Radiation as a Cure for Cancer

The History of Radiation Treatment in British Columbia

Stewart Jackson MD

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Jacket photographs: The three illustrations at the top from left to right, the Vancouver City Hospital site of the first recorded X-ray treatment, Vancouver's first cobalt, the world's second commercial unit and the TRIUMF cyclotron under construction.
The anonymous technician, representing thousands of dedicated professionals who have served the patients of the province, prepares a patient for treatment in Victoria in the 1940s.

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Contents

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Most of the material for the narrative has been obtained from minutes, correspondence, books, newspapers and the electronic media. The minutes and correspondence are held in the Agency Archives and direct quotations are individually referenced. Additional material was provided by several people including the following: Vera Hromada of the Fairmont Hotel Vancouver, Dr Phil Harrison gave recollections of his grandfather, a copy of his grandfather's textbook and records of treatment given in the Vancouver General Hospital in 1933, Don Melsness details of radiation therapy equipment, Jack Easton information about the cost of equipment, and Greg Kennelly cobalt treatment. Don Sawyer and Albert O'Bregan, who guided me

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Dedicated to
The cancer patients of the province

Additional source referenced information or corrections are welcome.
Please visit our web page.

www.bccanceragency.bc.ca/HistoryOfRadiationTreatment

Introduction

Röntgen Discovers X-rays

On the evening of Friday November 8th 1895, working in a darkened laboratory in the Wurzburg Physical Institute, fifty-year old Professor Wilhelm Conrad Röntgen made a remarkable discovery. When he passed a high tension current through a vacuum tube he had covered with black cardboard, Röntgen was surprised by a fluorescent glow away in the corner of the room. He traced the glow to a fluorescent screen that he had left lying on a bench. He pursued this finding with a brilliant series of experiments which, over the next few weeks, established that there existed a new ray that passed through objects. So intent was Röntgen on establishing the properties of this new kind of ray, that he worked tirelessly and, in the first few days, typical of his modesty, he told nobody of the discovery, not even his wife or his laboratory assistants. Frau Röntgen, six years her husband's senior, subsequently wrote that he had told her that he was "working on an interesting problem." He told a friend, "I have discovered something interesting, but I do not know whether or not my observations are correct."

By the 28th December he was in a position to deliver a preliminary hand written communication "on a new kind of rays" to the President of the Physical Medical Society of Wurzburg. A reprint of the communication was passed to the editor of the *Vienna Presse* and the story broke on the morning of Sunday, January 5th 1896. It was cabled to London and from there to the rest of the world, appearing in newspapers everywhere the following day. It first appeared in an English language scientific journal in Nature on January 23rd 1896. In an interview for McClure's Magazine early in 1896, the reporter described Röntgen as "an enthusiastic and energetic man whose dark hair stood straight up from his forehead as if he were permanently electrified by his own enthusiasm" (fig 1). Röntgen died at the age of 78 in 1923, and directed that, upon his death, all of his papers and notes should be destroyed. [1]

Within the first few months of 1896, the three ways in which X-rays impact on human life were clearly demonstrated. They were the use of X-rays for medical diagnosis, the use of X-rays for therapy, and the use of X-rays in industry.

The first mention of X-rays in British Columbia was of X-ray equipment, [2] built locally by Mr Robert Hutchison, being presented to The Royal Jubilee Hospital in Victoria on June 1st 1899, (described in Chapter 5). The first record of X-rays being used for treatment was at the City Hospital in Vancouver in 1902 (described in Chapter 1).

Fig 1. Wilhelm Conrad Röntgen "permanently electrified by his own enthusiasm". Reproduced with permission of the Wellcome Library, London

The Curies and Radium

Marie Sklodovska, a woman before her time, daughter of a poor Polish professor, left her homeland to study physics in Paris in the fall of 1891.

Four years later she married Pierre Curie, the tutored son of intellectual family stock. Eight years her senior, he held a Bachelor of Science by age sixteen and a master's degree in Physics by the age of eighteen. Now in his mid-thirties, he was Chief of the laboratory of the School of Physics and Chemistry of the City of Paris (Fig 2).

By the end of 1897, Marie had two university degrees, a fellowship, a husband and the first of two daughters. In the furtherance of her career, she needed a doctorate and looked for an opportunity for research that would lead to a suitable thesis.

Both she and Pierre were aware of the work of Henri Becquerel, who had found the year before, in November 1896, that uranium salts spontaneously emitted rays of an unknown nature that would pass through paper. Madame Curie suggested that the phenomenon should be called radioactivity. They soon realized that the radioactivity they measured in pitchblende (see p. 8) was a great deal stronger than the amount of uranium or thorium it contained. Only one explanation was possible to this brilliant scientific couple. There must be a much more powerfully radioactive substance present — a new element!

Fig 2. Pierre and Marie Curie during their early married life. (From MADAME CURIE by Eve Curie, translated by Vincent Sheean, copyright 1937 by Doubleday, a division of Random House, Inc. Used by permission of Doubleday, a division of Random House, Inc.)

They named it "Polonium" after Marie's homeland, and in the summer of 1898 determined they should purify it. (Polonium was later shown not to be a new element, but a daughter product of radium).

Arrangements were made, with the generous aid of the Austrian Government, to obtain pitchblende ore from mines in Central Europe. They were given permission to use a dilapidated shed at the back of the School of Physics in Paris. It was in this shed, with its bitumen floor, inadequate heating and leaking skylights, that Marie and her husband toiled. They handled several tons of the ore — in some estimates as many as 8 tons progressively separating purer and purer samples containing the radioactive element. After four years of toil, interspersed with family duties and teaching commitments, the indomitable Marie finally separated one tenth of a gram of pure radium and determined its atomic weight as 225. Marie Curie died in 1934 from aplastic anaemia, presumably caused by her long exposure to radium and radioactivity.

