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Spirit of Discovery: The history of cardiopulmonary pioneers at St. Paul's Hospital

by Käthe Lemon

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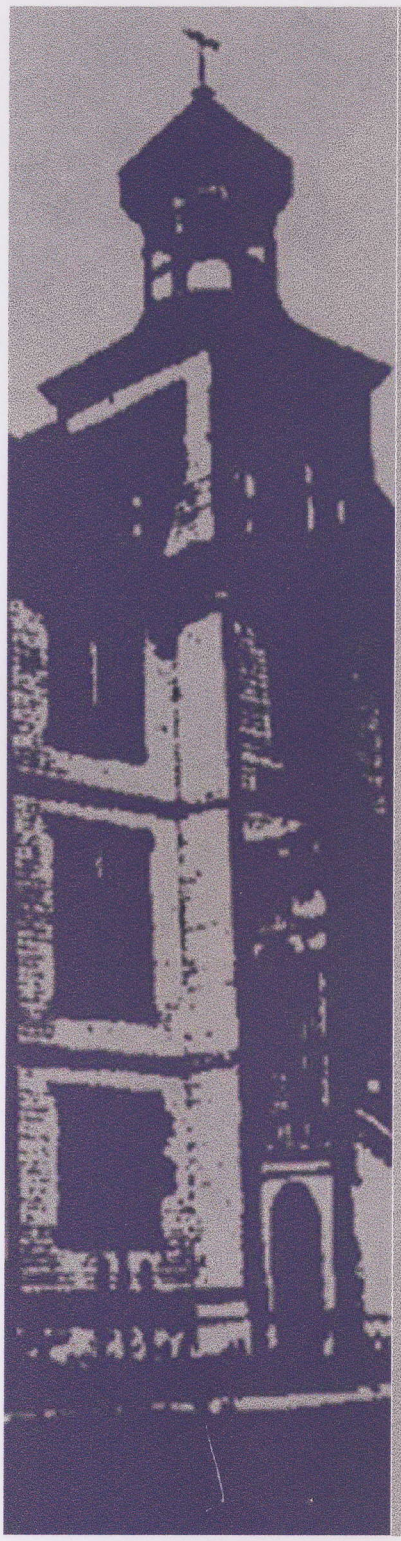

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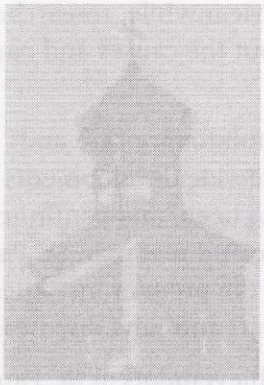


Spirit of Discovery: the history of cardiopulmonary pioneers at St. Paul's Hospital

By Käthe Lemon

Introduction

The most fundamental theme—and attraction—of the history of medicine is its potentially integrative quality…[its] necessary integration of theory and practice, of life and death, of family and institutional life, of the historical and the timeless. Medicine has its origins in the social response to unchanging realities: pain, death, childbirth, trauma and disease, the working out of the life cycle in men and women.

— Charles Rosenberg, 1992

Medical discovery is a matter of small steps, each building on the steps that came before it, scaling ever upward. The history of the diagnosis and treatment of heart and lung disease is no different. Current practice has been built on the back of previous work not only in heart and lung care, but also in other fields; advances in anesthesiology allowed for great improvements in thoracic surgery. The advances in surgery called for greater precision with diagnosis of heart and lung disease and in turn for further research.

Over the past decades incredible advances have been made in diagnosis, treatment and research of heart and lung disease. While tuberculosis, for example, is still a serious illness, the successful use of antibiotics has changed the face of this disease and forced the happy closure of sanatoriums across the globe. Advancing knowledge of the causes of asthma and other obstructive airway diseases has meant leaps in the effectiveness of care and the quality of life of those who suffer from such illnesses. While the heart was once thought of as forbidden territory for surgeons, cardiac surgery has become almost commonplace. Doctors are now able to repair minor congenital lesions such as a hole in the heart, to repair and replace valves and even to perform heart and lung transplants. Improvements in imaging techniques have also provided giant leaps forward in

the understanding of heart and lung disease. Meanwhile, researchers continue to demand answers to questions about the causes and cures for heart and lung disease.

Examining the history of cardiac and pulmonary care and research at St. Paul's offers a snapshot of worldwide developments in these fields. Despite its small size, St. Paul's has been, and continues to be, a pioneer in cardiac and pulmonary care and research. St. Paul's has grown from a "cottage" hospital to one of the premier institutes in Canada for both research and treatment of heart and lung diseases.

This book examines the people and achievements at St. Paul's that have led the hospital to its current position as one of the leading centres in Canada for heart and lung care and research. This introduction puts those achievements into the context of pioneering medical developments in heart and lung care around the world. Chapter One looks at the work of Dr. Harold Rice, who developed the only heart-lung machine ever designed and built in Canada. This machine was used for over 1,000 open-heart surgical interventions before it was retired to the hospital archives. Heart-lung machines allowed doctors to stop the flow of blood into the heart for a length of time, enabling them to perform ever more complex surgery. This capacity, in turn, greatly increased the demand for accurate diagnosis of heart disease. Chapter Two examines the development of cardiology at St. Paul's, in particular the work of Drs. Doris Kavanagh-Gray and Dwight Peretz. As cardiologists were able to more accurately diagnose heart disease and surgical techniques improved, the demand for open-heart surgery expanded rapidly. Chapter Three looks at the developments in heart surgery at St. Paul's, including Dr. Al Gerein's pioneering efforts to replace faulty heart valves, the development of pacemakers and the ever increasing demand for staff and resources for cardiac surgery. The heart and the lungs work together and the same could be said of heart and lung care at St. Paul's Hospital. Chapter Four looks at respiratory care at St. Paul's from the development of the Pulmonary Function Lab in the mid-60s through to today. Particular attention is paid to the work, and practical jokes, of Drs. Graeme Copland and Richard Donevan (or the "Bobbsey Twins" as they were sometimes called). Chapter Five explores respiratory research at St. Paul's, including the Pulmonary Research Lab, MacDonald Research Lab and the work of Drs. Hogg and Paré. In concluding this book, we look at the development of cardiovascular research at St. Paul's, the addition of Dr McManus and his group, the creation of the iCAPTURE Centre and

the future of heart and lung treatment and research at St. Paul's Hospital.

The cliché of history is that hindsight is twenty-twenty, and yet, often when we reminisce we do not see clearly. Our observations of the past are distorted by the lens of time. We see major events in extreme close up while smaller, day-to-day happenings vanish. The same is true of people; history has a habit of elevating the stars while diminishing the appearance of those who were not at the forefront of events. In many cases this is inevitable. Traces of the smaller roles and everyday occurrences are often unrecorded or not saved in archives or memories. However, this does not mean that those efforts were not valued. The advances in cardiac and pulmonary diagnosis, care and research could not have happened without the teamwork of the unsung nurses, technicians, anesthesiologists, administrators and trainees. This is not to mention the bravery and co-operation of the patients who underwent pioneering surgeries and agreed to participate in research efforts. The invaluable efforts of many people at St. Paul's will unfortunately not be adequately recorded here. Similarly, while it is the first time operations and discoveries that we revere, it is the fact that these initial successes can be repeated, time and again, and become routine, that makes them truly successful. Although we celebrate the achievements of a few, let us not forget these everyday triumphs and the spirit of teamwork that allowed for a select group to shine, both in the world of medicine and at St. Paul's Hospital.

In 1894 the Sisters of Providence opened St. Paul's, a small 25-bed hospital on the road to English Bay. As innovative and forward thinking as they were, it is unlikely that the Sisters had any inkling of the rapid advances in cardiac and respiratory care that would sweep through not only the world of medicine, but also the halls of St. Paul's Hospital in the coming years. After all, it wasn't until the following year that Wilhelm C. Roentgen would discover the X-Ray, ushering in an era of imaging technologies that would be invaluable for heart and lung care.

While the Sisters set about organizing their "cottage" hospital, the first tentative steps were being taken that would open the doors of heart and lung disease diagnosis, treatment and research. In 1896 Scipionne Riva-Rocci created a prototype of the blood-pressure cuff. The same year Ludwig Rehm was the first to successfully repair a laceration of the heart, launching the era of cardiac surgery. The heart was considered by many to be too delicate to touch. This made it one of the final frontiers for

surgery. However, in the late 1800s surgery was attempted to repair heart wounds and inflammation of the pericardium—the sac that surrounds the heart. In 1923, Sir Henry Souttar made what was possibly the first successful attempt to open a stenosed mitral valve by passing his finger into the left atrium of the heart through a purse-string suture. While his patient survived, he apparently was not asked to attend to others with similar problems.

Although it had long been known that oxygen played a key role in life support, it was a long time before it was used therapeutically. During the First World War, Dr. J.S. Haldane treated mustard gas injuries with oxygen. Following the war he published his experiences, and his paper is largely considered to mark the beginning of the modern era of oxygen therapy.

While many advances had been made up to that point, there were still issues that complicated heart and lung surgery. One was the problem of blood clotting when large blood vessels or the heart were opened. The second was the patients' spontaneous breathing, which caused obvious complications for lung surgery.

An eager medical student at Johns Hopkins, Jay McLean wanted a research question that he could investigate, solve and publish on in one year's time. His professor of physiology, Dr. William Howell asked him to sort out the active agent responsible for blood clotting from cephalin, which is extracted from brain tissue. McLean discovered that instead of causing clotting, brain, liver and heart extracts stopped the blood from coagulating. McLean later left the study, but Howell continued with the research and by 1918 he had isolated the chemical responsible and called it heparin. However, he was only able to make small quantities of the chemical, making it unusable for surgery. Drawing on the experience he had gained preparing insulin, Canadian Charles Best worked on the problem with a team and by 1936 they were able to prepare large quantities of pure heparin. Today, heparin is widely used as an anticoagulant during therapeutic procedures such as cardiac surgery and renal dialysis, as well as for the treatment of hypercoagulable states of thrombosis and pulmonary embolism.

The ability to control patients' breathing was necessary to perform heart and lung surgery. In 1812, the British surgeon Benjamin Brodie showed that an animal given the poison from South American poison darts, curare, could be kept alive with artificial respiration. However, it

was not until much later that this powerful muscle relaxant would be used in surgery on humans. In Montreal in 1942 Drs. Harold Griffith and Enid Johnson first used pure curare during surgery. By relaxing the respiratory muscles doctors were able to control patients' breathing making lung, and later cardiac, surgery much easier.

Necessity being the mother of invention, it is perhaps not surprising that rapid advances in surgery took place during the wars. Facing huge numbers of patients with massive injuries, military doctors in the Second World War pioneered developments in anesthesiology, antibiotics and blood transfusions. All of these advances helped surgeons gain access to the heart. One of the first surgeons to do so was Dr. Dwight Harken, who developed a technique to remove shrapnel lodged in the heart. Cutting a small hole in the side of the heart, Harken would carefully reach into the still-beating heart with a finger, find and remove the shrapnel, then repair the incision.

It did not take long for doctors to recognize that Harken's technique could also be used to repair defective heart valves. Working independently of one another, Russel Brock in London, England; Charles Bailey in Philadelphia and Harken in Boston each reported successful mitral commissurotomies in 1947. In this procedure the scarred and fused flaps of the mitral valve were separated to widen the narrowed valve. Similarly to Harken's method for removing shrapnel, in these "blind" closed-heart surgeries the surgeon would cut a small hole in the side of the heart and reach in with a finger to carefully widen the narrowed valve, allowing blood to flow properly. Initially, these surgeries were very risky and many patients did not live through them. As techniques improved so did the success rate. But even then, these blind techniques could only offer so much. Without the ability to stop the flow of blood and see inside the heart, doctors could not treat patients with complex or multiple problems.

According to medical lore, it was his memory of the cold Canadian winter and groundhogs' ability to survive hibernation with a lowered heart rate that brought Dr. Bill Bigelow to experiment with hypothermia as a means of lengthening the time the heart could safely be stopped. Leave it to a Canadian to make the most of the cold. Bigelow was able to show that at lowered temperatures the body and brain could survive for longer without oxygenated blood. In 1952, Dr. Walton Lillehai and Dr. John Lewis were the first to use this technique

to repair a hole in the heart of a five-year-old girl. After lowering her body temperature to eighty-one degrees Fahrenheit, the doctors stopped the flow of blood into the girl's heart. This meant that the heart emptied, leaving a clear view of the hole, which the doctors quickly repaired. This initial surgery was a success, as were many others that followed using the hypothermic method. However, often when they opened the heart, doctors found more serious defects than they could repair in the ten minutes they could safely stop the flow of blood using the hypothermic method.

The next step in the development of heart surgery was the creation of heart-lung bypass methods. Dr. Morley Cohen developed dog-to-dog cross circulation and showed that they could survive the lowered blood flow caused by one heart pumping the blood for both dogs. In 1954, Lillehai was the first to use cross-circulation for human open-heart surgery. Doctors attached the patient, a boy with a hole in his heart, to his father. Although both survived the surgery, the boy died eleven days later from pneumonia. While it was used for more than forty surgeries, this method had serious drawbacks, not least of which was the potential for 200 per cent mortality! In Toronto, Dr. Bill Mustard used lungs from rhesus monkeys as an oxygenator. He used this method successfully on a small number of patients, but the majority did not survive the surgery. The best solution developed was the heart-lung machine.

Dr. John Gibbon and his wife developed the first mechanical oxygenator, and on May 6, 1953 Gibbon performed the first successful open-heart operation using a heart-lung bypass machine. A couple of years later Lillehai developed a disposable bubble oxygenator.

Most of the first heart surgeons were chest surgeons, and that was true at St. Paul's as well. When heart surgery was still in its infancy there were, for obvious reasons, few opportunities for specialized training for doctors, nurses and technicians. Many learned in the dog labs and in practice from their colleagues. St. Paul's decided to start a cardiac diagnostic service in 1957, the same year the first heart surgery was performed in B.C. At the time the staff and administration of St. Paul's felt that the hospital was falling behind; while the Vancouver General was becoming a well established medical institution, St. Paul's was seen as a good community hospital, but hardly a cutting-edge facility. Within a few years the dedicated staff were able to turn that around and put St. Paul's on the path towards the facility it has become. When the members

of the Department of Medicine approved a plan to turn over all fees from the interpretation of ECGs to fund a new Clinical Investigation Unit (CIU) the hospital took steps towards becoming the clinical and laboratory research facility that it is today. One of the first projects of the CIU was to set up a cardiac catheterization service at St. Paul's.

They say that the line between stupidity and genius is a fine one, and German medical student Werner Forsmann certainly walked that line in 1929 when he used himself as the test subject to show that the right side of the heart could be catheterized by way of a peripheral vein. (And being a urologist he used a urinary catheter to do it!) However, it paid off, and in 1956 Forsmann shared the Nobel Prize with Andre Cournand and Dickinson W. Richards for their respective roles in introducing and standardizing cardiac catheterization. Cardiac catheterization became routine in the diagnosis of heart disease. By the time St. Paul's set up its catheterization lab in 1958, decades had passed since Forsmann's experiments. However, administrators at St. Paul's still insisted that Dr. Kavanagh-Gray demonstrate the technique in the dog lab. While the fact that the dog's leg would not lie flat on the operating table caused some initial trouble, Kavanagh-Gray was able to demonstrate the procedure to everyone's satisfaction and the service proceeded without further ado.

After establishing the catheterization service, the next step at St. Paul's was to acquire a heart-lung machine. Although funding was short at the hospital, ingenuity was not and Dr. Rice designed and built a heart-lung machine for St. Paul's. The first open-heart surgery at St. Paul's was performed on May 22, 1960 using Rice's machine. As the cardiac service grew, more staff joined the surgical team including Drs. Al Gerein, Bob Miyagashima, Andy Tutassaura, Hilton Ling, Samuel Lichtenstein, James Abel and Anson Cheung. The increase in surgical ability again demanded increased diagnostic abilities and the cardiology department, under Kavanagh-Gray also grew rapidly. Over the years, Drs. Dwight Peretz, John Boone, Art Dodek, John Webb, Charles Kerr, Marla Kiess and many others maintained the high quality of the cardiology services.

As in the rest of the world, the history of heart medicine is strongly linked to the history of lung medicine at St. Paul's. Treatment of lung disease has gone through several stages as the causes and cures for various diseases have been discovered. In the late 1800s, tuberculosis

was the number one cause of death in North America. At the time it was nicknamed the "White Plague" and was considered incurable. In 1885 Edward Trudeau, an American chest doctor who had had TB, built the first tuberculosis sanatorium in the United States. Sanatoriums built on Trudeau's model became the mainstay of tuberculosis treatment in the late 19th and early 20th century. The main benefit of the sanatorium may have been for those who were healthy—isolation did not offer a cure for TB and almost 75 per cent of those who went into sanatoriums were dead within five years. It was not until 1944 that Selman Waksman isolated streptomycin from a fungus, marking the beginning of antibiotic treatment of tuberculosis. While tuberculosis still affects many around the world, it is now a treatable disease and is no longer the focus of respiratory medicine in North America.

Another major turning point in the history of respiratory medicine was the polio epidemics that swept the world. This acute viral infection often paralyzes the respiratory muscles, which move air in and out of the lungs. The iron lung, invented by Philip Drinker, was a cumbersome machine approximately the size of a compact car that encased the patient's body from toe to neck leaving only the head exposed. Using suction to create a push and pull motion on the chest, the iron lung forced patients' lungs to move and pull in air. Dr. Rice, who worked in Edmonton at the height of the polio epidemic, oversaw the use of 32 iron lungs at one time. Fortunately, in 1955 Jonas Salk's polio vaccine was introduced and widely distributed, eventually virtually wiping out the disease around the world.

While St. Paul's was known in the early 1900s for having one of the best consultants in tuberculosis and silicosis in B.C., Dr. C.H. Vrooman, most of these early developments had passed before the hospital started its pulmonary service. In the mid-1960s the P.A. Woodward Foundation gave a grant to St. Paul's to establish the Pulmonary Function Laboratory. Dr. William Young ran this service, again with the addition of several machines made by Dr. Rice, until 1971. However, it was not until more than a year later after Young left that Drs. Graeme Copland and Richard Donevan joined the staff at St. Paul's and expanded the sophistication and capabilities of the Pulmonary Unit. Their work also included respiratory care for all patients on oxygen therapy throughout the hospital. Other changes that have affected respiratory care include a greater understanding of the dangers of smoking and inhaling industrial particles such as silica and asbestos. The

outreach work done by St. Paul's doctors has had a major effect on the community's understanding of heart and lung health.

Donevan and Copland quickly built a clinical practice that encouraged others around them to attain similar standards of excellence. Because of the many pulmonary complications linked to AIDS/HIV, in the early 1980s as this disease gained almost epidemic proportions in downtown Vancouver, it made sense to create a centre at St. Paul's for treating AID patients. The respiratory care for HIV/AIDS patients was lead to Dr. Lindsay Lawson. Another addition to the respiratory unit was the Adult Cystic Fibrosis Clinic, which came to St. Paul's when the Shaughnessy Hospital closed in 1993.

The doctors at St. Paul's were skilled clinicians and many of them published academic papers recounting the observations they made of their patients during surgery and diagnosis. However, until the late-1970s, St. Paul's was not actively engaged in major laboratory research. This changed in 1977 when Drs. Jim Hogg and Peter Paré were recruited from McGill University to join the St. Paul's staff in order to start research and establish the Pulmonary Research Lab. The Pulmonary Research Laboratory was also important in strengthening ties between the hospital and the University of British Columbia and in helping the medical school expand. Dr. Hogg was the first full-time professor based at St. Paul's, and when the respiratory division leadership was taken on by Peter Paré in 1982 it was the first university division to be centred at St. Paul's.

In the intervening years the research has outgrown not only the first Pulmonary Research Labs, but also the succeeding MacDonald Research Labs. In 1993 Dr. Bruce McManus, a cardiovascular pathologist and researcher, joined the faculty at St. Paul's bringing with him the University of Nebraska Medical Centre Cardiovascular Registry. This expanded the work at St. Paul's into the field of cardiovascular research and completed the circle of heart and lung diagnosis, treatment and research. In the late 1990s the cardiopulmonary research program had completely outgrown the MacDonald Research Labs. A group of investigators, together with university and hospital administrators worked together with a number of other funding groups including the B.C. Lung Association and the Heart and Stoke Foundation of B.C. and the Yukon to develop an application to the Canadian Foundation for Innovation (CFI). The CFI provided over $6-million of the over $17-million award that was used to establish what has become the James

Hogg iCAPTURE Centre for Cardiovascular and Pulmonary Research. Now, the iCAPTURE Centre is home to heart and lung researchers from all over the world. While there has been a long history of collaboration between clinicians and researchers in Canada, this idea has truly taken root at the interdisciplinary iCAPTURE Centre.

The work done at St. Paul's has always focused on ensuring the utmost quality in patient care, and the research at the hospital continues this. As we reflect back on the history of the development of St. Paul's it is with an eye to the future developments in research and patient care for heart and lung disease.

Chapter 1: The Beginning of Open Heart Surgery

What kind of men are these? Leadership comes easily to most thoracic surgeons, who are problem solvers and decision makers by nature and tradition... [they are] often wrong, but never in doubt.

—unknown

Introduction

Heart surgery itself, especially open-heart surgery, had only recently emerged as a recognized technique in the late 1950s when St. Paul's began to plan for its first cardiac surgery. The development of cardiac surgery at St. Paul's Hospital is an exhilarating part of the hospital's past, and one that shows St. Paul's history of pioneering work. Not only was St. Paul's a pioneer in the sense of doing work that was new around the world, but St. Paul's was one of the first community hospitals to start this sort of work. Even more impressive, St. Paul's developed its own heart-lung bypass machine—the only bypass machine designed and built in Canada.

Until the late 19th century heart surgery was considered next to impossible. Most medical professionals considered the heart to be surgically untouchable, making it one of the final frontiers for surgery. As late as 1896, Stephen Paget, who is well-known for his work in experimental medicine, wrote, "Surgery of the heart has probably reached the limits set by nature to all surgery; no new method, and no new discovery can overcome the natural difficulties that attend a wound of the heart." Fortunately, Paget's predictions have not been bourn out. By the end of the century, doctors had attempted surgery for cardiac wounds, pulmonary embolus and inflammation of the pericardium.

In 1923, Sir Henry Souttar made possibly the first attempt to open a mitral valve by passing his finger through a purse-string suture, into the left atrium. The same year, E. Cutler and S.A. Levine succeeded in widening a scarred heart valve. However, these occasional successes were followed by many more failures.

