed in the balance. On 30 January, a letter of Alexander McPhedran, the former professor of medicine and clinical medicine from 1898 to 1918, was read out: under the old system graduate instruction was impossible and the best people were lost to the United States for further training. It would be, he said, as though "the department stores should stock each floor with every variety of goods under an independent head; in fact, establish as many stores as floors." George Young, a member of the Department of Medicine for the previous thirteen years, added, in the words of the newspaper reporter, that "the present system provides the staff with better facilities for teaching medicine and gives a unity which was sadly lacking before … Looking back, he could not see how an effective reorganization could have been accomplished without the services of some one who could give his full time to the work."[63] (The special committee issued a begrudging report that was not further acted upon,[64] and the reforms in medicine and surgery remained in place.)

Starr himself continued in office until his death in 1929. It is interesting to see what the faculty considered to be his greatest honour. To be sure, in 1926 he had served as temporary chief surgeon at the Peter Bent Brigham Hospital in Boston, substituting for Harvey Cushing, the great American neurosurgeon. Yet for the faculty the crowning summit of his career, as things were then conceived, lay in England. "Just before his death he received what he looked upon as the highest and most flattering honour of his career, when he was proposed by the governors of St Bartholomew's Hospital in London for appointment to the temporary post of Director of the Department of Surgery,"[65] briefly to replace the incumbent, George Gask, whose name has not survived in the annals of surgery. But this was Toronto in the 1920s: it was a British colony.

Blood Transfusion

From the Hospital for Sick Children (HSC) came an early scientific triumph. Lawrence Bruce Robertson, a junior assistant surgeon at HSC, helped popularize the practice of blood transfusion. Born in Toronto in 1885 into a prosperous

Scottish merchant family, Robertson was educated at Upper Canada College and graduated in arts in 1907 from U of T. Two years later he became a medical graduate, interning at the Hospital for Sick Children, of which his uncle, publisher John Ross Robertson, was board chairman. (On graduation Lawrence Robertson chose as his motto for the yearbook, "The deepest rivers flow with least sound."[66]) In 1910 he trained in pediatric and orthopedic surgery at Bellevue Hospital in New York, learning there, evidently from Edward Lindeman, the concept of blood transfusion, and was evidently further instructed in the technique at the Boston Children's Hospital. By 1913 he was back at the HSC in Toronto as an assistant surgeon, introducing blood transfusion.[67] In 1914 he and Alan Brown wrote an article in the *Canadian Medical Association Journal* on the transfusion of blood in "infants and young children," followed by several further.[68]

At the outbreak of war he stepped forward, as did so many academic physicians, for military service. It was in 1915, as he was serving as a captain in the Canadian Army Medical Corps, that he introduced blood transfusion to British military physicians. For soldiers in shock, saline solution was already being widely administered, but, Robertson said in 1916, "The introduction of whole fresh blood into the circulation at once not only helps to restore the depleted bulk of circulating fluid, but provides the patients with [a replacement for lost blood]." Was compatibility a problem? "The milder degrees of incompatibility between the donor's blood and that of the recipient result usually in a slight chill and a rise in temperature … These symptoms are not uncommon even between familial bloods, and should occasion no alarm."[69] Blood transfusion saved the lives of thousands of men. One wounded British officer told Robertson in 1917 of his post-operative progress, "I owe most of all to your handling of my amputations and transfusion at the CCS [Casualty Clearing Station]."[70]

In the army Robertson had also attempted partial exchange transfusion – called "exsanguination-transfusion" – on two soldiers with carbon monoxide poisoning. Back at HSC in 1921, Robertson applied this treatment to "haemorrhagic disease of the newly born" (later called erythroblastosis fetalis): "In a few cases horse serum or human blood injected subcutaneously may be used successfully, but to ensure a cure blood transfusion is beyond any question the best and most reliable procedure." At the children's hospital they used a syringe cannula. In this population, Robertson felt that ascertaining the blood group was secondary. In a series of forty cases, thirty-six had survived.[71] (William Mustard resumed this approach again at HSC in 1948, see p. 102.) In 1921 Robertson also pioneered blood transfusion for severely burned children.[72] In a twelve-month period between 1922 and 1923, a total of 516 transfusions were undertaken at HSC. "The results show brilliant success," said G. Kerr Cross, a laboratory physician in Alan Brown's Department of Paediatrics.[73] Robertson died tragically in 1923 at age thirty-seven of pneumonia following influenza.

Gallie

A page was turned when Clarence Starr died on Christmas Day 1928. William Gallie, the great figure in the history of surgery in Toronto, now strides front and centre. In 1929 Gallie succeeded Starr as professor of surgery. Among Gallie's achievements were bringing St Michael's Hospital and Toronto Western Hospital into the university training program and creating the "Gallie Course." As one of his students put it, "When he became Professor of Surgery in 1929 … the University hospital facilities, supplemented by the resources of the Departments of Physiology, Anatomy and Pathology, were organized into an integrated whole for the purpose of training surgeons … This was the first organized plan for the systematic training of surgeons in Canada. His pupils have made it known as the Gallie Course in Surgery."[74]

Gallie, who was called "W.E," started out as an orthopedic surgeon, the first subspecialty in Toronto to split off from general surgery, and with his appointment in 1906 as a resident at the Hospital for Sick Children, he continued Starr's work.

Gallie was born in Barrie, Ontario, in 1883, his father the owner of a lumber mill. As a youngster he was an avid athlete and played hockey for Barrie teams – and later for the Meds. He graduated in medicine from the faculty in 1903, as his students Robert Harris and Robert Janes point out, "the youngest member of his class." While a student, Gallie played on the U of T hockey team – and coached varsity in intercollegiate matches before the war. (In 1910 he upgraded his MB degree to an MD.) After interning at the Hospital for Sick Children and the Toronto General Hospital, he spent a year at the Hospital for Ruptured and Crippled Children in New York. When he entered the Hospital for Sick Children, or HSC, his chief was Clarence Starr, the only other surgeon on staff. In these years, there weren't so many surgeons at TGH either, and the staff at each hospital often went back and forth, often holding simultaneous appointments. Thus Gallie progressed at HSC from junior surgeon to associate surgeon until in 1921 he succeeded Starr as surgeon-in-chief at HSC when Starr became surgeon-in-chief at TGH and professor of surgery at the university. After Gallie took over from Starr in 1929, he remained at both posts until he retired in 1947.

Starr and Gallie worked hard at expanding the surgery staff at both hospitals with promising young residents. Said Dean Joseph MacFarlane in 1959 at Gallie's death, "[At TGH Gallie] quickly recognized the need for a rational system of resident training and education for young Canadians who wished to meet the ever increasing challenge of surgery and of the various specialties which were rapidly developing within the parent discipline."[75]

By all accounts this was a tight little band of brothers, men knit together by the common challenge of building the discipline of surgery in these exciting early years when everything remained to be discovered. Gallie's students happily called themselves "Gallie slaves."[76] Starr recruited, for example, David

Edwin Robertson, who graduated with an MB from Toronto in 1907, three years after Gallie. Gallie and Robertson became fast friends, writing together in 1919 one of the earliest papers on bone metabolism and transplantation, a matter of great interest in treating the casualties of the war.[77] In 1936 Robertson and two companions became "trapped by the collapse of the shaft in the lower levels of a gold mine at Moose River in Nova Scotia." As Janes and Harris tell the story, "[Gallie's] frantic rush across one-third of the continent was followed by ten days of desperate efforts and agonized suspense. By good fortune that bordered on the miraculous two were finally brought out alive. One of them was 'D.E.R [David Edwin Robertson].'"

Gallie's reputation spread during the First World War as a result of his bone-grafting operations at the Davisville Military Hospital. Resting upon animal experimentation, this research gave rise to Gallie and Arthur LeMesurier's concept of "living sutures," or transplantation of the fascia (the tissue that wraps the muscles and other body organs) "into strips and sheets and other shapes which facilitated its use in the repair of defects." They published a preliminary report in 1921,[78] then in 1922 elaborated "the free transplantation of fascia and tendon": "It is obviously more rational to use as ligaments, tendons, or sutures, material which we know will live and retain its normal characteristics."[79] "In these forms," say Harris and Janes, "the fascia survived and became a part of the tissue into which it had been transplanted." These sutures were used for the repair of injured ligaments and to repair failed previous hernia operations. (Gallie said the idea had occurred to him "after absently watching someone darn a hole in a pair of socks with a cross-stitch."[80]) In 1923, two years after the introduction of the procedure, they reported great success in reuniting portions of the abdominal wall in patients –typically wounded veterans – whose previous hernia repairs had failed. "If these principles are followed, we believe we have at our command a method of dealing with doubtful and difficult hernias which will give general satisfaction and considerably widen the field to which surgical treatment is applicable."[81] This became known as the "Gallie operation."

The Gallie Course

In 1931 the Royal College of Surgeons of Canada was established, beginning a program of fellowship examinations in surgery. In that same year Gallie organized the first systematic training program in Canada for surgeons to help them pass their examinations. The larger significance of the Royal College exams was that, as Bigelow said, "It involved persuading the surgeons in charge of hospital surgery divisions at the university that it was no longer their privilege to appoint their own residents."[82] The training of surgeons was to be standardized as had been done in England. The immediate significance is that it made William Gallie the central figure in the history of surgical training in Canada.

The Gallie Course was originally conceived as a small, elite program. Gallie wrote in June 1932, "This year has seen the establishment in this school of a definite plan for the postgraduate training for surgeons. Hitherto it has been impossible for a graduate to receive adequate training here in general surgery and he has been forced to seek it in hospitals abroad." But now the Boards of Trustees of the general and children's hospitals had approved a three-year course "which it is hoped will place the teaching of surgery in this school on a high level. In this plan the Toronto General Hospital offers to graduates of approved medical schools who have served one year as rotating interns … two appointments of three years' and one of two years' duration which are arranged as follows."

He described the three-year program, which was to become the standard for training surgeons in Toronto:

- First year: six months' medicine and six months' pathology
- Second year: one year as senior house surgeon on a general surgical division
- Third year: one of the following options: (a) six months as house surgeon at HSC plus six months in a genitourinary department; (b) six months at HSC plus six months' neurosurgery at TGH; (c) six months' neurosurgery at TGH (this latter option evidently for those uninterested in pediatrics).[83]

"This plan has been in operation now for a full year [NB it was founded 1930–1]. It at once became very popular with our interns." Seventeen had applied for the three spots.

Gallie said the program had two choice features:

> First, these house surgeons are no longer treated as chance wayfarers through the wards of the hospital, but are accepted as apprentices to the art of surgery and are so treated by the attending staff. Second, when they accept their appointments they automatically enter the course for the postgraduate degree master of surgery and they undertake to pursue the course of study in anatomy and physiology and in surgery and pathology required for that degree. During the past year these house surgeons spent two evenings a week in the dissecting room and one afternoon with an instructor in physiology, so that they will be prepared for the primary examination for the master's degree and the diploma of fellowship in the Royal College of Surgeons of Canada or England, as they may choose.[84]

The Gallie program thus offered an intensive training program for trainees in surgery ("house surgeons") and a method of keeping them up to date on advances in science – the extra study in anatomy and physiology – to propel surgery away from its historical origins as a handicraft, alongside cabinetmaking and leather-tanning, that trained recruits through apprenticeships.

Then a kind of layering began, with the elite on top and the journeyman surgeons bound for nonacademic careers on the bottom. In the 1934–5 session,

Gallie said that originally enrolment in the master of surgery course was required for all surgical "interns" (meaning residents). Yet the department had to give this up because most interns, "owing to the pressure of work at the hospital, have been unable to take advantage of the opportunity provided by the Departments of Anatomy and Physiology to prepare for the primary examination. To get over this difficulty, we are now giving preference in the appointment of surgical internes to men who have already passed the 'Primary' examination for the MS [master of surgery] or for Fellowship in one of the Royal Colleges, and as a result almost all of our internes have obtained one of the diplomas before coming into Surgery [i.e., into the Gallie Course]."[85] This would be a surgical elite.

By the late 1930s there were clear levels. In 1938 Gallie described postgraduate training in surgery; one notes how small the number of core enrollees was. "In Surgery one must recognize three pretty distinct groups among the graduates: first, the ordinary Bachelor or Doctor of Medicine who has learned the fundamentals and is qualified to enter general practice … ; second, the master surgeon who has had several years of special training in Anatomy, Physiology, Pathology and Medicine, and a thorough apprenticeship in hospitals as assistant to a group of hospital surgeons; third, the very small group who because of their ability, enthusiasm and devotion to work are likely to be leaders and may be expected to become actual contributors to the science. It is in the development of groups II and III that this department has found the greatest enjoyment in the last decade."[86]

Thus began the training program for surgeons that would soon people the academic surgical departments of Canada and many American centres as well.

Gordon Murray

The overwhelming scientific figure in the Department of Surgery before the Second World War was not, however, Gallie but Gordon Murray, who pioneered the clinical uses of heparin before the war and heart surgery after the war. He was not a product of the Gallie program. Born in Oxford County, Ontario, in 1894 of a Scottish immigrant father, Murray was a real farm boy and later in life even returned to work the family farm. He attended high school in Stratford, Ontario, then enlisted in 1915. He evidently experienced great horrors in the trenches. Bigelow said later, "All four Murray brothers joined up – three were old enough for overseas duty, one was killed and Gordon, who experienced Ypres, Somme and Vimy Ridge, was blown up and buried [in the dirt of a shell explosion] with major wounds. It is said that the site in which he was buried was taken by the Germans, then recaptured before he was disinterred and discovered to be alive."[87]

Murray earned his MB from Toronto in 1921 at age twenty-seven, typical of so many of the men in this cohort of returning, battle-scarred veterans. As a

medical student he was anything but an antisocial recluse, having served, for example, as secretary of the Daffydil committee.[88] Once graduated, he apprenticed with a physician in Stratford, performing "fix it up" operations on the kitchen table when needed, which gave him the idea that he would like to be a surgeon. Murray spent a few months at the Mayo Clinic in Rochester, Minnesota, as a junior assistant pathologist, then left for England.

In London, Murray trained for the next six years, first as resident medical officer at the West End Hospital in 1922, then as house surgeon at Hampstead General Hospital and several other facilities. By 1926, according to historian Shelley McKellar, he had "performed over two hundred major operations during his various rotations." He passed the demanding fellowship examination of the Royal College of Surgeons in England on the first attempt; 76 of the 110 who tried it failed. Having acquired a comprehensive knowledge of anatomy in London, "[h]e saw how American surgeons, unsure of their anatomy, wasted time and lacked confidence. In contrast, Murray's mastery of anatomy and his extensive operating experience in London hospitals made him a skilful and confident surgeon." Murray's London experience also made him a determined Anglophile – he was later known to wear spats.[89]

On returning to Toronto, Clarence Starr offered him a one-year surgical residency at TGH; because it didn't start for another half year, in 1927 Murray spent some time in New York as house surgeon at New York Hospital under Eugene Pool, who introduced him to experimental research, trying new techniques first on animals. "Murray was delighted," says McKellar, "by the American enthusiasm for experimentation and innovation." He also worked at the Hospital for Ruptured and Crippled Children. Later in 1927 Murray returned to the General in Toronto and from 1929 on was senior surgeon in the hospital and associate professor of surgery in the university.