As radium was hugely expensive, one of its decay products, the gas radon, at first called "emanation", was used in the first treatments. By 1905, applicators and plaques were commonly used for skin lesions in New York, London and Paris. [1]

The first documented evidence of the use of radium in treatment in British Columbia is contained in a paper read to the Annual Meeting of the British Columbia Medical Association in 1911 by Dr Fernand L. de Verteuil of St Paul's Hospital (chapter 1).

The following chapters chronicle the use of X-rays and radium, in the treatment of various diseases, but most especially cancer, in British Columbia throughout the twentieth century. Much of the information is drawn from original minutes, correspondence and archival material and is source referenced. Additional "colour" is derived from interviews and personal material.

In the first part of the century, radiation treatment was in the hands of individual enthusiasts and could be described as "cottage medicine". In the 1930s pressure grew to improve the treatment of cancer with recommendations to centralize radiation treatment. This lead to the creation of the British Columbia Cancer Institute (BCCI), although treatment continued elsewhere in the Province until the establishment of the Cancer Control Agency of British Columbia in 1974. The latter years of the century saw the creation of a world class Radiation Therapy Program within the renamed British Columbia Cancer Agency.

References for Introduction

1. Jackson SM. Radiation oncology. St. Louis, MI: WH Green; 1985. p. 4-16.
2. Murphy HH. Royal Jubilee Hospital. Victoria, B.C.: Royal Jubilee Hospital; 1957. (Vancouver Public Library, Special Collections)

The city of Vancouver in 1898 showing the locations of the Vancouver City Hospital, St. Paul's Hospital and the future site of the British Columbia Cancer Institute. From a poster sold to benefit the Vancouver City Archives.

St Paul's Hospital
First radium treatment in 1910

Vancouver City Hospital
First reported X-ray treatment in 1902

BC Cancer Institute
First Cancer Clinic in 1938

Chapter 1
In the beginning

X-rays at the Vancouver City Hospital

The first mention of radiation treatment in British Columbia was in April 1902. Under the heading "X-RAY TREATMENT, Vancouver Keeps Pace With New York in the Strides of Medical Science", the following article appeared in the Vancouver Daily World on Wednesday April 9th. [1]

"Sarcoma, or malignant tumor of the jaw, is being treated by Dr. Poole at the city hospital by the X-rays. The treatment has not been continued long enough to express an opinion as to its efficacy. In this connection Vancouver is certainly up to date in the great strides medical science has been making of late. In a small way all the appliances in use in New York in medical scientific research are available here and when a new curative agency is announced in New York the medical profession of Vancouver are in position to test its efficacy. The latest sensation in the medical New York world is the numerous cures of tuberculosis of the skin or lupus, also cancer of the skin by the use of the X-rays.

Every part of the patient's body except the affected part is covered with lead foil, and the diseased portion is subjected to powerful X-rays for 10 minutes several times a day. The list of cures under this treatment are said to have been remarkable. Very beneficial results have also resulted from the same treatment of deep seated cancer, but there has not yet been time to give the treatment a fair trial in the latter cases.

If the case of tumor being at present treated in the city hospital according to formula published from New York, proves successful, it will mark an era in medical practice in Vancouver and will result in many kindred diseases being similarly treated in British Columbia."

Dr Alfred Poole is mentioned in an early history of British Columbia published in 1906. [2]

Fig 3. The Vancouver City Hospital circa 1902. Situated at the corner of Pender, Cambie and Beatty Streets, the original wood hospital building is on the left facing Beatty St. The operating room is the small structure in the centre. Incorporated as the Vancouver General Hospital by Special Act of the Legislature later in 1902. Started in 1898 it ceased operation as a hospital in 1905. Later used as an old people's home, crèche, McGill University College, and Social Services Department, it was demolished in 1950. (City of Vancouver Archives, BuP375N351)

Dr. Alfred Poole 1863-1911

"Dr Poole was born in 1863, at Wakefield, Quebec. He graduated in medicine from McGill University in 1886. From 1890 to 1893 he was located at Pekin, New York state, and in the latter year came to British Columbia, where for a year he had his office at Vernon, and in 1894 established himself at Vancouver, where he enjoys a large and profitable general practice in medicine and surgery.

Dr Poole is married and has two children. He affiliates with the Masons and with the Odd Fellows, is a firm supporter of the principles of the Conservative party and is a generally popular and capable citizen, manifesting an eminent degree of public spirit in all matters of community concern."

Dr Poole was president of the Vancouver Medical Association in 1908 and died three years later. [2a]

The Fifth Annual Report of the Vancouver General Hospital in 1906, recorded "*that the X-ray department has been made ready for any demands that may be made upon it*". A year later, "*the X-ray apparatus has been in continual use, both for Therapeutic and Diagnostic purposes*". In September 1909 for ten treatments or less, patients were charged $2.50 per treatment. [3]

Author's Note

In his original communication, Röntgen wrote "For brevity's sake, I shall use the expression 'rays' and to distinguish them from others of this name I shall call them 'X-rays'." Because physicists throughout the world had been working with electrical discharges within vacuum tubes, and the modifications required to produce X-rays were so simple, scientists everywhere were able to investigate X-rays and improve the methods of their production within weeks of their discovery.

X-rays are produced when electrons, accelerated under the action of an electric field between the anode and cathode across a vacuum in a glass tube, strike a metal target.

The first use of X-rays to treat malignant disease was reported from France in the summer of 1896, where Despeignes of Lyons described treating a carcinoma of the tongue and a carcinoma of the stomach. We are told that in treating the carcinoma of the stomach "pain was relieved, and the physician concluded that when applied to cancer Röntgen rays have a distinct anaesthetic effect and cause a general improvement in the condition of the patient, but exert little influence upon the growth"

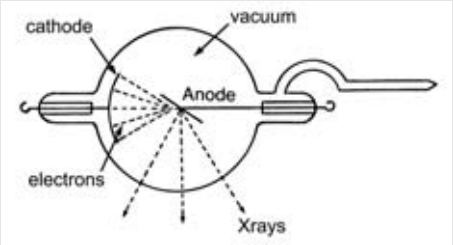


Fig 4. An early X-ray tube. (Drawing modified from *Electrical World*, 27,377, April 4,1896)

Within a year, tuberculosis and other infectious diseases were exposed to X-rays. By the turn of the century, acne, ringworm and eczema had all been successfully treated. In November 1896, a Vienna roentgenologist, Freund, treated a hairy pigmented birthmark that disfigured a young girl's neck. The mark was exposed to X-rays for two hours a day for ten days. The birthmark lost its hair, to the evident enthusiasm of the physician, the first experimental biological use of X-rays.