Early heart surgery was performed as a closed-heart procedure and used a variety of instruments that were passed into the still-beating heart through a purse-string suture. The main problem for heart

surgeons was that the major organs could only withstand a short period without oxygen. Surgeons were trapped in a Catch-22 situation—they needed to stop the heart to perform life-saving surgery, but stopping the heart killed the patient. Without the ability to open up the heart and stop the flow of blood during the operation, surgeons worked essentially blindly, and only relatively minor heart wounds and defects could be treated.

Working from his research into groundhogs' ability to hibernate, Dr. Bill Bigelow of Toronto discovered that lowering patients' body temperatures decreased their need for oxygen. Bigelow was able to show that at safe hypothermic temperatures the vital organs could withstand a stop in blood flow for eight to ten minutes. This made it possible for surgeons to perform the first open-heart surgery. However, the very short time of cardiac arrest that hypothermic methods allowed, still meant only relatively minor heart surgery could be performed. In many cases surgeons opened the heart only to discover defects too numerous or complicated to fix during the safe window of time.

Preparing for the First Cardiac Surgery at St. Paul's

The end of the Second World War was followed by a period of prosperity, growth and technological development in North America. These changes encompassed St. Paul's hospital, which up until the 1950s had been a very good, but small community hospital. St. Paul's was opened in 1894 by the Sisters of Providence to serve the mining and fishing camps as well as the local English Bay community. Although the hospital started a Department of Radiology in 1912 and was the first hospital in B.C. to use radium for treating cancer, by the 1950s St. Paul's had grown into a traditional general hospital that boasted few special procedures. There had been a genial rivalry between the Vancouver General, which had opened eight years earlier, and St. Paul's since the beginning, and in the mid-1950s St. Paul's seemed to be falling behind its local "competitor." The general impression at the time was that St. Paul's was "long on the art of medicine and short on the science of medicine." The staff and administration of the hospital recognized that medicine was advancing rapidly and that St. Paul's would be left behind if it did not move quickly to address these changes.

The urge for change may have also been spurred on by the opening of the medical school at UBC in 1950 and the signing of the

hospital academic agreement in 1952. Although St. Paul's had signed an affiliation agreement with the university, in the beginning VGH was the major hospital affiliated with UBC. Dr. Bill Hurlburt, Dr. John Sturdy and many of the other doctors at St. Paul's wanted to develop an academic Department of Medicine at the hospital. This meant strengthening St. Paul's clinical management, teaching and research abilities. To help achieve these goals the Departments of Medicine, Pathology and Surgery came together to create the Clinical Investigation Unit in 1956. The first project of the new unit was to reorganize the electrocardiographic (ECG) service so that the fees from the interpretation of the tracings would be pooled and used as an operating fund for the Unit's other goals. By the time Dr. Doris Kavanagh-Gray arrived in 1959, the ECG fees were being dedicated to raise money for the Clinical Investigation Unit's projects. Its first priority was to establish a cardio/respiratory service.

"Before I came here the internists were reading the results [of the ECGs] and they would pocket the little fee that went with it," Kavanagh-Gray says. "When I came they figured that really I ought to be doing it for nothing because I had this wonderful place to work, and it was fine with me. So I did all the readings of the cardiograms and the money then went to develop other things. It might go to support a cardiologist for the first six months till he or she could get on her or his feet, or whatever."

The ECG revenue gradually grew over the next decade from $2,000 a year to approximately $16,000 a year. According to Kavanagh-Gray, the program worked well and raised money to build and buy equipment, to help pay salaries and to establish new programs. "I had to admire the internists for voluntarily giving up this little sinecure that they had, had to admire myself for doing it for nothing, and I had to admire Bill Hurlburt for his foresight in seeing that these funds could be diverted to other areas to develop the hospital."

St. Paul's was not the first hospital in B.C. to perform open-heart surgery. However, it was one of the first community-based, non-university hospitals in the world to perform open-heart surgery. At the time, the predominant philosophy was that only major research hospitals could attempt heart surgery. Although St. Paul's had only minimal affiliation with the university at that stage, the hospital was not content to sit back and watch the big boys get all the glory. The first open-heart surgery in B.C. was performed at the Children's Hospital, which was part of VGH at the time, in October of 1957 using a bubble oxygenator

to repair a hole in the heart of a nine-year-old boy. The same year, after prolonged debate, the St. Paul's administration decided the hospital had enough patients to justify establishing cardiac diagnostic and open-heart surgical services—they took the first steps on the path toward creating what would grow to be one of the leading centres for cardiovascular pulmonary research, treatment and care in Canada. The administration and staff of St. Paul's set out to prove that hospitals without major university affiliation were every bit as capable of performing open-heart surgery if they had the proper equipment and facilities. The next problem was getting the proper equipment.

In addition to revenue from the ECG fund, the Clinical Investigation Unit received grants from the B.C. Heart Foundation and the Woodward Foundation, and Dr. Harold Rice began ordering cardiac catheterization equipment so that services could begin in 1959. However, in spite of these grants, much of the equipment, especially the heart-lung bypass machine, was still too expensive for the hospital. For example, the Mayo-Gibbon heart-lung machine cost $45,000.00—a prohibitive price for St. Paul's. Following in the make-due-or-do-without pattern that had been set by the Sisters of Providence, Rice set out to design and build much of the necessary equipment for the new cardiac diagnostic and surgical services. One of his first developments was a new method of analyzing blood oxygenation. The standard Van Slyke method took half an hour per test, and was quite expensive. Rice developed a colour photoelectronic method that allowed for a dozen tests to be done in the same amount of time. Other inventions included pulmonary function equipment to test CO_2 levels and total lung volumes, and a heart-lung bypass machine.

Rice had come to St. Paul's from Edmonton for an internship in 1955, and Hurlburt asked him to stay on as the director of the Clinical Investigation Unit. By all accounts, Rice had an incredible mind and was capable of designing and building just about any medical device. He was also known to be difficult to work with at times. Kavanagh-Gray has described him as a "small, vigorous and sometimes vexatious physiologist. He was a very innovative, inventive man. Irritating, but very innovative." Similarly, Dr. Bob Gourlay, the Chief Surgeon at St. Paul's from 1958 to 1978, once said about him in an interview, "Harold was a very difficult person as you well know, and Harold was a tremendous fellow to make anything."

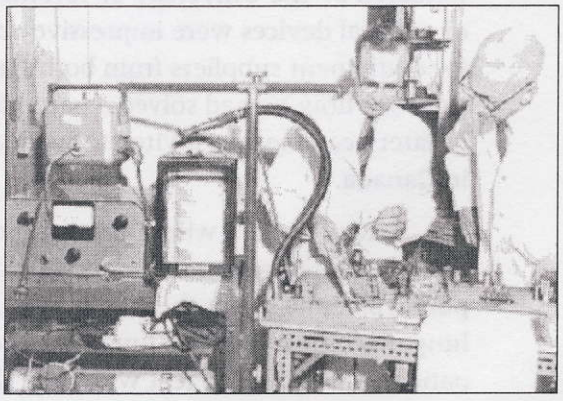
Rice's inventions did not start at St. Paul's. In 1940 he created the first in what would become an impressive series of medical devices. At the time penicillin was a new and precious drug and doctors were trying to find the most efficient way to give it to patients. Rice invented an apparatus that administered a controlled dose of penicillin to patients twenty-four hours a day. The next year he designed and built an electroencephalograph (EEG) for the Winnipeg General Hospital. It was the first such machine in Western Canada and the EEG service at the Winnipeg General that grew from Rice's invention was frequently used by the armed services. In 1942 Rice was awarded the Reeve Prize for Research by the University of Toronto. Rice's inventions and adaptations of medical devices were impressive enough that it was not uncommon for equipment suppliers from both Canada and the U.S. to ask his advice or to see how he had solved a particular mechanical or medical problem. In later years he was invited to work at NASA, but chose instead to stay in Canada.

Rice and his wife, Dorothy, moved to Edmonton in 1949. Rice's PhD thesis had been on the nervous control of respiration and when the polio epidemic swept the city in 1953, he worked to regulate the iron lung machines. The iron lung was a coffin-like machine that enclosed patients from neck to feet with only their heads exposed to the air. Using suction on the body, the iron lung forced the patient's lungs to move, thereby pulling in and pushing out air. At the peak of the Edmonton epidemic, 32 iron lungs were in service. The experience of working to regulate the iron lungs had a major impact on Rice. "This was the final event that convinced me that a new era in medicine had begun where scientific and technical resources would aid the experience and skill and knowledge of the traditional doctor," he wrote. In cardiac surgery this new era was already dawning.

Creating a pump that could replace the heart during surgery was relatively simple; the difficult part was in oxygenating the blood before returning it to the body. The first heart-lung bypass machine was developed by Dr. John Gibbons. The machine acted as both heart and lungs pumping and oxygenating blood for the patient, allowing doctors to stop the heart and let the blood drain out of it before beginning surgery. As Dr. Kavanagh-Gray has written, "From that moment, no lesion could resist surgical correction. Every month, and at every international meeting, new surgical triumphs were revealed to a breathless audience." Gibbons performed the first successful open-

heart operation with a complete bypass of the heart using a heart-lung machine in 1953, when he closed an intra-atrial septal defect, commonly known as a hole in the heart. In the early fifties other open-heart techniques were also attempted. These procedures relied on a variety of techniques including cross-circulation, where one patient's heart pumped and oxygenated blood for a second patient whose heart was stopped while surgery was performed, and hypothermia, where patients' body temperatures were lowered to decrease their need for oxygen.

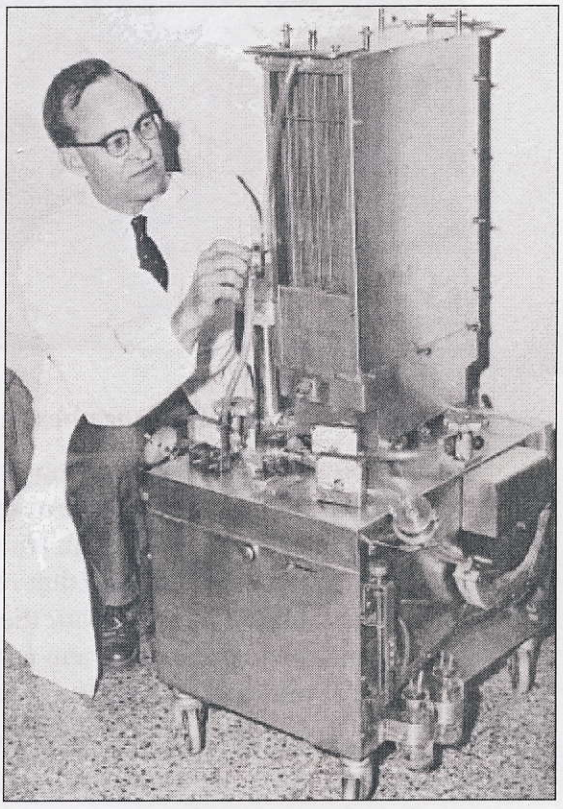
The same year as Gibbons performed the first successful open-heart surgery with a by-pass machine, Dorothy Rice became the fourth open-heart surgical patient in the world and the first at the Mayo Clinic. Both Dr. Rice and Dorothy had known that she had a congenital heart defect, however, because of the limited diagnostic testing that was available at the time, the exact nature of her condition was unknown. The defect limited her physical activity and doctors told her she would likely only live to be middle aged. "Today, with scores of new and radical procedures being employed daily, it is difficult to appreciate that many, probably the majority, of doctors, decried the aim of operating on the heart," wrote Rice. "One famous doctor in Boston publicly declared it to be impossible. One of my Edmonton colleagues told me it was medical malpractice. How things have changed."



Dr. Rice explains an early blood gas (CO_2) analysis machine to a colleague

Although the Mayo Clinic had completed its research and was ready for its first open-heart patient, the doctors were very frank about the possible outcome of the surgery. Up to that point only three open-heart operations had been performed, one in Boston, one in Philadelphia and one in Minneapolis. The results were that one patient was cured, one patient died and the other survived, but with no change in the condition—exactly a fifty per cent success rate. While doctors were able to correct Dorothy's atrial septal defect, a second defect was found during the surgery, an anomalous pulmonary vein. Without a heart-lung bypass machine doctors could not repair this second defect. By 1958,

however, the Mayo Clinic, working with Dr. Gibbon, had developed a heart-lung machine and was ready for patient trials. Dorothy had a second open-heart operation to repair the remaining defect. For the first time, in her late-forties, Dorothy had normal blood circulation. The result of the second surgery was to create an avid golfer who lived to be almost 77 years old. Having seen the Mayo-Gibbons machine in action and the results of the surgery first hand, Rice was intrigued by the surgical possibilities by-pass machines opened. The same year he told his colleagues at St. Paul's that he was confident he could build just such a machine out of stainless steel. "I was amazed when they accepted that statement," he wrote. Fortunately for all, both Rice and his colleagues were right to be confident.

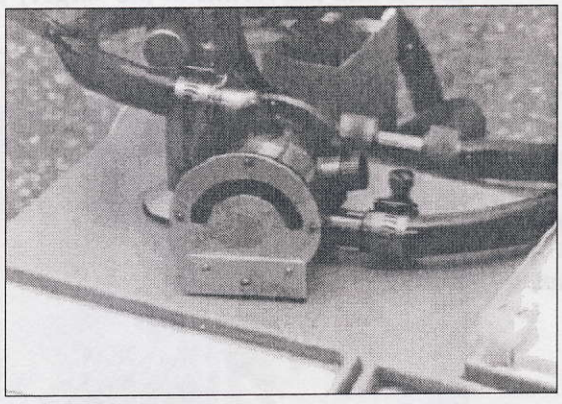


Dr. Rice with the heart-lung machine he invented. This machine was used in over a thousand open-heart operations before it was retired to the hospital archives, where it is still on display

With grants from the B.C. Heart Foundation, the B.C. Polio Foundation, the Koerner Foundation, the Women's Auxiliary and the B.C. Medical Foundation and money from the ECG pool as well as other donations from doctors at the hospital, Rice set out to develop what Dr. Al Gerein has referred to as the Rice Modification of the Mayo-Gibbon Oxygenator. When Rice started he wanted to create a machine that could be completely sterilized. Made out of soldered stainless steel, Rice's machine could be taken apart and sterilized in the autoclave meaning that it was much less susceptible to causing infection in patients than some other designs. According to Gloria Stephens, the scrub nurse on the first open-heart surgery at St. Paul's, Rice practically built the machine out of odds and ends and old bandage tins. "He went through the hospital and he'd see something and

he'd say, 'oh, I can use that and this,'" says Stephens. The machine went on to be used in over one thousand operations. It never failed to provide adequate oxygen and was never associated with acidosis or infection.

According to Gourlay, there was a great deal of debate at the time over the various merits of the different styles of oxygenators—the screen, disk and bubble oxygenators. Rice's machine was a screen oxygenator. The blood would flow down the screens and pick up oxygen as it flowed across them.



An arterial

In addition to designing and building the heart-lung machine, the staff at St. Paul's had to test it before it could be used on patients. The testing was done in the animal labs, where, Gourlay once joked, "We put dogs back together and sent them home again."

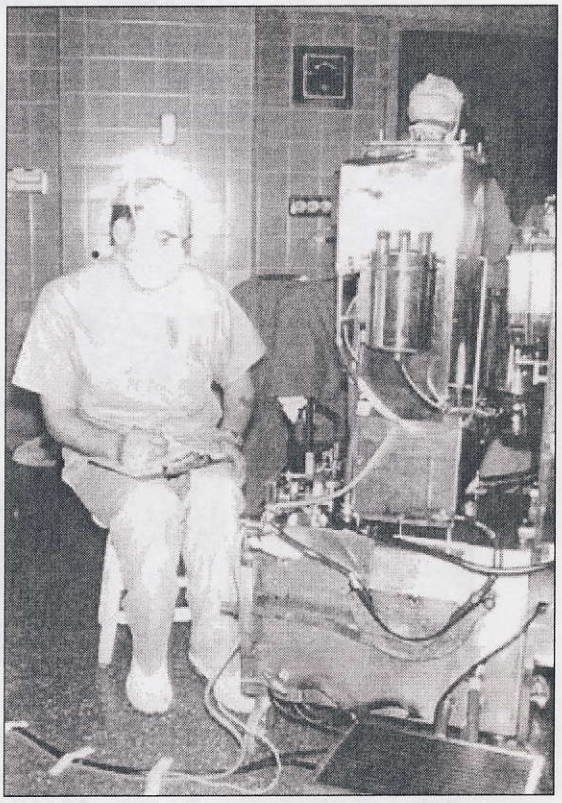
The testing included all aspects of the machine's function and surgical techniques. "We were testing everything," says Stephens. "How to give the patient enough blood, how to keep the blood from coagulating, we were doing all that research. So we would operate on dogs, establish a problem with their heart, nurse them back to health, and then operate on them again to correct the defect with that antiquated stuff that we had. But it worked."

As in other hospitals, the push for developing cardiac surgery came mainly from the thoracic surgeons. Leading the pack were Gourlay, Dr. Ted Musgrove and Dr. G. Coursley. Musgrove came to Vancouver to start practice in 1952. He had trained at the Mayo Clinic and his background was in general and thoracic surgery. Musgrove went on to develop peripheral vascular surgery at St. Paul's. Coursley was also a thoracic surgeon. However, it was Gourlay who led the surgical team.

Gourlay had strong ties to St. Paul's—his father, Dr. Henry Gourlay, had been a surgeon at the hospital before an early death from pneumonia, and his mother was part of the first class of nurses at St. Paul's. After getting his medical degree at McGill University in 1942, Gourlay did an MSc in Experimental Surgery in 1951—his thesis work

was on fruit flies. Following this, Gourlay returned to Vancouver to work at St. Paul's. "I don't think my mother would have spoken to me if I'd gone to the General," he once said in an interview about his choice of workplace. In 1958 Gourlay became Chief Surgeon and held that post for almost twenty years, one of the longest tenures of any Chief Surgeon in Canada.

By 1958 the surgical team was assembled. Rice, Gourlay, Musgrove and Coursley had visited the Mayo Clinic to investigate the heart-lung machine and to learn about open-heart techniques. However, there were still a few critical pieces of the cardiac team missing. In 1959, Dr. Doris Kavanagh-Gray joined St. Paul's to undertake cardiac diagnostic services in the new catheterization laboratory. That same year, training began for the open-heart nursing team and the by-pass machine technicians.



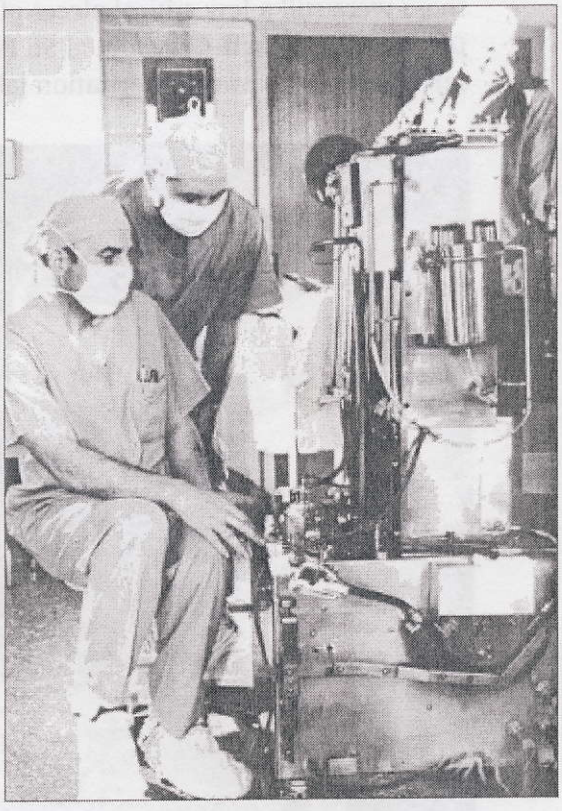
Tom Osborn monitors the heart-lung machine during surgery

At the time, because the techniques were so new, there were no technicians or perfusionists and no formal educational programs to teach them. Many of the early trainees were former hospital orderlies. At St. Paul's Rice recruited and trained Tom Osborne as his first technician. Osborne went on to be certified by the Board of Examiners of the Society of Engineering Technologists as a Senior Engineering Technologist.

Similarly, there were no training programs in open-heart surgery for nurses. At St. Paul's three nurses were selected to be on the open-heart team. They worked in the dog labs alongside the surgeons for their training. "We would go in on Saturdays, we did every Saturday for about

three months, and we would operate down in the dog labs, on dogs," says Stephens about the initial training she received to be part of the open-heart team.

With all the necessary steps underway, Kavanagh-Gray started looking for a good candidate for the first open-heart surgery at St. Paul's. "[Dr. Gourlay] was looking for an ideal patient who would do well, we certainly didn't want to lose our first patient or two, and had asked that I keep an eye out for somebody with an atrial septal defect: somebody with a hole in the upper chambers of the heart, which he thought was a relatively easy thing to repair," says Kavanagh-Gray.



Tom Osborn and Dr. Lewchuck monitor the heart-lung machine during open-heart surgery

Initially, many of the open-heart patients were children with congenital defects. Although these heart defects were life threatening, they were comparatively simple to repair and in most cases the patients had no complicating factors such as obesity or a history of smoking, which could make them poor candidates for surgery. Kavanagh-Gray has also been quoted citing other, less medically significant factors in the selection of the first patient: "It had to be a girl, she had to have freckles and she had to be pleasant." Anne Lavery, a 12-year-old freckle-faced young girl with a hole in her heart fit all the requirements. On June 22, 1960 in OR 14 of the old hospital, Drs. Gourlay, Coursley and Musgrove performed the first open-heart surgery at St. Paul's.

The operation was scheduled for 9:30 a.m. and preparation began

at 5:00 with the nurses and perfusionists coming in to the hospital to ready the machine and set up the operating theatre. "We had to make everything right at the time," says Stephens. "All the different types of suctions that you have to use and everything. You couldn't just snap your finger and get it from a company back then, you had to make it all up. And so we had to make sure that all the suctions, the tubing, wouldn't come apart and things like that. It would take us a couple of hours to set up."

Once the machine was set up, the team assembled. For the early open-heart operations the operating room was quite crowded as doctors, nurses and technicians came to observe and learn from the techniques and to ensure that every aspect of the procedure was carefully monitored. "At that time we always had two anesthetists in the room. And we would have a doctor with the heart lung machine. Now we have technicians with the heart-lung, but at that time we always had a doctor," says Stephens. "And then there would be two doctors or maybe the two main doctors scrubbed, plus two or three assistants, plus two scrub nurses and then you'd have two circulating nurses. So it was quite a full room."

Dr. Rice in the operating theater

For the first open-heart surgery, in addition to Gourlay, Musgrove and Coursley, there was an intern, Dr. Uptigrote; two anesthetists, Dr. N. McMillen and Dr. J. O'Donnel; four nurses, R. Stringer, G. Webb, B. Polvi and Stephens; two perfusionists, Rice and Osborne; and one cardiologist, Kavanagh-Gray.