At the Toronto General Hospital Murray came into his own. McKellar writes, "Starr recognized Murray as a good fit with the new philosophy and direction of the Department of Surgery. Murray's surgical apprenticeships, teaching experience, and interest in research corresponded well with the faculty's growing orientation towards medical science … Starr sought to replace the older, 'scientifically untrained' practitioners in the department with surgeon-scientists such as Murray – younger, more scientifically trained surgeons, who alongside their private practices were oriented towards surgical research and clinical instruction."[90] This, then, was the background of the heparin story.[91]

In the early 1930s Charles Best interested Murray in bringing heparin, an anticoagulant that Best and others were developing (see pp. 65–66, into the clinic. Goodness knows, the surgeons were ready for it, given that pulmonary emboli (blood clots in large arteries supplying blood to the lungs) were almost universally fatal and the various thrombi of the circulatory system equally devastating. Patients with pulmonary emboli would, in Bigelow's terms, become "extremely breathless, blue, and sometimes in shock." Pre-heparin the only

treatments available were morphine and putting the patients in an oxygen tent. Bigelow continued, "In 1930 everyone knew that when a hospital patient was placed in an oxygen tent it was a very bad sign. In those days, to describe a very sick relative a layman, with eyes uplifted and a look of resignation, merely said, 'She's in an oxygen tent.'"[92]

Murray brought heparin to the bedside. By the 1934–5 session Gallie said, "Dr. Gordon Murray, with the assistance and supervision of Professor Best, has continued the study of the application of the knowledge already acquired in regard to heparin, to clinical surgery … They have now arrived at a stage where the experiment may be tried on patients."[93] The following year, one of the assistant fellows, apparently Fredrick Wilkinson, was, as Gallie said, "released for six months from his regular clinical work in order that he may study those patients in whom heparin is used. It is hoped that the drug will prove of value in preventing thrombosis in blood-vessels which have been operated upon, and will lessen the incidence of pulmonary embolism after operations."[94]

By 1936–7 the animal trials had been positive enough, and heparin refined to sufficient purity, that human trials were possible. Gallie said in June 1937, "The drug has now been administered to over one hundred patients without deleterious effect and with what seem to be promising results as far as thrombosis is concerned." Soon the hundred patients would be a thousand, he said, and one had great hopes. In August 1937 Murray and Best filed their first report.[95] Funds "for this long and expensive research" had come from the Connaught Laboratories, from the Banting Foundation, and from contributions to the Department of Surgery of James Stanley McLean, president and founder of Canada Packers, the great Canadian meatpacking house, who sprang to fund the research when the Connaught Labs could no longer bear the expense.[96] In the 1937–8 session Murray gave "this expensive biological product" to a wide range of patients: "It is now definitively established that it is of great value in all operations on blood vessels and the heart, in preventing thrombosis."[97]

Murray now went one step farther, from being Best's tutee on heparin to opening up heart and blood vessel surgery. Gallie said in 1938, "Encouraged by the definite value of heparin in preventing thrombosis … Dr Murray has enlarged the field of blood vessel suture to include free transplants of veins to replace gaps in arteries. This can be done with a high percentage of success in animals … He has also made some progress in an attempt to replace damaged heart valves."[98] Two years later, in 1940, Murray presented heparin to a clinical public.[99] This was research with worldwide repercussions, and Murray knew it. In the early 1940s, he told the medical students, "I know you won't believe this, but I predict that before too many years have passed, cardiac and vascular surgery will be the commonest type of surgery done."[100]

But it was heparin, not heart surgery, that was the big prewar story. Writing in June 1939, Gallie praised the great clinical success that heparin had obtained: "As time goes on, it becomes more and more apparent that the tendency

to thrombosis, following injury to the intima [lining] of blood-vessels, can be controlled by the intravenous administration of heparin, and that by its use many surgical disasters can be avoided." He gave as an example, "In a case of accidental rupture of the brachial [upper arm] artery, an end-to-end suture was performed with immediate and permanent restoration of the pulse at the wrist." Gallie added presciently, "This suggests at once, that in wartime it might be possible sometimes to repair wounds of great vessels and so save lives and limbs."[101]

It is an interesting comment on Duncan Graham, the cranky professor of medicine, that he refused to allow heparin onto the medical wards of the Toronto General Hospital because of the imagined risk of haemorrhage.[102] Thus, though heparin made its triumphal march into the clinic in the late 1930s, it was in the surgical clinic and not the medical. As historian Susan Bélanger comments, "This rejection by an important part of the Toronto medical establishment seems to have had a profound effect on Murray, who for the rest of his career felt himself to be at odds with the TGH and the university."[103]

Insulin

In November 1920, a few days before his twenty-ninth birthday, Frederick Banting, a surgeon who had graduated from the University of Toronto in the wartime class of 1917, visited physiology professor John James Rickard Macleod to discuss the theory that the islets of Langerhans of the pancreas might give off an internal secretion somehow related to diabetes. Banting, who was then working as a demonstrator at the University of Western Ontario, had previously spoken to the professors of physiology and pharmacology there, who recommended that he consult Macleod, an international expert on diabetes and carbohydrate metabolism. Macleod, a Scotsman, had served as professor of physiology at Western Reserve University from 1903 to 1918, then joined the Faculty of Medicine of the University of Toronto as professor of physiology. In 1920, at forty-four, he was also appointed associate dean.[104] He retained a Scottish brogue, as the student satirical sheet *Epistaxis* gently mocked, "I must airge you to poot in the fool time in the laboratory."[105]

Thus Macleod came to the insulin story. Macleod told Banting that the research "was worth trying,"[106] but, as Macleod later said, "I also told Dr. Banting that it would be useless to attempt this work unless he was prepared to give up all his time for several months to the problem, but that if he agreed to do this, I would place every facility at his disposal and show him how the investigation should be planned and conducted."[107] Banting also discussed the plan with Clarence Starr, the professor of surgery in Toronto, under whom he had trained and considered a mentor; Starr advised him to concentrate on building his career in London.[108]

Banting was back to Toronto the following spring, with a keen interest in the subject but little experience in laboratory investigation.[109] He was knocking on the door of a Department of Physiology with a long and distinguished history. It has been seen how Archibald Macallum, who founded an independent chair of physiology in 1891, had pioneered the study of physiology in North America. Macleod himself, as Mladen Vranic notes, "was one of the world's leading physiologists, with a particular reputation in the field of carbohydrate metabolism." It was a department, in Vranic's words, "not only well-equipped to carry out the necessary experiments which led to the discovery of insulin, but one willing to gamble on an idea."[110]

"[Banting] arrived about the middle of May, 1921," Macleod later wrote. "I found that Dr. Banting had only a superficial text-book knowledge of the work that had been done on the effects of pancreatic extracts in diabetes."[111] Macleod suggested various approaches, assisted on the first experimental operation, and was involved with the research for nearly a month before leaving for Scotland in mid-June. According to historian Michael Bliss, who has written the definitive history of the discovery of insulin, "the widely held belief that Macleod set Banting and Best to work and then immediately left town for his holidays is not true."[112] During one of the early meetings, Macleod introduced Banting to his two student assistants, Charles Best and Clark Noble, both fourth-year students in the Honours Physiology and Biochemistry course planning to do the master's program with him the next year. Noble later confirmed that the two tossed a coin to see who would work with Banting first; Best won and ended up spending nearly the whole summer on the project.[113] Most of Best's accounts of the discovery omit the coin-tossing incident,[114] and his son and biographer Henry calls it a myth.[115] Best was then twenty-two, just finishing his undergraduate degree with an undergraduate's knowledge of diabetes from Professor Macleod's lectures. His aunt had died in a diabetic coma in 1918 – merely three years previously – so he had a certain personal involvement in the subject. Banting described the working conditions in the small room they had been assigned in the Medical Building during the summer heat, "The place where we were operating was not fit to be called an operating room. Aseptic work had not been done in it for some years. The floor could not be scrubbed properly or the water would go through on the laboratories below … There were dirty windows above the unsterilizable wooden operating table. The operating linen consisted of towels with holes in them."[116]

On July 30 the duo had encouraging results. Some of the pancreatic extract they had prepared lowered blood sugar in one diabetic animal, dog no. 410, as did subsequent injections into two other dogs.[117] On August 9, Banting and Best reported to Macleod that "they had obtained a fall in blood sugar following injections of extracts made from degenerated pancreas." Macleod wrote back encouragingly on the twenty-third, suggesting further experiments "in order that there may be no possibility of mistake … [I]f you can prove to the satisfaction of everyone that these extracts can really have the power to reduce the blood sugar

in pancreatic diabetes, you will have achieved a very great deal."[118] Macleod did supply useful guidance, and Best, referring to their first interesting results, said to Macleod, "We followed your directions in preparing the extract."[119] Yet by the time Macleod's reply arrived on September 6, Banting and Best had already implemented several of his earlier suggestions.[120] His claim to have guided them during these crucial summer months must therefore be skeptically assessed.

The research picked up steam during the fall of 1921, yet it did not always go smoothly. Soon after Macleod's return to Toronto, he clashed with Banting, who threatened to "apply to the Rockefeller Institute or the Mayo Clinic"[121] if his demands for a salary and improved working conditions were not met. A day or two later, Macleod "apparently relented," giving the researchers a separate room, offering a part-time lab boy to look after the dogs, and "having the physiology operating-room floor tarred so it could be cleaned properly." Macleod also arranged to have them paid for the summer's work,[122] but as Banting later remarked with some bitterness, Macleod never gave him "an appointment in the Department of Physiology." He was able to remain in Toronto only because Velyien Henderson offered him a temporary post in the pharmacology department to help him make ends meet.[123]

At this point Macleod suggested to Banting and Best that they publish their preliminary results. He helped them edit a draft. "When finally the manuscript was ready," said Macleod, "Banting asked me if I wished my name to appear along with his and Best's, and my reply was that I thanked them but could not do so since it was their work and 'I did not wish to fly under borrowed colours.'"[124] This statement contradicts the widely held belief that Macleod took undue credit for the work done in his lab but would have done nothing to counter Banting's growing resentment as Macleod's polished presentations of the research outshone his own halting attempts, first at the university's Physiological Journal Club on November 16 and more dramatically before the December 30 session of the American Physiological Society at Yale. Bliss noted, "About this time Banting began telling his friends that Professor Macleod was stealing his research."[125]

The dog research belonged to Banting and Best alone, and in the fall of 1921 they prepared a paper on their intravenous injections of extract from dog's pancreas that showed the pancreatic substance "invariably exercises a reducing influence upon the percentage sugar of the blood and the amount of sugar excreted in the urine." The paper was published in February 1922, the first public documentation of the research.[126]

In the meantime Banting moved to extracts from fetal calf pancreas and asked Macleod to invite James B. Collip to help him on the technical side, especially with the preparation of pure extracts. Collip, then twenty-nine, was an experienced researcher who had been promoted to professor of biochemistry at the University of Alberta in 1920 and just arrived in Toronto on sabbatical with a temporary appointment in the Department of Biochemistry.[127] (Historian Alison

Li calls Collip "a member of the first generation of medical researchers to obtain a PhD at a Canadian university and then to pursue a successful research career within the country."[128])

Macleod suggested that the three young men (all were under thirty!) put the pancreatic extracts into living rabbits that had experimentally been rendered diabetic in order to observe the effects on the rabbits' blood sugar. "Within a day or so, Dr. Collip reported that he had tried this and found the blood sugar to be lowered, thus confirming the effectiveness of the extract and making further development of its production for clinical purposes very much more simple since normal rabbits could be used to test its potency instead of depancreated dogs."[129] (Unlike previous researchers, Collip precipitated the insulin out of the pancreas extract with a solution of alcohol, largely freeing it from contaminants: insulin is insoluble in pure alcohol, which previous researchers who also had isolated pancreatic extracts never discovered.)

Word about "isletin," as the researchers were still calling the extract ("insulin" was coined only in April 1922) spread rapidly within the Toronto medical community. In December Banting and Best had a meeting with Walter Campbell, Duncan Graham, and Almon Fletcher from the General.[130] Campbell was already involved with diabetes research, and *Epistaxis* poetized of him in 1921, "C is for Campbell, who dickers with urine. / And says diabetes the nation will ruin."[131] So the meeting came very propitiously for him.

It was now January 1922 and time to try the pancreatic preparation in diabetic patients. After "repeated solicitations" from Banting, Macleod persuaded Duncan Graham to let him and Best try their extract on a case of diabetes in the Toronto General Hospital.[132] On 11 January they administered it to a lad under the clinical care of Walter Campbell. Charles Best tells the story from here: Best had gone to the slaughterhouse and removed the pancreas from a big steer, from which they extracted an insulin solution. "We tested it on diabetic dogs and it was very potent. Then Fred and I gave large doses to each other … The first patient to receive insulin was a very severely diabetic boy, aged 14, Leonard Thompson. The houseman, Ed [Edward S.] Jeffrey on the diabetic ward, gave the injection. Leonard's blood sugar decreased and the first trial was considered a success."[133]

Best's assessment, however, was overly optimistic. Impurities in the extract caused abscesses at the site of injection, and although Thompson was close to death, his doctors decided not to continue the treatment. Now under pressure to prepare a purified extract quickly, Collip refused to give the successful formula to Banting and Best, and a violent confrontation ensued in late January 1922. No contemporary references to the fight have survived. According to Bliss, Clark Noble drew a cartoon of the incident, "unfortunately now lost, of Banting sitting on Collip, choking him; he captioned it 'The Discovery of Insulin.'"[134] Subsequent accounts by Banting and Best indicate their suspicion that Collip intended to patent it himself "and was only prevented from doing so by Professors Macleod, [Connaught Laboratories director Andrew] Hunter, and

Henderson."[135] In a 1940 memoir, Banting described his reaction to Collip's refusal: "He made as if to go. I grabbed him with one hand by the overcoat where it met in front and almost lifting him I sat him down hard on the chair. I do not remember all that was said but I remember telling him that it was a good job he was so much smaller – otherwise I would 'knock hell out of him.'"[136]

Best claimed in a 1954 account that "Banting was thoroughly angry and Collip was fortunate not to be seriously hurt … I can remember restraining Banting with all the force at my command."[137] Best's son Henry provided a more graphic description matching the vanished Noble cartoon: "Banting jumped [Collip] and tried to throttle him. Best pulled them apart, prompting him to say later, 'I may have helped to save millions of diabetic lives, but I know of one life I saved for certain – Bert Collip's.'"[138] Macleod's anodyne comment was, "As a result of Collip's researches a non-irritating highly potent preparation of insulin was supplied to the Medical clinic and was used in the cases reported in the Canadian Medical [Association] Journal [*CMAJ*] in March."[139]

The appearance of the article in the *CMAJ* caused a local sensation. The front page of the *Toronto Daily Star* for March 22 ran the story under the banner headline "Toronto Doctors on Track of Diabetes Cure."[140] There had been a previous scientific report on the dog research in February in the *Journal of Laboratory and Clinical Medicine*, but the public was indifferent to dog research. The main announcement of the discovery to the international medical world, however, was given by Macleod at the May 3 meeting of the Association of American Physicians in Washington, DC. Banting and Best were not present.[141]

Yet there was a problem. When Collip attempted to make large amounts of insulin at the University of Toronto's Antitoxin Laboratories, his batches lacked potency. Then he started having trouble duplicating his original formula even in the lab. The result of this failure was "an insulin famine in Toronto during the spring of 1922" as the whole research team searched frantically to recover the secret, which they eventually did by mid-May.[142] In the meantime Macleod, concerned that someone else would discover and patent their own process, recommended that the Toronto group take out a patent of its own. Because physicians were barred by the Hippocratic oath from profiting from their discoveries – a lost world! – the two nonmedical members of the team, Best and Collip, patented their process of isolating the pancreatic secretion, then transferred the rights to the Board of Governors of the University of Toronto. The purpose of this move was not to prevent others from making the extract but to ensure that no one else could set up a profitable monopoly.

The Toronto group resumed production of insulin after rediscovering the method but could not make nearly enough to meet the demand. They needed outside help. At the recommendation of the research team and J. Gerald FitzGerald of the Connaught Laboratories, the Board of Governors set up an agreement between the University of Toronto and the Eli Lilly Company in Indianapolis, Indiana.[143] The Lilly Company made crucial changes in the production procedure,

and the Connaught Labs, in producing their own insulin, just adapted these. Proceeds from the patent license fuelled medical research in Toronto for decades to come.