In the early years treatment was hampered by unreliable and inadequate equipment. The first tubes were incompletely evacuated and still contained gas — hence the appellation "Gas Tube". Nevertheless, the first paper describing the treatment of breast cancer appeared in 1897 and by 1900 a *"Manual of Radiotherapy"* had been published with before and after photographs. In 1907, Kassabian published his classic *"Röntgen Rays and Electro-Therapeutics."*

It is not surprising then that people in Victoria in 1899, and Vancouver in 1902, were already aware of and using this *"New Kind of Ray"*

Radium and the Retired Naval Surgeon

On August 31st 1911, Dr Fernand L de Verteuil, MD(Edin), MRCS(Eng), LRCP(Lond), Surg RN(ret), read a paper entitled "Radium in the Treatment of Disease" to the Annual Meeting of the BC Medical Association in Vancouver. [4] In it, he described his own use of radium in Vancouver and some of the patients he had treated.

He reported, "*I shall briefly refer to one. Male, Age 65, Rodent Ulcer of left side of nose of several years duration, had eaten away lower part of nose exposing nasal cavity. The patient was completely cured after five applications of radium varying from 1 to 3 hours*".

In describing the effects of radium on rodent ulcer, he said, "*it acts like a charm, for which condition it may be practically classified as a dead certain cure. The scar left is almost invisible, being far superior to any scar I have yet seen.*

Fig 6. Surgeon de Verteuil on HMS Good Hope. The first person to describe the use of radium in Vancouver in a lecture to the annual meeting of the British Columbia Medical Association in 1911. Died in the sinking of HMS Good Hope in 1914, off the coast of Chile in the first naval battle of the First World War. (Photograph from the collection of JD Perkins. Imperial War Museum Q-104354)

In rodent ulcer it might be said that radium fulfils all the necessary conditions of an ideal prescription; it cures with certainty, safely, rapidly and pleasantly".

Dr de Verteuil went on to describe treatment, in 1910, of an extensive "epithelioma" of the face, but regretted that he did not have enough radium to treat more serious conditions.

He described having two apparatuses, one containing 80 mg of radium bromide and the other 20 mg. The radium bromide was mixed with inert barium salt in a proportion of one to four and distributed at the rate of 1mg per sq cm dissolved in a special varnish spread out in a small metal receptacle. The length of application varied "*from 10 minutes to 48 hours depending on the use of suitable screens of lead or platinum*".

Fig 5. Surgeon de Verteuil Enlarged from Fig 6 where he stands extreme left in the back row.

Dr de Verteuil, a retired Naval Surgeon, had traveled to the West Indies to study the curative effects of radium on leprosy when he was ordered to join HMS Good Hope at the outset of the Great War. He was lost with all hands in the sinking of HMS Good Hope at the Battle of Coronel off the coast of Chile on November 1st 1914. This photograph of the officers of HMS Good Hope was taken in the Falklands two weeks before the fateful battle. The gun turret behind them was the first part of the ship to be destroyed by enemy fire. [5]

Author's Note

Pitchblende contains uranium, first discovered by the German chemist Klaproth in September 1789. The Curies extracted radium from pitchblende taken from Austrian mines. The radiation given off by radium includes alpha particles which are so soft that they cannot penetrate a single sheet of paper, beta rays which travel only millimeters in tissue and gamma rays which are more penetrating and the mainstay of radiation treatment.

At first, radium was so difficult to extract and prohibitively expensive that the material itself was not used, only one of its daughter products, the radioactive gas radon. This allowed radium to be kept as a "permanent" source of radiation. The radon gas, called "emanation" by the Curies, at first ingested or inhaled, was soon collected in glass and later gold tubing.

Interest in radium led the Colorado mines in the United States to turn to the extraction of radium from their carnotite ore which contained uranium. In 1914 the National Radium Institute and the US Bureau of Mines combined to construct a radium recovery plant in Denver. From 1914-1917 8.5 grams of radium were recovered at a cost of US$37.50 per milligram, although the price on the world market was around US$120 per mg. The production of radium from Colorado Plateau ores declined disastrously after 1921, due to the exploitation of extremely rich pitchblende in the Belgian Congo, first discovered in 1913. The first shipment of ore reached Antwerp in Belgium on December 5th 1921. The Belgian monopoly pegged the price of Radium at US$70 per milligram which was designed to force the American producers off the market. The discovery of rich Canadian pitchblende beds at Great Bear Lake brought the price down further.

As radium became more available it was placed in containers that could be placed in body cavities or directly into tissue. Margaret Cleaves in New York was the first to use radium for carcinoma of the cervix as early as 1902. In 1915 a series of 213 patients treated in Baltimore was reported. The American surgeon Abbe was one of the first to bury radium containers inside a tumour, although Alexander Graham Bell had suggested the idea about six months earlier in August 1903 and Pierre Curie in 1901.

Early treatments relied on guesswork as to how much radiation to deliver. By 1912 the amount of radiation leaving the radium was known, but not how much was absorbed by the body. It was not until the 1930s that methods were developed to try to evaluate a meaningful dose received by the patient. Quimby in the United States and Paterson and Parker in England, showed that by combining the amount of radium with an area or volume to be treated, under certain standard distribution rules, the dose delivered to the tissues over a certain length of time could be accurately described. Rules of this kind led to reproducible treatments and the birth of modern radiation treatment.