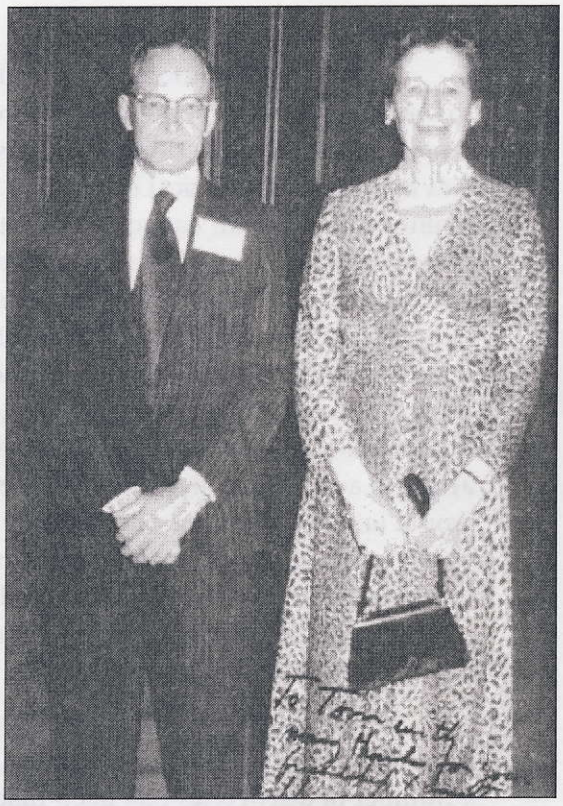
According to Stephens, the heart-lung machine had not been working properly the Saturday before the operation and Rice had worked throughout the weekend to get it ready for its debut. When the machine was turned on at 11:25 a.m. Stephens remembers saying a silent prayer. "I remember saying 'Please, Dear God, make everything work.' I think I held my breath through the whole rest of the surgery, because when I got home that day I could hardly touch my arms they were so sore."

During the operation doctors opened the right atrium of the heart and repaired the inter-atrial septal defect, which was about 2.5 centimetres in diameter–approximately the size of a quarter. The bypass machine was turned off after 18 minutes. The operation was a success!

Although the equipment the doctors at St. Paul's used was the latest in medical technology at the time, it seems almost primitive by current standards. The only vital sign that was monitored during the surgery was central venous pressure. Today, surgeons would consider that inadequate monitoring for any type of surgery, let alone open-heart. At the time, devices used to record intravascular pressure were limited to a single continuous measurement. However, the technology improved rapidly and it would take less than a decade before monitors were available to measure several pressures at the same time. Another vital element that had not been developed by that point was a way to measure the rate of flow of blood through the heart-lung machine into the patient. "It was always important to know how much blood was going through the patient per minute or per second, how many litres were flowing," says Kavanagh-Gray. "We tried to make it as close to the normal blood flow as possible, but we had no way of measuring how much blood was going. So what we would do at the end of the operation, when everything was finished, Harold would hold the blood pipe in one pail, turn on the stop watch, turn on the machine and see how much blood accumulated in one minute in the pail and say well, the

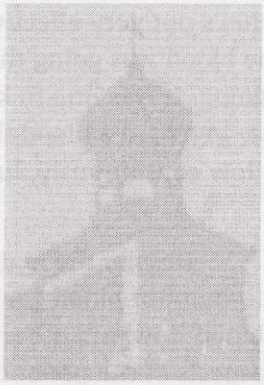
Tom Osborn monitors the heart-lung machine during surgery

flow was x number of litres per minute. Well that's not very effective, as you can imagine. It was nice to know when the blood was going through the patient how many litres per minute were going. It was fine to know after, but you'd like to know during." Later Rice invented a blood flow meter that allowed doctors to read the rate of flow continuously during the operation.



Dr. Harold Rice with Mrs. Gibbon at a ceremony where Dr. Rice was given honorary membership in the American Society of Extracorporeal Technology

Despite the inability to monitor blood gas levels, blood flow and other aspects of the patient's vital signs, the surgery was a success. In the remaining six months of 1960, the St. Paul's team performed five more open-heart operations and over the next five years they performed a total of 146 open-heart surgical interventions on a variety of cardiac lesions. The can-do attitude exemplified first by the Sisters of Providence and then by Dr. Rice in combination with the hospital's commitment to improving patient care launched what has grown to become one of the leading centres in cardiac diagnosis, treatment and research in the country.



Chapter 2: Cardiology at St. Paul's Hospital

The heart is purest theater...throbbing in its cage palpably as any nightingale.

—Richard Selzer, 1976

Introduction

With the invention of the heart-lung machine surgeons were able to operate on cardiac lesions that were previously untreatable. The whole range of intracardiac lesions, those inside the chambers of the heart, was opened up to surgical treatment. The first group of patients were mainly children with congenital heart defects, however, the high rate of success with these patients soon led surgeons to treat other problems such as defective heart valves and arterial diseases. The increase in surgical treatments demanded a simultaneous increase in diagnosis, and cardiology was pulled along in the current of surgical progress. As Dr. Doris Kavanagh-Gray has written, "the surgeon was King, dragging his cardiological colleagues along—demanding ever more precise and accurate anatomical diagnosis." However, as cardiology developed it would take on a leading role not only supporting surgeons, but in many cases replacing them. Interventional cardiology, electrophysiology and other developments would allow cardiologists to not only diagnose but treat many heart problems without surgery, meaning much less risk and shorter recovery time for patients.

Over the past century cardiologists have made incredible strides in understanding the heart's function. By the end of the 19th century a number of discoveries had been made that would be crucial in the development of modern cardiology. In 1896, Sapione Riva-Rocci invented the prototype of the blood-pressure cuff that is still in use today. This was one of the first devices that allowed physicians to take blood pressure measurements without piercing the patient's skin.

In 1895, Wilhelm C. Roentgen discovered the x-ray, ushering in a new era of medical imaging, diagnosis and therapeutic radiology. For the first time the x-ray allowed physicians to "see through" the tissue of the body and get a glimpse of the blood vessels, heart and lungs. Over the following few years Walter B. Cannon and Moses Swick discovered that feeding bismuth, barium or iodine compounds to the subject during the

x-ray procedure could bring the organs into view more clearly. The x-ray was undeniably important to the cardiologist, whose subject of study was hidden behind the rib cage.

In July of 1929 cardiology received perhaps its greatest thrust into the modern era. Werner Forssman, a German medical student, conceived the idea of passing a catheter into the heart through the venous system. Forsmann's goal was to deliver medications directly to the heart for resuscitation. Like the stereotypical mad genius from a sci-fi movie, Forsmann used himself in his initial experiments with the heart catheter. Since he was a urologist, he used a urinary catheter for the first procedure! Fortunately, his story had a happy ending; in 1956 he shared the Nobel Prize with André Cournand and Dickinson W. Richards for their respective roles in introducing and standardizing cardiac catheterization. Only three years later St. Paul's opened its cardiac catheterization lab with Dr. Doris Kavanagh-Gray at the helm.

Cardiology Begins at St. Paul's

While there was a pediatric cardiology unit at the Vancouver General Hospital, there was no cardiology unit at St. Paul's in the mid-1950s. The Clinical Investigation Unit was set up in 1956 to push the hospital into new areas of medicine, and its first priority was to create a cardiac diagnostic and surgical unit. By 1959 Dr. Gourlay had organized a cardiac surgical team, Dr. Rice was hard at work perfecting his heart-lung machine and much of the cardiology equipment had been purchased in anticipation of hiring a cardiologist.

In 1959 Dr. Doris Kavanagh-Gray came to St. Paul's to develop the cardiac catheterization laboratory and cardiac investigation services at St. Paul's. She was the first full-time specialist St. Paul's hired. Both Kavanagh-Gray and her husband, Dr. John Gray, came to St. Paul's from Detroit where they had trained at the Ford Clinic. "Dr. Bill Hurlburt was in the process of trying to change the department of Medicine and have an emphasis on sub-specialty groups," says Kavanagh-Gray about what led to her coming to St. Paul's. "He was looking for gastroenterologists, for somebody to head neurology and somebody to develop cardiology. So, he was interested in what I knew. I came and met him and started to work here to develop the unit of Cardiology."

Kavanagh-Gray had originally intended to study dermatology,

Dr. Doris Kavanagh arrived at St. Paul's in 1959 to start the cardiology unit. She was the first full-time specialist at St. Paul's

but switched to cardiology. "The cardiologists had a lot of glamour at that time because things were changing so quickly," she says. "I think first of all there was a lot of drama in it, which appeals to the young; not so much as you get older. Things were changing so rapidly in cardiology at that time. Heart surgery was just coming on the scene. People were curing patients who we had never any idea could be cured before, mainly through surgery. Cardiology was kind of tagging along, as the surgeons demanded more and more accurate diagnosis. Then the heart catheterization labs were developing and every day there was another sort of new turning point. I found that very exciting and I wanted to get in on the ground floor." As cardiac surgery continued to develop, there was ever-greater demand for accurate diagnosis of heart defects. "Because of the surgery requiring accurate diagnosis, the diagnosis became very accurate," says Kavanagh-Gray. "When it didn't really mater because there was no treatment, there wasn't the urgency to diagnose accurately. Then there came a time when you had to know exactly where the hole in the heart was, exactly what and how much was shunting from right to left or left to right."

Another attraction for Kavanagh-Gray was the cardiac patients' willingness to help themselves. "They were very motivated to help themselves," says Kavanagh-Gray. "I always suspected if you asked them to stand on their head against the wall for 24 hours they would do it."

By 1960, when Kavanagh-Gray and Rice were ready to perform their first catheterization, cardiac catheterization was an established technique. Despite this and the fact that Kavanagh-Gray had a great deal

of experience catheterizing children from her work at the Ford Clinic, the hospital administration insisted Kavanagh-Gray demonstrate the technique on a dog before they would allow her to start working with human patients.

In the morning of the first heart catheterization at St. Paul's a large black dog was brought to OR 19 in the operating room on the 6th floor, stretched on the OR table, anesthetized and had his right groin shaved in preparation for surgery. "The small viewing window was filled with spectators, some standing on boxes, so that the whole area was filled with expectant faces," Kavanagh-Gray has written.

As experienced as she was, Kavanagh-Gray was new to canine catheterization. She found that the dog's leg would not lie flat on the operating table to allow for convenient access to the venous system, and she had to dig around in the "patient's" groin trying to find the vein. Becoming impatient with the delay, Dr. Gourlay stepped in to help out. However, he also seemed not to have had a lot of experience with canine patients. In the ensuing battle with the dog's leg the femoral artery was severed and there was massive hemorrhaging before things were brought under control. "This complication had the advantage of decreasing the number of spectators," Kavanagh-Gray has written in her reminiscences about the day. "Eventually we ploughed through–the catheter was maneuvered through the heart (which I found to be peculiarly long and slim), samples were obtained and analyzed by Mary Bedford, technician, using the Van Slyke apparatus. Pressures were recorded and finally the catheter removed, the artery repaired, the skin sutured and the beast taken to the hospital cellars to recuperate–while I tried to put the whole painful experience behind me. Sister Pat, in charge of the OR, was fascinated and for the next two weeks would ask daily after 'our patient,' and more ominously, 'Was he still alive?' The animal appeared to have suffered no ill effects, and even seemed pleased to see Sister and I when we visited with doggy treats." After this first patient recovered, cardiac catheterization began in earnest at St. Paul's.

In the early years of cardiac surgery at both Vancouver hospitals, as elsewhere, the patients selected for open-heart surgery were usually children with relatively easily repaired defects. "First of all there was a whole realm of congenital heart disease that had never been operated on and repaired, and that was a backload that had to be cleared," says Kavanagh-Gray. When St. Paul's first opened its cardiac catheterization

service, Dr. Morris Young, a pediatric cardiologist at VGH asked if Kavanagh-Gray would do catheterizations on some of the children who had been waiting to be seen by a cardiologist. When Kavanagh-Gray agreed, Young sent over a list of 400 children who had been waiting to be studied, some as long as four years.

Because of the success surgeons had with treating congenital defects in children, procedures for treating other heart diseases soon began to emerge. So once the backload of congenital heart defects was dealt with, cardiologists found themselves diagnosing patients with narrowing of the coronary arteries, of which there was unfortunately a virtually unlimited supply.

Dr. Kavanagh

While most of the cardiac catheterization equipment was purchased, some with funding from the ECG pool, cardiology also benefited from the inventive mind of Dr. Harold Rice. One instrument in particular that caused a great deal of frustration for Kavanagh-Gray was a phonocatheter that Rice invented. Rice theorized and was able to demonstrate that heart murmurs, which indicate functional or structural abnormalities, would be audible inside the heart on the opposite side from where they were produced. So, for example, if there was a hole in the heart and the blood was flowing from left to right, the sound would be audible inside the right chamber of the heart. Rice's phonocatheter transmitted this sound from the microphone at the tip of the catheter to the operator. This allowed the cardiologist to hear heart murmurs more clearly. The transmitter was housed in a large and cumbersome catheter. Kavanagh-Gray was often reluctant to

use the awkward instrument on small children, who were the bulk of her patients at the time, and a battle of wills between the two doctors sometimes ensued. However, according to Kavanagh-Gray, the fatal flaw of Rice's phonocatheter was its ability to pick up radio waves as well as heart murmurs. "It was disconcerting and certainly confusing to hear heart murmurs replaced by Big Band sounds, or even the agony of the soaps (I recall vividly something called 'One Man's Family') all emanating from the small chests of my tiny infants."

Women in Medicine

Kavanagh-Gray was the first full time specialist that St. Paul's hired. According to Faye Meuser, head nurse of the PAR for six years in the seventies, Kavanagh-Gray's contribution to St. Paul's cannot be over estimated. "She was an articulate very intelligent, visionary person. And she would communicate so well, you couldn't argue with her, she was so good. Everybody had so much respect for her," says Meuser. "I don't think anyone ever bothered her about being a woman or whatever. She was just somebody who was there to get the job done." While it is true as Meuser notes that Kavanagh-Gray got the job done and was highly respected, it was also the case that women did receive different treatment, both as doctors and as patients, during Kavanagh-Gray's early career.

As a female doctor in the sixties and later, Kavanagh-Gray experienced and struggled against the gender discrimination that was part of the times. Although she sometimes had reactions from patients ranging from "My doctor said that you were a woman but that you're very good, so here I am," to "My God, you're a woman," she usually found that within a few minutes, as she demonstrated her expertise, any negative feeling about her ability faded. Kavanagh-Gray also fought against different treatment of women as patients and has given many public lectures encouraging women to be activists for the quality of their own health care.

However, it was her work to change attitudes within the medical community that Kavanagh-Gray seems most proud of—one of her accomplishments was to force St. Paul's to include women in the annual dinner. "They had annual staff parties at the Keith Journal Club and no women were allowed to go to those. So the women who were working, the interns and the female residents and staff people, would look after

the hospital while the men had their party." Kavanagh-Gray thought the policy was more than a little outdated and decided to do what she could to have it changed.

She joined the hospital advisory board and at every chance brought up the issue of the female staff being excluded from the annual dinner. "It got rather awkward, so finally after about three years of badgering, the powers that be said, 'alright, we'll give you, the women, some money and you can go have your own little party.'" While Kavanagh-Gray thought it wasn't as good as joining the men's party, it was some measure of progress. "We decided we'd have a lovely cultural evening, no buns would be thrown, it wouldn't be like the wild parties the men were having," Kavanagh-Gray recalls.

Dr. Mary Mate knew the chef at the William Tell, a fine dining restaurant and arranged for a dinner, and Dr. Jospehine Mallek, a senior physician at St. Paul's at the time, arranged for the women to go to the opera afterwards. "We had a superb dinner," says Kavanagh-Gray. "Lots of Pink Ladies I recall, and we weren't finished by the time the opera was on." Fortunately, because Mate knew the chef, the restaurant agreed to stay open while the doctors went to the opera. "We all came back, ordered more Pink Ladies, Baked Alaskas were brought out, the rest of the restaurant was closed but it was open for us. We had a grand time."

That grand time was reflected in the grand total of the bill. "When the Medical Advisory Board got the bill they turned somewhat pale and said, 'Well, from now on the women will join the men [for the annual dinner].' So we hit them in their financial weak spot. From then on we were with [the men] all the time."

Cardiology Grows

In the early years of cardiac surgery, the procedures were very labour intensive in the sense that so many people were involved. Roles that are now handled by one or two nurses were in the beginning looked after by a team of nurses and doctors. When St. Paul's first started performing cardiac surgery, Kavanagh-Gray would be in the operating room for each surgery to ensure that the diagnosis had been accurate. But as time went on, and everyone became more confident in the diagnoses, the cardiologist would only be called in to the OR if there was a problem.

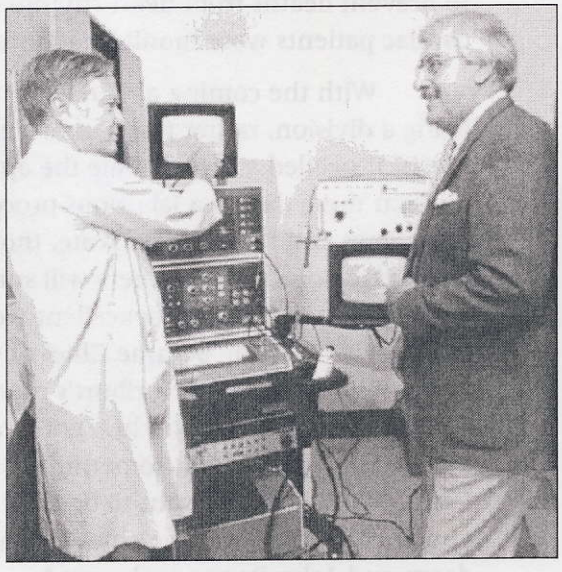
Similarly, in the early years the cardiologists spent a great deal of

Dr. Dwight Peretz, shown here in 1987, joined the staff of St. Paul's in 1965 and was instrumental in setting up the Intensive Care and Cardiac Care Units

time with patients in post-operative care. "Initially I would stay with the patients for the first 24, 48 hours," says Kavanagh-Gray. "But of course, later on, the anesthetists took that job over and the surgical residents took that job, so we didn't have to do that anymore." Also, as the department grew there were more people to take on many of the tasks including on-call duties.

Through the early 1960s the Clinical Investigation Unit actively recruited medical specialists including specialists in cardiac surgery and cardiology. In 1963, a group of internists—Drs. Palmer, Hurlburt, Gillis and Traynor—began a study to examine retrospectively the treatment of myocardial infarction in St. Paul's in order to establish a plan to improve treatment. The results of this study led St. Paul's to adopt a new approach to treatment using a specialized acute care unit.

In 1965, Dr. Dwight Peretz arrived at St. Paul's after having finished his training in cardiology at McGill University and the Royal Victoria Hospital. Peretz was brought in to advise the members of the myocardial infarction study about the development of intensive care units. These units, which are now a mainstay in most hospitals in North America, were a new concept at the time. Coronary Care and Intensive Care medicine were virtually unknown, either in Vancouver or anywhere else in the world, and St. Paul's found itself on the leading edge



Dr. Peretz explains cardiac monitoring equipment to Mr. Ed Blond, president of the Vancouver Rotary Club. The equipment was donated by the Rotary Club in 1985

Dr. Peretz shown with the then new cardiac care monitor in 1987

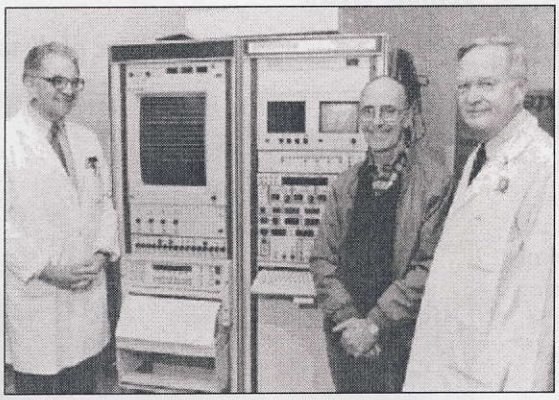
of patient care. That year, Drs. Hurlburt, Kavanagh-Gray, Peretz, MacDonald and Sister Superior Patricia did a tour of the better intensive care units in North America. After gaining financial support for the plan from the Woodward Foundation, the group began planning a similar unit at St. Paul's. Peretz met with architects to plan the construction of a circular Intensive Care and Coronary Care Unit in what had been the Sisters' common room, and in September 1966 the units opened under Peretz's direction.

"Dr Dwight Peretz was brought in to develop and run the Intensive Care Unit," says Kavanagh-Gray. "That was a big step forward." While the Intensive Care and Coronary Care patients did not require identical care, there was an obvious relationship between the two new facilities. In the coming years mortality for patients with myocardial infarction dropped from 30 per cent for patients admitted to the general medical wards, to 15.2 per cent for patients admitted to the Coronary Care Unit. Most of this reduction was attributed to the increased ability to prevent deaths from heart rhythm disturbances (arrhythmia) when cardiac patients were monitored more closely in the Coronary Care Unit.

With the coming of Peretz, cardiology could make a claim at being a division, rather than just a single doctor, and being a department meant it needed a chief. While the appointment of a chief of a hospital division these days is a laborious process involving committees, postings, interviews and forms in triplicate, those were much simpler, more autocratic times. While others will surely object and point to her many credentials and history of excellent work at St. Paul's, according to Kavanagh-Gray, she became Chief of Cardiology simply by demanding to be. "I went in to Dr. Hurlburt's room and I said, 'look, I just brought Dr. Peretz on the staff and he's got a carpet in his room and I don't have a carpet in mine. I want something.' He said, 'What do you want?' And I said, 'Well, I think I want to be chief of cardiology.' He says, 'Okay, you're chief.' So I was the chief for about thirty years and then I stepped down and John Boone took over."

According to Kavanagh-Gray, being the Chief of a two-person department is not that arduous of a task. "At first it was no problem at all," says Kavanagh-Gray. "There was nobody except Dwight Peretz, and I was chief over Dwight." However, the coming years brought an increasing number of additions to the department, and Kavanagh-Gray was responsible for recruiting people to the staff. Kavanagh-Gray describes getting space for new staff as a big hassle. "Each new person was seen as a threat to the rest of the hospital. I got eleven people on, but with a lot of anguish and a lot of finagling and a lot of maneuvering and bullying."

Each new addition to the department brought new expertise and areas of interest and knowledge. According to Kavanagh-Gray, after developing the Intensive Care Unit, the next step was to improve the understanding of the heart and lungs as a unit. "We needed somebody who had knowledge of lung disease and heart disease together because so many of our patients were smokers and they already had emphysema and we had trouble with them in surgery. So we asked Dr. John Boone to join us and he brought that expertise with him." Boone joined the staff in 1969. He was another of St. Paul's many doctors from McGill University. After arriving he took over the Pacemaker Clinic and continued to direct the clinic until he became Chief of Cardiology.