It was the Department of Medicine at the General that helped move insulin from test tube to bedside. In June 1922 Graham "organized a diabetic clinic on the second floor of the Pavilion" under Campbell, Fletcher, and Goldie.[144] The hospital established a "Metabolic Kitchen" for diabetes and other metabolic conditions as well, the staff of which grew from one dietitian in 1922 to seven in 1931.[145] The Rockefeller Foundation donated $10,000 for its support in 1923.[146] In 1925 Macleod and Campbell published a monograph on the underlying science of insulin and its use in the treatment of diabetes. The preface contained epochal news: "Since it became available, insulin has proved to be of inestimable value in the treatment of diabetes … By its use combined with intelligent regulation of the diet, the efficiency and the sense of well-being of the patient can be restored practically to normal and life again made reasonably tolerable."[147] On the basis of this kitchen, in 1937 Campbell said, "[D]iabetes is a controllable disorder of metabolism" and described the stringent daily diet required, initiating the dietetics of diabetes.[148]

The clinical results of the use of insulin were among the most dramatic in the history of medicine. Bill Bigelow, a young surgeon, recalled routine scenes several decades after the discovery of insulin: "Patients who were brought into the emergency ward, unconscious in diabetic coma, [and] when they were injected with insulin they awakened dramatically, snatched from death's door."[149]

The historic drama that Michael Bliss recounts – of young lives saved by the availability of insulin – is deeply moving.[150] But lending piquancy is the personal misunderstandings that alienated the investigators from one another. Hoping to settle the matter of credit once and for all, Colonel Albert Gooderham, chairman of the university's Insulin Committee, wrote to Macleod, Banting, and Best on 16 September 1922 – Collip had by this time returned to Alberta – asking each of them for a typewritten statement of their understanding of the discovery. The resulting accounts, though "invaluable sources" to Bliss and subsequent historians, proved impossible to reconcile, and no comprehensive version was ever prepared.[151]

Macleod's response of 20 September provided the longest account, emphasizing his "position with regard to the most unfortunate misunderstandings which have arisen concerning questions of priority … To Dr. Banting and Mr. Best is … due full credit for showing that extracts of foetal pancreas have a beneficial effect on experimental diabetes." Banting and Best had offered Macleod the option of putting his name on their original paper but he declined, as many laboratory chiefs would not have done (the practice was standard of head of a laboratory including one's name on a paper whether one had contributed to it or not). "By this step I made it perfectly evident that I considered the full credit

for this investigation to be Banting and Best's. This is surely what counts in questions of priority."[152]

In a 1923 addendum, a wounded Macleod expostulated of Banting's continuing protests, "I consider this a most unjust, ungracious and unreasonable attitude. With regard to Dr. Banting being allowed even to start the experiments there are, I imagine, very few directors of laboratories that would have been willing to allow an outside person the free use of whatever animal material was available at the time, of the only operating room and its appliances that the department possessed, of the services of the animal caretaker, of anaesthetics and other surgical necessities, of the chemical apparatus and reagents necessary in the analysis." Moreover, Macleod had made Charles Best available, who was being paid as a research fellow, and paid various salaries and expenses.

Macleod also explained essentially why the research of the Department of Physiology in decades ahead would be dedicated heavily to insulin and pancreatic endocrinology: "The present status of our knowledge of Insulin depends practically entirely on work which has been done in this Department with the collaboration of the Medical Clinic and the Connaught Laboratories. Through concentrated effort, for the co-ordination of which I have been responsible, we have given to Science in little more than one year a practically completed piece of research work – we have proved the value of Insulin."[153]

Banting and Macleod were jointly awarded a Nobel Prize in 1923. An enraged Banting threatened to turn down the prize before being calmed down by Colonel Gooderham, then immediately sent a telegram to Best giving him "equal share in the discovery … hurt that he is not so acknowledged by the Nobel trustees." Macleod, upon hearing this news, shared half of his with Collip.[154] But history is fickle. In the eyes of the public, Banting and Best have retained the historic priority and Macleod has been unjustly forgotten – though in 1926 he authored the book that remained the standard text for decades, *Carbohydrate Metabolism and Insulin*.[155] Yet as Michael Bliss has shown, the discovery was made in an entirely collaborative way. Macleod's name is preserved in a medical auditorium in the faculty named after him. The names Banting and Best are reflected in several buildings of the faculty, in a department of research scientists named after them, and in the memory of a grateful world that the terrible scourge of diabetes had at least been tamed if not banished.

In May 1922, the Board of Governors of the university constituted a Special Committee on Diabetes, later called the Insulin Committee, to administer the several patents arising from the discovery, including the later patent for protamine zinc insulin, and to disburse the royalties for medical research. The final royalty payments arrived in October 1956, and in 1957 the Insulin Committee Trust Fund, by then worth around $3 million, recommended that the funds be "confirmed for the purposes of the Banting and Best Department of Medical Research." This gets ahead of the story a bit but is worth noting here, a member of the committee said, as "the first example of a university undertaking to

administer a university invention for the public good."[156] (This is not exactly true, considering the University of Minnesota granted the thyroxine patent to Squibb in 1919.)

Out of insulin came a number of benefits for the University of Toronto. One was the establishment of the Banting Research Foundation, incorporated in July 1925. The background was this: Early in 1923 President Falconer approached the chancellor, Sir William Mulock, asking if the latter might be willing to raise funds for a foundation to honour Banting and to fund medical research now that the benefits of such research for the public welfare were so apparent. Mulock, a former president of U of T and veteran fundraiser from World War I, convened a dinner at the York Club, from which emerged commitments of almost $1 million. In July 1925 a campaign to raise further funds was then launched and the foundation was duly incorporated. An organizing committee recommended a constitution to the Board of Governors and the Alumni Association, and a Board of Trustees for the foundation was organized. In addition to monies from the initial fundraising campaign, the foundation lived over the years from bequests, such as that of $600,000 in 1948 from the estate of Miss Kate E. Taylor.[157]

This development is significant because "from 1926 to 1938 the Banting Research Foundation was virtually the only organization in Canada which offered financial support for Medical Research throughout the country."[158] It is hard to imagine by what a slender thread medical research hung in those days and what large benefits flowed from so little money.

FitzGerald, Connaught Labs, and the School of Hygiene

Origins

The teaching of hygiene and public health goes right back to the refoundation of the faculty in 1887. William Oldright had graduated from the Toronto School of Medicine in 1865, lectured on hygiene there, and was forty-five as he acquired the chair of "hygiene and sanitary science" in 1887 in the newly founded faculty.[159] He came on staff as well at St Michael's Hospital as an associate professor of surgery. (Something of a polymath, Oldright also began lecturing in 1869 on Spanish and Italian in the Faculty of Arts.) At his retirement in 1910, he was praised for his enterprise "in establishing a practical and theoretical course leading to a diploma in Public Health."[160]

By 1903 U of T had a Department of Preventive Medicine, chaired by Charles Sheard, and a Department of Sanitary Science, chaired by Oldright. Sheard, born in Toronto in 1857, was unlike most of the farm boys who became academics before the Second World War; he originated from the upper crust of Toronto. His father was a future mayor of the city, and he himself attended exclusive Upper Canada College and graduated from Trinity Medical School in 1878. He trained further in Europe; acquired his membership in the Royal College of Surgeons of

England; and taught histology, physiology, and clinical medicine at Trinity from 1880 until it joined the Faculty of Medicine in 1903. From 1893 to 1910 he was the city's medical officer of health, where he worked diligently on behalf of testing the milk and water for bacteria and improving the water and sewage systems. In general, Sheard led a rather upper-middle-class lifestyle with a house on Jarvis Street in the days when that was a fashionable address. Historian Heather MacDougall's judgment is that "Sheard's career represented the transition from doctors as 'professional gentlemen' to research scientists." Sheard was known for "diffusing European knowledge among Canadian practitioners." Later involved in politics, he was not exactly focused on academic life, yet it was he who founded the Department of Preventive Medicine.[161]

Oldright stepped down from the chair of hygiene and sanitary science in 1910, succeeded by John Andrew Amyot, an 1891 medical graduate of the University of Toronto and a key figure in the history of public health in Ontario. (In 1910 Amyot also became director of the Provincial Board of Health Laboratory.) Sheard resigned in 1911 from the chair of preventive medicine, and in future years the title Department of Hygiene and Preventive Medicine became used as well as Department of Hygiene.[162]

In 1904 the faculty created a postgraduate Diploma of Public Health program (as it was initially called) to train physicians as medical officers of health for Ontario's local Boards of Health. It attracted no graduates until 1911, however, when an experienced health officer obtained the diploma by examination without taking any courses. The first applicant actually trained by the university was Robert Defries, who began the program in the 1912–13 session and earned his diploma in 1914.[163] Donald T. Fraser, a major scientific figure in the early days of the School of Hygiene, said in 1945, "As far as I am aware this department in the Faculty of Medicine is the first to provide for formal and regular graduate instruction to physicians." Since then, "some 400 physicians have successfully completed their courses of study."[164]

FitzGerald and the Connaught Antitoxin Laboratories

Although the history of hygiene and public health at the University of Toronto antedate the appearance of John Gerald ("Gerry") FitzGerald, his name is inextricably connected with the development of vaccines in Toronto – the finest work of the School of Hygiene and the Connaught Laboratories. FitzGerald was born in Drayton, Ontario, in 1882 and apprenticed in his father's drugstore. His mother seems to have had some kind of chronic illness, possibly depression, and his father descended into a grief-stricken depression upon her death in 1907.[165] FitzGerald may thus have inherited from both of them the melancholia that dogged him in his later years. He had, in any event, an early tropism towards psychiatry, and after graduating in medicine from U of T in 1903, he served on the staff of a private mental hospital in Toronto run by Campbell

Meyers (who in 1906 organized the psychiatry service at the Toronto General Hospital – see pp. 367–369).

FitzGerald spent the next several years kicking about the asylum world, first at the Buffalo State Hospital, whose superintendent, Arthur Hurd, recommended that he proceed to Hopkins, where his brother, Henry Hurd, was professor of psychiatry. FitzGerald landed a staff post at the Sheppard-Pratt Hospital, a private asylum outside of Baltimore. Clarence B. Farrar, professor of psychiatry in Toronto who knew FitzGerald in those Baltimore years, recalled jolly evenings at the staff table, "where good-natured pleasantries at the expense of one or another of the group were routine, and FitzGerald was likely to be the gayest at the table." After a year, FitzGerald returned to Toronto, taking a post as pathologist at the provincial mental hospital from 1907 to 1908.[166]

Yet his interest shifted from psychiatry to bacteriology, possibly because the one seemed a dead end – a "funereal science" as someone put it[167] – whereas bacteriology appeared to hold the promise of the future. Between 1909 and 1911 he became a lecturer in bacteriology at the University of Toronto.

Married in 1910 to the heiress of a foundry fortune, he and his new bride, Edna Leonard of London, Ontario, were able to summer in Europe. FitzGerald spent the time as a research student at the Pasteur Institutes in Paris and Brussels, "establishing," in the words of medical historian Chris Rutty, "close friendships with Emile Roux, director of the Institute in Paris, as well as other European leaders in the field.[168] This "working honeymoon" marked the beginning of "an extraordinarily intense three-year period" during which FitzGerald repeatedly shuttled back and forth across North America and Europe. In the summer of 1911 he visited the Institute of Pathology in Freiburg and made a quick "side trip to London and the Lister Institute" before travelling 7,000 miles to take up a two-year appointment as an associate professor of bacteriology at the Hearst Laboratory in Berkeley, California. Within eighteen months he had visited four major labs in four different countries. In the spring of 1912, he again hurtled eastward for another working holiday, this time studying the latest advances in the treatment of diphtheria with William Park, director of the New York City Department of Health.

When FitzGerald returned to Toronto following his second year in California, he was eager to apply what he had learned. In 1913 he was invited by Amyot to assist in producing Canada's first indigenous rabies vaccine at the provincial lab during the summer, then take up an appointment as an associate professor in the Department of Hygiene.[169] In all of these venues FitzGerald learned, as his friend Farrar put it, "about the preparations of sera and vaccines for the treatment and prevention of certain infectious diseases."

Farrar continued, "One of his immediate concerns was the alarming death toll of diphtheria among children. The necessary antitoxin was not made in Canada."[170] As of 1913, FitzGerald's grandson James explained, Canada was "one of the few remaining Western nations that still depend[ed] on other countries to

supply its preventive medicines." Because few families could afford the prohibitive cost of imported American antitoxin, diphtheria remained the leading killer of children under fourteen, with death rates from the asphyxiating throat inflammation of up to 12 percent in the first decade of the century.[171] In a 2004 interview, James added, "[M]y grandfather thought this was appalling, and he just said 'I can make this medicine myself here, because I now have the expertise' – and he was the only man in Canada really who had it at that point."[172]

Encouraged by his success with the rabies vaccine, FitzGerald "boldly proposed to the University of Toronto that he manufacture a safe, effective Canadian-made antitoxin for diphtheria, and distribute it free or at cost … to boards of health across Canada."[173] The university's Board of Governors was uneasy about linking their academic mission to the commercial production of a drug and unwilling to fund a laboratory for FitzGerald. So with $3,000 from his wife's inheritance, in December 1913 he built a small stable at 145 Barton Avenue, fitted it out with lab equipment, bought four aging horses "bound for the glue factory for about $5 each and hired a technician." The horses – named "Crestfallen," "Surprise," "Fireman," and "JHC" – were injected on 1 February 1 1914 with diphtheria toxin;[174] in March, after their immune systems produced antitoxin, the serum was harvested and the antitoxin extracted. The same month, the Ontario Board of Health agreed to purchase it for 35¢ per thousand units (representing a 10¢ profit margin for the lab), and the first batch was sold on 31 March at one-fifth the going commercial price.

In April 1914, just before the outbreak of war, the Board of Governors approved the Antitoxin Laboratory as part of the Department of Hygiene, and on 1 May the lab, stuffed into the basement of the Medical Building, opened for business.[175] Private investors in Toronto sprang to FitzGerald's assistance, including Colonel Albert Gooderham, commanding officer of the Royal Grenadiers, an officer of the Canadian Red Cross, and member of the Board of Governors of the University of Toronto. As the antitoxin was distributed in Ontario, the death rate from diphtheria fell from 31 per 100,000 cases in 1903 to 12 in 1918. "Deaths from diphtheria are preventable," said FitzGerald, "and delay in the administration of antitoxin is one of the most important reasons why deaths continue as a result of this disease."[176]

In 1915 Colonel Gooderham offered to the university a 57-acre farm on Dufferin Street (north of what was then Toronto), where FitzGerald was able to construct more extensive laboratories and mass-produce diphtheria and tetanus antitoxins that he sold to the provinces of Canada, which distributed them free to the population. During the war there was a huge demand for tetanus antitoxin for the armed forces. Gooderham asked only that the farm be named after the Duke of Connaught, who had been the governor general of Canada, so in 1917 the facility was renamed the Connaught Antitoxin Laboratories. Laboratory insiders, however, always referred to it as "The Farm." In July 1920 the

Connaught Labs became an independent unit within the university, reporting directly to a "Connaught Committee" appointed by the Board of Governors; in 1923 the committee approved shortening the name to "Connaught Laboratories" to reflect the facility's expansion into research and the preparation of insulin and other products.[177]

Amid the horrors of the Great War, Canada had achieved a significant public health triumph: In contrast to past conflicts, where eight soldiers died of disease for each one killed in battle, the proportion dropped to one in twenty. The Connaught Labs contributed in no small measure to this reversal, producing one-fifth of all the serums used by Britain and her allies.[178] Close on the heels of this advance came a second triumph for Toronto with the discovery of insulin in 1921–2. These were momentous developments.