Source: from Jackson SM, *Radiation Oncology*, (WH Green, St. Louis) 1985, and a paper by FJ Hahne given to the Fourteenth International Symposium held by the Uranium Institute in London, September 1989. www.uilondon.org/usumin.htm

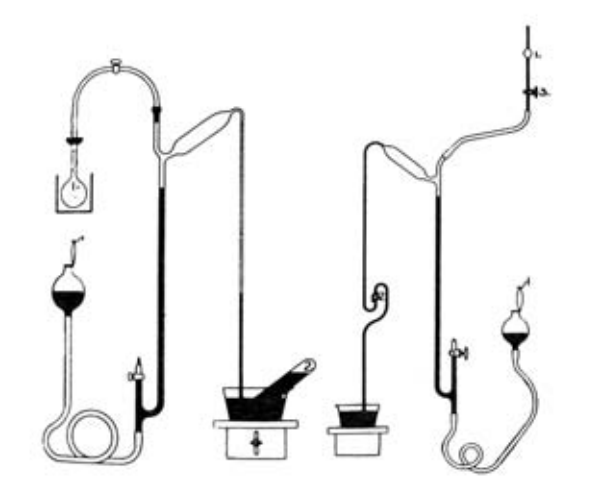


Fig 7. An early Emanation Extractor to collect radon gas (From *The Trail of the Invisible Light, Grigg, ERN, p222* with permission of Lea & Febiger)

St Paul's Hospital and the Sisters of Providence

The author of the following report, extracted from a short biography of Dr CW Prowd, is not known, nor the date of its writing. [6][7] The last date noted is 1937, so it is safe to assume that it was written before the Second World War.

"In 1906, when St Paul's X-ray department opened, it included in its equipment a small coil-type machine. Dr. F. L. DeVerteuil of Edinburgh, one of the first men in British Columbia to become interested in X-ray therapy, had charge of the operation of this machine. He was succeeded by Dr. George V. Lockett, a graduate who brought his own machine from England, and who was very much interested in the physics of the new ray.

On his retirement, the department was closed until 1912 when it moved to the new building erected in that year, where it was under the combined supervision of Dr. G.E.Richards, now professor of radiology at the University of Toronto and radiologist in chief of Toronto General Hospital, and Dr. C.W.Prowd, the present head of the department.

In 1920, St. Paul's was the first hospital in Vancouver to have the privilege to acquire radium, and has since that time kept pace with the frequent modifications, changes and modernization in technique which have taken place in the use of the new element.

With the increasing demands of the services of the radiology department, the move to the present location in the North Wing erected in 1931, was very necessary. Built exclusively for the use of X-ray and radium, the department today offers full protection for both patient and operator, and is equipped with the most modern machines."

In his "*History of the Medical Staff of St Paul's*" Keith writes; "*Dr Prowd carried the X-ray Department on during the First War when Dr Richards went overseas. After the war in 1918, Dr Richards returned to Vancouver. A few months later he accepted the position of radiologist-in-chief in the Toronto General Hospital.*" [10]

In 1920, Dr Prowd traveled to Germany, Stockholm and Paris for some months to study radium. He brought back a supply of radium and began treatment with this new and powerful therapeutic agent. The report does not tell us how much radium was purchased , or how much it cost.

It became Dr Prowd's custom to visit the great European centres every three years, where progress was being made in Röntgen and Curie therapy.

Fig 8. St Paul's Hospital circa 1910. The portion below the tower in this photograph is the original wooden building opened on November 22nd 1894. There were no buildings south of the hospital on Burrard St. The whole was demolished shortly after 1910 and replaced with the existing brick building. (City of Vancouver Archives, BuP712N605)

Dr Prowd also inspected and studied recent developments made at the radiation equipment plants of Siemens, near Berlin, and Philips, at Eindhoven in Holland. He installed the first deep X-ray therapy machine in western Canada in St. Paul's Hospital. [8]

Dr Prowd was the author of "Analysis of Radium Treatments in 600 cases in the period 1921-1926". [13] Of the patients he reported, 84% had malignant disease, and a wide spectrum of tumour sites was treated. A majority of patients had epitheliomata of skin (147), lip (72), mouth (84) and the uterine cervix (93).

Dr Prowd was an enthusiastic supporter since its inception of the concept of a centralized service, and the beginnings of the British Columbia Cancer Foundation. He, along with Dr BJ Harrison and

Dr C W Prowd 1883-1949

Ms AS Low wrote the following in a letter to Doctor Ethlyn Trapp in 1970. [6]

"I began work with Dr HB Gourlay in 1916 in the Bower Building, 543 Granville Street, but did not meet Dr Prowd until 1918 when he moved to share the offices with Dr Gourlay.

He was then Director of the X-ray Department at St Paul's Hospital in the mornings but saw his private patients in the afternoons at the Bower Building. He often dictated the X-ray reports there as well.

When I went to the X-ray Dept. in 1921 we were in the old wooden building on the Pendrell Street side and used glass plates for the X-rays.

A few years later we were moved to the center of the hall on the first floor, and the staff increased with Doctors, Nurses etc.

Following that we moved to the North Wing to the present X-ray Department. Dr Prowd deserved great credit for his work in bringing the X-ray Department up to its present efficiency."