Dr. John Boone (left) and Dr. Peretz (right) with an unnamed technician, show off equipment for monitoring cardiac patients

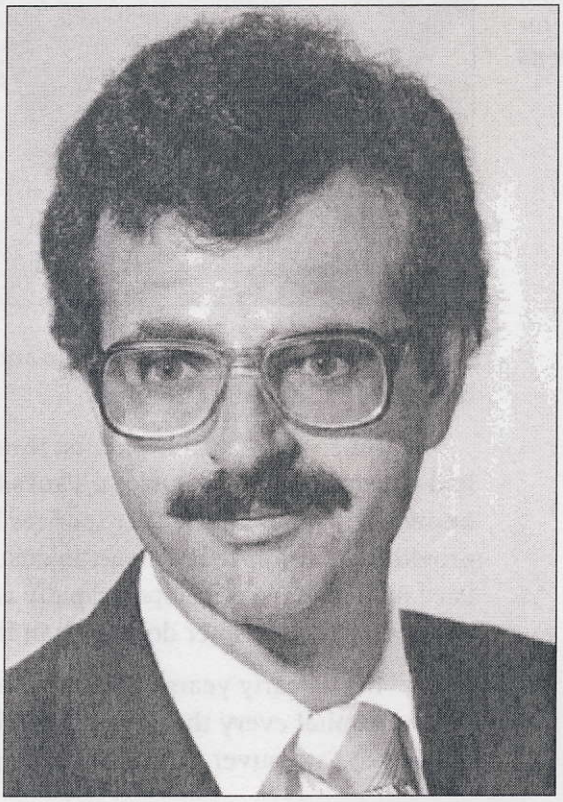
Since 1964, when the first three patients in the Lower Mainland had pacemakers implanted, St. Paul's has gone on to become a well known centre for pacemaker services in B.C. These electrical devices provide a stimulus to the heart to ensure that it keeps a steady pace. Pace makers have developed rapidly and are now much more complex, although much smaller devices than those from the sixties.

In the early years patients with pacemakers had to come back to the hospital every three months to be assessed. For those who lived outside of Vancouver this meant a long trip into the city, perhaps

even an overnight stay, four times a year. However, by 1971 St. Paul's replaced part of the pacemaker service in the Outpatients Clinic with a telephone system that let patients phone in their pacemaker readings. "The pacemaker company had an instrument whereby you could hold the instrument over the pacemaker and the pacemaker clicks would come down to us over the telephone and come out as an ECG tracing," explains Kavanagh-Gray. "It was so effective that most people in Vancouver wanted to get in on the act too, and they did."

The Pacemaker Clinic wasn't the only cardiology service that took advantage of the phone lines. In some communities in B.C. hospitals or clinics were equipped with ECG machines and technicians, but not with the Cardiologists needed to interpret the results. "Another service we did was the interpretation of electrocardiograms over the fax machine," says Kavanagh-Gray. "People would send down their cardiograms and we would read them and send them the answers back right away to the remote areas."

In addition to this type of distance service, the cardiologists at St. Paul's also had a popular and successful outreach program. Cardiologists from the hospital traveled throughout B.C. and even to the Yukon to give lectures and provide some consultation services. Many of the lectures were set up through UBC, with the university paying for travel and accommodations. "The university called and asked would I like to go to the Kootenays and give three days worth of lectures," says Kavanagh-Gray about the first of these excursions. "I went out and I mainly gave a lecture or two and then



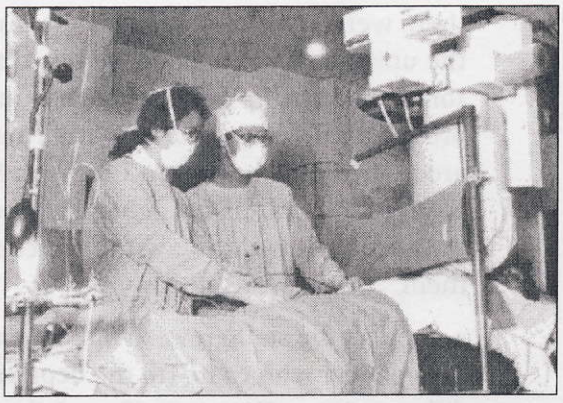
Dr. Art Dodek joined the staff of St. Paul's in 1970. Dodek brought with him an interest in non-invasive procedures such as angioplasty and was instrumental in starting such procedures at St. Paul's

there were questions and answers. And then a lot of other areas phoned the university and said 'we've heard that this went on, can we have someone come up and spend a day or two with us?'" St. Paul's has provided cardiologists to Kelowna, Terrace, Prince George and remote areas including the Queen Charlotte Islands and the Yukon. "They would collect all the cardiac patients that needed to be seen in one place. Rather then send them each down to Vancouver, we would go up and see them," says Kavanagh-Gray.

As the staff grew, so did the expertise of the department. "Each new person who came [to the department] came with a little something different," says Kavanagh-Gray. When Dr. Arthur Dodek was recruited in 1970 he came with an interest in interventional cardiology and cardiac rehabilitation. He was also interested in non-invasive procedures for coronary artery disease. This area was developing rapidly and in 1972, Dodek was one of the first cardiologists to use transeptal catheterization and the Swan-Ganz catheter. By 1977, Dr. Andreas Gruntzig of Switzerland had developed a non-surgical treatment for coronary artery disease—angioplasty. This technique allowed patients to be treated and sent home, often within 24 hours, avoiding costly and bed-consuming hospital stays. "They could go home in 24 hours and do well," says Kavanagh-Gray. "They'd come in one night, have the angioplasty and then go home the next day." The procedure involved inserting a "guiding" catheter into the heart, then threading a smaller catheter through it. The second catheter had a double-lumen balloon attached, which was then inflated, compressing the plaque on the artery and widening the artery. "It was a very exciting innovation," says Kavanagh-Gray. "I went to Switzerland to study under [Gruntzig] for a couple of months and came back, and then Arthur already had some knowledge and so we were able to develop [angioplasty]."

Dr. Kavanagh talks with a cardiac patient (c. 1983)

In 1980, after Kavanagh's



Dr. Art Dodek and Dr. Lau perform heart catheterization at St. Paul's

sabbatical in Switzerland and a teaching conference in Atlanta to learn about the procedure, Dodek and Kavanagh-Gray performed the first angioplasty at St. Paul's Hospital. This service has now grown into a very active branch of cardiology that is directed by Drs. Dodek, Webb and Carere at St. Paul's.

By the early seventies, the cardiology service at St. Paul's had outgrown its home. Catheterization had moved into the special procedures room in the Radiology Department in 1968. However, although the equipment was modern, it was not designed for cardiac catheterization and time and space had to be shared with Radiology. Between 1960 and 1972, almost a thousand patients had been referred to the Cardiac Division at St. Paul's. By 1973 almost 15 patients were seen each week by St. Paul's cardiologists, and the demand for procedures outpaced the cardiologists' time—the cardiologists estimated they had enough referrals to warrant performing ten additional cases each week. New developments in cardiac surgery, such as valve replacement and bypass surgery, placed ever more demand on cardiology for accurate and timely diagnosis. After a lot of negotiation, the administration agreed to convert the old chapel into a new cardiac and pulmonary unit. In July of 1973 the board of the Greater Vancouver Regional Hospital District approved the plan to build a new Catheterization Laboratory as well. The new Cardiac and Respiratory Unit officially opened on the third floor, center wing on September 7th, 1973.

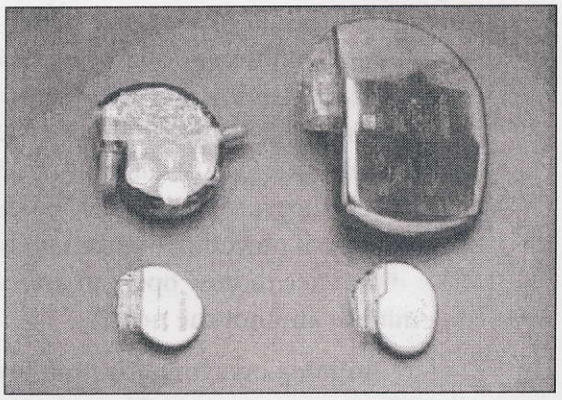
Kavanagh-Gray saw a great advantage in developing new procedures and techniques in the department not only through recruitment, but also through training. One of her innovations as Chief of Cardiology was to develop a sabbatical program for the department. Although St. Paul's had an affiliation with UBC, the cardiologists did not receive salaries from the university and were therefore not eligible for the university sabbatical program. "The sabbatical program was set up to bring new information into our group," says Kavanagh-Gray. "Every doctor in cardiology was expected to go away for anywhere between

three months to a year. And during that time we, the other cardiologists, would pay her/him while he/she was away so she/he could live. And when they came back all of their patients would be there waiting for them, they didn't have to build up a practice again. And it worked wonderfully." Although many of the doctors were at first reluctant to go on sabbatical, the program caught on. Kavanagh-Gray went to Switzerland to study angioplasty procedures with Gruntzig, Boone went to England and learned about hypertrophic cardiomyopathies, others went all over the world. "Everybody went, and they went because if they didn't go they'd lose all the money they'd given to the other doctors, so that was a good incentive."

Cardiological Advances

Over the years cardiology's role in treating heart disease has shifted from being primarily diagnostic, to increasingly focused on curative procedures. These have included electrophysiology and interventional procedures.

"The only thing cardiologists used to do was diagnostic procedures and medical treatment, and now it's moved into more curative procedures and interventions," says Dr. Charles Kerr, who was head of the division of cardiology at St. Paul's Hospital from 1995 to 2003. In particular Kerr cites the areas of interventional procedures (including angioplasty and the use of stents) and electrophysiology (the study and treatment of abnormal heart rhythms) for changing the face of cardiology. "It's taken a lot of patients who used to require surgery and [made it so they] now no longer need it," says Kerr.



These various pace-makers show the decreasing size of these life-saving devices through their development

Electrophysiology is the study of the electrical aspects of heart problems, specifically arrhythmias, which are caused by disturbances in the electrical impulses in the heart. Kerr was the first doctor to perform electrophysiology studies in Western Canada. Initially he worked at the

Vancouver General and the UBC campus hospitals. However, in 1995 the university moved Kerr, and with him the headship of the division of cardiology, to St. Paul's.

One of the major areas of work is with pace makers and defibrillators, which help to regulate the heart beat. Another area of electrophysiology treatment has been ablation treatments. In these procedures, wires are inserted into the heart through the veins. The end of the wire is directed to a part of the heart where the electrical circuit is abnormal, causing arrhythmia, and a radio frequency current is passed through the wire. This cauterizes the area. "This will interrupt that particular path of electrical circuit the patient would have," says Kerr. "We can cauterize those circuits and cure people's arrhythmias. The sophistication of the mapping equipment is really quite astounding. We are able to do ablations of very complex arrhythmias we never thought we could cure before."

Since the early development of angioplasty at St. Paul's in the 1980s, the hospital has continued to be at the fore of interventional techniques. In 1990 Dr. John Webb joined the St. Paul's division of cardiology to take over the Coronary Care Unit from Dr. Peretz. Webb is now the director of cardiac catheterization, interventional cardiology and interventional cardiology research. Webb was the first person in B.C. to train in interventional cardiology as a specialty and brought an incredible amount of expertise with him. "There were a lot of interesting possibilities for intervention being developed when I was training, in terms of angiography and angioplasty and stenting and things of this sort," says Webb. "Unlike a lot of other medical specialties there were a lot of things that you could do that actually had a clear, definitive result. The benefits to people were somewhat dramatic in my eyes. With an interventional procedure, within an hour you could see you'd made a clear difference to how open an artery was. Patients would have pain one minute and not the next."

Building on catheterization procedures, angioplasty allowed doctors to open arteries without having to perform surgery on patients. Interventional treatments have developed since then to include a range of procedures that previously would have involved surgery or been unthinkable. One of the first developments was stenting procedures, which were first done at St. Paul's in the early 1990s. While angioplasty uses balloons to open arteries and compress plaque against the artery

walls, stents act as scaffolding on the inside of the artery, holding it open. Following its initial success with stents, St. Paul's was involved in developing a new family of stents in the early 1990s.

Over the years, St. Paul's interventional cardiology group has been involved in a number of firsts. In 1999 St. Paul's was the first hospital in B.C. to perform percutaneous atrial septal defect and ventricular septal defect closures. St. Paul's was the first place in North America to successfully implant a percutaneous heart valve, in other words to implant a prosthetic heart valve through the veins rather than with open-heart surgery. St. Paul's is now home to the world's second largest experience in these procedures. St. Paul's was also the first in the world to perform a percutaneous coronary sinus angioplasty. In each of these procedures cardiology has come to replace open-heart surgery for patients who are at too high of a risk. "I think all of these things have displaced a lot of surgery," says Webb. "More and more, angioplasty is going to replace surgery for more and more patients. So I think that the tide is changing." In particular he points to percutaneous valve replacement as a landmark for patients, especially for those whose health poses a high risk for surgery. "As to whether it will supplant surgery in low-risk patients, I think that's yet to be seen," he says.

Another change in practice for cardiologists has been a direct result of the ever-increasing improvements in cardiac surgery and cardiology procedures. While congenital heart defects used to be a problem primarily of children, as surgical and now cardiology treatments have developed there are an increasing number of adults with congenital heart disease. After the Shaughnessy Hospital closed in 1993, the Pacific Adult Congenital Heart Disease (PACH) Clinic moved to St. Paul's. "It's one of a kind in this province," says Kerr. "It has pediatric cardiologists and pediatric surgeons, and adult cardiologists and adult surgeon, and nurse specialists treating these very complex patients."

In addition to advances in cardiac surgery that have increased the need for improved diagnosis, and new treatments such as angioplasty and ablation, cardiology has changed through the years with the improvement in pharmacological treatments. "Developments in medications made a huge difference," says Kavanagh-Gray. "Beta blockers, calcium channel antagonists, vasodilators of all types. Wonderful treatments. So in the area of drugs alone there was a huge development of therapeutic agents that you could use to help patients."

Advances in imaging have also made a huge difference in the work cardiologists perform. "We always had a very close affiliation with the X-Ray Department," says Kavanagh-Gray of the early years of cardiac imaging. "They would service the equipment for us and often send a radiologist if we wanted special views of the patient. So it was a co-operative effort with x-ray." Since those days, the variety of imaging technology has increased greatly with the development of CAT scanning, PET scanning and digital x-ray. Other techniques, such as vector cardiography, came and went over the years.

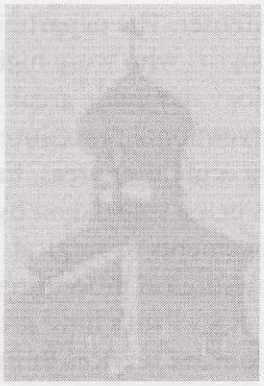
Diagnosis techniques, including stress testing, also improved over the years that cardiology has been a part of St. Paul's Hospital. "Stress testing was in its infancy [when the cardiology department started]," says Kavanagh-Gray. "People walked up and down a couple of steps and then you did an electrocardiogram to see if they had any area of heart muscle that might be in jeopardy. Now it's a very extensive procedure and very much more accurate." Stress testing is now done using radioactive isotopes that "paint" areas of the heart to help cardiologists see which areas of the heart have adequate blood flow and which do not. In 1985 another cardiologist, Dr. Marla Kiess was recruited to help develop nuclear cardiology in the Division of Nuclear Medicines.

In May 1984, Dr. Dwight Peretz headed a team of seven cardiologists and cardiac surgeons who went to China for a medical conference. Pictured here at the Great Wall, the group included, from left, Dr. Al Gerein, Pat Gerein, Dr. John Gray, Dr. Russell, Dr. John Munch (from Victoria General Hospital), and his wife, Dr. Kavanagh, Dr. Reudy, and Dr. Peretz

Cardiology, like all of medicine, has become increasingly specialized, with doctors working on only one area or procedure. "Quite frankly no one cardiologist now is able to handle the whole works," says Kavanagh-Gray. At the same time, cardiology is also highly integrated into the team atmosphere of the whole hospital. "It's integrated certainly with surgery and radiology and with nuclear isotopes. It has its fingers in a lot of pies."

In just over forty years, cardiology at St. Paul's has grown from a one-woman operation studying two case a week, to an active and growing service that regularly performs five studies a day. "The cardiologists, Kavanagh-Gray, Peretz, Boone and Dodek, they were

just superb, they were second to none," says Meuser. The department has attracted (and continues to attract) cardiologists who were highly trained and skilled. During these years, cardiology has made great bounds forward with the development of interventional procedures, electrophysiology, nuclear medicine assessment and other areas. In addition, the advances in cardiology, as well as being spurred on by advances in cardiac surgery, allowed for improvements in surgical treatment and have now come to replace many surgical procedures. The Cardiology and Cardiac Surgery Divisions at St. Paul's have grown and melded to become the leading centers for cardiac services in British Columbia.



Chapter 3: The Expansion of Open Heart Surgery at St. Paul's

A physician at the bedside of a child dying of an intra-cardiac malformation as recently as 1952 could only pray for a recovery! Today with the heart-lung machine, correction is routine.

—Walton Lillehai

Introduction

Following the first open-heart surgery at St. Paul's the demand grew rapidly. While the first patients were mostly children with congenital heart defects, the success of surgery with this group soon led to surgical treatments of other, more complex heart problems. The pioneering days did not end with the first few open-heart procedures. Surgeons, cardiologists, anesthetists, nurses and technicians were kept busy ironing out the kinks in their techniques as well as developing new procedures.

"The early days of pioneering open heart surgery was very emotional for people, traumatizing," says Dr. Al Gerein, who was the head of the division of Cardiovascular and Thoracic Surgery from 1979 to 1991. "You were always under pressure. I think now it's much easier than when we were pioneering. They know the anatomy better, they know the exposures better, they've got better means of hemostasis. It makes it all look pretty easy, less stressing."

In a matter of less than fifty years St. Paul's has taken open-heart surgery from a pioneering effort to an everyday affair, if not for the patients, at least for the talented staff at what has become one Western Canada's leading centres for cardiac care.

While some procedures, such as atrial-septal defect closures, have left the realm of surgery and passed into cardiology treatments, surgery has also grown and the possibilities of surgical treatment have meant that the demand for heart surgery has continued to increase.

The Development of Cardiac Surgery

By the end of 1961 St. Paul's had performed 18 cardiac surgeries and was home to a small but busy cardiac catheterization service. It was

clear that the hospital would soon need another cardiac surgeon. Dr. Al Gerein had grown up in Vancouver and then completed medical school at UBC before going to Cleveland for training in cardiac surgery. As his training neared completion he looked forward to returning to Vancouver. "I wanted to come back to my hometown," says Gerein about his decision to return. "I was educated in Canada, the government put a lot of money in my education, a lot more than I paid in tuition. I felt I owed something to the country; I owed something to the people."

Dr. Al Gerein joined the staff in 1963. His expertise in valve replacement soon opened up a new area of surgery at St. Paul's

In 1961 Gerein joined the staff at St. Paul's. Gerein remembers being taken in immediately by the friendly and collegial atmosphere at the hospital. "They were very friendly, and they were interested in what we were doing, because it was all new," says Gerein. "They'd come around and come up to the OR when we were putting valves in to see what we were doing. It was very, very good." Initially, Gerein continued on the research project that he had started in Cleveland, investigating valve replacement surgery.

Heart Valve Surgery

Like the valves in any pump, when the valves of the heart do not operate properly, the heart cannot pump efficiently, and blood does not circulate properly through the body. After repairing atrial septal defects, valvulotomies and valvuloplasties–operations to repair faulty valves–were one of the next major steps in heart surgeries. Like the initial atrial septal defect surgeries, the first valvulotomies were performed "blind" using a variety of instruments. Eliott Culter and Samuel Levine in Boston performed one of the first successful valvulotomies. After two

years of laboratory work, Cutler and Levine performed the surgery on a 12-year-old girl in 1923. While their first patient survived, most of their subsequent patients did not. They soon gave up the operation.

The same year Sir Henry Souttar made what was possibly the first successful attempt to open the mitral valve by passing his finger into the left atrium of the heart through a purse-string suture. His patient also survived, but Souttar was not asked to attend to others with similar problems. Reportedly, in 1961 Dr. Dwight Harken, another cardiac surgery pioneer, wrote to Souttar to discover why he had not continued with mitral valvuloplasties and received the following reply:

Dear Dr. Harken:

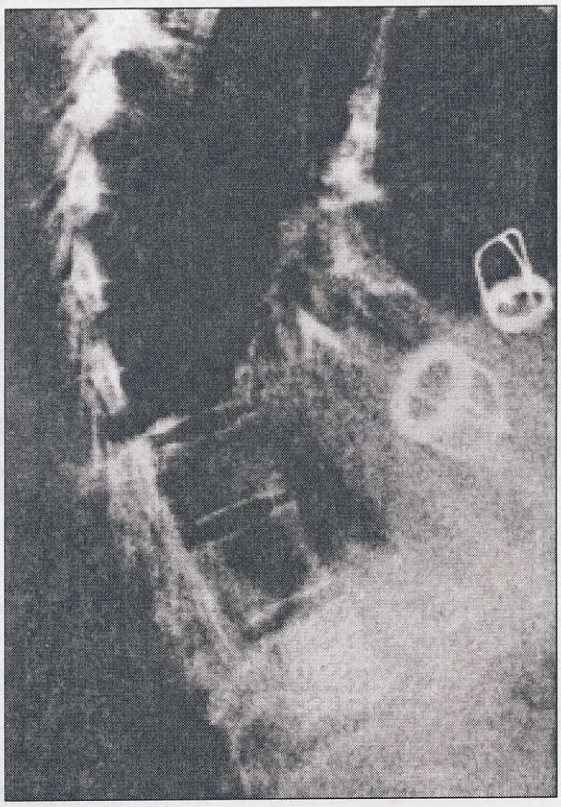
Thank you so much for your very kind letter. I did not repeat the operation because I could not get another case. Although my patient made an uninterrupted recovery, the physicians declared that it was all nonsense and in fact the operation was unjustifiable. In fact, it is of no use to be ahead of one's time. . . .
With very kind regards.
Sincerely yours,
Henry Souttar

After the late twenties, no further surgical attempts were made to repair mitral stenosis until after World War II. In 1947, Russel Brock in London, England; Charles Bailey in Philadelphia and Harken in Boston each independently reported successful mitral commissurotomies. These surgeons were able to improve their techniques, but as with repairs of holes in the heart, because these early valvuloplasties and valvulotomies were performed without being able to stop the heart and see into it, they were still a highly risky surgeries.