The School of Hygiene

Meanwhile, on the academic side, hygiene was a gathering concept. After completing his course work for the Diploma in Public Health (DPH) in the 1913–14 academic year – but before sitting the exam – Defries became a demonstrator in hygiene, FitzGerald teaching the course. This was the beginning of a twenty-seven-year partnership and also marked the start of public health education in Ontario and beyond: the second graduating class included John W.S. McCullough, the chief officer of health for the province, and A. Grant Fleming, who became a professor of preventive medicine at McGill in the 1920s.[179]

Following the creation of a federal Department of Health in 1919, Amyot was made the first deputy minister of health. He turned over his academic duties at the University of Toronto to FitzGerald, who was then promoted to the first full professorship in the Department of Hygiene and Preventive Medicine. FitzGerald proceeded to appoint Defries and other Connaught staff members to the teaching staff – thereby formally linking the university department with the lab[180] – and to upgrade both undergraduate and postgraduate instruction in public health, transforming the DPH from an apprenticeship program to a comprehensive full-year curriculum. In 1924 he pushed through a regulation mandating a field course in preventive medicine for all medical undergraduates.[181]

In May 1924 the Rockefeller Foundation gave the university $650,000 for a School of Hygiene ($400,000 for a building, $250,000 for the endowment).[182] This donation constituted the Rockefeller Foundation's second big gift to the Faculty of Medicine; the first, of $1 million, was conveyed in 1920–1.[183] "Over the next two years, a stately red-brick, four-storey School of Hygiene [was constructed] on the southern edge of the University of Toronto campus adjacent to the twin-towered medical school, at 150 College Street."[184] It was formally opened on 8 June 1927, with a ceremony in Convocation Hall, following which the assembled dignitaries proceeded to tour the new facility with FitzGerald leading the way, "flanked by his wife and sister, the Bantings, and the Bests."[185] Toronto's

School of Hygiene was to be one of three in North America being funded by the International Health Board of the Rockefeller Foundation, the others (called "Schools of Public Health") at Johns Hopkins University and at Harvard.

In 1924 FitzGerald became director of the School of Hygiene, which, like the Connaught Laboratories, was not part of the Faculty of Medicine but reported directly to the president and the Board of Governors. The Connaught Labs were adjoined to the new school, and the antitoxin and insulin units merged "to constitute a public-service section of the School." The Connaught Laboratories Research Fund was also to contribute to the endowment.[186]

Among FitzGerald's leadership team in both institutions were Robert Defries and Donald Fraser. Both became significant figures in the history of Toronto medicine.

Robert Davies Defries was thirty-eight years old when the School of Hygiene opened in 1927; he firmly established himself as FitzGerald's right-hand man. A native of Toronto and 1911 medical graduate, he was awarded an MD the following year for postgraduate work in biochemistry under Macallum before, as seen earlier, becoming the first applicant for the DPH course. His first public health appointment outside the Faculty of Medicine was as assistant bacteriologist to the Ontario Board of Health in 1913–14; then in February 1915 FitzGerald asked him to head up tetanus antitoxin production for the army at the Department of Hygiene's Antitoxin Laboratory (housed at the time in the medical school's basement). In 1916 Defries was named assistant director of the lab and the following year became associate director at the newly established Connaught Antitoxin Laboratories north of the city. He remained in that position until 1940 when he succeeded FitzGerald as the second director of both Connaught and the School of Hygiene until his retirement in 1955.[187]

Defries was instrumental in the research and production of numerous vaccines and other products and in the wartime expansion of Connaught and the School of Hygiene. During the Second World War, antitoxin production required the purchase of more than 1,100 horses, housed in temporary buildings at the Farm and in Hamilton. To accommodate the school's research and production of penicillin and blood products for the war effort, he persuaded the Board of Governors to purchase the former Knox College building on Spadina Crescent. (This facility became known as the Spadina Division.)[188] Like his predecessor FitzGerald, Defries was involved in numerous scientific and health organizations, including the U of T's Insulin Committee, the Dominion Council of Health, and the Canadian Public Health Association (editing the latter's journal for more than thirty-five years). Following the war, he oversaw the Connaught Labs' production and supply of nearly all of the polio virus used in the 1954 field trials of the Salk poliomyelitis vaccine in both Canada and the United States. For this achievement, as well as for his "distinguished leadership in the development of preventive medicine and public health throughout Canada," Defries was honoured with a Lasker Award in 1955.[189]

Defries's life was shaped by the early death of his father and the influence of his stern and pious mother, who "relentlessly pushed both her sons to become ascetic, self-sacrificing doctors."[190] The earnest "Bobby" took these lessons to heart, his entry in *Torontonensis* describing him as "one who will never spare himself if he can be of help to others."[191] An evangelical Presbyterian, he entered the public health field with the intention of becoming a medical missionary but was persuaded by FitzGerald to devote himself instead to developing the discipline in Toronto and Canada.[192] He nevertheless remained a staunch supporter of Bloor Street Presbyterian (later United) Church and of medical missionary activities,[193] and he never married, living with his widowed mother until her death in 1942.[194]

Donald Thomas Fraser, thirty-nine as of 1927, was the son of William H. Fraser, long-time head of the departments of Spanish and Italian at the university. Donald obtained a degree in arts, then graduated in medicine in 1915. After service in the war, he joined the Connaught Labs in 1918 and became a lecturer in the Department of Hygiene and Preventive Medicine two years later, obtaining his DPH in 1921. His scientific contributions included developing a mouse assay for insulin; he was, as his eulogist put it, "the first to publish on this subject."[195] Fraser was among the Canadian leaders in the war against diphtheria in the middle decades of the twentieth century and cut an international profile in the rising field of immunology. A trial led by Fraser in 1943 established the effectiveness of tetanus toxoid with the typhoid element added (TAB T) and the workability of the recall schedule (a recall dose should coincide with "the entry of troops into the combat zone").[196]

At the School of Hygiene, Fraser assumed much of the responsibility for the text of FitzGerald's textbook, *An Introduction to the Practice of Preventive Medicine* (which Mosby of St Louis published in 1922), and helped plan the expansion of the school building in the early 1930s. By 1933 he was not only a full professor but the de facto head of the department as FitzGerald's other responsibilities multiplied. He also distinguished himself as a mentor: as colleague Donald A. Scott later remarked, "'Ask Fraser' was a common solution to any baffling problem facing researchers or students in the School of Hygiene Building."[197] Following FitzGerald's death in 1940 Fraser officially became the head of the Department of Hygiene and Preventive Medicine as well as the associate director of both the School of Hygiene and the Connaught Laboratories;[198] he remained in that position until his death during an official visit to Santiago, Chile, in July 1954.[199]

In addition to his scientific accomplishments, Fraser excelled at combining research with a humanistic focus and remained part of the larger university community. The Frasers lived in an exclusive little enclave of Toronto called Wychwood Park along with numerous other university figures. At the time of his death in 1954, Dean MacFarlane summed up that broadly learned quality that had clung to Fraser throughout his career (and that characterized his son,

pediatrician Donald Fraser, as well): "He had what another bacteriologist, Dr Hans Zinsser, has described as 'a type of learning that cannot be acquired by study alone, but represents the ripening of gifted minds that are attracted by everything about them worthy of interest.'"[200]

When the new School of Hygiene opened its doors in 1927 with FitzGerald as director, it consisted of three departments: Hygiene and Preventive Medicine (which continued as a joint department of the school and the Faculty of Medicine); Epidemiology and Biometrics; and Physiological Hygiene. The Department of Hygiene and Preventive Medicine was the largest of the three, with twelve part-time faculty members, including FitzGerald as professor and Defries and Fraser as associate professors.

The Department of Epidemiology and Biometrics was established in 1924 and until the early 1930s was largely a three-person operation, with Defries as head, assisted by Neil McKinnon and Mary Ross. The department also included two part-time instructors from the provincial health department: John W.S. McCullough, the chief officer of health for Ontario, who taught public health administration, and Albert Berry, a demonstrator in public health engineering.[201]

McKinnon, thirty-three in 1927, had graduated from U of T in 1921, selecting for the university yearbook the motto, "I am in earnest; I will not equivocate; I will not excuse; I will not retreat a single inch, and I will be heard."[202] Of tough Highland Scots ancestry (and a speaker of Gaelic),[203] McKinnon was known for his strong opinions and forceful manner. Although not always popular or easy to get along with, he established a reputation, in the words of historian Paul A. Bator, as "one of the unique characters in the School of Hygiene," gaining respect "as a serious teacher who constantly challenged his students to give evidence for their views and who presented them with issues of philosophy and humanism." By 1930 he had become an assistant professor at the school and was head of its Department of Epidemiology from 1944 until his retirement in 1962.[204] In the summer of 1932 he was also appointed as director of the Connaught farm and relocated with his family to a house on the property, becoming as well one of FitzGerald's closest confidants during his troubled last years.[205]

Mary Ross, another original member of the department, was a nonphysician who spent five months at the Johns Hopkins School of Public Health studying epidemiology before beginning her responsibilities at the School of Hygiene. She assisted McKinnon in conducting a major field study of diphtheria toxoid in 1927 (detailed later) and prepared a statistical analysis of mortality from the disease in Ontario between 1880 and 1925 for her 1928 MA thesis at the school. In 1934 she earned her PhD for further work on the decline in mortality and morbidity from diphtheria and other diseases in the province.[206] Defries, McKinnon, and Ross emphasized "the imaginative use of statistics in the planning and direction of health services" in instructing DPH students, and they put this policy into practice by upgrading the collection of vital statistics in Canada, particularly in the classification of causes of stillbirth and morbidity. Their work

resulted in the creation of a new death registration certificate by the Dominion Bureau of Statistics.[207]

The Department of Physiological Hygiene, the third original academic unit, benefited from the international renown of Charles H. Best, who headed the department between 1927 and 1941. Although not formally connected with the Faculty of Medicine's Department of Physiology, the two were closely linked, especially after Best succeeded Macleod as professor of physiology in 1929, becoming at age thirty (and only four years after obtaining his medical degree) one of the youngest departmental chairs in the history of the faculty. Yet such was the magnitude of the insulin discovery that he was instantly lionized.

After becoming professor of physiology in the faculty, Best resigned his administrative responsibilities as an assistant director at Connaught but remained a research member in addition to his position at the School of Hygiene.[208] For the next thirty-five years he was closely involved with both the Department of Physiology and Connaught, beginning by assembling a heparin team just after assuming the chair (see p. 65). Following Fred Banting's death in an airplane crash in February 1941, Best was appointed head of the faculty's Banting and Best Department of Medical Research in addition to continuing as head of physiology. He gave up his position in the school at that point[209] but remained an honorary consultant to the Connaught Labs.

In his later years, Best was plagued by depressive illness (having apparently a family history), beginning with a possible bout in the 1950s, then a distinct episode in 1963, followed by a severe depressive experience the following year. He was obliged by illness to step down as chair of physiology in 1965. In 1978, Best became critically ill just after hearing of the death of his older son, Sandy, and died shortly thereafter.[210] Said his eulogist at the Faculty Council at the time of his death, "Dr. Best was a man of action, a realistic, hard taskmaster, but also a kind man. A genuine understanding of human misery was an outstanding trait of his personality."[211]

Connaught between the Wars

In the years to come, the Connaught Laboratories contributed to public health by developing a variety of vaccines and other drugs. The usefulness of liver in the regeneration of hemoglobin in pernicious anemia had been noted in 1926 by George Minot and William P. Murphy at Harvard.[212] Minot suffered from diabetes and had been treated with insulin at the Toronto General Hospital, so he told Charles Best of their findings, and Best asked Earle W. McHenry at the Connaught Labs to develop a liver extract for clinical use. By 1929 McHenry had devised a suitably purified oral extract, by 1931 an extract for intramuscular injection. Defries later said that McHenry's success was "the result of the high degree of purification which he obtained." Working together with Ray Farquharson at the General, they established the efficacy of the extract in a trial of

more than sixty patients with pernicious anemia, publishing in the *Canadian Medical Association Journal* in 1933. "Liver extract prepared for intramuscular administration … has been found safe, dependable, and effective when used in adequate dosage," they concluded.[213]

The clinical story of heparin at the General has been told. The physiological story transpired at the labs. Here is how heparin developed: In 1916 Jay McLean at Johns Hopkins University extracted from dog liver a substance that delayed the coagulation of the blood, named "heparin" two years later by William Henry Howell and Luther Emmett Holt at Hopkins, who isolated it.[214] But the substance was impure and could be produced only in small amounts. In 1929 David A. Scott and Arthur F. Charles at Connaught embarked upon an effort to overcome these roadblocks, learning that heparin could be derived from beef liver with an alkaline aqueous extraction. Several further technical steps were required, and by 1933 they had devised a method capable of extracting heparin from large lots of beef liver, with a yield of about 1,000 units per pound, indeed doubling this return by letting the raw liver sit for a day ("autolyse") before extraction. After 1935 they used only beef lung, also a source of heparin, because it was cheaper.

The crude heparin extract they came up with in 1934 was not usable clinically, but by 1936 Scott and Charles succeeded in purifying the crystalline pure sodium salt that, as has been shown, surgeon Gordon Murray immediately employed in operations on blood vessels. The preparation of the extract created such foul odor that in 1937 heparin extraction was shifted from the Hygiene Building on College Street to the Connaught farm, which processed about 400 pounds of beef liver a day.[215] In 1938 Best and his younger colleague in the Department of Physiology Donald Solandt showed how heparin could prevent the formation of thrombi in the coronary vessels of dogs. "The availability of a potent solution of heparin which can safely be administered to human patients … makes necessary a consideration of the possibility of clinical application of these findings," they wrote.[216] The following year Solandt and Best experimentally produced cardiac mural thrombosis in dogs, demonstrating that heparin would prevent the formation of such thrombi.[217]

Scott and Albert Fisher at the laboratories determined that adding zinc to protamine insulin increased the miscibility of the insulin (Best had obtained some protamine insulin from Hans Christian Hagedorn in Denmark; protamine prolonged the action of the insulin). The laboratories began distribution of protamine zinc insulin in 1936, and the TGH insulin team of Robert B. Kerr (then a junior staffer), Campbell, and Fletcher, together with Best, reported on its use in diabetes ("gives promise of being an important contribution to the restoration of a more physiological state in the diabetic patient").[218] In 1938 Kerr and Best demonstrated experimentally that the duration of action of protamine insulin was much longer than with regular insulin, permitting the maintenance of low blood sugar without a "hypoglycemic reaction."[219]

In the years between 1919 and 1939 the laboratories developed – in addition to the diphtheria toxoid (discussed on p. 68) – a long list of antitoxins, toxoids, and vaccines, a detailed discussion of which would range too far afield; among the most important were scarlet fever streptococcus toxin (the "Dick Test," 1924) and antitoxin (1930); staphylococcus toxoid and antitoxin (1934–5); tetanus toxoid (which P.A.T. Sneath began in 1927, following the discovery of tetanus toxoid at the Pasteur Institute); and Nelles Silverthorne's preparation of a practicable pertussis (whooping cough) vaccine in 1936.[220] Of the pertussis vaccine, Alan Brown, professor of pediatrics, said, in the words of a journalist, "Results obtained with whooping cough vaccine perfected in conjunction with the Connaught laboratories indicate that 98 percent of the children inoculated are rendered immune, so that 'the universal use of this vaccine will result in the saving of many lives.'"[221] These accomplishments, poorly remembered today, all took place on FitzGerald's watch.