The following is taken from a *"History of the Medical Staff of St. Paul's Hospital."*

"Dr Prowd was a great influence in making the staff members acquainted with the ever-increasing value of X-ray as a diagnostic and therapeutic agent in curing some and alleviating others". [8]

"In April 1930 he drew attention to the therapeutic relief which X-ray treatment gave in some bone cases with extensive degeneration and pain." [9]

Dr Prowd was extensively honored. He was president of the Canadian Association of Radiologists on two occasions and president of the Vancouver Medical Association in 1933. [12]

Fig 9. Dr C W Prowd. He was in charge of the X-ray and Radium Department at St Paul's Hospital throughout four decades. He traveled extensively in Germany, Scandinavia and France to learn more about radium, X-ray diagnosis and treatment. In the 1920s he brought back a supply of radium for use at St Paul's. The Sisters of Providence purchased this radium from Dr Prowd in 1947. (Reproduced with permission of the authors *A New Kind of Ray, Aldrich &Lentle, Vancouver*)

Dr Ethlyn Trapp, were major forces in the medical community in helping bring about the BC Cancer Institute. An article in the Vancouver Province on Saturday January 29th 1938 read *'For some time Dr Prowd has been urging a private donation to purchase radium to build a "bomb", engage a cancer specialist and physicist to conduct the work. "This radium is Canada's birthright. We should use it before it is taken away and the great work done in the United States or Europe," said Dr Prowd'.*

In 1933, the Sisters of Providence at St Paul's Hospital placed Sister Charles in charge of the management of the whole of the X-ray and Radium Department with, after Dr Prowd's death, Dr CG Campbell as Director of X-ray and Radium and Dr WH Thorleifson and Dr JS Madill as associates. All three had specialist qualifications from the Royal College in Diagnostic and Therapeutic Radiology. The Sisters of the Hospital purchased the radium equipment from Dr Prowd in 1947.[11]

A tumour clinic was established in St. Paul's in 1937 with the approval of the Sisters Council. The tumour subcommittee recommended that *"a small fee be charged for registration purposes of each case and that a subcommittee under the Medical Staff be formed as a Cancer Study Committee according to the plan submitted by the Cancer Study Committee of the CMA and approved by the Cancer Committee of the BC Medical Association."*[14] At a staff meeting on December 21st 1938, the following motion was passed *"the Staff of St. Paul's is willing to cooperate with the BCMA in regard to the B.C.Cancer Institute."*[15]

Examples of radium use at St Paul's Hospital include the treatment by Dr Prowd in 1937 of a 48-year-old sub-foreman from the Powell River Paper Mills with an exfoliative cancer of the cervix.

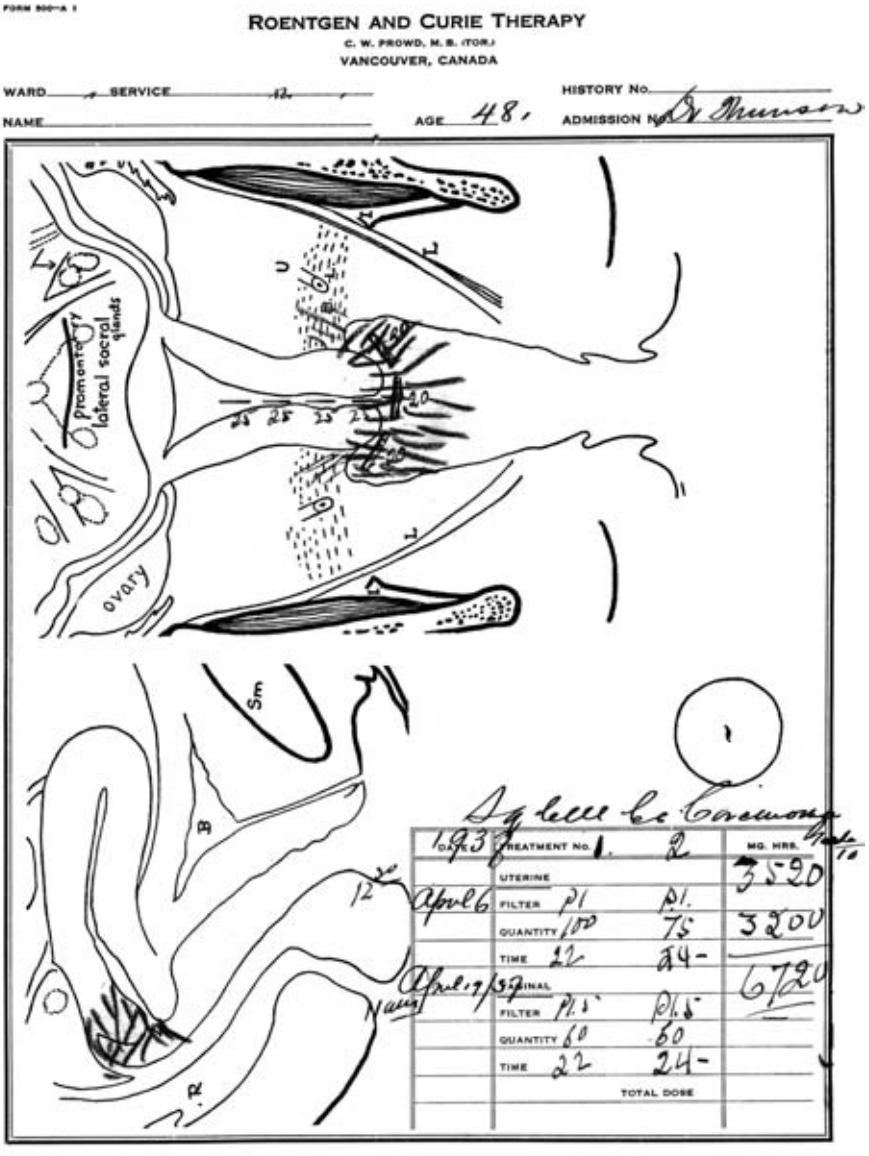


Fig 10. Records of a patient with carcinoma of the cervix treated with radium at St Paul's Hospital in 1937.

The treatment sheet is headed: "*Roentgen and Curie Therapy C.W.Prowd, M.B.(Tor) Vancouver Canada*"

The patient was treated with two radium insertions two weeks apart. The first consisted of an intrauterine tube with four 25mg tubes and three vulcanite containers in the vagina each containing 20mgs of radium. Although it is not stated, the vaginal containers were probably loaded with 10mg needles. The first insertion was for 22 hours and the second, with one less tube in the uterus, was for 24 hours. The dose was expressed as 6720mg.hrs. This was followed by four field 200KV X-rays using 15cm circular applicators to a total given dose of 3000r. (see p. 17) Two fields were treated daily in 30 overall days. No estimate of "tumour dose" is given. The patient was charged $100 which she paid in

Author's Note
"The Golden Age of Radiology"

The Coolidge tube introduced in 1913 had two revolutionary features: first, the heated tube, which allowed an increase in electron emission from the filament (more fuel for the fire) and second, the heat resistant tungsten target (so the fire would last longer).

