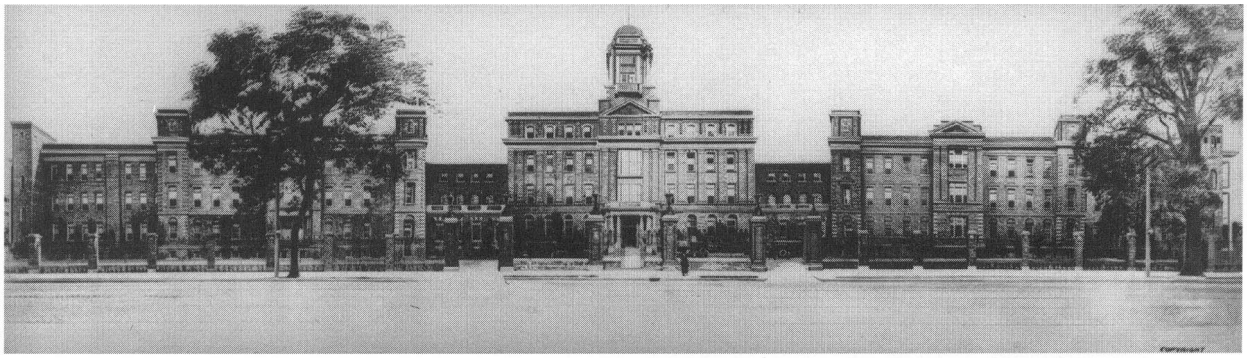

From "The Ward" to Discovery District
101 COLLEGE STREET:
AT THE HEART OF CANADA'S HEALTH CARE HERITAGE

A Heritage Report for MaRS
(Medical and Related Sciences Discovery District)
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On April 11, 1911, at the cornerstone ceremony of the new Toronto General Hospital at 101 College Street, the Lieutenant-Governor of Ontario made a significant comment. "The recovery of over ten acres of land in the College-Elizabeth-Hayter-Christopher section of the historic 'Ward,' and the devotion of so large an area to the uses and requirements of a hospital is nothing short of an event in the history of this city."

Over 90 years later, and after many significant medical events within the walls of Toronto General Hospital, particularly the main College Wing, the Lieutenant-Governor's words

are again relevant to a significant new phase in the history of the former "Ward" site. The new mission will be very much entwined with the 101 College Street building, to be called the "Heritage Building," as the centerpiece of the redeveloped site known as the "Discovery District for Medical and Related Sciences," or simply MaRS.

Since its official opening on June 18, 1913, and through most of the 20th century, the TGH College Wing stood at the centre of a dynamic discovery district not unlike the new "Discovery District" envisioned by MaRS. It was built upon strong linkages between TGH, the University of Toronto (which included Connaught Laboratories until 1972), the Ontario Ministry of Health, the City of Toronto, the Hospital for Sick Children, and other hospitals of the area, all of which are key partners in the MaRS initiative today. It was a discovery district responsible for the clinical development of insulin, heparin and other life-saving extracts, such technologies as the artificial kidney and pacemaker, as well as many pioneering surgical techniques. Through MaRS, this area -- a poor "Ward" transformed into a great hospital -- will continue to be a Discovery District responsible for many more medical discoveries in the future.

"The Ward"

The opening of Toronto General Hospital in 1913 was really a third re-opening. The origins of the hospital stretch back to 1819, originally occupying a small building at King and John in what is now Toronto's Theatre District until it moved northeast to Gerrard Street East and Parliament in 1855. However, by 1904 it was clear that a new hospital was necessary, preferably closer to the University of Toronto and the centre of the rapidly growing city.

Among the key factors influencing the move were the outdated and overcrowded buildings, the consolidation of the University's Faculty of Medicine and the need for better hospital facilities for medical education, and the donation of funds for a new outpatient building. Also critical was the appointment of Joseph W. Flavelle as Chairman of the TGH Board of Trustees in 1904. Flavelle was among Toronto's wealthiest and best connected citizens, primarily through owning the largest pork-packing business in the British Empire and serving as a Director of several major companies.

After some debate about the location of a new site, and securing provincial, university and city funding, in 1906 Flavelle and the Board settled on the College and University area for the new hospital. The site seemed ideal, as it was diagonally opposite the University's new Medical Building, just south of Queen's Park and next to the Hospital for Sick Children. However, the chosen site was occupied by almost 200 houses that made up the northern limits of the "St. John's Ward," a large, densely populated and often notorious part of the city, bounded by College, University, Queen and Yonge Streets. The original plan was to build a 400-bed hospital on half the block than was finally used, the expense of expropriating so many properties limiting the project. However, support from the City of Toronto government enabled a much grander plan of a 670-bed hospital to proceed.