FitzGerald and the School of Hygiene to 1940

An important feature of the School of Hygiene during FitzGerald's tenure was the familial (if paternalistic and hierarchical) spirit he sought to instil in his senior staff. He established a special "officers' mess" for the scientists (the male ones only!) where he always sat in a chair reserved for him at the head table.[222] "Tea was also served in the late afternoon" to this inner circle as a further venue for collegial discussion, "a tradition carried on by FitzGerald's successor," Defries. Yet these gatherings were evidently quieter affairs than those FitzGerald enjoyed during his early psychiatric sojourn in Baltimore – no longer the source of jocularity at the staff table, "he detested noise and loud laughter or singing."[223]

He was also a proponent of healthful living, mandating regular physical checkups for the entire staff and maintaining a full cafeteria at the school under the direction of a trained dietician. He also ran "a mandatory program of recreational sports, including an annual golf tournament and regular games of deck tennis on the windy roof of the School of Hygiene." The scientific staff were also keen on running around the track at Hart House (the university's athletic centre, at the time also restricted to men) and swimming as many lengths of its pool "as time allow[ed]." In 1930 an annual competition was launched for the "FitzGerald Cup, a silver, foot-tall trophy with the names of the annual winners carved into plaques." FitzGerald and Best, the keenest athletes in the group, were the only two-time winners.[224]

The Department of Hygiene and Preventive Medicine remained the largest department in the School of Hygiene throughout FitzGerald's tenure, becoming the "launching pad for a number of lifelong careers at the School."[225] Frieda Fraser, Donald Fraser's sister and a physician and scientist in her own right, completed her MB at Toronto in 1925 and joined the staff of the department in 1927 as a demonstrator in hygiene. Her work on scarlet fever streptococcus toxin

and antitoxin between 1927 and 1936 was important, although active immunization against the disease was eventually rendered unnecessary with the introduction of the sulfonamides in the mid-1930s and penicillin in the 1940s.[226] She eventually rose to the rank of full professor, moving from the department to the school's Department of Microbiology in 1956.[227] Other departmental "alumni" included Milton Brown, appointed as a demonstrator in 1931, who became the third head of the department in 1956, and Frank Wishart, who lectured on immunology and later took over direction of the building's immunization clinic.[228] Like Fraser, he became a professor in the microbiology department in 1955.[229]

By 1930, the building of the school, as the university division of the Connaught Laboratories, needed to be enlarged to accommodate both its academic mission and its rapidly growing insulin and liver extract production. Seizing the initiative, FitzGerald personally contacted F.F. Russell of the Rockefeller Foundation to seek support. The foundation agreed on the condition that the additional costs be shared by Connaught's research fund and an increase in the annual grant to the labs from the Province of Ontario. The following April the deal was finalized, with Connaught (and the province) putting up $350,000 and the Rockefeller Foundation providing an additional $600,000, thereby increasing the total grant to the School of Hygiene to $1,250,000.[230]

In autumn 1932 the northern wing of the Hygiene Building (later called the FitzGerald Building) was completed, and the Department of Hygiene had space for its rapidly growing graduate program, which was attracting young physicians from many parts of Canada who then returned home with their diplomas in public health to spread modern concepts.[231] In 1930 the department established the school's first sub-department, "Chemistry in Relation to Hygiene" – a parallel to the faculty's big departments of pathological chemistry and biochemistry – under the leadership of chemist Peter J. Moloney, another of FitzGerald's key recruits.

Born in 1891, Moloney completed an MA in chemistry at U of T in 1915 and joined the staff of Connaught Laboratories in September 1919. He assisted in the purification of insulin in the early 1920s and received his PhD in 1924 for a dissertation based on this experience. Moloney was one of the first scientists without a medical degree recruited to Connaught and the School of Hygiene, and as historian Paul Bator pointed out, "His contributions revealed the growing importance of non-medical specialists in public health."[232] During his lengthy career – which extended for nearly two decades past his official retirement in 1961 – Moloney went on to become one of the founders of the discipline of immunochemistry.[233] (For improving methods of producing heparin at Connaught he received a Gairdner Award in 1967.)

Chief among Moloney's early achievements was his involvement in introducing diphtheria toxoid, a denatured and safer version of the diphtheria antitoxin, which had been discovered in 1923 by Gaston Ramon at the Pasteur Institute in Paris. The following year, FitzGerald visited Ramon in Paris,[234] where he

"became so impressed by the new toxoid that he immediately called Dr. Peter J. Moloney at Connaught … and asked him to drop everything"[235] and begin duplicating Ramon's methods. In 1925 Moloney became the first scientist in North America to prepare the toxoid and in addition made a critical contribution to its safe use by developing a skin test to identify children who would react adversely to the new vaccine.[236]

In results published in 1931, McKinnon and Mary Ross from the school's Department of Epidemiology and Statistics, along with F.S. Burke from the Toronto health department, conducted a field trial of the new toxoid on 30,000 schoolchildren. In the absence of immunization, the 16,829 high-risk children who received it would have had an estimated 222 cases of diphtheria. Given the toxoid, the actual number of cases was twenty-three. There were no deaths. "This is a reduction of approximately 90 percent," the authors concluded.[237] The toxoid had virtually banished diphtheria, the once-feared childhood killer, in Toronto and wherever else it was given, usually in combination with pertussis and tetanus vaccines.

The conquest of diphtheria represented another major scientific advance for FitzGerald and his colleagues, as their field trials "made history by statistically demonstrating for the first time the value of a non-living vaccine in preventing a specific disease."[238] Yet because the findings were initially reported mainly in the *Canadian Journal of Public Health* rather than in the international literature, this breakthrough was not widely known for some time. In addition, the British authorities, who had a much more cautious approach to preventive medicine, remained unconvinced and failed to launch a decisive vaccination campaign until 1941.[239] The Americans got the message much more quickly. According to James FitzGerald, "Toronto and Hamilton were the first cities in the world to be diphtheria-free – like wiped out, eradicated. So that's one of the big feathers in their hat. And that's why people started taking notice, and Rockefeller started sending people here. And Toronto became the international hub. This is what Canadians don't know, is that we became the lighthouse School [of Public Health, or Public Hygiene] in the world … They were doing a lot of firsts."[240]

The 1930s were years of great activity for FitzGerald. Between 1930 and 1936 he served on the Health Organization of the League of Nations, travelling to Geneva to attend its semiannual congresses; in May 1931 he was selected as one of the six scientific directors of the Rockefeller Foundation's International Health Division, becoming the first Canadian named to the position; and at U of T, he received his "third major appointment within the space of months" upon becoming dean of the Faculty of Medicine, effective January 1932. (During this era the deanship was still a part-time post held in connection with some other headship; FitzGerald also remained director of the School of Hygiene.) According to his grandson James, the decanal appointment was "seen as a clear endorsement of Gerry's vision, a recognition by the faculty and university of the growing importance of hygiene and preventive medicine in the medical

curricula."[241] FitzGerald was also close to the Rockefeller Foundation, serving them in various capacities.

Eclipse

In the fall of 1936, FitzGerald stepped down from the deanship and took a leave of absence from the university in order to undertake a nine-month project for the Rockefeller Foundation, "touring eighty-five medical schools in twenty-seven countries in North America and Europe" to investigate the "state of undergraduate teaching in preventive medicine."[242] When he returned to Toronto the following June, "[c]olleagues were quietly shocked by his haggard appearance; in the space of a nine-month trip living out of a suitcase, he seems to have aged twenty years."[243] The graduating class photos for the School of Hygiene confirm his rapid decline: in the 1937–8 picture his hair has "turn[ed] completely white in one year."[244] The official explanation of FitzGerald's subsequent breakdown was thus "overwork." The poor man had merely collapsed from the strain. But the story is more malignant.

Already in 1932, as he began his first tour as dean, was there a hint of depressive ideation? In accepting the office he told the Faculty Council, "[N]o one, I am sure, can be more deeply conscious of the shortcomings and inadequacies of your newly appointed Dean than I am."[245] A reflexive kind of self-deprecation is often appropriate for such ceremonial occasions, but still.

According to his grandson James, Gerry FitzGerald was troubled with insomnia and migraine headaches from 1932 on; during the summer of 1938 he spent nearly two months in a London hospital with a haemorrhaging duodenal ulcer. He sailed home at the end of September, determined to resume his work, but after a final brief effort of rallying himself to escort Governor General John Buchan around the Connaught Labs on 23 November, he collapsed in his office and was hospitalized in the grips of a psychotic depression.[246] "I mark that as the moment when he really fell apart," James said.[247]

In February 1939 he made his first suicide attempt, with Nembutal tablets (the barbiturate pentobarbital), falling into a coma but recovering. His old friend Farrar arranged for his admission to the Retreat in Hartford, Connecticut, a private and very expensive psychiatric hospital, though owing to his high professional standing, FitzGerald was charged the charity ward rate of $17.50 per week[248]). McKinnon took him down, FitzGerald, reluctant to go, begging him, "Don't let them, don't take me, don't take me." At Hartford he had fifty-seven insulin shock treatments. FitzGerald wrote in a letter to Farrar, "I am a disgrace to my family … I should be taken outside and shot." Though not a religious man, he asked for a Catholic priest, saying that he had committed an unpardonable sin for which "the penalty is death."

In April 1940, "Gerry returned to Toronto and tried to resume work. But on June 16, 1940, in a state of paranoia he told his wife that the University of Toronto was out to get him." He overdosed with Nembutal a second time and was admitted to

Toronto General Hospital, under the care of Ray Farquharson. "On June 20, 1940, as my grandfather lay recovering from the toxic drug overdose … a nurse placed a tray of food on his lap. When she withdrew, he grasped the knife and … felt for the femoral artery in his thigh, and stabbed his flesh again and again. In less than five minutes, John Gerald FitzGerald was dead. He was 57."[249]

The details of this story were known to only a handful of insiders.[250] "Imagine the shock," said James. "Dean of Medicine kills himself in TGH." A wider circle was aware, however, that he had committed suicide, although the story never reached the public press. His hospital chart disappeared. Such was the stigma attached to suicide that people froze when they heard FitzGerald's name. James describes the memorial service for his grandfather held on the stage of Convocation Hall, the university's main lecture hall. "When people were invited to view the body, only a single soul – an elderly caretaker who had worked for my grandfather for years – shuffled up to the stage and gazed at his face. My grandmother suppressed a cry of anguish. No one else came forward."

A vast silence settled upon the memory of John Gerald FitzGerald and upon many of the triumphs that the School of Hygiene had achieved in the early decades. "Almost eradicated," said James in an interview. "It's almost as if that unpardonable sin … had caused this amnesia, or wiping out this great achievement. But I'm saying, 'Wait a minute. Just look at the achievement. Forget the suicide for a second.'" From the historical viewpoint of this author, what is interesting is the fact that all of this has slumbered in semiforgetfulness because of the suicide. To this thought, James FitzGerald replied, "I believe so."

There is an interesting historical lesson here for those who write histories of faculties of medicine. The facts, the achievements and journal articles, do not speak for themselves. History edits things in strange ways. It was the personal hell of one man, who happened to be the director of the School of Hygiene and the dean of the faculty, that caused this story of the vaccines that triumphed over infectious disease almost to be lost. The old School of Hygiene was dissolved in 1975. But this tradition of progress in health has come to life again with the foundation in 2008 of the Dalla Lana School of Public Health in the Faculty of Medicine. As Dean Catharine Whiteside noted in 2008, "The Dalla Lana School builds on the Faculty's pioneering work in public health as well as the ongoing tradition of excellence, and it will help our modern world tackle new challenges faced by health care systems internationally."[251]

From 1887 to 1932

In January 1932 retiring dean Alexander Primrose looked back on the past forty or so years of the history of the faculty he had joined in 1888. Although the faculty had been refounded a year previously, it was in 1887 still located in the single building in the east end of Toronto that had been home to the Toronto School of Medicine. Since then, he said, "The laboratory equipment has

gradually increased until at present we have a series of buildings in which the various departments are adequately housed." First came the so-called "Medical Building" that he dated from 1902 but was really ready for occupancy only in 1903. Then came the Pathology Building on the grounds of the Toronto General Hospital in 1911. There followed the Anatomy Building just after World War I and the School of Hygiene in 1927, "made possible by the munificent gifts from the Rockefeller Foundation." It was, he said, "a far cry" from "the small brick building … to the series of fine laboratory buildings and hospitals which now constitute the teaching quarters of the Faculty of Medicine of the University of Toronto."[252] Yet there was more to come.

An Appendix to the Chapter: Further Eaton Gifts

The Department of Medicine later had some difficulty reconstituting the story of the Eaton gifts because the files had vanished and memories started to fade. In 1969 Kager Wightman, the professor of medicine, told Dean Chute, "Professor Graham tells me that the original donation was merely to support a full-time Professor and Department Head – at first more or less on a quinquennial basis. After about three years (1922?) the University at the urging of Sir Robert Falconer, set up the Sir John and Lady Eaton Professorship as a named Chair in recognition of the generosity of the family … This really means that John David Eaton may have something to say about what their money is used for." Wightman said that Graham was "positively contemptuous about my (our) lack of knowledge of the history of the situation."[253] It is unclear how the Eaton Chair was financed in the 1920s and early 1930s.

In 1937 the Eaton gift was renewed in the amount of $25,000 per year for five years. This attracted wide notice, including an editorial in the *Globe and Mail* that saluted the public benefits of support for science: "Because of such gifts the Department of Medicine of the University of Toronto has become noted throughout the world for its research work and its assistance to research workers … If the scourges to which humanity is heir are to be overcome, there remains to be done a vast amount of research work … By virtue of these contributions in money, other now baffling diseases [aside from diabetes] will be understood and mastered. In what better way can citizens who can afford to do so benefit the human race?"[254]

When in 1944 the Eaton gift was renewed, William Goldie – who had retired from teaching in 1928 – was again the liaison between the family and the faculty. In July 1944 he sent President Henry John Cody a cheque for $125,000 the Eatons had given him and wondered what the best way might be for the family to endow a permanent chair in medicine. Would there have to be a change in provincial budget arrangements? He reminded Cody that not only had the department been "efficient" in making medical discoveries but "has also materially

contributed to the War effort, for the men trained by the Medical Department have shown distinguished leadership in the Army, Navy and Air Force."[255]

In 1946 the Eaton Company gave the university a further $375,000. This and the 1944 cheque were intended to establish a $500,000 Endowment Fund for the Sir John and Lady Eaton Chair of Medicine, which would produce an annual interest payment of around $15,000 for the Department of Medicine. Meanwhile, unspent portions of past grants had accumulated in the Endowment Fund. This unexpended balance was used for salaries of members of the Department of Medicine returning from military service. In consequence, Graham told Smith, the expenditures of the Department of Medicine were greater than the revenue from the Endowment fund and the department would need "to increase very substantially the University grant to the Department to maintain a pre-war basis of work."[256] Today, these do not seem like large sums but at the time they were considerable. The Eaton family stands historically as the first great benefactor of the Faculty of Medicine. Many other benefactors were to follow.

5 Big Deeds

After the Second World War, academic medicine in Toronto made several very large strides with worldwide implications. These steps occurred in the areas of neurological surgery, heart surgery, the victory over polio, and – the great medical watchword in the 1990s and after – the discovery of stem cells at the University of Toronto.

Teaching Hospitals

In the background of these strides were the teaching hospitals of Toronto. Just after the war there were three of them, though numerous others later joined the story.