These features, combined with the highest attainable vacuum, allowed the development of X-ray tubes capable of producing X-rays of sufficient energy to treat deep-seated tumours. During the First World War, at about the time that General Electric in the United States was developing high voltage tubes, the wife of a manager of General Electric in Fort Wayne developed breast cancer and was referred to Dr Case for X-ray treatment. He told the husband that he had been hoping to have available a high voltage tube.

Within forty-eight hours the manager developed an X-ray tube capable of delivering 196,000volts. When the transformer burned out, the gentleman promised to replace it with a 300,000volt transformer by *"the day after tomorrow".* This was done and the lady was treated apparently successfully.

X-rays in the kilovoltage range (100-300KV) remained the mainstay of X-ray treatment until the development of linear accelerators (linacs) in the late thirties and forties and cobalt teletherapy after the Second World War.

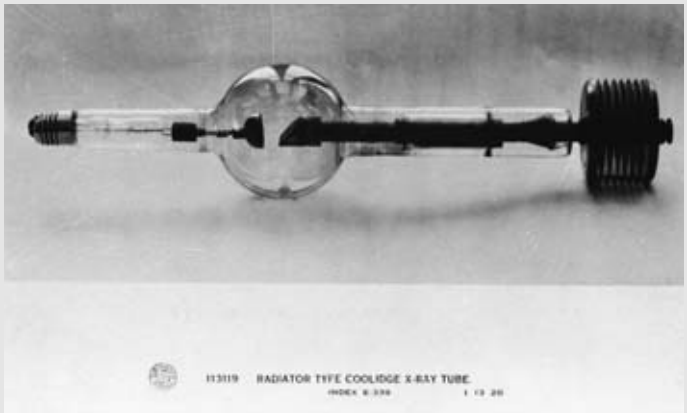


Fig 11. William David Coolidge and his hot cathode tube. (Reproduced with permission of Int. General Electric Co. New York).

installments, the last in 1944, seven years after the treatment was given!

In 1941 a similar patient was treated with three insertions but the X-ray therapy was given using the "pin and arc" technique (Fig 41).

Very similar treatments were in use by Dr JS Madill when he was in charge of gynaecological radiation treatment at St Paul's until the late 1960s.

These treatments and the doses used remain similar to this day with the exception that the internal radiation is given by remotely controlled devices to protect staff from radiation exposure and the external treatment is given by high energy accelerators to reduce radiation dose to the superficial tissues of the patient.

Clinical records are available from the late 1930s through to the 1960s describing X-ray and radium treatments given at St Paul's. We know that thymic radiation for infants was used until 1948 and that several physicians were involved in the use of X-rays for benign conditions and various malignancies until the closure of the Radiotherapy Department in 1969. Orthovoltage (X-rays at 200 and 230 KV) and Chaoul therapy at 60KV were used for various skin diseases and plantar warts. Records of radium needle implants used for skin and lip cancers are available from 1938 and as late as 1954. It is possible that only 10mg needles were available and Paterson-Parker implant rules were not used. Dose was expressed as mg hrs.

The Vancouver General Hospital Radium at a Bargain Price

As early as 1914 consideration was being given to the establishment of a Radium Institute at the Vancouver General Hospital (VGH). In a letter dated the 22nd May 1914, the Hospital's General Secretary, George Haddon, wrote: *"Acting on instructions of the Hospital Board at its meeting last night, I beg to enclose herewith a letter from the Secretary of the Radium Committee, Chamber of Mines, in connection with a proposed plan of action as regards the formation of a Radium Institute."* [16]

Perhaps the Great War put this process on hold, for the next evidence of a demand for radium treatment comes in a letter to the Provincial Secretary in Victoria on May 14th 1921. Dr MT MacEachern, General Superintendent of the VGH wrote: *"The demand for Radium treatment for Cancer cases is getting so marked that I am going to make you a proposition by which we can effectively establish a Radium Service for the host of unfortunates in this Province. I would like to combine this service with our X-ray treatment and to that end would make you the following proposition: 'That the Government put in $25,000.00 worth of Radium here for the Province, and we to assume all responsibility for it and to pay the Government 6% interest on the investment until such time as we are able to pay this sum out to the Government'. May I have your very early decision as I have an opportunity to get Radium at a bargain if I act quickly.'"* [16]

The response was indeed prompt, but hardly sympathetic, and came from the Deputy Provincial

Secretary on May 23rd. "*I regret that there are no funds from which a grant of the nature proposed by you, could be made. I fear therefore, that nothing can be done at the present time in the direction of assisting the Hospital to procure a supply of Radium. I have the honour to be, Sir, Your obedient servant.*" [16]

Those interested in radium were not deterred. A "Report re Radium" was submitted to the Board of Directors, VGH, by John Banfield on October 5th 1921. The report included "*I beg to announce that we have been able to secure a splendid radium Treatment Service for the use of any patient requiring same. Dr. J. W. Good of this city and one of the first men to introduce it into Canada, has consented to place his radium in the hospital. Dr. MacEachern has a small room set aside for this work which will be designated as "The Radium Treatment Department".* The details of the arrangement were set out in a letter to Dr Good from the hospital Secretary, George Haddon, on December 16th 1921. "*I was instructed to extend to you the sincere thanks of the Directors for your kindness in permitting of such an arrangement, which is sure to be of inestimable value to the patients using this institution. For your information, and in order that a proper record of the same be made, will you kindly let me know in writing if the following is your understanding of the arrangements, viz: that you will place your Radium in the hospital for the use of all patients suitable for the treatment. That you will supervise and direct all treatment. That fees from patients for treatment shall be paid to you in lieu of treating all cases whether they can pay or not, including all charity patients. The arrangement does not obligate the hospital financially. No insurance shall be carried upon the radium by the Hospital unless requested to do so, and it is understood that the hospital will not be held liable for any loss in the event of no insurance being placed.*" [16]

No documented evidence of radium being used at this time in the Vancouver General Hospital has been found. It is possible therefore that this arrangement was never followed through.