"The Ward" was home to recent immigrants for the most part, especially to Jewish families, Eastern Europeans, and a large Italian community. Most "Ward" residents were working class and poor, while much of area was little more than a dilapidated slum and a growing public health hazard. However, the conditions were somewhat better in the 10-acre block of interest to the hospital, bounded by College, Elizabeth, Christopher (later removed for the hospital's expansion in 1928-30) and University. Several streets within this block would have

to sacrificed or shortened to make way for the hospital. The streets included Chestnut Place, which was a narrow lane just south of College that ran between Elizabeth and University, while Centre Ave (which had been a "red light district") and Chestnut Street were both severed north of Christopher (and by 1930, north of Gerrard). Hayter Street was stopped between Elizabeth and Chestnut Street to ensure an even square block.

Each of these 200 properties would have to be expropriated and demolished. It was a long and detailed process that involved 93 property owners, took 5 years to complete and cost just over $600,000, most of the cost borne by special grants from the City. Once the site was razed, the final step involved removing outdoor privies and then thoroughly sanitizing the soil with hundreds of bushels of disinfectants. As the *Canada Lancet* underscored in 1909, this "will seal the fate of the myriad germs that have led a free existence for generations under the old houses that so recently occupied the site." At the same time a tree doctor was called in to thoroughly attend to all the trees left standing that required treatment.

The Building

While efforts were focused on appropriating, clearing and cleaning the new hospital site, detailed consultations were conducted, including tours of major hospitals in the United States and Great Britain. The results of this process were integrated into the detailed hospital designs by local architects Darling & Pearson, who were also responsible for many major buildings, including the Hospital for Sick Children and the U of T Medical Building.

Construction finally began in November 1910, the project boosted by a "princely gift" of $250,000 from J.C. Eaton to be used for the Surgical Wing at the eastern end of the main

hospital building as a memorial to his father, Timothy Eaton, founder of the Eaton's store. Construction of the Medical Wing at the western end, at a cost of $260,000 (later underwritten by Flavelle), and the central Administration structure also began. While all part of the same main College Street building, the Surgical, Administration and Medical Wings were carefully segregated, as was noted on opening day, "eliminating even the minimum possibility of cross contagion that remains after the expert battle has been waged in the wards and sterilizing rooms."

Work also began on the other new buildings of the site, including the Out Patient Department on University Ave., underwritten by Cawthra Mulock, the second richest man in Toronto at the time, who had originally pledged $100,000 to build this department at the old TGH site. Between the main building and the Out Patient Department was the Shield's Emergency Hospital, paid for by Agnes and Jane Shields in memory of their brother, which also included the city's first two ambulances. However, to make way for two new MaRS buildings, the Mulock and Shields buildings will soon be torn down.

On June 19, 1913, thirty-one months after construction began, the new Toronto General Hospital was officially opened with a total of 670 beds (520 public and 150 private). With 11 new buildings spread over 9 acres, it was the largest hospital in Canada and, as was noted in the *Toronto Star*, "the most modern and complete hospital in the world." The total cost of the project was $3,500,000, to which the City contributed $610,000, the University of Toronto, $600,000, and private citizens, $1,400,000. The original 1904 estimate was $1,250,000.

While the interior of the main building at 101 College has undergone several renovations since 1913, especially since the late 1950s when the hospital underwent the first of several major expansions, its exterior has changed little. The free Renaissance treatment of the façade remains intact, as does the iron fence along the front. The outside bricks were larger than usual and

specially made to obtain the desired colour, the walls relieved by trimmings of terra cotta from Britain and the interesting spacing of windows. Most of the floors inside had a cement finish topped with red Scotch battleship linoleum to give a smooth and noiseless surface. This feature, according to an extensive article on the new TGH in *Construction* magazine in 1913, was "an ineffable boon to the nurses who will have to traverse it almost unceasingly for hours both day and night."

The main entrance at the central Administration building was not designed for admitting patients; the Emergency and Out Patient Buildings served that purpose. When visitors entered off College Street, they would first see the main rotunda and waiting room, with its marble floor and stained glass windows. To the left was the general office, while the information bureau and telephone exchange were on the right. Nearby were the offices of the medical and nursing superintendents, the secretary and steward, along with the boardroom.

The public wards of the hospital were all located in the main College Building, Wards A, B, and C in the eastern Eaton Surgical Wing, Wards D, E. and F in the Administration Building, and Wards G, H, and I in the western Flavelle Medical Wing. The Administration Building was also home to 26 interns who each had private rooms on the top floor. There were a total of 11 operating suites in the hospital, most in the College Building, each with their own operating, sterilizing, anesthetizing and wash-up rooms and independent ventilation system. The X-Ray department was located in the basement of the Medical Wing until 1933, equipped with five X-Ray machines and the first orthodiarscope in Canada, which projected a parallel beam of X-Rays to help illuminate the movements of the heart of digestive organs. In addition to six public wards, the Surgical Wing also housed the main kitchen, orderlies' quarters and servant's dining rooms. The roofs of the Medical and Surgical Wings were devoted to convalescent patients, while

spacious verandahs at the ends of each wing were "a priceless factor in the welfare and recovery of patients."