The queen bee of Toronto medicine is the Toronto General Hospital. Established in 1812, it was the oldest and largest general hospital in English Canada and in 1945 had around 1,200 beds. By the time this story picks up, it had moved from its site on Gerrard Street in Toronto's east end (where it began in 1855) to its College Street site in 1913. It expanded from there to include tall towers in the entire block that runs south and east from the intersection of College Street (a major east–west avenue) and University Avenue (a major north–south route). Toronto General Hospital, or just "the General," was the original teaching hospital of the faculty, and all the early generations of medical students learned on its wards. The General dominated academic medicine in Toronto, and its great barons did so in a rather lordly way. As obstetrician Jim Goodwin later said, "Immediately after the [Second World] War, the place was called the House of Lords, and nothing else mattered. The General was just the place. And the surgeons were very lofty, just arrogant as they could be, and I will not mention names, but they just were."[1]

The wards themselves were divided into two categories: the single rooms for "private patients," whom clinicians admitted on a fee-for-service basis, and

the open public wards in the main College Building consisting of long rows of beds, where patients paid no fees, physicians received no honoraria, and medical students received hands-on instruction. In a tit-for-tat, clinicians lived off the income from their private patients whom they saw on "the Pavilion" in the General and in their offices in the Medical Arts Building. In exchange, mainly for the recognition and whatever pleasure the involvement in teaching and research brought, they ranked as members of the Faculty of Medicine and had university appointments as junior or senior lecturer or, the very few, as "Professor." (For readers unfamiliar with Toronto topography, the hospitals of "University Row," on University Avenue, are at the absolute heart of town. The university campus, with its Faculty of Medicine buildings, is slightly to the north and west, and the Medical Arts Building, at the corner of St George and Bloor Streets, is just north and west of the campus. The Medical Arts Building was erected in 1928 in a cooperative effort of 200 physicians and surgeons headed by Alexander Primrose.[2])

The second teaching hospital of the faculty in 1945 was St Michael's Hospital in the east end on Queen Street. A Catholic hospital, it was founded in 1892 by the Sisters of St Joseph and had over 600 beds. Care at all of these teaching hospitals was excellent, but St Michael's in particular had a historic reputation of great kindness to the patients. By the end of the Second World War the nuns were fading from the scene as nurses, yet the caring climate of the hospital lingered on and even at the present writing remains a distinguishing characteristic of the hospital.

The Toronto Western Hospital, on Bathurst Street in the west end, was the third teaching hospital. Established in 1896, it had around 500 beds. Originally conceived by the local doctors who founded it as a community hospital, the Western's ambitious board saw to it that by 1945 clinicians in most of the services had faculty appointments, thus making their departments "teaching departments" for medical students, interns, and residents. For example, at the Western, the Department of Medicine became a teaching department in 1936 with the appointment of Herbert K. Detweiler, fifty at the time and a U of T medical graduate in 1914, as physician-in-chief of the hospital. Duncan Graham, then the head of the university's Department of Medicine, later said, "In 1936 Toronto Western Hospital reorganized its Medical Service and provided facilities for the scientific study of patients. A teaching staff, the majority of whom had received training at the Toronto General Hospital, was appointed. In order that the staff might be able to devote more time to hospital work, the Western Hospital agreed to remunerate the Physician-in-Chief and one junior member of the staff."[3] This process, multiplied many times over for the various departments of the city's hospitals, ensured that Toronto's medical graduates received proper clinical training at the university's teaching hospitals.

The Hospital for Sick Children – always called "the Children's Hospital" or by its initials "HSC," never "Sick Kids" – was a fourth teaching hospital at the end of the war. Established in 1875 and with over 400 beds at the close of the

First World War, it was a pediatric hospital, not a general hospital, and will be considered in chapter 10.

These events were part of tremendous post-war growth of health care in Toronto and in Canada. "The last ten years have seen a remarkable expansion in the hospital and medical research facilities of Toronto," said President Sidney Smith in 1955. "Since 1944 the Hospital for Sick Children, Sunnybrook Hospital [a veterans hospital] and Mount Sinai Hospital [a Jewish hospital] have been erected; substantial additions have been made to the Toronto Western Hospital, St Michael's Hospital … The long-awaited building at the Toronto General Hospital is under way; the Cancer Treatment and Research Institute is being erected."[4]

The motor driving these various hospitals to join the Faculty of Medicine as "teaching hospitals" was in part the prestige that the distinction conveyed, in part the university's own desperate need for more teaching beds. As average class sizes in the first clinical year began to top 150 after the First World War, the General simply did not have enough beds to avoid patients being swarmed by the scads of students keen to acquire the skills of physical examination and history taking. The teachers were quite sensitive to the question of how much the patients could bear, so the continual addition of clinical units to the category "teaching department" in these three hospitals, and in others, relieved the pressure of numbers. Ray Farquharson, who in 1947 had just become the Eaton Professor and head of the Department of Medicine, told his colleagues in 1949 that the department could now expand teaching to the Wellesley Hospital, a community hospital in the east end that had just been annexed by the General Hospital, thus increasing the number of clinical groups in the second year from twelve to sixteen and in the third year from twelve to fifteen. Now there would be only ten students in a group. But the large incoming class of demobilized veterans would make the groups as large as before, "and the problem of providing close critical supervision of each student's work will actually become more difficult. The student must learn by working under guidance; relatively little can be told him in lectures; he must take histories and examine patients and discuss his findings with trained teachers till he acquires skill and confidence and understanding." All this will be more difficult in coming years, Farquharson said.[5] Ultimately, the New Mount Sinai Hospital, Women's College Hospital, and Sunnybrook Hospital would all affiliate with the faculty as general teaching hospitals. In each case there was a momentary sigh of relief as the medical students were accommodated, the residents found services where they could train, and the pool of researchers (and the patient population upon whom they drew) was enlarged.

Neurosurgery

In the beginning Toronto had two sites of neurosurgery, the Toronto General Hospital and the Hospital for Sick Children. Even though the participants dash back and forth, it is simpler to tell the stories separately.

McKenzie

Neurosurgery as a discipline was established in North America early in the twentieth century, and in Toronto even before 1914 nonacademic surgeons conducted operations for brain tumours in places such as the Grace Hospital.[6] Considered mildly courageous, they were part and parcel of general surgery.

The history of academic neurosurgery in Toronto began in 1924 when Kenneth McKenzie was appointed to the surgical staff of the Toronto General Hospital. McKenzie was born in 1892, the son of a busy practitioner in rural Ontario. His parents sent him in 1905 to a private school, St Andrew's College, in the chic Rosedale district of Toronto, where McKenzie played rugby, cricket, and – as McKenzie's biographer, fellow neurosurgeon Tom Morley, points out – "really shone in wrestling and, to a lesser extent, in boxing." Indeed, in his second year at U of T, McKenzie became the intercollegiate wrestling champion in his class (125-pound class), called "'Rubber' McKenzie because of his agility in the ring." He received a medical degree from the University of Toronto in 1914, beginning his postgraduate training in the Department of Pathology. Weeks after the First World War broke out in August 1914, McKenzie joined the Royal Army Medical Corps and served in France with a field ambulance unit. In 1917 he transferred to the Canadian Army Medical Corps (CAMC) and joined the medical officers of the Davisville Military Hospital in Toronto.

After the war's end, he bought a general medical practice in Toronto, working as well at the Christie Street Hospital for veterans (established 1920 as the Dominion Orthopaedic Hospital, with 875 beds for veterans). At this point – apparently following a conversation with Clarence Starr[7] – surgery began to interest him. As neurosurgeon Harry Botterell tells the story, "He was, with great persistence, trying to persuade Clarence L. Starr, the Professor of Surgery, to help him to become a surgeon. He took a correspondence course from England and then went to England to try the primary examinations of the Royal College of Surgeons, passing in physiology and failing in anatomy."

At this point, quite fortuitously, McKenzie learned that Toronto had awarded Harvey Cushing, the American founder of neurosurgery, the Charles Mickle Fellowship, which was accompanied by an award of $1,000. "McKenzie learned of the award from the newspapers, and of the fact that Cushing had asked Clarence Starr to send a man to Boston to train as a neurosurgeon and to whom he would contribute the $1,000 from the Mickle Fellowship." McKenzie – who, according to Botterell, had a total of $2 in his pocket at that point – asked Starr if he, McKenzie, might not go down to Boston and study with Cushing for a year. The McKenzie family, now penniless, rented out their house in Toronto; Mrs McKenzie took the three children to live with her family in Chatham, and McKenzie found himself training in Boston in neurosurgery with the world authority.

On returning to Toronto in 1923, McKenzie served a residency year in surgery with Starr at the General, apparently selectively being given neurological cases

for operation. After the completion of this residency year, neurosurgery began as an independent service at the General – and in Canada – in 1924.[8] (Neurosurgeon Wilder Penfield came from New York to Montreal only in 1928.)

As McKenzie came on staff, Dean Primrose noted, "While we may deplore the multiplication of specialties, yet it is an obvious fact that remarkable advances in recent times in the surgery of the nervous system demand very special training in order that the surgeon may be able to carry out with skill and judgment the difficult technique required in … lesions of the brain and spinal cord."[9] Yet despite this decanal endorsement, McKenzie at first was a bit of a black sheep. Clarence Starr was slow to accept specialties in surgery, just as Duncan Graham opposed them in medicine, and only slowly did the Department of Surgery cotton to the subspecialty of neurosurgery. Morley said, "It was years before the neurosurgeon was given his own OR [operating room]. Meanwhile he had to be satisfied with the use of an OR at the end of the day, when the nursing staff was tired; to wait until the room had been cleaned after preceding cases; and to find an assistant from among the house or nursing staff and an anesthetist who were prepared to delay their own departures home, often for many hours." Morley writes, "McKenzie survived the difficult years, protecting himself from overt anger and despair, by withdrawing into his shell."[10]

Then in the 1930s McKenzie began to come into his own. A Division of Neurosurgery was formed in 1929–30 with him in charge (see p. 79). He won his first student in 1930, when William Keith became his first full-year neurosurgery resident. Only in 1936 did "KG," as his residents called him to one another, get a dedicated operating room for neurosurgery. Then the keen young surgeons desiring training in the neurosurgical specialty became more frequent. A neurosurgical group began to grow.[11] In 1936, in the context of Gallie's new program for training surgeons, E. Harry Botterell signed on as a resident in neurosurgery under McKenzie. And in 1940 William ("Bill") Mustard, of whom one shall read later in connection with cardiovascular surgery, stepped up as McKenzie's only assistant. McKenzie's pleasure at this small coup was brief, given that Mustard shortly decided to enlist.

Down in Operating Room D "all by his lonesome," as Don Wilson said, McKenzie developed his own style as a neurosurgeon. Said one of his residents later, "Being educated under [Harvey] Cushing, he had learned many things, not the least of which was patience and great gentleness in the handling of the special tissues with which he worked. Until McKenzie came on the scene, it was generally thought that there was at least some virtue in speed in operations but McKenzie showed us that with proper anaesthesia and plenty of donor blood there was no need for hurry … During these long hours, he never seemed to weary or lose his patience or control, even in the face of the most critical and terrifying situations."[12]

Charles Drake – who learned his lessons well and went on to become a brilliant aneurysm surgeon at the University of Western Ontario (surgery on sacs

formed by dilatations in the walls of arteries) – recalls the following memories as a resident on McKenzie's service: "As a surgeon he was superb, a master nearly unequaled in his time. I was privileged to watch the best of that day later in the United States and in the UK and Europe – few were his equal. His touch on the brain whether with his forefinger searching for a soft spot overlying a deep glioma [a tumour of glial cells] or with the forceps or retractor was gentle and there followed beautiful technical precision." "He called the acoustic neuromas [tumour of the acoustic nerve] the queen of brain tumors. They were all huge in those days and … he had one of the lowest morbidities of the time." "The two things he loved to do because the patients had such good outcomes were a chronic subdural hematoma [bleeding in the narrow space between the layers that line the brain] and a benign spinal cord tumour before the patient had become paraplegic."[13] Many of the other patients had terrible outcomes, and McKenzie was weighted down by the constant deaths. Indeed, he was often subject to bouts of depression.

McKenzie is known for several innovations. Among the earliest problems the budding specialty of neurosurgery took on was spasmodic torticollis, or jerking of the neck. McKenzie recalled his first case in 1923 while he was a resident with Cushing: "The patient, an intelligent woman with a pleasing personality, was dreadfully incapacitated by constant spasmodic jerkings of the head to the left and backwards." McKenzie suggested to Cushing a certain approach to the roots of the spinal nerves that he published the following year. The procedure turned out to be a failure, although it became known as "the McKenzie operation," "or the McKenzie-Dandy operation," after the Johns Hopkins neurosurgeon Walter Dandy who in 1930 described a similar operation. Over the next thirty years, however, McKenzie kept at it, refining his approach in the course of treating eighteen cases. In 1955 he published his revised and much more successful technique, which involved paralyzing one of the sternomastoid muscles and dividing several of the cervical motor nerves intradurally (in this case beneath the covering of the spinal cord). McKenzie said of the revised approach, "Satisfactory results have been obtained in 10 out of 12 patients by radical surgery. When one considers the hopeless pre-operative condition of these patients the results are indeed gratifying."[14]

McKenzie is also remembered in the history of neurosurgery for his demonstration in 1932, as Morley puts it, of "the advantage of dividing the vestibular component of the acoustic nerve to relieve Ménière syndrome [hearing loss, tinnitus, and vertigo from inner-ear disease]."[15] In the 1930s McKenzie finally started receiving international recognition, becoming in 1936 president of the Cushing Society (American Association of Neurological Surgeons). Subject to periodic depression and, in Findlay's analysis, somewhat demoralized by all the deaths that then haunted neurosurgery, he retired in 1952 at age sixty.[16]

An unhappy footnote in McKenzie's memory is his involvement in the partial destruction of the frontal lobes of the brain for treatment of mental disease

in an operation known as leucotomy or lobotomy, depending on how it was done. The operation was introduced by Portuguese neurologist Egas Moniz in a monograph in 1936, and it quickly attained great currency in the absence of other means of quieting the agitation of severely disturbed patients. Lobotomy came to a quick end in the early 1950s with the introduction of the first antipsychotic drugs. McKenzie and Lorne Proctor at the Toronto Western Hospital made Toronto a centre of leucotomy, describing in 1946 a series of twenty-seven cases: "A special instrument is passed through the frontal lobe to the orbital plate. The instrument is then opened, closed, rotated and again opened, then closed and withdrawn. This procedure is repeated on the other side. The dura is closed … The scalp is closed with a double layer of fine silk." They claimed that 85 percent of their often severely ill patients were "improved or recovered." "In our opinion, this neuro-surgical procedure offers a valuable addition to our therapeutic armamentarium in the treatment of what previously would have been considered hopelessly ill mental patients."[17]

In 1945 Clarence Farrar, the professor of psychiatry, said, "We are favourably impressed with the value of this neurosurgical therapeutic procedure in the treatment of our chronically mentally ill patients."[18] Many of the operations were conducted at the Toronto General Hospital and supported by a grant from the Rockefeller Foundation. Of course one is always wiser in hindsight, but it does look like lobotomy, in view of the permanent brain damage it inflicted, represented a significant failure of clinical judgment, certainly on the part of the psychiatrists who referred the patients, as well on McKenzie's part for acceding to the requests.