Dr Good had obtained his MB from Toronto in 1877 and LRCP (Edin) in the same year. He spent most of his career in Winnipeg where "*he took an important part in the evolution of medical institutions in the city during forty years while it increased its population from seven thousand to hundred thousand.*" [17] He spent three years in Dawson City during the gold rush at the turn of the century before returning to Winnipeg. Dr Good came to Vancouver after the First World War for the last eight years of his life. "*The best type of physician who endeavour to perfect their knowledge of medicine and devote their time to the relief of suffering with little regard for financial rewards.*" [17]

The Practice of Radiotherapy in the Thirties

In the 1930s and 1940s Dr BJ (Bede) Harrison was a major player in the Vancouver radiology scene and especially in the conception, formation and early years of the British Columbia Cancer Foundation and Institute. In March of 1935 he was one of the first six men in Vancouver who proposed the establishment of the British Columbia Cancer Foundation and the creation of a centralized treatment service.

In addition to Harrison's textbook we are fortunate in having treatment records from 1933 to help understand the nature of radiation treatment at that time in British Columbia. Vancouver General Hospital records from this era indicate that individual treatment requests and records for each patient were bound at the end of each year in alphabetical order. Many of these binders were destroyed to provide much needed space in the hospital, but one year's set of records was rescued during his first year of residency at the VGH by Dr Phil Harrison, a diagnostic radiologist working out of St. Paul's Hospital in Vancouver and grandson of "Bede". This one remaining binder entitled "X-RAY TREATMENTS 1933" includes the treatment of 35 infants for enlargement of the thymus. [19] The ages of 22 of the children were recorded and ranged from newborn to 2yrs 4months. Thirteen were treated within 3 months of birth and 5 beyond the first birthday. The most frequently prescribed doses were 5 weekly treatments of 112 or 160 r at 80 or 115KV. (Author's Note: treatment for thymus enlargement was very popular with some paediatricians recommending the treatment for nearly all newborns and continued in Vancouver and New Westminster until the early 1950s, when increasing concern about its validity and safety caused it to be discontinued.)

The binder contains the records of 294 treatments for the year. Although a wide variety of benign conditions were treated, there were examples of malignancies, representing about one-third of the total. Patients with breast cancer were treated preoperatively, for local inoperable disease, and post mastectomy. The usual treatment was a three-field technique with each area receiving 400r in 4 or 5 fractions over 2 to 4 weeks.

In his textbook, Harrison describes the use of radiation for a variety of inflammations and skin conditions such as tinea capitis, ringworm, eczema and pruritus ani, as well as Dupytren's contracture, menorrhagia, angina pectoris (with treatment to the dorsal spine region) thyroid and thymus lesions and various malignancies. [20]

"*Exophthalmic goiter responds to roentgenotherapy with such uniformly beneficial results that irradiation should be tried in all cases before operation. …The treatment extends over periods varying from one to nine months…There is remarkable improvement in practically every case, and frequently all the general symptoms disappear entirely, a complete clinical cure being attained.*"

"*Its* [the thymus] *relation to sudden death in infants and children appears to be a definite fact …The clinical evidence from the extensive use of roentgenotherapy … forces upon one the conclusion that those cases which show apparent thymic enlargement, and in which, as a result of treatment by irradiation, the size of the gland returns to normal, are not likely to meet with sudden death of the type which has been called, for want of a better term, the thymic death.*"

"*It has become the practice in some clinics to examine the thymus roentgenologically in every nursling and to classify the size of the supracardiac shadow into grades. Those babies with definitely enlarged thymic shadows,*

or shadows which may be thymic, are irradiated."

The text highlights the sensitivity of the thymus to irradiation and suggests "*minute doses repeated frequently for those with symptoms*". This clinical syndrome is described as "*intermittent laryngeal dyspnea with stridor and cyanosis, the symptoms increasing considerably when the head is hyperextended*". For those with thymic enlargement but no symptoms "*treatment can be carried out according to a definite weekly routine*".

Dr BJ (Bede) Harrison 1887-1979

Born in Australia, his wife Bonnie was from a wealthy family with a large sheep station, "Mylora", situated on the banks of the Murrumbidgee River. He graduated Gold Medallist from Sydney University and went into general practice in Macquarie Street in Sydney. The Office had a small X-ray machine in a corner of the room that may have raised his interest.

For his thesis on *"Radiation Treatment of Malignant Disease"* in 1925 he received the D.M.R.E. from Cambridge University. He took his family to England, but lost a considerable sum of money in the 1929 stock market crash.

There was little work in England with locums being paid sixpence a patient inclusive of medicines (but bring your own cork and bottle). In search of better paying work he responded to an advertisement for head of radiology at the Vancouver General Hospital. His application was successful and he came in 1930.

It is suggested that if the VGH had known he was catholic he would not have been appointed. [18] During the 1930s he toured Europe giving lectures. He wrote a major *"Textbook of Roentgenology"* that contained several passages on radiation treatment.

His grandson described him as follows: *"Harrison was autocratic, bright, well read, would never shy away from a fight. He could intimidate people and made some enemies along the way. He was an opinionated man. He would come into a room for a conference or the like and people would stand up (not so unfamiliar a practice in those days)".* [18]

He widely promoted and sought funding for the BC Cancer Institute and as Honorary Director was chairman of the search committee that appointed the first Radium Therapist.