Once open-heart surgery became possible, valve surgery techniques improved rapidly and soon surgeons were able to perform valve replacements. After years of experimentation, the Starr-Edwards caged-ball valve prosthesis was introduced to the market for implantation in 1963. With his expertise in valve replacements from his work in Cleveland, it was only a matter of months before Gerein performed the first valve replacement surgery at St. Paul's. While it was not the first valve replacement in B.C., it was the first successful valve replacement surgery in the province.

On May 26, 1963, Gerein performed the first mitral valve

replacement surgery at St. Paul's. During the surgery a defective mitral valve was removed and replaced with a Starr-Edwards prosthesis. The patient, a woman in her late fifties, had suffered from rheumatic fever, which had damaged her heart. The valve replacement allowed her heart to once again function properly.

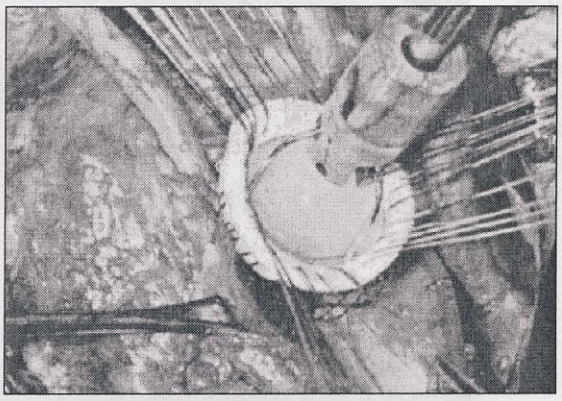


This x-ray shows a heart with two prosthetic ball-cage valve replacements. Dr. Gerein is the first to have reported performing a double-valve replacement in Canada and is also likely the first to have performed triple valve-replacement surgery in the country

While valve replacement could help patients with defective heart valves, there was initially some question over how to proceed with patients who suffered from multiple defective valves. Gerein felt that in patients with more than one valve problem the only solution was to replace all of the faulty valves at the same time. "You've got to repair all damaged valves at the same time, because they [the patients] are no better than their worst valve," says Gerein about the decision to perform surgery on multiple valves. In the year following the first valve replacement, Gerein performed the first double valve replacement reported in Canadian medical literature (on February 26, 1964) and what is likely the first triple valve replacement in the country (on April 22, 1964).

About his decision to go ahead with the triple-valve replacement Gerein says, "Starr, who made the Starr-Edwards valve, had put in a triple valve, and I thought, if Starr can do it, I think I can do it." In fact, it was only a year earlier, February 1963, that Starr had performed the triple-valve replacement. However, for Gerein, although the surgery was initially successful, the case was also a learning opportunity about the limits of surgical treatment. "We put the valves in, that wasn't much of a problem, that was an easy case," says Gerein. However, the patient's

heart had become enlarged from years of trying to compensate for the defective valves, and even with the valves replaced the muscle could no longer function properly. "The myocardium was kaput. It was stretched. And then it's got no zip to it," says Gerein. The patient passed away shortly after being discharged from the hospital. The problems with her heart muscle were only exacerbated by other health problems including advanced liver disease. Even successful valve replacement was not enough to save her life.



A prosthetic Starr-Edwards ball-cage valve being surgically implanted in a patient's heart

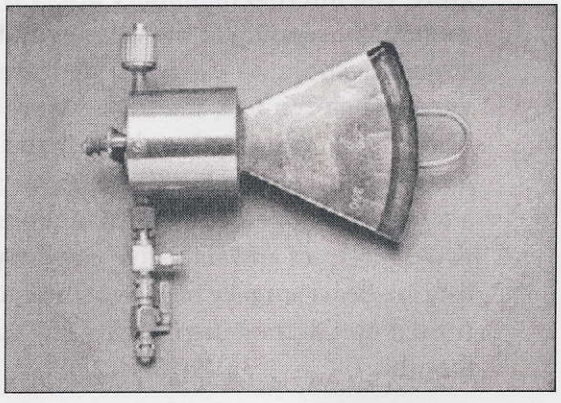
While there were some frustrating lessons to be learned, there were also a great many triumphs. Valve prosthesis technology has continued to advance rapidly and mechanical valves such as the Starr-Edwards have given way to valves made of teflon and other materials, with has reduced problems associated with . In 1979 Dr. Eric Jamieson started an extensive study of the long-term performance of cardiac valve replacements. Jamieson's has examined both the cases at the Vancouver General Hospital and at St. Paul's and his work has formed the basis for a widely recognized and well used database of valve replacements. "We've got one fellow that they keep sending me follow-up on," says Gerein, as an example. "We put a Starr-Edwards ball valve in 1971, so that's thirty-three years survival. He's sixty-five now, and it's the original valve. He needed no further surgery. Not bad, eh?" Indeed.

Coronary Artery Disease

With the few rare exceptions of patients who reach adulthood with untreated or not completely treated congenital defects, most heart surgery in adults is a result of acquired heart disease, whether it be through damage that happens as the result of another disease, such as rheumatic fever, or the result of genetic susceptibility combined with poor lifestyle choices such as the arterial damage caused by inactivity, smoking and poor diet. "The need for cardiac surgery accelerated as the population grew older," says Gerein, "And what we could do got better

and better." By the late sixties arteriosclerosis, a chronic heart disease where the artery walls become thickened and hardened, was one of the major causes of death in Canada and has continued to be so to this day. With other successful treatments in their wake, cardiac surgeons began to address the seemingly endless number of patients with coronary artery disease.

The immediate precursor to coronary bypass surgery was the Vineberg procedure. Named for its creator, Dr. Arthur Vineberg, of Montreal, in this procedure, surgeons divided the internal mammary artery and implanted one end into the cardiac muscle next to the ischemic region (the area of the heart that was being deprived of blood). Vineberg hypothesized that because the heart is a striated muscle with the fibres intertwined, it would act like a sponge. When the internal mammary artery was tunneled through the muscle to the location of the ischemia the muscle would soak up enough blood to control the ischemia. New blood vessels would sprout from the internal mammary to supply the heart muscle.

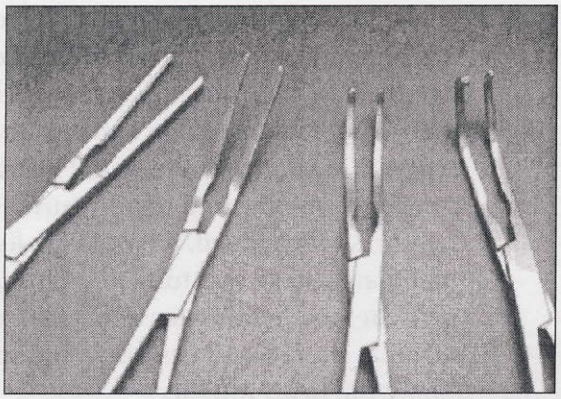


A flow meter invented by Dr. Rice

According to Gerein the procedure was quite controversial, but it was also very popular. "Everyone said that putting this graft in there is doing a controlled infarction. Well, maybe so... All we know is the pain went away. Some [patients] would be better and some wouldn't improve at all, and you didn't know how to select [the patients]." About choosing to perform the operation Gerein says, "[Vineberg] did it and so did we because you got some relief of symptoms."

Despite what critics said, not only did the Vineberg procedure relieve symptoms, studies eventually showed that the procedure did what Vineberg predicted. In 1965, using coronary angiography, Dr. Mason Sones of the Cleveland Clinic demonstrated collateral blood flow from a Vineberg implant to the anterior descending coronary artery. A few years later at St. Paul's Dr. Dick Hooper demonstrated on 100 studies that there was communication between the implanted artery and the

coronary artery. In other words, the Vineberg implant allowed blood to bypass the problem artery. This was quite significant. According to Gerein, the fact that the Vineberg procedure could be shown to work tipped surgeons off and they started to perform bypass surgery. Over the years, sixty-four Vineberg procedures were performed at St. Paul's Hospital.



A variety of clamps used in cardiac surgery

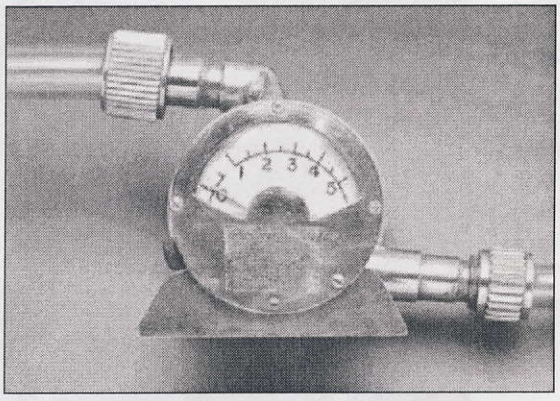
As Gerein has written, coronary artery bypass surgery was the "next logical advance in myocardial revascularization." Veins or the internal mammary artery harvested from the patient him or herself ultimately proved to be the best conduit for a bypass graft. The internal mammary artery is preferred because it does not undergo hardening of the arteries and so the bypass lasts longer. Bypass surgery techniques were quickly improved and the procedure became very popular. In fact, the results were so good, and coronary artery disease so prevalent, that the demand for bypass surgery began to place a huge strain on the hospital's resources. In 1971, St. Paul's performed a total of 115 open-heart surgeries—nine congenital defects, forty-one valve surgeries and sixty-five coronary artery bypass surgeries. Waiting lists for heart surgery began to grow to dangerous levels and the media turned up the pressure by featuring stories of people on wait lists for months.

Keeping Pace: the Development of Pacemakers

Another area of cardiac surgery that grew during this time and affected the waiting lists for both cardiology and cardiac surgery was the development of pacemakers. The first pacemaker was an external device developed in 1950 by Dr. John Hopps, working with the National Research Council. Dr. Paul Zoll is also often cited as the inventor of the first pacemaker, although he built his external device in 1952. In May of 1958, Wilson Greatbach built the first implantable pacemaker.

Initially the pacemaker gave a constant pace, but doctors soon

discovered that the constant jolt of the pacemaker set some people off into fibrillation. Soon pacemakers were developed to only cut in and pace the heart if the cardiac rhythm exceeded or was less than a certain range. Another major development was to decrease the size of pacemakers. "The initial ones we put in were 80 or 90 grams," says Gerein, "That was a problem because the weight tended to erode the skin. But it didn't take long to get them down to about the size of two loonies put together." At St. Paul's Hospital implanting pacemakers was a large part of the cardiac unit's work. Since the first pace makers were developed, defibrillators have also been developed and increasingly implanted in patients.



The arterial blood flow meter invented by Dr. Howard Rice. This meter allowed surgeons to monitor the rate at which blood flowed through the heart-lung machine while patients were in surgery. According to Dr. Gerein, inventions such as this were one of the reasons that St. Paul's had a high success rate with early open-heart surgery

One of the largest growth areas for the use of pace makers and defibrillators has been as primary prevention devices. Instead of waiting until people have had a heart attack, pace makers are now often used in patients who are considered to be at high risk of heart attack. "If they have enough impairment of the heart muscle they are at high risk of having potentially fatal arrhythmia," says Dr. Charles Kerr, head of the department of cardiology from 1995 to 2003. "Studies have been done that show that you should be putting these devices in people on a preventive basis." Because of this research, the use of pace makers is sure to grow as the population ages.

Waiting Lists

"Cardiac surgery was not a hard sell," says Gerein about the popularity of the procedures. Between 1969 and 1971 the number of open-heart procedures performed at St. Paul's more than doubled. Despite this, the waiting list for heart surgery was growing and becoming both a political and public health liability. Gerein noted in a 1970 letter to Dr. Hugh McDonald that two patients had died while waiting for heart surgery and with heart surgery limited to two cases per week, new patients were being scheduled for surgery four and five months down

the road.

According to Dr. Kavanagh-Gray, the waiting lists were bad for patients in several ways. Not only did they face the danger of having a heart attack while waiting for surgery, but those who had to wait for surgery were often less likely to return to normal activity afterward. "The waiting lists were very long and very bad for the public because if you had to wait for six months and were not able to work, you didn't really much want to go back to work. But if you could get operated within the first month, you'd go back to work after your convalescence," says Kavanagh-Gray.

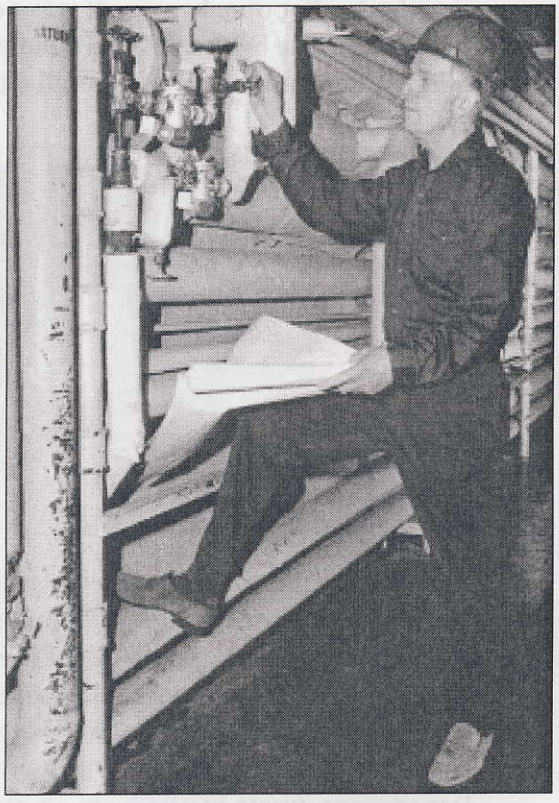
In April 1985, St. Paul's hosted several senior physicians from Hebei province in China as part of an ongoing exchange of information between China and the West. From left Dr. Gerein, three visiting doctors, Dr. Gray, Dr. Paré and Dr. Peretz tour the hospital

The waiting lists also put a great deal of strain on the cardiologists, surgeons and administration. "The surgeons found it very hard, people were phoning constantly," says Kavanagh-Gray. "I found it terrible. I couldn't sleep many nights worrying about Mr. So and So, Mrs. So and So. Administration was caught in a real bind. They could see that they could fill their whole hospital with cardiac patients. They were getting a lot of opposition from other services who felt they were being engulfed, and they were."

As Dr. Gourlay wrote in a memo in February of 1970 regarding the issue of adding another operating day for open-heart surgery, "This is a serious problem, for there is still a large load of general surgery which must be met, for it is equally important. Many patients requiring general surgery are as urgent as open heart cases."

The waiting list put a strain on the whole hospital, not only in terms of trying to get space, but also in terms of interdepartmental and interdivisional relationships. According to Gerein, the expansion of cardiac surgery through this time tested some of the relationships in what was by all accounts a very friendly hospital. "The cardiac surgeons

wanted beds. The cardiologists wanted beds. The surgeons wanted more operating [staff]. Well, now you're in conflict with the general surgeons, so then there are interdivisional bad feelings," says Gerein. The waiting list was also very hard on nurses and technicians who often felt pressured to work harder and faster and cut corners in an attempt to fit more surgeries into each day.



Larry Cubbage, an engineer at St. Paul's, received a heart transplant at the hospital in 1985

In 1971 the 3rd provincial Heart Surgery Review Committee (HSRC) was assembled to deal with the issue of waiting lists. Gerein served as a committee member on the 3rd as well as the 4th and 5th HSRCs. "The demand became so great that we were always short of resources," says Gerein, "and that's why the committee was formed." After long deliberations, the 3rd committee recommended that the St. Paul's chapel be converted into a new fifteen-bed cardiac surgical and nursing unit. This plan was later revised to include a pulmonary unit on the third floor. In September 1973 the cardiac unit was official opened, which, for a time, addressed the problem of the lengthy waiting list. However, it wasn't long before the waiting list returned as the demand for heart surgery continued to increase.

Cardiac Surgery Expands

Following the opening of the new cardiac unit, St. Paul's increased the number of open-heart surgeries to five each week. This growth demanded greater efficiency in the use of both time and resources. St. Paul's finally retired Dr. Rice's heart-lung machine and

purchased standard equipment. The Rice machine was over twelve years old when it was taken out of service. It was a rugged machine and had served the hospital well, but as Rice wrote at the time, "Even a Rolls Royce does not work forever."

Although it had been used for over a thousand surgeries and had never caused infection or acidosis, the Rice machine had several drawbacks. For one, because it was not a standard design, all of the parts had to be made by the St. Paul's Biomedical Department. This included all the tubing and seals. Also, unlike the later designs, which relied heavily on disposable parts that were thrown away after each use, the stainless steel Rice heart-lung machine had to be taken apart and put through the autoclave then reassembled following each use.

An unidentified nurse in the cardiac care unit (c. 1987)

Rice himself was very critical of the tendency towards disposable items. "As in modern life, the concept of 'use plastic' and 'dispose of it' took over and replaced most stainless steel pump oxygenators," he wrote. "This is a wasteful system, but no doubt it will not end unless plastic gets too scarce and expensive." While it was less wasteful, taking apart, cleaning and reassembling the Rice pump oxygenator was a time-consuming and labour-intensive process. As Dr. Heyworth, then head of the Biomedical Department, wrote in 1972, "In all cases a pump run and the subsequent clean-up and reassembly are an exhausting day's work for the men involved." It was the time of these technicians that St. Paul's could no longer afford to waste.

Another drawback was that the early heart-lung machines required a blood prime before they could be used. Essentially, the Rice machine had to be filled up with seven units of blood before it could be connected to the patient. This meant a huge amount of precious blood was used before the surgery even began. It also meant that the patient received a large amount of foreign blood during the course of the surgery, which increased the risk of transfusion reactions and infection.

With the invention of the no-blood-prime heart-lung machine, the Rice machine and others like it quickly became obsolete. After the Ladies Auxiliary donated money to purchase a modern heart-lung machine, the Rice machine was relegated to the archives, where it remains.

Despite the increase in resources and equipment, the hospital was barely able to keep up with the demand for heart surgery—according to Gerein, by 1974 there were eighty patients on the waiting list. Records also show a continual struggle between the surgeons and the administration over the allowable number of cardiac surgeries performed at the hospital. Surgeons frequently exceeded the number the administration allowed or booked the absolute maximum and then forced in emergency surgeries beyond that.

An unidentified nurse in the cardiac care unit

As cardiac surgery increased in frequency at St. Paul's the number of staff also increased. While the original cardiac surgical team of Gourlay, Coursley and Musgrove all moved on to other types of surgery, new cardiac surgeons joined St. Paul's. Gerein had joined the staff in 1961, and the next to come were Dr. Robert (Bob) Miyagashima, in 1969, and Dr. Andy Tutassaura in 1975. Other staff also joined the cardiac team including new perfusionists, technicians and nurses. In 1968 Dr. Lewchuck began to take over for Dr. Rice in supervising the heart-lung machine. In 1981 Dr. Hilton Ling joined the staff and, as Gerein has stated, "set an unprecedented standard for high volume of open heart surgery among his colleagues in the province." Since then St. Paul's has attracted several more cardiac surgeons including Dr. Sam Lichtenstein, who is now the head of the division of Cardiovascular Surgery for St. Paul's and UBC; Dr. James Abel and Dr. Anson Cheung.

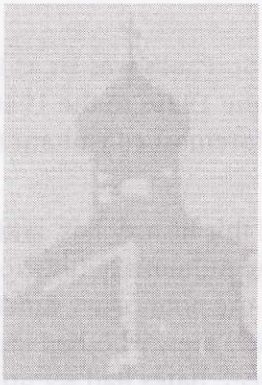
While the number of heart surgeries increased, the length of the hospital stay for cardiac surgery patients decreased steadily. In 1971 the average length of stay for a cardiac surgery patient was twenty-six to thirty days. In only two years this was decreased to between sixteen and twenty days. More recently this had been decreased even further, down

Dr. Hilton Ling (front, seated) donated $10,000 to help purchase a much needed Marquette monitor system used in open-heart surgery for St. Paul's cardiac unit. Here his colleagues celebrate his generosity

to less than a week. With the use of less invasive treatments, such as angioplasty, many patients no longer need open-heart surgery and can often return home after as little as twenty-four hours.

In 1979 Cardiovascular and Thoracic Surgery was granted divisional status at St. Paul's. This brought the hospital's structure into line with UBC, which had declared divisional status for Cardiovascular and Thoracic Surgery within the Department of Surgery. Gerein was appointed head of the new division and he maintained the post until his retirement in 1991, at which time Dr. Lichtenstein became head of the division. The stronger connection with UBC also meant a greater teaching role for St. Paul's, which has since become the training ground for many cardiac surgeons, and St. Paul's is now the designated provincial Heart Centre.

By the early 1980s, the cardiac surgical ward had grown to thirty-beds, four of which were equipped with cardiac monitors. The number of open-heart surgeries continued to expand, as did the demand. Since that time ever-improving techniques and new surgeries have been introduced to St. Paul's with great success. The division has continued to grow and attract and train many talented surgeons. While it is the pioneers of cardiac surgery that we celebrate, perhaps their most important work at St. Paul's has been their lasting legacy of such a high-quality surgical division



Chapter 4: Respirology at St. Paul's Hospital

What is the use of breathing? That it is not a trifling use is clear from our inability to survive for even the shortest time after it has stopped... It remains, then, that we breathe for regulation of heat. This, then, is the principle use of breathing, and the second is to nourish the psychic pneuma.

— Galen, 130-200 A.D.

Introduction

Much has been learned about the function of the lungs since the days that Galen took his last breath. We know now, for example, that the heart and lungs work together to oxygenate and circulate the blood through the body. The heart and the lungs cannot be separated; likewise neither can the history of cardiovascular and pulmonary care and research at St. Paul's hospital.

Rather than simply evolving along a straight path, the history of chest medicine has been one that has had several distinct phases. Respirology first became separated from general medicine with the treatment of tuberculosis. In 1903, William Osler wrote, "pneumonia is the captain of the men of death and tuberculosis is the handmaid." This sentiment reflected the fact that at the time tuberculosis was a virtual death sentence for most of the people who contracted it. The first tuberculosis sanatorium was built in the U.S. in 1885, and through the end of the 19th and the beginning of the 20th century isolation and fresh air were the accepted standard of treatment for the disease. In 1944 Selman Waksman isolated streptomycin from a fungus, allowing doctors to treat TB with antibiotics for the first time. While tuberculosis has not been eradicated, it is now a treatable disease. Antibiotic treatment also means that most patients who contract TB do not become as sick. As sanatoria closed down, chest doctors began to apply their knowledge to other lung diseases, including obstructive lung diseases such as asthma, chronic bronchitis and bronchiectasis as well as a host of occupational lung diseases.

Respiratory Medicine at St. Paul's

The first record of a chest physician at St. Paul's was Dr. C.H. Vrooman, who practiced at the hospital from the 1920s to the 1940s and was considered by many to be the province's foremost consultant in the field of tuberculosis and silicosis.