Neurosurgeon Thomas Morley asks, "Why is it important for us to remember McKenzie? Hardly for his surgical innovations and dexterity alone." Rather, says Morley, it is in the words of Hippocrates "to honor and emulate as far as we are able our teachers and our teachers' teachers to keep the memory of their example a permanent part of our professional heritage." McKenzie's contribution to the great neurosurgical tradition in Toronto was thus: as a model of "diligence, his detached empathy toward his patients, his self-discipline, and equanimity … are the necessary basics on which every career in clinical medicine must be built."[19]

A hospital "division," meaning the basic subunits into which departments are divided, grew up about McKenzie. Gallie said in 1930, "Through the successful efforts of Dr. Kenneth McKenzie neurological surgery has advanced so rapidly that it has become necessary to create a separate division for this branch of surgery and to release Dr. McKenzie from all other duties in order that he may take charge of it … one of the outstanding advances made at the hospital during the past few years."[20]

Technology raced ahead alongside neurosurgery. In the 1937–8 session, the Department of Medical Research in the Banting Institute built an electroencephalograph machine (EEG), and McKenzie had it installed "in a room adjacent to

the neuro-surgical operating room." Gallie said, "It is hoped that this apparatus will prove of value in the definite localization of brain tumours. Having the apparatus close to the operating room will make it possible for the surgeon to apply electrodes directly to the surface of the brain."[21] In 1945 Douglas C. Eaglesham, who had trained at the Montreal Neurological Institute, was appointed as Toronto's first neuroradiologist. His successor in 1948, Delbert Wollin, had similarly trained at the Montreal Neurological Institute, as had his successor in 1959, George Wortzman. (The lesson of this story is that Toronto often fed from the strengths of McGill, though the relationship went the other way as well. In pediatric neuroradiology Toronto was a world leader and owed nothing to McGill – see pp. 88–89 and 270–271.)

Botterell

McKenzie students began to spring up. Among his earliest was Edmund Henry Botterell, known universally as "Harry." Harry Botterell was born in Vancouver in 1906 and graduated in medicine in 1930 from the University of Manitoba, where he trained in general surgery and in medicine at the Montreal General Hospital. In 1932 he moved to Toronto and served as a tutor in the Department of Physiology under Charles Best; then, owing to a fortuitous vacancy among the surgical trainees, he moved across College Street in 1933 to begin training in neurosurgery. (He was McKenzie's chief resident from 1936 to 1937.) One day in 1934, according to biographer Max Findlay, Botterell bumped into McKenzie at a lunch at Hart House, the university's campus centre, "and McKenzie, having learned of Botterell's qualities, suggested that Botterell join him in neurosurgery." McKenzie then immediately sent Botterell off on the grand tour that characterized the training of the elite young surgeons: In 1934–5 he served as an intern in neurology and neurosurgery at the prestigious National Hospital for Nervous Diseases in Queen Square, London, "where," says Tasker, "he came to know the amazing constellation of neurological figures of the time."[22] The following year found Botterell at Yale in a research fellowship in the new Department of Neurophysiology under John Fulton. In 1936 he returned to Toronto, now attending neurosurgeon, to continue his career with McKenzie. (Bill Keith was actually McKenzie's first resident, and his career at HSC is followed later.)

Botterell became interested in the care of patients with spinal lesions. As early as 1936, before completing his residency, he began to work with spinal cases and saw that nurses, orderlies, physical therapists, and doctors must provide a coordinated effort in the treatment of these patients, whose previous prognoses had been so hopeless. The orthopedic surgeon Robert I. Harris brought back from England a tidal drainage apparatus for Botterell to irrigate the bladder and reduce infections in these patients.[23] According to Findlay, "Professor Gallie, a generous man dedicated to supporting his young staff with new practices, made a point of sending to Botterell any of his spinal fracture patients who had

associated spinal cord injuries. One of the first was a young man who was paralysed from a football injury. Botterell took on this patient, who had only a trace of cord function left, and tried carefully to prevent bladder infection … The result was dramatic. At a time when such patients usually died from sepsis this patient made a remarkable recovery."[24] Botterell operated with similar success in two more patients, then decided upon a lifelong interest in the care of paraplegic patients.

In 1940 Botterell enlisted in the Royal Canadian Army Medical Corps and was sent to the Canadian No. 1 Neurological Hospital in Basingstoke, England, which was redesignated the Neurological and Plastic Surgery Hospital in 1943. There, Botterell soon became chief neurosurgical officer. Wounded soldiers and civilians received state-of-the-art care. According to John Russell Silver, historian of the treatment of spinal injuries, "Their policy was to perform suprapubic catheterization [inserting a catheter into the bladder above the pubic bone] to control the bladder during transportation of the wounded; and management of the bowels by enemas on alternate days. Patients were turned every two to three hours day and night and wet beds were changed immediately to prevent the development of pressure sores … They were conservative in their neurosurgical procedures on the cord for pain and believed that their treatment programme was a model, which other nations followed."[25]

In 1945, Botterell was recalled by the army in order to organize a Neurosurgical Unit at the Christie Street Military Hospital.[26] Upon his return he found, says Findlay, "many of the spinal cord-injury patients from the war, some who had gone through his service at Basingstoke, 'lying around rotting' at the Christie Street Department of Veteran Affairs Hospital in Toronto." He resolved to "remain in the army long enough to assist in the plight of these pitiable patients, and straighten out in particular the problem of the young veteran paraplegic patients." Botterell needed a full-time physician to take over an institution that he organized in January 1945 for their care, Lyndhurst Lodge near the intersection of St Clair and Bathurst Streets. McKenzie pointed him towards the internist Albin Jousse, who had aided the short-staffed McKenzie during the war and was just about to take a post in Sudbury. Botterell talked Jousse out of Sudbury and, says Findlay, "in 1945 Jousse was appointed Medical Director to the first hospital dedicated to the rehabilitation of spinal cord injured patients in North America." Jousse later told Findlay, "It became clear to us that we were not saving them for much of a life to look forward to: to send these young fellows home to live in bed, or get pressure sores and die, or have recurrent urologic infections that the local doctor might not know how to treat. You had to educate them and get them in wheelchairs and get them active … to make them self-sufficient so that they could live independently with a vocation … in society as productive citizens."[27]

"Lyndhurst Lodge," says Silver, "was the first institution of its kind in North America. The programmes provided individuals with the knowledge they

needed to manage their own care when they returned to the community. By 1946 many veterans had purchased cars with newly designed hand controls. They used their wheelchairs to go to restaurants, barbershops and a local cinema."[28] "Dr Botterell was a no-nonsense man, I suppose one might say he was a bit rough," according to one former patient, "but he knew what he was doing, and every paraplegic owes their life to him."[29]

By 1946 Botterell – together with urologist Carl Aberhart, plastic surgeon Stuart Gordon, and Jousse – was achieving such "dramatic results," as Dean Gallie put it, "that the programme has been extended to Workmen's Compensation cases and to civilian patients. Their contribution is of the highest practical importance."[30] Botterell's student Tom Morley later said that Botterell had "removed spinal cord trauma from the list of causes of death."[31]

In 1952 Botterell succeeded McKenzie as head of the Division of Neurosurgery at the Toronto General Hospital. It was here that he and William Lougheed pursued his second great research theme: the treatment of cerebral vascular disease, mainly aneurysms and subarachnoid haemorrhage (the arachnoid is one of the layers that envelop the brain), then treated conservatively with bed rest. Hyland and Richardson's work on the neurological side of these brain haemorrhages had interested Botterell, and he pursued his belief "that direct neck clipping [of the aneurysm] was going to become the optimal method of treatment," despite his own initial poor results (58 percent mortality up to 1953). Botterell persuaded, in the words of his neurosurgical colleague Fred Gentili, "young bright anaesthetists Drs Stuart Vandewater and Brian Marshall to take an interest in neuroanaesthesia and he recruited Del Wollin in neuroradiology to develop the techniques to image aneurysms." He also encouraged "a bright young nurse, Jessie Young, to take charge of that field by the boast that he was going to develop the best (damn) neurosurgical unit in the world."[32]

Bill Lougheed was then Botterell's resident, and Botterell encouraged Lougheed to pursue in Boston the interest in hypothermia, or operating once the patient's body temperature had been lowered, that Lougheed had already developed (see pp. 83–84). With all the pieces in place, in 1956 Botterell and colleagues reported their results in twenty-two patients who had experienced direct surgical clipping of ruptured "berry" aneurysms under conditions of hypothermia between May 1954 and April 1955. Of nineteen survivors, sixteen were considered excellent or good. (The paper also introduced a scale from one to five for judging operative risk that later became known as the "Botterell scale.")[33] Gentili comments, "The timing of this paper was very important because, coming at a time when there was hesitancy and uncertainty in aneurysm surgery, it encouraged others to be more aggressive and to operate directly on aneurysms with or without hypothermia." The paper established Botterell as "a major force" in neurosurgery.[34] (This new technique of clipping aneurysms was a big deal: when former Botterell student Ross Fleming clipped his first aneurysm as a staffer, Botterell somehow heard of it and called Fleming's wife to "let her know how pleased and proud he was."[35])

Under Botterell's aegis, in 1958 a "New Unit" for neurosurgery was opened on the twelfth floor of the Urquhart Wing of the TGH, marking the definitive take-off of neurological surgery in Toronto. "A tall, imposing individual, with a rich, forceful, and commanding voice," said Findlay of Botterell, "he had more than most the presence of a neurosurgeon … He was by nature impatient, and according to some, sometimes difficult to assist in the operating room. At least one of his residents took to putting folded newspapers into his socks when assisting Dr Botterell, in order to protect his vulnerable shins in the event that the Chief felt he was not concentrating on his task sufficiently."[36] In 1962 Botterell left Toronto to become the dean of medicine at Queen's University.

Botterell's Chief Residents

Just after the war, McKenzie and Botterell established a structured program for training neurosurgeons. McKenzie soon stepped down, and the baton was passed to a generation of Botterell's students. Botterell had eight chief residents, and in their careers one can read the progress of neurosurgery in English Canada in the 1950s and 1960s. (Of course, the other part of the story would be Wilder Penfield and his students at McGill University; Botterell's students Bruce Hendrick and Harold Hoffman are discussed later under neurosurgery at HSC.)

William Horsey, Botterell's first chief resident, finished training in neurosurgery in 1954 and returned to St Michael's Hospital, where he had interned, to establish their neurosurgery program. Horsey and fellow resident William Lougheed were men of slight stature, and Botterell, "a tall man made even taller by his imposing and dominating demeanor, towered above them," as Max Findlay recalls. "The sight of this group on the wards, and the occasional difficulty the residents had in assisting Dr Botterell with their heads in his direct line of vision, sometimes had comic overtones." At St Michael's, Horsey "became a notable spinal surgeon," in Findlay's terms, "and in Toronto kept that aspect of surgery firmly in the realm of neurosurgery."[37]

William Lougheed, Botterell's second chief resident – a 1947 medical graduate of U of T – finished neurosurgical training in 1955, following a McLaughlin Fellowship in Europe and the United States. While a fellow in the neurosurgical service at the Massachusetts General Hospital in 1953, Lougheed was, with Hannibal Hamlin and William H. Sweet, in on a first: in a fifty-year-old widow, they removed an occluded segment of the left internal carotid artery and, suturing the ends together, created an "anastomosis."[38] This was "one of the world's first surgical corrections of carotid stenosis," said Findlay, but they reported it only in 1958 and didn't get the priority.[39]

Then there was hypothermia, a technique that cardiac surgeon Bill Bigelow had pioneered. Lougheed had previously discussed the procedure with Bigelow (who wanted Lougheed to become a cardiovascular surgeon[40]). In 1955 in Boston, Lougheed and D.S. Kahn introduced hypothermia into neurosurgery

while stopping the circulation in cerebral vascular surgery.[41] Two such firsts for a junior fellow are not bad.

In Toronto, Lougheed initiated hypothermia in neurovascular surgery at the General in 1954. The first Toronto publication on hypothermia in this area was issued in 1956, together with Botterell, anaesthetist Stuart Vandewater, and neurophysiologist John W. Scott, on the management of the team's first twenty-two patients with ruptured intracranial aneurysms.[42] Aneurysms tend to rupture during surgery, and in repairing them it is often necessary to interrupt the cerebral circulation by clipping the carotid or vertebral arteries supplying blood to the brain. Yet prolonged stoppage can cause brain damage. The logic was that hypothermia lessened the damage to the brain during the interruption of blood flow. It was Lougheed who worked up the technique. Hypothermia was induced in the following way: First the patient was given a cocktail of phenothiazine agents plus Demerol. As the preliminaries were underway, "the patient is in the hypothermic bath on the operating table and his legs, groins and lower abdomen are covered with crushed ice." Then "the bath is filled with ice water covering the legs and trunk to about the nipple line," the patient's rectal temperature being monitored continuously. The results of the operation were good: of twenty-two patients operated on for berry aneurysms, there were only three deaths. This was thought an improvement over the previous seven deaths in nineteen patients. Yet there was no control group, and it is unclear, given other changes in procedure and selection, how these patients would have done in the absence of hypothermia.[43] Findlay says, "This paper … was the world's first description of hypothermia and temporary cerebral circulatory arrest for aneurysm surgery."[44]

Further accounts of Lougheed's career in the 1960s and 1970s are found at p. 388.

In 1956 J. Ross Fleming, who graduated from Toronto in medicine in 1947, finished training as Botterell's next chief resident, then embarked upon the kind of grand tour of European centres that Botterell himself had undertaken: neurology at Queen Square, stereotactic surgery (a three-dimensional technique for locating areas precisely in the brain) on the Continent. He joined colleagues Bill Keith and Bruce Hendrick at the Toronto Western Hospital later that year, then became head of the division in 1965 after they went over to the Hospital for Sick Children.

In 1957 Robert Hetherington, a Rhodes Scholar and U of T graduate in 1950, served as Botterell's chief resident, decamping then for Queen's University, where he inaugurated neurosurgery.

Last in this series of Botterell students pioneering neurosurgery was Ronald Tasker, who finished his medical studies in 1952 as one of its two silver medalists. (The other was John Evans, who went on to become president of the university. The gold medalist was Marguerite "Peggy" Hill, later physician-in-chief at Women's College Hospital. "Not a bad triumvirate!" according to

current president David Naylor.[45]) When Tasker began training in medicine, he was "bewildered by the high death rate of hospitalized patients on the medical floors," and switched to surgery, which he completed in 1959. With a McLaughlin Fellowship, he spent a year in neurophysiological research at the University of Wisconsin, then a second in Europe studying stereotactic surgery, which opened the door for him to thalamotomy in the treatment of movement disorders (the thalamus in the base of the brain is a relay station to the cerebral cortex for sensory impulses). No sooner was he back in Toronto than he was appointed a Markle fellow for 1961–6, permitting him to do research alongside his clinical work at the General. Tasker became an international authority on using electrodes to situate the exact site at which to operate in surgery, for example, for Parkinson's disease. Tasker also helped advance radiofrequency-lesioning in pain control and is considered one of the pioneers of "stereotactic and functional" neurosurgery.[46]

Despite this list of glittering residents, it was rather Thomas P. Morley, who had trained in neurosurgery in Manchester with Sir Geoffrey Jefferson, who would succeed Botterell in 1962 as head of the Division of Neurosurgery at the General; he became head of the university department two years later. Born in Manchester in 1920, Morley had studied medicine at Oxford (taking his degree in 1943) and had come over to Sunnybrook Hospital, then a veterans hospital, in 1954. Morley's field was cancer surgery, but it was as a surgical leader rather than a cancer specialist that the next generation of neurosurgeons trained under him.

In 1957 the Division of Neurosurgery of the Toronto General Hospital came up out of the basement in Operating Room D to a brand-new neurosurgical unit that was then "officially" opened in November 1958 with the hosting of a meeting in Toronto of the American Academy of Neurosurgery.

Neurosurgery at the Hospital for Sick Children

The sick child in need of an operation for a spreading brain cancer or a haemorrhaging vessel has a poignancy all its own. And whereas the technical side of the story can be folded into the main narrative of neurosurgery, the emotional side cannot.