The Health Heritage Legacy

Between 1913 and 1959, the College Wing of Toronto General Hospital was the scene of many significant medical discoveries and developments. In 1959, when a new central building officially opened to consolidate the hospital's surgical and medical services and most of its other departments, the focus of the College Wing shifted more to administrative, out patient and support services. During the first half of the century, however, several major events in the College Wing provided the keys to a wide range of medical and surgical innovations at TGH and elsewhere.

The most significant key was the discovery of insulin across the street in the U of T Medical Building in the summer of 1921, followed by the first clinical use of the new wonder drug on a diabetic patient at TGH on January 11, 1922. The discovery of insulin story has been well documented by Michael Bliss, but the role of TGH in demonstrating its clinical value is less known. About a month after being admitted to Ward H of TGH as little more than skin and bones, 14-year-old diabetic, Leonard Thompson, was given a shot in his buttock of Frederick Banting and Charles Best's "thick brown muck." The initial results showed a modest reduction in blood sugar. After Bertram Collip was able to purify the extract, however, Thompson was given another shot on January 23 and the results were "spectacular."

The sudden publicity, as well as the political and personal tensions among the insulin discoverers and TGH, was also spectacular, as Bliss has described. However, the discovery of

insulin brought world attention to Toronto, and particularly the University of Toronto and its Connaught Laboratories, where insulin was produced, and to TGH, where it was first used and clinically refined. Such success with an extract to control a chronic disease like diabetes also generated new opportunities for doctors and researchers struggling to control or cure other diseases and conditions that had hitherto seemed impossible.

Pernicious anaemia is not as dramatic a disease as diabetes, but its control was closely linked to the Toronto TGH insulin story. Pernicious anaemia is a vitamin B12 deficiency that can lead to a variety of neurological problems. In 1925, researchers in Rochester, NY, demonstrated the value of liver in the regeneration of haemoglobin in the blood. A member of this research team, Dr. George Minot, was a diabetic and had received insulin from TGH. Through this association with Toronto, Minot made the results of his work with liver concentrates available to Dr. Charles Best and Dr. Earle E. McHenry, who worked in the University of Toronto's School of Hygiene and Connaught Laboratories. In 1928, Best asked McHenry to prepare a concentrated and purified liver extract for clinical use, which he did between 1929 and 1933, first as a solution, then a powder, then in an injectable form based on beef liver. In the clinical development of liver extract, McHenry worked closely with over 60 patients at the TGH Out Patient Department.

Shortly after starting McHenry's liver extract project, Best became increasingly interested in the problem of blood coagulation and how a substance known as heparin could control it. Discovered in 1917 at Johns Hopkins University, a crude form of heparin derived from dog liver had been available for research purposes. However, Best thought that a similar extraction process used to make insulin could be applied to the problem of producing a purified supply of heparin, after which it might be clinically tested at TGH. In 1929, Best first assigned

the problem of developing heparin production and purification methods to Drs. D.A. Scott and A.F. Charles of Connaught Laboratories.

By 1933-34, an efficient heparin production method based on beef lung was perfected, by which time the question of applying it clinically was assigned to Dr. Gordon Murray, a rising surgeon serving Ward C at TGH. While Murray experimented successfully with heparin using dogs across the street in the Banting Institute laboratory, Scott and Charles worked on purifying heparin. They also prepared a crystalline form of the elusive substance that could be tested on patients in need of vascular surgery for the prevention of embolisms, or dangerous blood clots. On April 16, 1935, Murray first administered heparin to patients with mixed results. Six months later, on September 30, 1935, Murray resumed his clinical work, using the new purified heparin with much improved results. By 1940, Murray had treated 400 patients with heparin in a variety of surgical operations without the occurrence of thrombosis or embolism. Despite Murray's success with heparin, its use was not as dramatic as insulin, nor was it as clear to other doctors and scientists how heparin worked to prevent blood from clotting; this is still a mystery today. However, Murray, ever the practical surgeon and researcher, recognized that being able to control blood flow and coagulation inside and outside the body opened up many possibilities for treating a variety of medical and surgical challenges.