However, our story begins, as much of this history has, with the work of Dr. Harold Rice and the creation of the pulmonary function laboratory. Rice and Dr. Bill Young developed the pulmonary function lab based on the model developed by Dr. David Bates, who had trained Young at the Royal Victoria Hospital in Montreal. Bates had set up a series of lung function labs in the Veterans Hospitals throughout Canada. "[Bates] set up these labs so that they were uniform. A lot of the pulmonary function study labs in Canada were based on this model," says Dr. Richard Donevan, who later became one of St. Paul's respirologists. "Of course, when Bill Young moved out to St. Paul's it was natural that he would want to essentially have the same sort of laboratory," says Bates, who later became dean of medicine at UBC. The lab at St. Paul's had equipment to provide measurements of lung volume, flow rates, mixing efficiency and a steady-state end-tidal diffusing capacity.

Young joined the staff at St. Paul's in 1963. He provided a full pulmonary consultation service and was able to secure several research grants from the Department of Defense. However, after almost a decade at St. Paul's, Young left in 1971 to move to New Zealand. It was almost two years before the hospital was able to find a replacement.

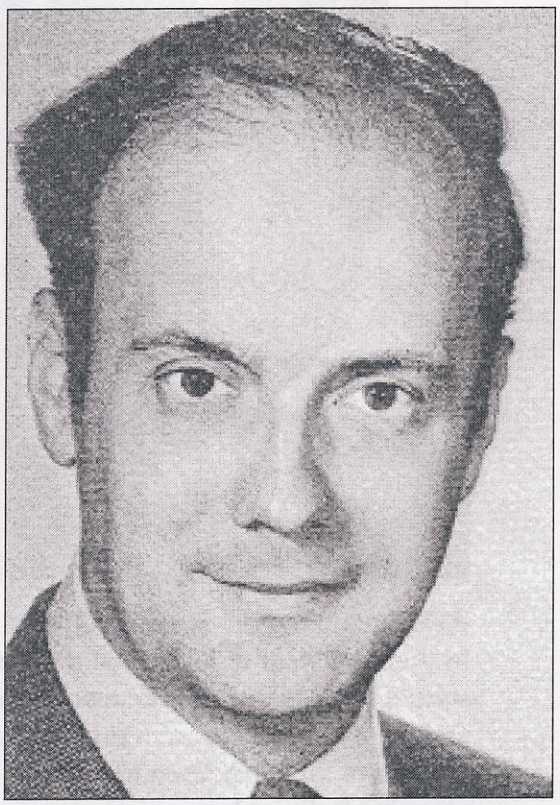
Dr. Graeme Copland was one of the first respirologists St. Paul's interviewed. "I came out and had a look at it, and it seemed to me to be a tremendous place to be. It was an exceedingly good hospital at that time. And there were many physicians who were just superb."

However, the job seemed too big for one lung physician to handle. "I said to the head of medicine, 'I don't think this is a job for one person, it needs at least two people.'" Copland turned down the position, but recommended that St. Paul's offer it to Dr. Richard (Dick) Donevan, a respiratory doctor at the Royal Victoria Hospital in Montreal.

"Their problem was with money," says Donevan. "They didn't think they had enough money to support [two physicians]." Donevan tried to convince the hospital administration that the income from

increased lung function studies would support a second respiratory physician. "I kept saying, 'Well I think we can do more function studies, the function studies will pay for some of our income.' And I tried to see a source of income for us, because that was their worry, that there wasn't enough work for two of us." Donevan also ended up turning the job down because it would be so difficult for one person to handle alone. According to Copland, the administration's fear about lack of work never proved to be correct.

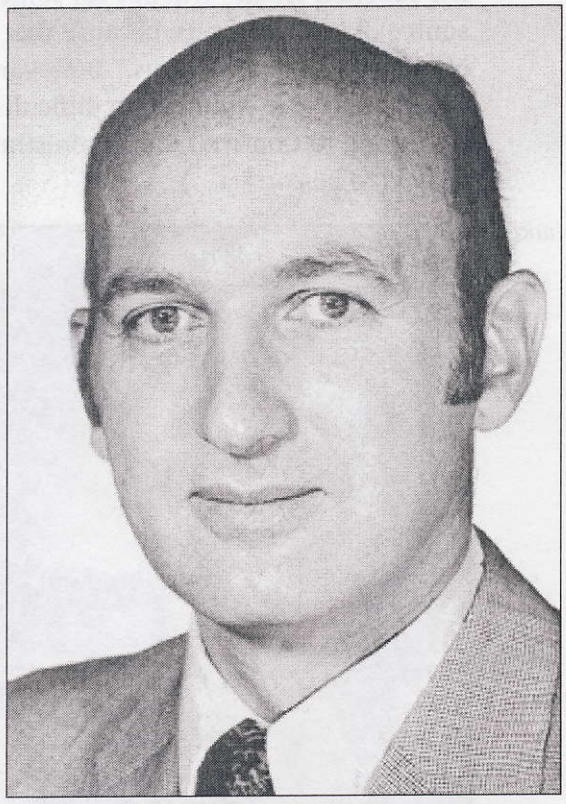
Dr. Graeme Copland



Eventually, St. Paul's was able to secure a grant from the B.C. Lung Association, which allowed the hospital to offer jobs to Donevan and Copland to come out as a team. Copland accepted the position almost immediately, but Donevan had some second thoughts. "Unbeknownst to me Graeme accepted, but I wasn't sure," says Donevan. "After I had turned it down the first time, I had decided that we would stay in Montreal, because we loved Montreal. Then I got this [second] call, and I couldn't decide whether to go or not. It was the worst time I ever had. I had to contact Dr. Hurlburt, who was the physician in chief here and I'd lift up the phone and then I'd put it down. I had these lists of pros and cons, and that never works. I tried flipping coins, but I wouldn't agree with it. So I decided that if I couldn't agree I shouldn't go. I phoned Graeme, to tell him that I wasn't going. And Graeme started talking very rapidly, telling me all the wonderful things about St. Paul's."

Copland convinced Donevan to think about his decision for a bit longer. As fate would have it, one of Donevan's friends, a cardiologist

who had moved to Yakima, Washington, phoned that evening and was able to convince Donevan to move out west.



Dr. Richard Donevan. Dr. Copland and Donevan came to St. Paul's together in 1972. Their arrival marked the opening of a new era in respiratory care in B.C

"I phoned Graeme the next morning and I think it was then that he said, 'you know Dick, I'd already decided.'"

As Dr. Dwight Peretz said in a speech to the B.C. Lung Association, "The arrival of Dr. Graeme Copland and Dr. Dick Donevan [opened] an era of unprecedented [respiratory] research and treatment in B.C." Copland and Donevan arrived at St. Paul's in July of 1972. Because of the lapse in the leadership of the respiratory division caused by the long delay in hiring the new respirologists, morale was low in the division and the service was being misused, Copland and Donevan wrote in their first year report to the B.C. Lung Association. When they first started there was very little teaching of interns, residents or nurses, and all of Young's research projects had been terminated. "Our early roles have therefore been to improve patient care," they wrote, "while planning facilities for respiratory research which will become operational this summer." To improve the teaching capabilities, both Donevan and Copland were cross-appointed as Clinical Professors at the University of British Columbia in addition to their roles at the hospital.

The unit was also appointed a Respiratory Nurse, Miss Joanne Perry. Miss Perry was one in a long line of excellent nurses. Copland is quick to emphasize the important role nurses played in building such a successful practice focused on patient care. "It's very important to have good nurses," he says, "And we had some wonderful nurses."

The Practice and the Pulmonary Function Lab

One of the reasons both Copland and Donevan believed the job was more suitable for two than one was the large amount of work it involved. In addition to respiratory patients, the respirologists were responsible for ventilator management in the Intensive Care Unit. This practice continued until a full-time Intensivist, Dr. James Russell, was appointed in the mid-1980s. With only the two of them in the unit, it meant they were each frequently on call. "In the beginning, we were on call every other weekend, every other night, because there was nobody else to handle the respirators. And if a patient comes into the emergency room with a respiratory problem, we'd be called in. So we worked hard in those days," says Donevan.

Dr. Copland works with an asthma patient. Asthma and other obstructive airway diseases represented a large segment of the cases that the respiratory unit treated

Copland and Donevan not only came to the hospital together they practiced together. The two did their rounds together and were often seen around the hospital together, garnering them the nicknames Drs. D and C, and the Bobbsey Twins.

"I think there was a big advantage that we practiced together," says Donevan. "It wasn't efficient, in that we always made rounds together. We could have made them much quicker separately, but it was great for the patient, because then we both knew the patient. When you're called at night, and you know who it is, and they know you, that gives [the patient] a little confidence." They also made a practice of sharing patients and alternating consultations so that the referring physicians would regard them as a team.

In addition to their daily rounds together, Donevan and Copland regularly made combined rounds with surgeons, nurses and physiotherapists. This led to close and open relationships between the departments. But more importantly, it improved patient care and morale

by ensuring that everyone was up to date on the patient's progress.

According to Donevan, while the two doctors didn't do a large practice, it was a wonderful work experience. "We had our offices in the hospital and we felt we had to contribute to the hospital a certain amount. Because we were there and we did a lot of in-hospital work we only did three half-days a week of practice and the rest of the time we were making rounds or teaching or whatever. It was very, very enjoyable, we got along really well together. It was a very happy practice."

Dr. Donevan (left) and Dr. Lindsay Lawson (right) consult with a patient

Donevan and Copland also spent a great deal of time on teaching. "With our offices right in the hospital, if we saw an interesting patient we'd call a resident and they'd come and see him or her with us," says Donevan who explains that teaching was a holistic part of the work that they did. A number of the respirologists around the city and the province have come through the respiratory program at St. Paul's as residents and fellows, including Dr. Lindsay Lawson and Dr. Pierce Wilcox, who are still working at St. Paul's.

Lawson, who was a pulmonary fellow with Copland and Donevan from 1979 to 1982 and is now a clinical professor in respirology at UBC, says that academically, the experience of learning from Donevan and Copland was fantastic. "You learned a lot about taking care of patients in the true sense of the word 'care,'" says Lawson. "You learned also that you could have fun while you're doing it, which is important. But most of all what I learned from them was the role of a compassionate caring physician. And that's the most important thing we do."

The respiratory unit, like the cardiology unit, has also done a lot of teaching and consulting outside of the hospital. St. Paul's sent respirologists to Fort St. John, Powell River, "All over the place," says Copland, adding that St. Paul's continues to send respirologists to Powell River, Squamish, Sechelt and Lilloet.

In the early days the lab had a variety of machines that each

studied one aspect of lung function. Since then, newer equipment has been developed that combines multiple studies into one machine. The result is a shorter visit for the patient. "You can get a full set of lung function tests done in two or three minutes, because you don't go through all these different procedures," says Copland. Although the lab was improved and new equipment brought in over time, when Donevan and Copland first arrived the pulmonary function lab had several function machines and was poorly laid out.

Shortly after they arrived as St. Paul's Copland and Donevan were asked to help with the planning of the new respiratory unit. According to a memo from Copland written in 1973, while St. Paul's had excellent routine function assessment, it could not provide the more complex respiratory function tests that would be expected at most teaching hospitals. When the new cardiac and respiratory units opened in September 1973, the new unit featured a variety of new equipment that allowed for more sophisticated lung function measurements both at rest and during exercise. "Graeme [Copland] and Dick [Donevan] made a big impression on people because they brought a modern concept f medicine and respiratory care," says Bates, "and all this was completely unknown before that and people noticed these two physicians were revolutionizing pulmonary care and doing lung function tests which were unknown more or less, at that time."

Once the new pulmonary ward was opened in the renovated chapel, the respirologists started to do rounds with the surgeons. "We set it up with the surgeons so that we had both medical and surgical patients in the ward," says Donevan. "They would make rounds, we would make rounds, and once a week we'd make rounds together. That was the first time that happened where they combined medical and surgical wards in one."

Both Donevan and Copland concede that combined rounds may have been a less efficient use of time, but it also greatly improved patient care and is a practice that continues to the present. "We were tightly related to the surgeons and the x-ray people and the microbiology people and that made it just wonderful. Just tremendous," says Copland.

In talking to their colleagues it quickly becomes clear that Copland and Donevan were and are known for their great senses of humour and their camaraderie. The pair were also known for their practical jokes.

"Graeme is a great practical joker," says Donevan. "I had to respond in kind just for self defense. Every time we'd go away for our holidays, there'd be something when we came back as a joke." One of the most memorable for Copland was the time Donevan transferred him to the Vancouver General Hospital.

A patient in the pulmonary rehabilitation program working on the stationary bicycle

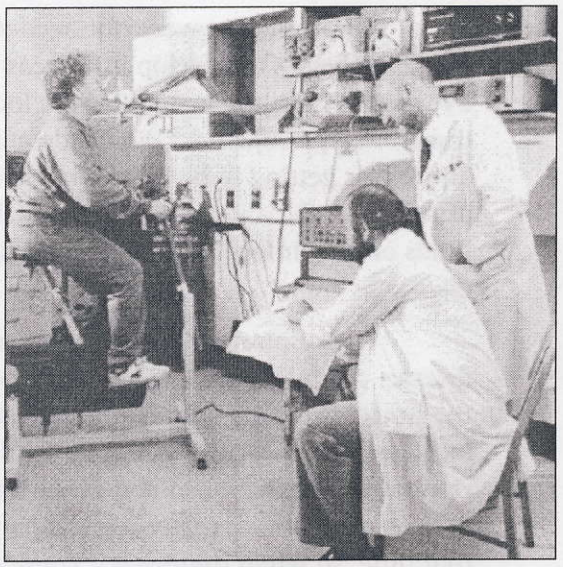
"I got this registered letter on the head of medicine's stationary telling me that I'd been transferred to the Vancouver General effective immediately and would I please not call," Copland says. "I was so mad."

Donevan had written in the letter that Copland should not mention the upcoming transfer to anyone because an official announcement had not yet been made. However, the letter also instructed him to leave his keys when he left the office that day.

"Graeme got this registered letter and I walked by and glanced in. And he says, 'Come here Dick, come here. Read this.' I read it and said, 'Graeme it says down here you shouldn't be telling anybody.' He said, 'I don't care. I'm going to go right down now and speak to Bill Hurlburt.' He raced out, he was furious." Fortunately Dr. Hurlburt was out of the office at the time and Copland came back to the respirology unit still quite shaken up. "Then I started to laugh and he knew," says Donevan. "But we did occasional serious medicine as well."

"We had a lot of fun practicing medicine," says Copland. "It was a very pleasant place to practice. It was very high quality of medicine and it was a place that we thoroughly enjoyed. We enjoyed each other a great deal too."

Over the years the respiratory unit grew in numbers and by 1986 it had expanded to six physicians, three associate physicians, three clinical respiratory function technicians, four secretaries and twenty-three associated respiratory technologists. Additions to the staff included Dr Peter Paré in 1977, who went on to be the St. Paul's and UBC Respiratory Division head (1982-92), Drs. Bob Schellenberg, who brought with him an interest in allergy and immunology both in clinical practice and in research, Dick Pardy, Tony Bai, Barbara Nakielna, Marylyn Brumwell (a dedicated thoracic surgeon), Bob Levy, who now heads the division, and Wilcox and Lawson. In 1987 Donevan resigned from St. Paul's to take a position as head of the respiratory division at the King Fahad Hospital in Riyadh, Saudi Arabia. Dr. Richard Pardy, who Copland describes as a dynamic young physician and researcher replaced Paré as division head in 1992; Pardy remained with the unit until 2001 when he returned to his native New Zealand.



Dr. Donevan and Dr. Richard Pardy monitor a patient to see how exercise affects her breathing

The addition of the Pulmonary Research Laboratory in 1977 brought Dr. James Hogg, a lung pathologist, Dr. Peter Paré and Lisa Baile, a respiratory researcher to St. Paul's and started a new era of research and a further expansion of St. Paul's capabilities.

Changes in Techniques and Technology

The face of respiratory medicine has changed since St. Paul's first developed its respiratory service in the early 1960s. "Pulmonary medicine at that time was a relatively new profession," says Donevan. "It has changed considerably since then, in its emphasis in research for example. Before that pulmonary medicine was really in the hands of TB specialists. It was changing when we went in."

According to Copland, in the 1960s, at the Toronto Hospital,

which was the TB hospital, thoracic surgeons were performing between four- and six-thousand surgeries per year on TB patients. "Then, along came the new drugs and over about a three-year period it went from five-thousand a year down to three-thousand."

"We jut got in on the ground floor, to some extent," says Donevan. "There were non-TB chest physicians before us, but we were in the early stages of chest medicine."

TB physicians were not needed as much any more and chest medicine began to develop into areas that had previously been handled by general practitioners. "We were looking at all different kinds of disease," says Copland. "We did do a bit of tuberculosis, but not too much and it was getting to be more straight-forward. We did an awful lot of asthma. We did a lot of chronic bronchitis, emphysema, many different kinds of lung infection. We got quite involved in occupational lung disease as well."

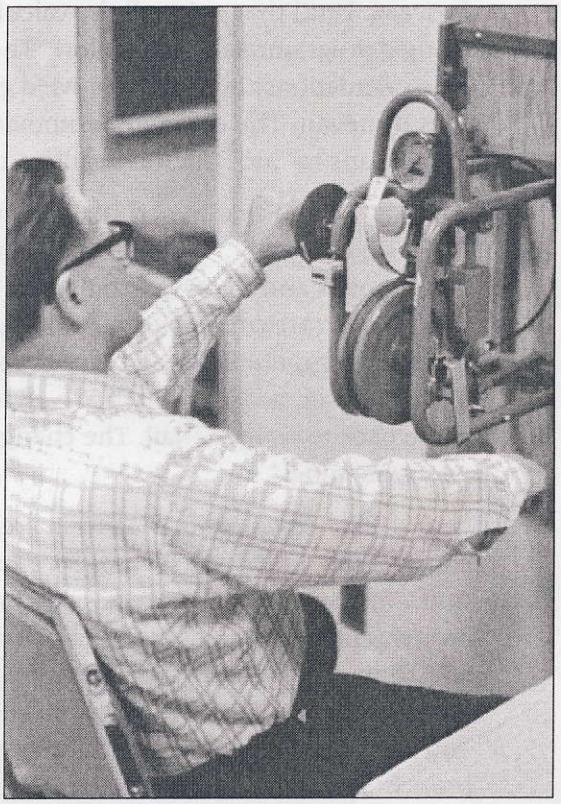
The respiratory unit also saw a lot of cases of connective tissue disease, chronic bronchitis, obstructive airway disease and masses in the lung. "We got a variety of cases, far more than we would have at a local general hospital because St. Paul's became a referral hospital for respiratory medicine. So you saw a lot of unusual cases," says Donevan. "There weren't that many respiratory physicians through the province at that time, so when there was a complicated case they would refer either to us or to VGH. And by going out to some of these areas we became pretty well known through the province."

Because their referral base was so wide, respirologists at St. Paul's had the opportunity to see many rare respiratory diseases. For example, Copland shares a story about seeing many instances of a certain rare disease. "There's a disease called Wegener's disease of the lung, which is a rare thing, and people will see one or two in a life time. But I'll always remember one day in Powell River I saw four people who had Wegener's disease in the same day and I thought this was just astounding."

For Donevan, this aspect of seeing so many different types of illness made the practice at St. Paul's more interesting. "As Graeme said, you might see one or two in your career, but at St. Paul's we had a lot of patients with Wegener's over the years, mainly because we had such a large referral base. That made it far more interesting."

In the early 1970s, endoscopy was a new and developing

technique. Prior to that only the rigid bronchoscope had been available for respirologists to see inside the lungs. Both the rigid bronchoscope and the flexible endoscope were passed into the lungs and allowed respirologists to see the lungs from the inside. "With the rigid bronchoscope you really couldn't get beyond the bifurcations (division of the trachea into main bronchi) of the lung," says Donevan, "But with the flexible endoscope you could get way out in the lung. When we came to St. Paul's Graeme wanted to do flexible endoscopy, so he taught me how to do it. We did a lot of endoscopies."



A patient in the pulmonary rehabilitation program using a machine to exercise the upper body

Like the heart, the lungs are hidden within the rib cage, which means that the ability to diagnose disease had always been hindered by the ability to see the organ. Changes to imaging techniques have had a huge impact on the practice of chest medicine. "When CT scanning came along that totally changed the practice of medicine," says Copland. "With the up-to-date CTs you can see anything in the lung about a millimeter or a half a millimeter in size. And that was just impossible with a chest x-ray. I couldn't recall how we'd been able to practice respiratory medicine before there was CT scanning. It was a pivotal source."

Improved imaging techniques have meant that respirologists can see, diagnose and treat lung disease much earlier in its progression than they could in the past. Biopsy techniques have also improved. It is now possible to perform a biopsy of a nodule or mass in the lung without surgery. "With a nodule in the lung, if it's accessible to the endoscope you can biopsy it through the endoscope," explains Donevan. "When we started practicing, that wasn't available, you had to [perform surgery].

You can also do transthoracic-biopsies, where you put a needle through the chest into the lung. That wasn't done very much when we started, either."

Another significant change to respirology has come about because of the improvements in much more mundane technologies. When the new pulmonary ward opened in the renovated chapel in 1973, the lung function lab featured a brand new desktop computer that was used for the calculations of the test results. "The computer had a total of 64 K," says Copland, laughing. But at the time it represented a major step forward. Until that point all the calculations had been done by hand or using a programmable calculator. "The respiratory technicians would do [the calculations] by hand and we'd get the results and interpret them," says Donevan. The computer automated that work and allowed the technicians to calculate the results more quickly.

"When I first joined Dick and Graeme, we had one telephone line," says Lawson. "We had an electric typewriter, we all had our Dictaphones and the transcriptionist. We had one pager and who ever was on call carried the pager. And that was it. Now we have fifteen different computers, we all carry pagers, we have two fax machines, a photocopier, a laser printer. We all telephone in our letters, which come back to us by e-mail. The change in technology is just kind of overwhelming."

Like advances in diagnosis, treatment of lung disease has changed considerably in the years since St. Paul's first opened its pulmonary unit. "Treatment of asthma has been made easier by the way of inhaled bronchodilators and inhaled steroids and a different way of looking at asthma," says Donevan. "Now they recognize asthma as primarily an inflammatory disease that you can treat with anti-inflammatories. You treat the inflammation and then you treat the flare-ups, or the bronchospasm, in addition to treating the inflammation. It's combative treatment right now," says Donevan.

Changes in treatment of lung disease have also affected the severity of the lung disease that respirologists see. "When Dick and I started at St. Paul's we'd see people with severe asthma any day of the week," says Copland, "and some would die. But that's gotten less and less and less and less, because of the improved treatment."

Some other areas of treatment have been eliminated by preventative and combative medicine. For example, bronchiectasis,

a chronic inflammatory condition where the walls of the bronchioles become dilated and lose their elasticity, is very rarely seen any more. "We used to whittle out pieces of the lung all the time and now we hardly ever do that," says Donevan, "because the patients are treated with antibiotics very quickly and get better. We used to do a study to investigate bronchiectasis, which was called a bronchiogram. You'd put a liquid dye down into the lung to outline these areas of bronchiectasis. It was a very difficult procedure for the doctor and the patient because they had to inhale this stuff."