Bill Keith

In 1929 Gallie "conceived the idea that [the Hospital for Sick Children] needed a full-time neurosurgeon," as Harold Hoffman put it, and asked William Keith to prepare himself for such a post.[47] In 1933 Keith initiated pediatric neurosurgery in Toronto. Born in 1902, Keith grew up in Toronto and earned a Toronto medical degree in 1927 (excelling in rugby and winning the silver medal). He interned at the Toronto General Hospital, where, according to his biographer

Robin Humphreys, William Gallie "encouraged Keith to pursue further education in the neurological sciences." On a fellowship, Keith studied at the University of Chicago with Roy Grinker in neurology and Percival Bailey in neurosurgery, returning thereupon to Toronto for a year to work with McKenzie. In 1931 Keith clerked at the National Hospital at Queen Square on the neurology service. "He subsequently became chief resident in Surgery at HSC, and upon joining the staff in 1933 was expected to be equally facile in general and orthopaedic surgery as well as neurosurgery." Three years later, in 1936, Keith started the neurosurgery service at the Toronto Western Hospital as well. There was tension with Alan Brown, the powerful professor of pediatrics at the children's hospital. "They argued," says Robin Humphreys, "over which patients Keith would operate on and where he was to park his car."[48]

These years were the fear-filled epoch of neurological survey. "[Keith] recalled operating in 1961 on an aneurysm in a three year old girl and having exposed it asked his resident if 'you remember I told you I wasn't afraid of these things anymore?' When the resident nodded in the affirmative Keith replied, 'Well, that was a lie!'"[49]

Keith had strong basic science as well as clinical interests, and as early as 1935, under the supervision of Eric Linell in neuropathology, he and Joseph Albert Sullivan of the Department of Otolaryngology at St Michael's attracted campus attention for their studies of nerve regeneration.[50] Keith joined the Canadian armed forces in 1942, saw action in France and Germany, then in 1945 was recalled by HSC, needed more urgently there and at the Toronto Western Hospital to train young neurosurgeons than at the front.[51]

On the scientific side, according to Fleming, "[Keith] was an early proponent of lumbo-peritoneal shunting for hydrocephalus, which he introduced [to HSC] in 1948." His student Harold Hoffman recalls, "He had to work at a frenetic pace, since he was the only neurosurgeon at the Hospital for Sick Children and the Toronto Western Hospital until he was joined by Dr. Ross Fleming at the Toronto Western Hospital in 1954 and Dr. E. Bruce Hendrick at The Hospital for Sick Children in 1955."[52] Ross Fleming said that at HSC Keith was "[c]hief of what is widely recognized as one of the world's outstanding paediatric neurosurgical units."[53]

The Three "H's"

In the 1950s, there were two young neurosurgeons who joined HSC under Keith. Both their last names began with "H," and there was a third "H" who came a bit later, giving rise to the appellation "the three H's." The older of the two was Bruce Hendrick, "a rare Torontonian who was actually born in the city in which he still practices."[54] In the history of pediatric neurosurgery in Toronto it was not so much Keith who built up the service – many operations on children continued to be conducted at TGH on his watch – but Hendrick.

Hendrick graduated from U of T in medicine in 1946 but achieved the bulk of his training in Boston in a two-year fellowship at the Children's Medical Center and Peter Bent Brigham Hospital. After a travelling fellowship abroad, Hendrick returned to Toronto in 1955 to begin neurosurgery under Keith at HSC and the Toronto Western Hospital (TWH). But his heart was clearly at the children's hospital. Hoffman recalls, "Many a resident [might] find himself suddenly caught in the crossfire of a water pistol fight between Bruce and his patients. It was a serious business on Friday afternoons, when nurses, parents and child life therapists joined the patients to develop strategies for these sessions. The children wore green garbage bags; 'Uncle Bruce' took the soakings in his OR scrub suit."[55]

On Keith's retirement in 1964, Hendrick became neurosurgeon-in-chief at HSC and thus, says Findlay, "the first full-time paediatric neurosurgeon in the world."[56] His principal achievement was training the following generation of pediatric neurosurgeons.

The other young pediatric neurosurgeon at HSC, the second "H," was Harold Hoffman, who was, as his student James Rutka points out, "in his day … arguably the most famous paediatric neurosurgeon in the world." Hoffman earned a medical degree from U of T in 1956 and travelled to various neurosurgical centres in Europe and the United Kingdom with the aid of a McLaughlin Fellowship. This trip included studying with Murray Falconer at the Maudsley Hospital in London, where Hoffman acquired an abiding interest in the surgery of epilepsy; in 1964 Hoffman returned to Toronto to join the HSC neurosurgical staff. This was the year when the thirty-two-bed specialized pediatric neurosurgery unit was opened on Ward 5G of the Gerrard Wing. For years, Hoffman and Hendrick were the only two neurosurgeons in the hospital, and, to get on with research, they alternated weeks on call.

Humphreys recalled the surgeons' lounge at the children's hospital, "which almost took on a country club atmosphere. A Hospital attendant waited on tables and served hot, fresh coffee and doughnuts on sparkling china … Characteristically, the residents sat about the perimeter of the room perhaps analyzing their role models most of whom were then world prominent."

Hoffman published so widely that he became, as Rutka says, "an authority on virtually every topic in paediatric neurosurgery." In 1968, for example, Hoffman began a databank on hydrocephalus (an accumulation of cerebrospinal fluid within the skull), then expanded it to spina bifida (a defective closure of the vertebrae through which the spinal cord might protrude) and brain tumours; the bank was supported financially by Mr David Bloom, CEO of Shoppers Drug Mart. The divisional newsletter noted in 2000, "We have reached the point where this division has shown its international primacy in the analysis of hydrocephalus shunting techniques, the associated infection risks and alternative therapies."[57]

But Hoffman's fame in the public eye dates to 1993, when Hira and Nida Jamal were born in Pakistan as conjoined twins, joined at the head. The government of

Pakistan donated $100,000 for what the *Toronto Star* termed "a global search for a doctor who would take on the challenge. The hunt ended at Toronto's Hospital for Sick Children, where Hoffman and his team separated the Jamal twins in a harrowing 16-hour procedure that involved detaching brain matter and blood vessels one by one. One of the twins, Nida, failed to survive. The other, Hira, "came out of the surgery healthy and alert."[58] Rutka assisted at the operation and remembers, "At one critical juncture in the case, a blood vessel which joined the twins had let loose and was bleeding profusely. Harold quickly hooked the vessel with his index finger and clipped it with his other hand. In answering questions about this Harold simply stated, 'One doesn't think about what one is going to do, one just does it."[59]

The third "H" in the neurosurgical division of the Hospital for Sick Children was Robin Humphreys, a U of T medical graduate in 1962, who joined the staff in 1970 and inaugurated with surgeon Ian Munro the craniofacial program. Their student Jim Rutka recalled, "As all three neurosurgeons' last names began with the letter 'H', they became known endearingly as the '3 H's.'" (Humphreys, modest to a fault, claims that "[t]he ladies of the Women's Auxiliary dubbed them, 'He, Ho and Hum!'") Rutka noted, "Collectively, they co-authored most of the definitive works on paediatric neurosurgery."[60]

Derek Harwood-Nash

The story of neurosurgery has a sort of footnote though not really a footnote because Derek Harwood-Nash was probably the best-known neuroradiologist in the world – but, nonetheless, not a surgeon. Harwood-Nash was born in Bulawayo, Rhodesia, in 1936 and studied medicine at the University of Cape Town. Alan Hudson, who later became president of The Toronto Hospital (TTH) following the merger of TGH and the Western in 1986, was a classmate; both graduated together in 1960 and both interned in surgery under, among others, the famous pioneer of heart transplantation Christiaan Barnard. Hudson's fiancée was living in Toronto, and in 1963 the two pals travelled to Canada to let Alan spend some time with her. Hendrick astutely gave both of them fellowships in neurosurgery at HSC working, according to Harwood-Nash's biographer Michael Huckman, on a project on pediatric head injuries. (Humphreys calls the publication that eventuated from this "a benchmark in children's head injury analysis."[61]) Harwood-Nash stayed on to train in surgery in Toronto, doing a one-year residency in neurosurgery at TGH and another year in orthopedics at Sunnybrook. Yet at the encouragement of George Wortzman at the General, Harwood-Nash became increasingly interested in neuroradiology and from 1964 to 1967 embarked upon a three-year residency in the Toronto program under Brian Holmes. In January 1968 Harwood-Nash joined HSC as a staff radiologist and director of neuroradiology. In 1976 he and colleague Charles Fitz published their magisterial *Neuroradiology in Infants and*

Children, "giving birth to the specialty of pediatric neuroradiology and making Toronto its capital."[62] The Hospital for Sick Children, says Huckman, "soon became the Mecca to which men and women from all over the world flocked to be trained in his section. He taught his fellows to perform neurodiagnostic procedures with safety and meticulous radiographic technique in the most fragile of human creatures."[63]

Heart Surgery

All three of the techniques required for open-heart surgery originated in Toronto: Murray introduced anticoagulation; Bill Mustard and Lawrie Chute achieved the first survival in a canine cardiac bypass; and Bill Bigelow introduced body temperature control using hypothermia. "The origin of these separate factors within a single university is of interest," deadpans heart surgeon Bernard Goldman.[64]

Thus the story begins in the 1930s as Gordon Murray introduced heparin into vascular surgery. And it was Murray who led the new wave of post-war innovation. He began, actually, in 1936, with Frederick R. Wilkinson and Ross Mackenzie, in experimental animal work replacing the mitral valve in a closed-heart operation that involved punching through the apex of the auricle. (The mitral valve prevents backflow from the left ventricle into the left atrium.)[65] In 1937 Murray, Best, and others reported on the physiological effects of administering heparin in seventy-six patients post-operatively: it lengthened the clotting time.[66] The first clinical application of heparin – an important one – was Charles Best and Donald Solandt's demonstration in 1939 that administering heparin in a heart attack would help localize the damage and prevent the clot from extending: "We would like to … point out that the administration of heparin early in an attack of coronary thrombosis, even before the actual vascular thrombosis, is not necessarily contra-indicated."[67] The comment is a triumph of indirection and understatement.

In 1941 Murray reported on the over 400 surgical patients who had received heparin, with famous results in the treatment of pulmonary embolism in particular: "When pulmonary embolism has occurred and the patient has survived long enough to have heparin administered intravenously, there has been striking clinical improvement": forty-four of forty-six patients had suffered "no further attacks of embolism and showed rapid clinical improvement."[68] (As noted, Duncan Graham remained suspicious of heparin and refused it admission to the medical wards of the Toronto General Hospital until after the Second World War.[69])

In 1946 Murray took a big stride upon the stage of cardiac surgery as the first to perform successfully in the commonwealth the operation for oxygen-starved babies ("blue babies") that Alfred Blalock and Helen Taussig had introduced in 1945 at Johns Hopkins University; the operation targeted a pediatric cardiac

malformation called the "tetralogy of Fallot," in which the surgeon performs an anastomosis, or joins, a branch of the aorta to one of the pulmonary arteries.[70] This is not open-heart surgery because the infant's heart is not actually penetrated, yet it is risky enough, and the brilliant operation opened up cardiac surgery for both infants and adults. (Blalock was probably willing to risk it only because the sulfa drugs – and soon penicillin–were available to control the infections that had doomed so many of the dogs on which these experiments had previously been performed.) By December 1947 Murray had performed the operation sixty times, with a mortality of 11 percent.[71] In that year Murray also succeeded in the partial closure of atrial septal and ventricle septal defects (holes in the heart's interior walls) using, as Baird says, "fascia lata sutures passed in and out of the beating heart."[72]

In 1947 as well Murray described under the term "paradoxical systole" the experimental surgical creation and excision of those parts of the muscle of the heart that had been damaged, or infarcted, in a heart attack, opening an approach to the damaged myocardium that would later be of importance. Cardiac surgeon Rudolph Matas – who was sitting in the audience next to Alfred Blalock as Murray was presenting his paper in an American Surgical Association meeting at Hot Springs, Virginia – said to Blalock, "This work may be epoch-making." Typically, Murray declared in the paper, "This work was done without University or other assistance, apart from limited laboratory facilities in the Banting Institute."[73] (Murray and Ray Heimbecker revived this approach in 1967.[74])

At the same time that Murray was immersed in heart operations, he applied his remarkable surgical virtuosity and active mind to the problem of kidney failure and pioneered the mechanical kidney! Murray was preceded – possibly even inspired – in these efforts by William Thalhimer, then at the Manhattan Convalescent Serum Laboratory, who later became a visiting fellow in Toronto, profiting from the work of Best and Donald Solandt on "experimental exchange transfusion." In 1938 Thalhimer jury-rigged an artificial kidney that was never used clinically. Technically, it is a first. In Toronto, Thalhimer worked at a lab in the School of Hygiene, just across University Avenue from the Banting Institute where Murray laboured; in 1938 he published an article with Solandt and Best on "experimental exchange transfusion." It is inconceivable that Murray did not know of this work.[75]

Beginning in 1933 Murray had undertaken animal experiments to clear the blood of acute toxemia. "It seemed possible that if the patient could be protected from death from toxemia in such conditions, after a time there would be sufficient recovery in a number of cases so that the affected kidneys might resume function," he wrote in 1947. He actually attached the renal dialysis machine he had constructed to a patient who had been given up for lost, and she survived. It was a twenty-six-year-old woman who had stopped passing urine for nine days after an attempt at induced abortion, thus poisoning her kidneys. "She was comatose, was having mild uremic convulsions, was greatly edematous,

and was not passing urine. She was seen by the internists, the gynecologists and the genitourologists, all of whom agreed that the case was utterly hopeless." Murray hitched her up to his dialysing device by passing a catheter into the inferior vena cava on the right side and another into the femoral vein on the left. She was dialysed over a period of days. "The clinical improvement of the patient was striking. She was comatose at the beginning of each of these runs, and at the end the delirium and coma had disappeared." A day after the last dialysis "there was an enormous secretion of 4000 cc of urine." She made an uninterrupted recovery and left the hospital well.[76] At the end of 1949 he reported in the *British Medical Journal* that about half of the patients were surviving, those who succumbed having chronic kidney disease whom even "purification of the blood" was unable to keep from relapsing into a uremic state.[77]

In 1952 Murray carried out a successful kidney transplantation, a subject then of active interest in international scholarship, but this must have been one of the very first. Of the four patients on whom he attempted kidney transplants, only the fourth, twenty-six-year-old Dorothy Pezze, survived. As Shelley McKellar tells the story, "She had suffered chronic kidney disease for fifteen years and had no chance of survival without a new kidney. Pezze wanted the experimental surgery and understood the risks." She underwent the transplant operation on 2 May 1952 and apparently lived on for years, although Murray did not follow her up. In 1990 Joseph E. Murray at Peter Bent Brigham Hospital in Boston won the Nobel Prize for kidney transplantation, having done, it must be said, a much more thorough job of working up the science than did Gordon Murray.[78]

Triumph followed triumph. In October 1955 Murray successfully transplanted the aortic valve of a young man dying of heart failure. "The first patient was one with marked aortic regurgitation," he reported, "with typical findings, with a very large heart going into failure." They harvested an aortic valve segment postmortem from another young patient. "It was very gratifying, on removal of all the clamps, to see the effect of this valve in the thoracic aorta." Following the operation the patient's heart decreased greatly in size, and, eight months later, he seemed perfectly well.[79]

Murray's operation was the first valve replacement. Ray Heimbecker, who had just joined the Department of Surgery, assisted and the day before had harvested the valve. Heimbecker described the operation:

> The aorta was finally clamped off. This had to be done gradually and gently in order to avoid a sudden severe strain on the ailing heart. This huge artery was then divided, and the new valve was transplanted into place. Forty minutes later, the clamps were gradually released. The transplanted leaflets began to open and close with each heart beat. Our excited fingers could feel the vigorous throb as the fragile leaflets closed and opened with each contraction. As I placed my hand on the heart muscle, it too had dramatically changed to a much quieter and more peaceful contraction … The aorta was now carrying a smooth, sustained flow of blood, where