By this time Murray had applied heparin to pioneer the repairing of damaged arteries and veins of TGH patients, capturing the attention of the press and other surgeons around the world. He next turned to heart valves and in 1946, the particular problem of "Blue Babies," whose blood was not properly oxygenated because of heart defects. Murray's fist "Blue Baby" operation, which involved re-routing an artery from the heart to the lungs, conducted at the Wellesley Hospital, was not successful. His second attempt, performed at TGH a few months later, proved

to be a glorious success, attracting considerable media attention. Encouraged, Murray focused on trying to repair the damaged heart itself without seeing it directly, tediously inserting a needle through the septum of the heart, taking care not to puncture the coronary arteries. In June 1948, Murray again made headlines after he successfully repaired heart defects in four children; a surgical first. Between 1946 and 1951, Murray performed almost 600 heart operations, often performing two "blue baby" operations a day.

While he was busy with heart surgery, Murray somehow found time to experiment with the kidneys, and in particular, applying heparin to allow the blood to bypass a dysfunctional kidney and be filtered of its liquid waste products outside the body. In 1945, Murray designed and built an artificial kidney machine that could cleanse the blood through a semi-permeable membrane. After testing the machine with dogs, on December 6, 1946, he decided to try it on his first human patient, a 26-year-old pregnant, unmarried woman who had tried to abort herself with a disinfectant, causing severe infection and complete kidney failure. She had been admitted to Ward F at TGH in a coma and Murray thought there was little else he could do but try his odd-looking, homemade kidney machine. After hooking her up to the machine via veins in her legs, and turning it on, her blood flowed through the machine and her condition improved, albeit after several relapses that signaled to Murray that adjustments were needed to regulate the procedure. After 33 days of treatment, the woman was released. For Murray and TGH, this was another celebrated case in the press. Murray went on to treat 16 more cases with is machine by 1952. However, his cardiac surgical work limited his time to further develop the technology, although others certainly did.

Murray was also focused on the problem of transplanting kidneys and other organs. He performed his first human kidney transplant in May 2, 1952, on a 26-year-old woman suffering

from 15 years of chronic kidney failure. While he waited for a suitable donor kidney, Murray carefully selected his operating team at TGH, who were ready for the call at two o'clock in the morning when the donated organ finally arrived. Using heparin to irrigate the donated kidney, Murray proceeded with removing the diseased organ from the woman and then carefully sutured the new one in its place. After "willing he new organ to begin functioning," Murray watched the blood circulate through it and, within a few minutes, urine start to flow. Murray could not have been more pleased as the operation was a success. "The woman with three kidneys" lived another 35 years.

By the early 1950s, despite Murray's obvious successes, a younger crop of surgeons at TGH had started to approach heart surgery in new ways, particularly moving into open-heart surgery. In November 1955, Raymond Heimbecker, a student of Murray's, proceeded with the first successful human heart valve transplant on a 25-year-old man with a leaky aortic valve.

Another young surgeon at TGH, and a student of Best's, William Bigelow, pioneered the possibilities of open-heart surgery with the use of hypothermia. Based on experience with frostbite, beginning in 1947, Bigelow experimented with lowering the body temperature to such an extent that the blood would stop circulating, allowing the surgeon some time to operate cleanly on the heart. After success with monkeys, in 1953 he began to try this procedure on human patients, and by 1960 had performed fifty "deep-freeze operations" at TGH using blankets with cold-water cooling coils. This type of operation only allowed a short time to operate on the heart and was soon supplanted with the development of heart-lung machines.

A more lasting offshoot of Bigelow's pioneering surgical work at TGH was the first artificial cardiac pacemaker. The concept of a pacemaker to regulate the heartbeat had originated in 1932 but had not been pursued. Curious about why the hearts of some of his research animals

stopped while in hypothermic states, Bigelow discovered that short, specific and repeated electrical stimulation could simulate how the heartbeat is controlled naturally. In 1950, Bigelow and several colleagues built a pacemaker that was about the size of a cabinet radio and they used it to regulate the heartbeat of dogs. However, it was not until about 1960, with the invention of the transistor, that a pacemaker could be made small enough to be implanted inside a patient.

All of these developments in cardiac surgery, and others at TGH and elsewhere, as well as such technologies as the kidney and heart lung machines, depended upon the precise control of blood flow inside and outside of the body that heparin provided. TGH played an essential role in the development of heparin, experimental and clinical work that was painstaking and precise and conducted almost single-handedly by Murray. However, Murray's research would not have taken place without TGH's earlier role in the insulin story, or the essential contributions of the University of Toronto and its Connaught Laboratories to the discovery and production of insulin, and then the production and purification of heparin. The close physical proximity of the College Wing of TGH to the University's Medical Building, and to Connaught, when it was based in the School of Hygiene Building, was critical to expediting the development, productions and human application of these two essential "wonder drugs". It was certainly a discovery district centred on the College Wing during the 1920s through the 1950s, not unlike the Discovery District envisioned by MaRS that will involve a variety of partners focused around the same College and University site once known a "The Ward."