"Now they do a CT," says Copland. "You can see much more detail and you don't need to do a bronchiogram, which is nasty."

Another major change has been a shift in society's attitude toward many of the causes of lung disease. "Fewer people are smoking. Hallelujah," says Lawson. "That's actually a huge change in society. The recognition that this is a health hazard to everybody and the restrictions we've put on it, that's very gratifying. We have a ways to go, but that's an area that's really changed." Lawson also highlights the change in attitude towards occupational lung disease and the importance of protecting workers from health hazards. "I haven't made a new diagnosis of silicosis in fifteen years," says Lawson. "On the other hand, there are other problems out there in the environment that we've discovered, but I think there's been an improvement there."

AIDS/HIV

While new treatments for older diseases have changed the face of respiratory medicine, so has the development of new diseases such as AIDS and SARS. St. Paul's was the first hospital in B.C. to treat AIDS patients, and in the early 1980s AIDS started to become a major part of respiratory care. AIDS patients frequently had respiratory complications and as with any new disease, the initial learning curve was steep. At the time, it was not only groundbreaking work, making it challenging, but it was also at times heart-breaking, frightening and took a political edge.

"The attitude of some hospitals was to try and deny that HIV AIDS was a real problem," says Bates. "But St. Paul's was willing to pick it up to its credit and to develop the resources necessary for care. And I believe they've done a very distinguished job. There's a lot of pulmonary problems there because of the resistant pneumonias and the immune

deficient pneumonias and so on, so it quickly became quite an important part of the pulmonary group's work."

"It got bigger and bigger and bigger and bigger. And all of us were involved," says Copland. "But as it became bigger [Lindsay Lawson] came to do all of it." Lawson had been on call when the first AIDS patient with pulmonary complications was admitted to St. Paul's. Soon after, she was approached by a group of general practitioners who asked her to be the AIDS lung specialist for Vancouver.

Dr. Donevan (right) consults with a general practitioner, about the health of a patient

"A group of family doctors here in Vancouver, most of them gay themselves, realized that if San Francisco was having a problem, Vancouver was going to have an even bigger problem," says Lawson. "They approached me and said, 'we want one specialist in each area that we will refer everybody to so that the learning curve is fast. Are you interested?' I was a year into practice and I said, 'sure,' little realizing then what an incredible experience it would be." Lawson credits the group of general practitioners who had the initial idea with the success of treating AIDS patients. "They were a very astute group of about four of five family doctors who realized that was the fastest way to get people educated in the complications of a new disease. [To send all the patients] to one person so that one person had a rapid accumulation of knowledge instead of spreading it between [several] people. Back in the mid-1980s it was a pretty new disease and we were seeing complications we'd never seen before, and it was a brilliant idea. And it worked really well. [The work was] exciting, challenging, tragic, frustrating, all of those things. But most of all, illuminating from the point of view of the incredible patients we dealt with."

Since that time St. Paul's has become home to the National HIV/AIDS Clinical Trials Network and has been designated as the BC Center of Excellence in HIV/AIDS.

The Adult Cystic Fibrosis Clinic

Over the years St. Paul's had developed not only a reputation for excellent respiratory care, but for being home to a group of physicians, nurses, therapists and technicians who are devoted to patient care. This reputation has attracted not only other staff, but also patients. In the early 1990s, as the Shaughnessy Hospital prepared to close, the patients of the Adult Cystic Fibrosis Clinic were given the option to choose where the new clinic would be located. The patient committee elected to go to St. Paul's and clinic moved there shortly after. "We met with different committees and [the patients] thought the St. Paul's committee was very welcoming," says Dr. Barbara Nakielna, director of the clinic. "[St. Paul's] was accessible and had a very welcoming attitude."

Dr. Barbara Nakielna started the Adult Cystic Fibrosis Clinic in 1979 after she was approached by Dr. Davidson from the pediatric clinic. "They came to our department looking for someone to start an adult clinic, and nobody felt very comfortable with it because until then it had always been considered a pediatric disease, plus a fatal disease," says Nakielna. "The understanding was that we would be looking after terminally ill patients and it wasn't something people felt comfortable with." Nakielna, however, didn't see cystic fibrosis in the same light as some of her colleagues. "I felt that, obviously people were surviving, maybe more could be done to improve their survival even at this stage of the game."

The Vancouver Adult Cystic Fibrosis Clinic was only the second adult clinic opened in Canada. Until that time, cystic fibrosis had been thought of as a disease of children. When it was first described in the early 1940s, 75 per cent of the children died before they reached three years of age. With improvements in treatment, the median age of survival is now 36 years and more adults than children have the disease. Over the years the clinic has grown from fewer than 30 patients to now treating approximately 150 patients. The bulk of this growth has been caused by the increasing life expectancy of the patients. One of the rewarding changes for Nakielna has been that many of her patients have started their own families. "A thing that we didn't have then [in 1979] but now we get more and more of is our women having children, they often come in with their babies."

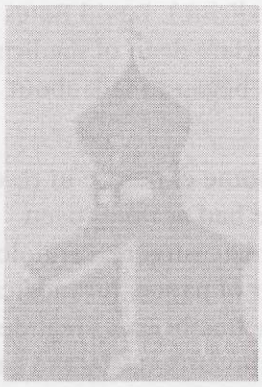
One of the developments in treatment has been a shift in thinking about how to treat bacterial infections. Where previously doctors would

treat bacterial infections once they began to cause serious symptoms for patients, now doctors try to prevent chronic colonization of patients' airways with bacteria. "The survival of CF patients is to some degree related to the type of bacteria they grow," says Nakielna. "So if they never grow pseudomonas or cepacia, then their median survival is about 55 years. In the absence of a cure we know that it's the infections that kill the patient, so there's been a huge focus on how to treat the bacteria more aggressively, how to eliminate them."

The clinic has close co-operation with the rest of the respiratory division in St. Paul's as well as the researchers, but also has strong ties to the Children's Hospital where most of its patients have been receiving treatment through their childhood. As St. Paul's has grown, these ties with groups outside of the hospital itself have increased and strengthened.

Conclusion

Since the mid-1960s, when Rice and Young started the pulmonary function lab at St. Paul's, through the rapid expansion and improvement in respiratory care at the hospital during the 1970s with Copland and Donevan, up to today, the pulmonary unit has seen several incarnations. As with cardiac care, respiratory medicine has developed rapidly during this time and St. Paul's has firmly established itself at the forefront of this field as a leader in pulmonary care. With support from the B.C. Lung Association, an organization that would continue to be instrumental in developing respiratory work at the hospital, St. Paul's was able to bring in Drs. Copland and Donevan to help build the respiratory unit. Under Copland and Donevan and their successors, respiratory care at St. Paul's has developed into a major area and has gained an excellent reputation. With the addition of pulmonary research in 1977, St. Paul's began a new era that including groundbreaking new discoveries but has always kept patient care at the fore.



Chapter 5: The Establishment of Research at St. Paul's

To those who have the urge to do research and who are prepared to give up most things in life eagerly pursued by the man on the street, discovery should come as an adventure rather than as the result of a logical process of thought. Sharp, prolonged thinking is necessary that we may keep on the chosen road, but it does not itself necessarily lead to discovery. The investigator must be ready and on the spot when the light comes from whatever direction.

— Theobold Smith, 1934

Introduction

By the mid-1970s, Drs. Copland and Donevan had established a respected respiratory unit with a wide referral basis at St. Paul's. They were eager to grow the respiratory unit and to begin developing research capacity at St. Paul's. Coupled with strengthened ties with UBC and funding from the Health Resources Fund as well as the B.C. Lung Association, this set the stage for starting a pulmonary research program at the hospital. The Respiratory Division became the first university division to be centered at St. Paul's Hospital and this in turn led to increased collaboration and integration between the hospital and university. Since 1977, when the Pulmonary Research Laboratory first opened its doors, lung, and later cardiovascular research at St. Paul's has outgrown several labs. It has also outgrown the simple "pulmonary research" designation with the addition of critical care, HIV/AIDS, cardiovascular and renal disease research. The year 2000 will often be sited as a turning point. At St. Paul's it holds special meaning as the year the James Hogg iCAPTURE Centre for Cardiovascular and Pulmonary Research was founded with a grant from the Canadian Foundation for Innovation and donations from many other partners. The iCAPTURE Centre continues St. Paul's history of pioneering efforts in cardio-pulmonary care by constantly venturing into the next new frontiers of cardiovascular and respiratory medicine.

The Pulmonary Research Laboratory

While planning the new cardiac and pulmonary wing to be opened in the converted chapel, Drs. Donevan and Copland, along with

Drs. Bill Hulbert, John Dirks (UBC head of medicine), David Bates (UBC dean of medicine), William Webber (UBC associate dean of medicine) and David Hardwick (UBC head of pathology) began to talk about developing a pulmonary research program.

"It was quite obvious that we needed some expertise in research," says Dr. Doris Kavanagh-Gray. Although there had at times been some clinical research at the hospital—the cardiac surgery, cardiology and pulmonary units each produced a number of papers for medical journals and conferences—and of course there had been a great deal of lab research involved in developing Dr. Rice's inventions, by the early 1970s St. Paul's was not involved in any laboratory research. As Dr. Al Gerein wrote in a letter to Dr. Hugh McDonald in 1969, "The hospital has provided excellent facilities for animal research. Yet, in spite of these facilities, research in cardiac surgery has not progressed with the vigor and flare [once] imagined." There were several reasons research had not developed at the hospital, but the main one was that there was no one at St. Paul's whose main responsibility was developing a research program.

Another important part of the equation in starting a research program was St. Paul's relationship with UBC. Shortly after the medical school started in 1950, St. Paul's signed an affiliation agreement with UBC. However, as Dr. David Bates has stated, this was not a "proper" affiliation agreement.

"We did not have formal affiliation agreements with any of the hospitals," says Dr. Webber, dean of medicine from 1977 to 1990. "There was a one page agreement with St. Paul's, which was a statement of good intentions." However, the agreement gave St. Paul's no real status with the university. Although a lot of undergraduate teaching was done at St. Paul's, it received no part of the budget and had no full-time faculty working there. UBC wanted to sign formal affiliation agreements with the hospitals and at the same time expand the capacity of the school of medicine.

In the mid-seventies, at the same time as St. Paul's was looking to start a research program at the hospital, the university was trying to double the size of the medical school. These two goals intersected. "It was propitious that Donevan and Copland and others had looked at developing the pulmonary [research]," says Hardwick, "but it was also important from the university's perspective to have the emergence of a second major centre in Vancouver and to bring St. Paul's into the

forefront. It was a matter of research for some, it was institution building for others."

In 1976, Dr. Peter Paré was invited out to St. Paul's for an interview to take on the role of starting and running the new Pulmonary Research Laboratory. Paré had just finished his research training with Dr. Jim Hogg at McGill and was beginning to look to move from Montreal where he had grown up and completed all of his education. As the eldest son of a well-known respirologist, Paré was also eager to find his own place to allow him to emerge from his father's shadow. "Dick Donevan and Graeme Copland had established a good clinical lung unit and they wanted to add a research component," recalls Paré. "So they invited me out here. I came and I looked at the job. But, I was just a junior person and they wanted me to start a big research lab. Although I was attracted to work with those two guys because they had set up such a good clinical unit, I thought it was going to be too hard all by myself."

Paré returned to Montreal to continue working with Hogg. Undeterred, the St. Paul's and UBC team—which by now included a large number of ex-McGill doctors, including Donevan, Dirks and Bates—began to consider getting Hogg to come to St. Paul's. Dirks and Hogg were friends and had attended the University of Manitoba together in their undergraduate years before both ending up at McGill.

"It was obvious that we needed somebody like that," says Kavanagh-Gray of Hogg. "The whole city needed somebody of Jim Hogg's expertise, so he was gulped down right away."

Hogg is a researcher's researcher, admired and respected by his colleagues and students. As Fanny Chu, a student of Hogg's, writes in a book created for Dr. Hogg's retirement, "He is a man who has dedicated his entire self to research." At the same time, he has dedicated a large part of himself to his students, of which there have been many. "He has a very profound preoccupation with the training and encouragement of young people," says Hardwick.

"I think the most rewarding experience is to see the folks come along," says Hogg about his career and his students. According to Paré, who began work with Hogg as a post-doctoral fellow, Hogg's skill as a mentor is in being able to provide support and training, while encouraging students to work independently. "He's trained many, many people. And I think he's done a great job of giving them enough freedom to become independent and enough guidance to be successful," says

Paré.

Hogg's interest in research started when he was a medical student at the University of Manitoba. "My plan really was to go into practice at the time," says Hogg. "I came from a small town. I'd never met a scientist until I got to medical school." However, after trying his hand at research he discovered he enjoyed it even more than he enjoyed clinical practice.

This may have been a sign of the quality of teaching in the medical program at the U of M at the time. "There was a period of time when the University of Manitoba disproportionately produced clinical medical leadership in Canada," says Webber. "Dr. Dirks went to that program, Dr. Hogg did, Dr. Sutter who was head of pharmacology here. Clearly for a time that program had a highly academic orientation so the people who went through it tended to go on to successful academic careers and indeed provided a lot of academic leadership nationally."

After graduating, Hogg joined the air force as a medical officer and spent part of that time working in the Institute of Aviation Medicine research laboratory in Toronto. One of his colleagues in Toronto had encouraged him to do his PhD, and when he got out of the air force Hogg went to McGill and completed a PhD in experimental medicine in the pulmonary group. By the early 1970s Hogg had become a full professor in pathology at McGill, one of the most prestigious lung research centers in North America.

In 1976, Hogg came out to look at St. Paul's and was impressed by what he saw. "I thought it was a very good clinical hospital," says Hogg. "I thought the care that the patients got was excellent and I thought there was a very good department of medicine and that the teaching was of a very high quality. Research was the next natural step. And I thought that was a bit of a challenge to start something new and see what you could do with it."

Hogg suggested to Paré that they go out to St. Paul's as a research team. With both a senior researcher and a junior researcher, they believed it would be much easier to start a new lab. In addition, Paré represented a much-needed connection between the lab and the clinical practice. "You needed to have a clinical interface," says Hardwick. "Donevan and Copland were most anxious to make sure that [the lab] was integrated with the clinical side so that it wasn't just some sort of research enterprise drifting off, hanging from a zeppelin or something." Hardwick saw Peter as an obvious choice. "He's an internist, a bright

young man at the time, bright older guy now, and he fit into that criterion. We had the link with medicine, and a link with an already existing enthusiastic group of people who wanted to foster academic development, and we had somebody who knew and worked with Jim and they could obviously be a team."

However, the challenge of starting a new lab in a hospital with almost no any existing research program was quite large. "For Jim, who was coming from one of the most established lung centers in North America, to come out here and start just with he and I was pretty bold," says Paré. If the research program was going to flourish, Hogg and Paré needed not only to establish the lab physically, but also to establish the laboratory and its work in the minds of their fellow researchers and in the heart of the hospital. "There was not a real culture of scientific research [at St. Paul's]," says Paré. "So, that was our mission, to try to establish a laboratory and then start influencing the whole culture of the hospital, which is something we haven't completed yet."

St. Paul's was once again able to secure funding through the B.C. Lung Association and UBC and Hogg and Paré began to make preparations for the Pulmonary Research Laboratory. Starting virtually from scratch meant that St. Paul's not only had to designate and renovate a space for the lab, but also had to acquire all of the necessary equipment. "I remember we walked around the lab in McGill to see what we had that we would need to get started," says Paré. "We had a long shopping list of everything we needed." Paré says that at first, he and Hogg weren't sure if St. Paul's would be able to provide everything that was on their shopping list. According to Hogg, the B.C. Lung Association was also a bit surprised by the researchers' list. "They gulped a bit, but they said that's what they had in mind was to do something different, and move ahead and have something that was solid and established and would have an impact on the place," says Hogg.

"The way they did it was by a combination of funding from the hospital, the B.C. Lung Association, and the university," says Paré. In addition, because the lab was to be interdisciplinary in its approach and would cross both medicine and pathology, it had greater backing and funding from within the hospital and the university. "It was a partnership between medicine and pathology, between the hospital and the university and the Lung Association. All of those players brought some resources," says Paré.

The money that came from the university had a long and interesting back-story. In the early 1960s, the dean of medicine at UBC, Jack McCreary, had been chair of a committee to double the size of medical schools across Canada. The result of the committee's consultations was the creation of the $450-million federal Health Resources Fund. The money was to provide facilities for any medical school that would double its size. Unfortunately for McCreary, who had hoped to capitalize on the funds, UBC was not able to pull together a proposal that the provincial government would agree to.

By the early 1970s the Health Resources Fund had been spent in each province except B.C. "Shortly after I arrived as dean I got a note from Health Canada in Ottawa, which said that the money was unspent," says Bates, "and unless we got about spending it, it would disappear. It was about $36-million, which was a lot of money." Fortunately, at about the same time, Dr. Pat McGreer, a member of the faculty of medicine, became minister of education and advanced technology and decided to move forward with a plan to build a campus hospital and doubling the size of the medical school. Even with a new hospital, finding space for twice as many students would not be easy–the Vancouver General was already teaching more students than it could handle.

"We had what is technically known as two pounds in a one-pound bag," says Hardwick of the situation at the Vancouver General. "Increasing it by adding a whole cadre of students there was simply not going to work. We needed another campus, so working very closely with Dr. Webber [then associate dean] I set about putting into place the planks to distribute the medical program to St. Paul's Hospital. And a key piece of that would be Jim Hogg." Hogg became the first full-time UBC professor working out of St. Paul's. Ultimately, St. Paul's was the first institution in B.C. to receive money from the

In 1977 Dr. Peter Paré, Lisa Baile and Dr. Jim Hogg came to St. Paul's from McGill University to start the Pulmonary Research Laboratory

Health Resources Fund. "It was an interesting wrinkle that it was to get the first dollop of money that came to British Columbia, and deservedly so," says Hardwick.

In 1977 Drs. Hogg and Paré, along with Lisa Baile, a lung research Master's student who had been working with Hogg, came to St. Paul's and started the Pulmonary Research Laboratory. Soon after, they were joined by a secretary, the first of whom did not stay very long, and was quickly replaced by Joan Dixon. Dixon became a fixture of the laboratory and worked there until her retirement.

The full-body plethysmograph measures how effectively a person or experimental animal is breathing. Here the minister of education, Pat McGeer, sits inside the machine, while Dr. Hogg (left) and Dr. Paré (center) look on

Space for the lab was found in an under-used nurses' locker room. "We had to get the [hospital] surveyed to see the best place to put the electron microscope," say Hogg. "We weren't even sure we were going to get it in those days, but we thought we had to have that if we were going to move ahead at that time. And [the nurses' locker room] happened to be the space that had the best electrical fields and the least magnetic interference for the big power lines, and it was a space we could renovate relatively inexpensively."

One of the first series of experiments done in the Pulmonary Research Lab was a continuation of the work that Hogg and Paré had been doing at McGill. This research examined differences in the ways asthmatics and non-asthmatics responded to antigens in the lungs. The Pulmonary Research Lab concentrated on airway diseases, mainly asthma and emphysema. "We look at the pathology and then more recently the molecular and cellular basis of what causes emphysema, and then to a lesser extent but a similar extent to asthma," says Paré. "We've had lungs sent to us from around the world from patients who have asthma, and we look at those lungs to investigate the mechanisms of asthma." Other research has examined the role that viruses and genetics

play in these lung diseases.

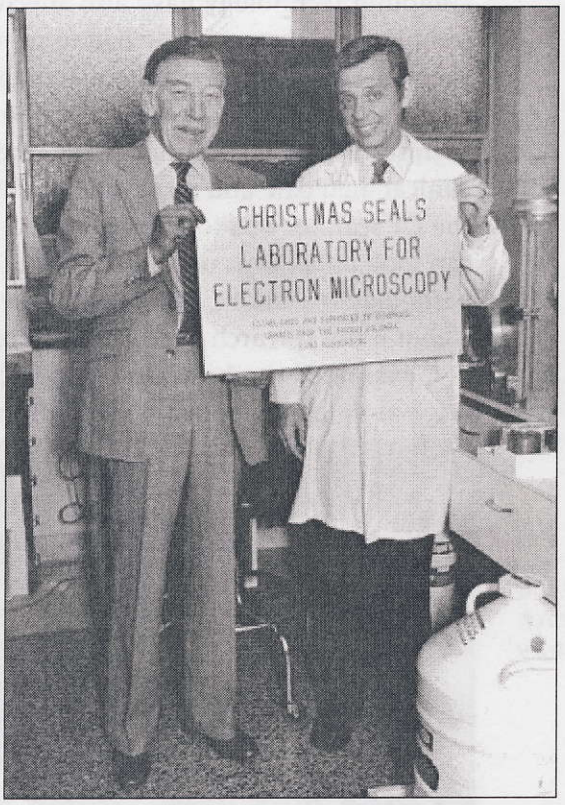
The Pulmonary Research Laboratory quickly integrated itself into the hospital. In 1979, the UBC Division of Respiratory Medicine was transferred to St. Paul's under the leadership of Bates, and he remained the Head until Paré succeeded him in 1982. It was the first division to be headed at St. Paul's. By 1980, the lab housed over a million dollars worth of equipment, including an electron microscope and a freeze-cleave apparatus. The laboratory's success could be measured in part by the high number and quality of grants it was able to secure—by the early-1980s the laboratory's budget was more than $600,000.00 a year, all of which was brought in from outside agencies and sources. Another way of measuring success would be to look at the people that the lab was attracting to do research—and this was clearly another way in which the Pulmonary Research Lab was succeeding. As the Pulmonary Research Lab grew, several researchers joined the staff, including Dr. Bob Schellenberg and Dr. David Walker. By the early-1980s twenty-five fellows and students from all over the world were enrolled in pulmonary research at St. Paul's. "We really have people that have come from all parts of the globe," says Hogg. "South Africa, Australia, New Zealand, Argentina, Britain, Ireland, all of South East Asia, particularly now we have lots of people from Japan and China."

Dr. Hogg and Dr. Paré preparing samples in the Pulmonary Research Laboratory

Changes in Technology and Techniques

Over the years the techniques and technology used for research have changed dramatically. "It's been a sea change," says Hogg. "When we moved from Montreal, the cutting edge of research was the correlation of structure and function measured in patients." At that time researchers looked at lung function and lung pathology. Now researchers are more concerned with molecular studies. "Now we are looking at not only the tissue, but the cell, not only the cells but the molecules right down to the DNA," says Paré.

"I never would have dreamed when I came here in 1976 we would be doing the sort of work that we are now," says Hogg. "The molecular biologists that were out there, breaking new ground, working on yeasts and bacteria, things like that, suddenly with progression that work became applicable to human tissue. So that advance in molecular biology created a revolution in the rest of the biological scientific world."



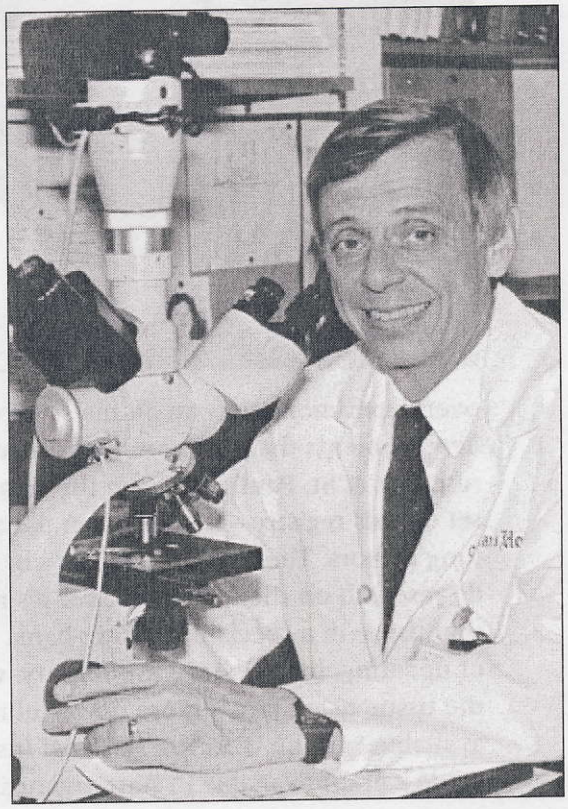
In 1983, Christmas Seals and the BC Lung Association donated an electron microscope to the Pulmonary Research Laboratory. Dr. James Hogg is on the right

As John Tsang writes in the book for Dr. Hogg's retirement, "[In the early years] the experimental sample was measured in terms of milligrams or even grams sometimes, a far cry from the nanogram of some nucleic acid in the gel nowadays." Tsang also writes that the size of the sample seems to be inversely correlated to the size of St. Paul's lab, so as the lab has grown the sample size has become smaller.

Another change has been an increased emphasis on the use of human tissue over experimentation on animals. According to Hogg, one of the developments that has been instrumental in the success of pulmonary research at St. Paul's has been the creation of the lung tissue bank. "We set up this registry—it is based on patients who are having surgery for lung tumors. Then we approach them to see if they will allow us to do research on the specimen after it's removed. We've been banking that tissue in a specialized tissue bank. It's taken a tremendous amount of updating, but we have the registry, which allows us now to study the tissue using much more powerful molecular techniques that are available." In the U.S., the National Institutes of Health has recently made a grant available to start organizing similar tissue banks. Dr. Hogg

estimates that it will take American researchers at least five years to catch up to St. Paul's. "That provides us a tremendous advantage in terms of the investigative work that we do," he says. One research project that has recently taken advantage of this tissue bank is a study of the effects of steroids in obstructive pulmonary disease.

As in all areas of medicine, developments in imaging and computer technology have also affected research. The work of analyzing samples, which previously had to be done very laboriously crouched over the microscope, is now done on computer with high resolution images taken of the sample. "When we came here, there was no such thing as a high resolution CT scanner," says Paré. "CT scanning has revolutionized clinical medicine and respiratory medicine and research because we use the CT scanner as a tool frequently. It almost replaces pathology. You can look at patterns of diseases in the lung and be confident of what the pathology is without doing the biopsy." Another advantage of imaging is that if the research needs to be re-examined the exact image that was first examined can be looked at again, rather than having to find the original slide and look at it through the microscope.

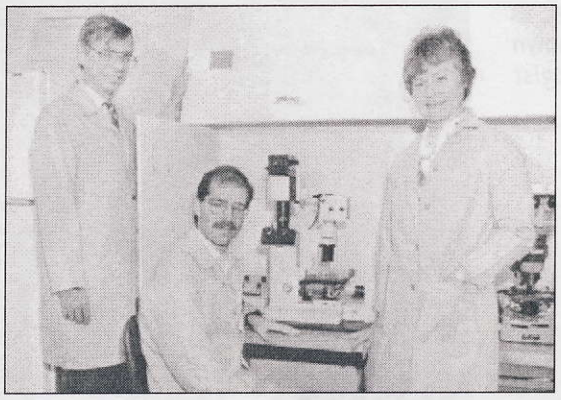


Dr. James Hogg in the Pulmonary Research Laboratory

The McDonald Research Laboratory

By the mid-1980s, the work of the Pulmonary Research Lab was outgrowing its original space. St. Paul's was constructing a new hospital building and the clinical laboratories would be moved into the new wing, leaving the old clinical lab empty. One group that had their eye on the space was the administration, headed by the hospital president Dr. McDonald, who thought the area would make an ideal suite

of offices. Another group with plans for the space was the Pulmonary Research Lab. The deciding factor was the fire regulations. "I've always felt I should put up a plaque to the Vancouver Fire Department," says Hogg. "They ruled that if it was going to be used for a different purpose, then it had to be brought up to the current fire standards. But if it was going to be used as a lab, then it didn't have to do that, because it had already been a lab." McDonald had to concede that the area should be given to an expansion of the Pulmonary Research Laboratory. To make the decision a little easier, Hogg suggested to the hospital board that the lab be renamed the McDonald Research Laboratory, in honour of Dr. McDonald, who was set to retire shortly.



In 1985, the Woodwards Foundation donated an inverted microscope to the Pulmonary Research Laboratory. Shown here with the inverted microscope are, from left, Dr. Hogg, Dr. Peter Dodek and Dr. Anne Autor

The McDonald Research Laboratory opened in 1987, only ten years after the original Pulmonary Research Lab was established. The extra space allowed the research group to start thinking of expanding the scope of research conducted at St. Paul's. "It gave us the space we really needed to expand into cardiology research," says Hogg. There had always been a great deal of interaction between the researchers and the cardiac surgeons because the surgeons were the ones who gained access to the tissue samples the researchers needed. However, until the 1990s, the cardiac surgeons and cardiologists at St. Paul's did not generate any laboratory research.

"The cardiologists here are excellent clinical cardiologists," says Paré. "They're well recognized. But they never really did what the lung people did. The lung people got a good clinical service built around Copland and Donevan and then they said, 'we want to add a research element.' And they recruited people whose mission it was to primarily do research." The cardiology unit, on the other hand, had encouraged cardiologists to pursue research, but had not hired researchers specifically. So when UBC began to search for a new head of pathology, Hogg suggested Dr. Bruce McManus, an internationally known cardiac pathologist. "[I suggested that] one possibility would be to offer [McManus] the job in pathology and put his labs at St. Paul's Hospital so

he could build up the cardiac pathology here," says Hogg. "That fit with St. Paul's goal because our major clinical work has always been on the cardiac side." The Council of University Teaching Hospitals (COUTH) had identified St. Paul's as the teaching hospital for cardiovascular care, and so in terms of aligning the care and possible research it also made sense for McManus to be at St. Paul's.

Dr. McManus, shown here in the iCAPTURE Center, is an internationally known cardiac pathologist

In 1993 McManus came to St. Paul's and brought with him his research team and the Cardiovascular Registry from the University of Nebraska, where he had worked previously. "In terms of research at this institution, if recruiting Jim [Hogg] was the first step, then recruiting Bruce [McManus] was the second major step," says Paré. "That's when the cardiovascular research really got started and it's sort of along the same lines as what we do in lungs."

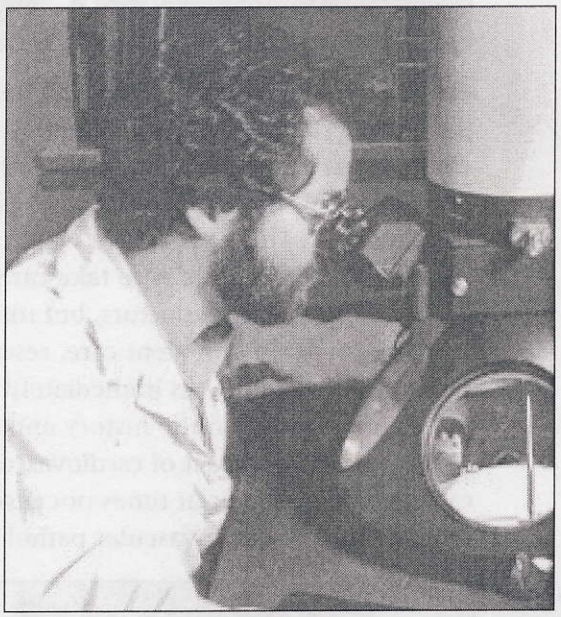
McManus has been involved in research since he was an undergraduate student when, as he says, he "became infatuated with physiology." He has long had in interest in the role that various stresses play on cardio-respiratory adaptation, and this has played into the research he has pursued. After finishing medical school in Saskatchewan, McManus completed a residency at the Boston Children's Hospital and subsequently went to the National Heart, Lung and Blood Institute in Bethesda, Maryland. McManus was on the faculty of the University of Nebraska for eleven years before coming to St. Paul's and UBC as the head of the Department of Pathology and Laboratory Medicine.

Through the 1990s research at St. Paul's continued to grow—the Athlerosclerosis Specialty Laboratory joined the group after the Shaughnessy Hospital was closed, and in 1996 the Vancouver Vascular Biology Research Centre, which McManus also headed, was established

with a partnership between St. Paul's and Eli Lilly and Company. "The laboratories started to expand outside the actual McDonald wing," says McManus. "And we agreed that the way to bring some kind of coherence around this was to give an umbrella name of McDonald Research Laboratories, so all of the units were within this collage."

The Interdisciplinary Approach

When the Pulmonary Research Laboratory started out, the concept of interdisciplinarity was not as well established as it is now. However, even at that time, the lab took a multidisciplinary approach that incorporated both pathology and medicine. Over the years, that interdisciplinary nature has grown and expanded to encompass multiple fields. As Dr. Norbert Berend (Head of the Woolcock Research Institute in Sydney Australia) wrote in the book for Dr. Hogg's retirement, "The multi-disciplinary approach to answering important questions is now taken for granted, but Jim [Hogg] was a pioneer in combining the disciplines of pathology, physiology and more lately, molecular biology."

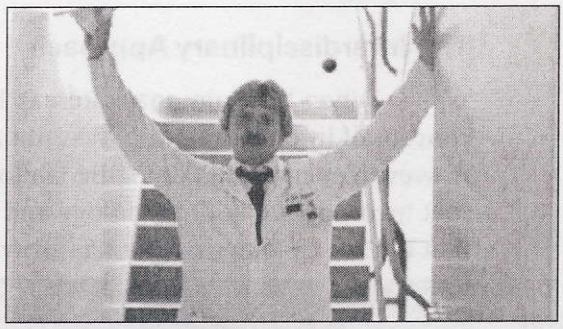


Dr. David Walker using the electron microscope

As with patient care, there are ways of doing the research work that might be more efficient in the short run, but that would have resulted in inferior work overall. For the researchers there are certain disadvantages to working in a hospital, but according to Hogg, these are by far outweighed by the advantages. "A lot of the animal work that we've done here over the years and a lot of the cell culture work, it would have been easier in the Department of Zoology out on the university campus, but we wouldn't then have had access to patients and patient tissue. We're fundamentally physicians—we want to study disease, and being in a hospital is very

important to us," says Hogg. "The research that's conducted in close proximity to where patient care is delivered is what moves things ahead... It's very important to study the disease itself and see what's really happening in humans. The interplay between the two [animal and human tissue research] is where you have the best chance of progress."

Dr. Bob Schellenberg



Not only does being based in a hospital give researchers access to patients, it also gives them access to doctors. Being part of a hospital has meant that the researchers work with clinicians as part of their daily routine. "The problem is increasingly recognized that the gap in medical research is not so much in the generation of knowledge, it's the translation of that knowledge into changed practice and policy," says Paré. "There's much more emphasis now on knowledge transfer from the basic scientists who generate it to the clinicians. There are lots of ways of doing it, but one of the best ways is to involve the people who take care of the patients in the research." By involving not only doctors, but nurses, physical therapists and others who are involved in patient care, researchers can demonstrate how the research they conduct is immediately relevant to practice. As McManus writes in his essay on the history and development of cardiovascular pathology, "The impact of cardiovascular pathology on the quality of cardiovascular care is at times not easily discerned... [however] seamless relationships of cardiovascular pathologist and cardiovascular surgeons is implicit in the delivery of superior care."

Dr. Michael Allard at a press conference

In the beginning, one of the things that helped reinforce the co-operation between researchers and clinicians in the pulmonary unit was the fact that Paré shared an office in Copland and Donevan's office suite. "In

the beginning he had his office right in the same small unit with us," says Donevan. "There was a lot of interaction. They were very inclusive. It worked out in a variety of ways. We taught together. If we had an unusual pathology we could discuss it with Jim [Hogg] or some of the other pathologists. If there were unusual function studies for example, we could discuss it with Peter [Paré]. We'd bring up cases in our rounds and they would contribute as well as us. So it was very good."

"You got a much bigger discussion that way," adds Copland.

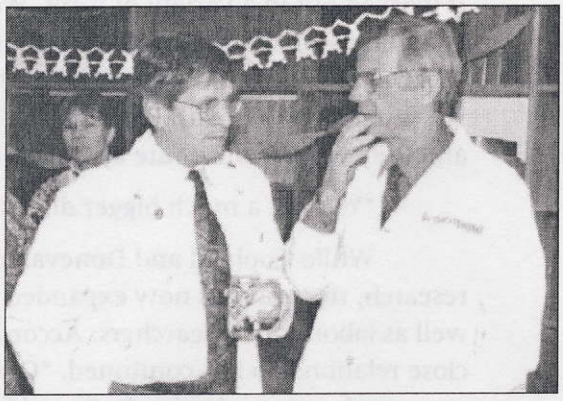
While Copland and Donevan didn't participate in much clinical research, the unit has now expanded to include clinical researchers as well as laboratory researchers. According to Dr. Lindsay Lawson, this close relationship has continued. "One of the neat things we have here is very good communication back and forth with our research colleagues. In our new clinic, the clinical researchers are all up here with us."

Dr. David Walker in the McDonald Research Lab

In 1999, the multidisciplinary approach was tackled in another way. All of the research groups working under the McDonald Research Lab umbrella came together to apply for the Canadian Foundation for Innovation (CFI) grant to upgrade the laboratories. "We were all working together, but we weren't one unit," says Paré. "We needed to upgrade our research space, so we put in an application to the CFI and we called the project the iCAPTURE project, which stands for Imaging, Cell Analysis and Phenotyping Toward Understanding responsive, reparative, remodeling and Recombinant Events. Writing the grant made us work together and start thinking along the same lines."

The iCAPTURE Centre opened in 2000 with funding from not only the CFI, but also the B.C. Lung Association, the B.C. and Yukon Heart and Stroke Foundation, the B.C. government's Knowledge Development Fund, UBC, IBM and a variety of other partners. The team also made the decision to name the new centre in honour of Dr. Hogg—the James Hogg iCAPTURE Centre for Cardiovascular and Pulmonary Research. Most importantly, St Paul's Hospital (now Providence Health

Care) pledged and delivered substantial operating funds to run the state-of-the-art facility.



Dr. McManus and Dr. Hogg at one of the many research group parties

McManus agrees that in establishing the iCAPTURE centre, the team has created a whole that is greater than each of its parts was previously. "We're much more integrated and I think everyone now thinks of themselves as being an iCAPTURE investigator, student or staff, more than they do anything else. So there's now a very robust harmony as well as balance and true integration between what would have been considered before pulmonary and cardiovascular." McManus identifies a great advantage in this because of the common ground shared between these two areas of research. "The scientific cross-talk between disciplines and different investigators from previously different silos has really led to a tremendous amount of integration. I think that the planning that we've done, in addition to the iCAPTURE awards the CFI provided us, have really driven a more and more integrative, true trans-disciplinarity."

A Culture of Learning

From it's beginnings as the Pulmonary Research Laboratory up to today, there has been an emphasis in the St. Paul's labs on maintaining a welcoming and open environment where people are encouraged to learn and strive for excellence. Dr. Michael Allard, who was a research fellow in the Pulmonary Research Lab from 1985 to 1987, writes in his recollections of the lab, "What struck me as particularly special was the constant buzz and enthusiasm people had about discovery and new ideas... much of the atmosphere was a result of Jim [Hogg] himself. I think Jim's apparent easy-going manner and his excellent sense of humour (he's a man who can have a good laugh about himself) made all of us feel relaxed despite his constant urging (and, I guess demanding) to strive for excellence."

The high standard of excellence and achievement, however, did

not stop the researchers from also having fun. Joan Dixon remembers "goof off Fridays" when the lab closed early and the whole group would go for a beer together, often at the Century Plaza. The lab staff have always enjoyed spending time together, and the imaging centre houses not only the slides and photos of countless experiments, but also scrapbooks overflowing with snapshots from Christmas parties, Bar-B-Ques and other events. Many of the photos show the babies and small children of the faculty and trainees, who have always been welcome at the research group's events. "We always included the children, which always is a made it a bit of a family thing," says Hogg. "When you're a post-doc and you don't get paid much money and you're a long ways from home, it's nice to go out with your kids because first of all you don't have that much money, you don't know anybody, you don't need a babysitter. To include people with their children is sort of a nice thing."

This congeniality has also fed into the multi-disciplinary approach of the researchers. "The integration of conventional departments into the center is not unique, but a special feature of iCAPTURE," says McManus. "We're drawing on the intellectual capital or resource of a wide range of professional scientists and clinicians... It's a very dynamic, fluid, open-architecture environment where I think everyone feels really very comfortable in sharing and learning and asking questions."

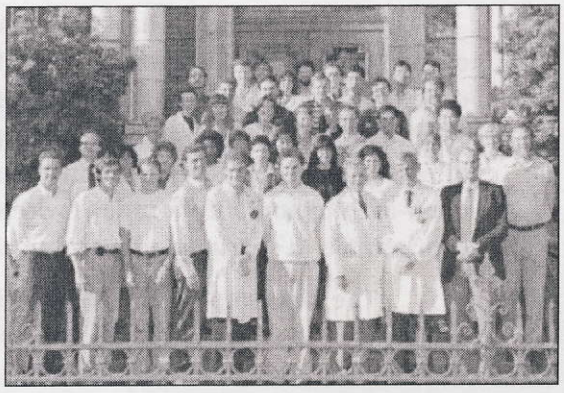
The next step for the iCAPTURE Centre is to make research a project for the whole hospital, not just the researchers. "The challenge we have is to integrate research into the culture of the whole place," says Paré. "We have to make sure we are all involved in research. We're going to try to change the perception so that research isn't something that is done in our hospital, but that everyone recognizes that we are a research hospital." By integrating research into patient care at every step, the iCAPTURE researchers will undoubtedly be able to reach their goal "to be the world leader in understanding and eliminating heart, lung and blood vessel disorders."

From its start as a three-person operation to its current status as home to over thirty principle investigators, basic cardiovascular and pulmonary research at St. Paul's has followed in the pattern of ground-breaking work set by the cardiac surgery, cardiology and respiratory units that preceded it. With its emphasis on family and fun, the iCAPTURE Centre also follows another great St. Paul's tradition—being welcoming and friendly and integrating enjoyment into quality medical care.

Conclusion

Diagnosis is not the end, but the beginning of practice.
—Martin H. Fischer

Since its beginnings, St. Paul's has been dedicated to excellence in patient care. When the Sisters of Providence first opened the doors of St. Paul's Hospital in 1894 it was a simple twenty-five-bed hospital almost lost among the trees on the road to English Bay. The nuns established a legacy of hard work, perseverance and pioneering spirit that continues to this day. While success and innovation have been top priorities at St. Paul's, the patient has always come first. This has meant that even as St. Paul's has grown in size and scope, it has continued to be as welcoming, friendly and warm as it was in its "cottage" hospital days.



Researchers at the McDonald Research Laboratory

In the areas of heart and lung diagnosis, treatment and research, St. Paul's has established an excellent reputation and has become the designated provincial Heart Centre. From the initial development of open-heart surgery at the hospital, St. Paul's has continually pushed to ensure that it provides patients with the best equipment, techniques, facilities and staff. In many cases St. Paul's has had to overcome special hurdles caused by its size and budget. The idea of what a small hospital is, or isn't, capable of, has never stopped the staff of St. Paul's. Instead of being barriers, these hurdles have forced the staff of St. Paul's to create innovative solutions and have resulted in some incredible creations.

One such example is Dr. Harold Rice's heart-lung bypass machine, the only such machine ever designed and built in Canada. By building their own heart-lung machine, St. Paul's was able to start an open-heart surgery program at a much lower cost than most hospitals. While others believed that this sort of surgery could only be done in large, university-affiliated hospitals, St. Paul's was able to show that with the proper facilities and equipment, small hospitals were just as capable of excellence as larger institutions.

Through the years, the cardio-pulmonary units have maintained this early pioneering sprit and have continued to push the boundaries of what others believe a small hospital is capable of. After establishing strong clinical cardiology and respiratory units, St. Paul's stepped into pulmonary research in 1977, even though at that time there was virtually no laboratory research happening at the hospital. Since then research at the hospital has mushroomed to become a major component of cardiovascular and pulmonary care at St. Paul's. With the opening of the iCAPTURE labs in 2000, St. Paul's has established itself as one of the leading centres for cardiovascular and pulmonary research in North America.

Dr. McManus (center) and his research team. In 1993, Dr. Bruce McManus came to St. Paul's as the head of UBC's pathology department. He brought with him his research team and the Cardiovascular Registry from the University of Nebraska

In all areas of cardiovascular and pulmonary care—diagnosis, treatment and research—St. Paul's has exceeded expectations and succeeded while maintaining a friendly and welcoming atmosphere.

St. Paul's success is a sign of not only the achievements of a few bright stars, but of the co-operation between physicians, researchers, nurses, technicians, administration and volunteers, as well as the partnership between the hospital, its many benefactors and funding bodies, the University of British Columbia and of course patients themselves. St. Paul's cardiology, respiratory and research departments have all often and continuously benefited from generous funding from, among others, the Hospital Foundation, the Heart and Stroke Foundation of B.C. and the Yukon, the B.C. Lung Association, the Canadian Institutes of Health Research, The B.C. Knowledge Development Fund, the Canadian Foundation for Innovation and the Woodward Foundation. Through these various groups the people of British Columbia have also supported St. Paul's and the work it has done.

As St. Paul's looks towards the future and increased growth and expansion, the history of these pioneering efforts in cardiac and pulmonary care inform the next steps the hospital will take. Over the past forty years the hospital has built a legacy of excellence that promises to carry it forward to meeting its next goals in superior patient care.