In July 1940 he was elected to the Board of Management of the British Columbia Cancer Institute. He was a member of the Attending Staff until 1949. After the war he immersed himself in the VGH, at that time the largest hospital in the British Empire, and concentrated on diagnostic radiology. He left the VGH and went into private practice in 1952, retired in 1969 and died in 1979.

Fig 12. Dr BJ Harrison. A powerful radiologist who played a leading role in the establishment of the BCCI. Honorary Director at the time of its inception. He became Head of Radiology at the VGH in 1930, "had they known he was catholic he may not have been appointed". His textbook published in 1936 gives valuable insight into radiation treatment of the time. (Photograph Reproduced with permission of the authors *A New Kind of Ray, Aldrich &Lentle, Vancouver*)

In describing the treatment of breast cancer Harrison seemed undecided. "*No standardized method of treating carcinoma of the breast by radiation has yet been adopted, either with roentgen rays or radium, or both, and the solution of the question of standardization of the whole of the treatment, surgical as well as radiation, has yet to be achieved. Hence, though one cannot expect an accurate analysis to be made on inaccurate data, one is forced to accept the general impression gained from a perusal of the statistics, especially when the general trend in all clinics appears to be in the same direction. Which of the particular techniques or groups of techniques should be adopted as a standard is problematical, and in this as in the other fields of medicine, the personal skill of the physician, whether he be surgeon or radiation therapist, will always remain a very potent factor in determining the final result.*"

Similarly in describing treatment of carcinoma of the cervix no mention of dose or fractionation is made. "*Numerous methods of attacking carcinoma of the cervix by irradiation have been developed but they all consist essentially in the application of radium intravaginally to any lesion which can be reached, accompanied by external irradiation using either the radium pack or the roentgen ray.*"

His recommendations for roentgenotherapy of bone disease include "*600r three to six times for osteomyelitis at weekly intervals*" and for tuberculosis of the small joints "*400r every month supplemented by the usual general treatment.*" For granuloma of the teeth "*200r will bring about the rapid disappearance of pain and apparent complete clinical cure shortly after a single application.*" For giant cell tumor he recommended, "*Every case of giant cell tumor responds to roentgen therapy and in some cases the tumor disappears completely. This is especially true in young patients.*" In "*Secondary neoplasms in bone*" he writes, "*The response of metastases in bone varies with the tendency to the osteoblastic reaction which the tumor presents. The more osteoblastic the reaction the better the response to irradiation and sometimes complete healing of the lesion occurs.*"

The book concludes with some sensible precautions to be taken with both X-rays and radium.

In 1938, the Vancouver General and St. Paul's Hospitals each had two 200KV X-ray machines at their disposal. [21]

Author's Note
The measurement of radiation

In order to deliver a safe and repeatable radiation treatment it is necessary to know how much you are giving and how much the patient is receiving.

In the first years of the century the effect of X-rays was measured by the redness of the skin resulting from exposure, the "Erythema Dose". The dose of radium was described as a combination of the amount of radium and the time the patient was exposed to it, the milligram/hours or "mgm hrs". In the second half of the century most authorities used the roentgen or the rad to describe the dose of radium, or alternative sealed sources, given to a particular point or volume.

In 1928, a unit of radiation exposure was defined and called the roentgen (R). The roentgen is a quantity of X or γ radiation such that the associated corpuscular emission in 1cc of dry air at 0°C and 760mm pressure produces one electrostatic unit of electricity. (The symbol "r" was often used).

In order to express the dose received by the patient, a formal definition of absorbed dose was introduced in 1953. The "rad" is the amount of energy absorption of 100ergs per gramme. To conform to the present SI system, the equivalent unit to the rad is the gray (Gy). 1 gray = 1 joule/kg = 100 rad. There are 100 centigrays (cGy) in 1 Gy. For historical comparisons the rad, roentgen, and centigray are practically equivalent.

A Remarkable and Revered Pioneer

The remarkable Dr Ethlyn Trapp was the third member of the trio, which included Dr Prowd and Dr Harrison who were so influential in establishing the British Columbia Cancer Institute (BCCI) and piloting it through its early years. Much of the following information is contained in her personal files at the City of Vancouver Archives. [22,23,24]

Dr Ethlyn Trapp 1891-1972

Born in New Westminster, Dr Trapp graduated in Arts from McGill in 1913. From 1914 to 1918 she worked in a military hospital. Ethlyn later returned to McGill and obtained her MD degree in 1927. After working with Dr Prowd at St Paul's Hospital she decided to specialize in radiotherapy. In 1931-1932 she studied in Vienna, Stockholm and London and between 1935 and 1937 gained additional experience in Brussels, Berlin, Frankfurt, Paris, Stockholm and Manchester.

In Manchester she was Resident Medical Officer at the Christie Hospital and Holt Radium Institute. During the Second World War she was Acting Medical Superintendent, and later Medical Director of the British Columbia Cancer Institute from September 1943 to September 1945, in the absence of Dr Evans who was on military service. After the war she returned to private practice in Vancouver. She was in partnership with Dr Olive Sadler at 925 West Georgia Street from 1950 until 1959. Drs Trapp and Sadler held hospital privileges at the Royal Columbian Hospital in New Westminster from 1954.

Dr Trapp was elected President of the British Columbia Medical Association (BCMA - 1947) and President of the National Cancer Institute of Canada (NCIC - 1952). She became the first woman to hold either of these posts. She gave the Osler lecture to the Vancouver Medical Society in 1952.

Fig 13. Dr Ethlyn Trapp. A remarkable and revered pioneer of radiation therapy. Medical Director of the BCCI during the Second World War. The first woman to be elected President of the BC Medical Association and the National Cancer Institute of Canada. (Photograph from the BCMA Archives).

Her honours included an honorary degree of Doctor of Science from UBC in 1954 in recognition of her contribution to medicine in British Columbia and Canada. The degree was conferred on the same day that the first class graduated in medicine from UBC.

Dr Trapp was awarded Fellowship without examination in the charter year of the Faculty of Radiotherapists in London in 1954. The privilege cost her 20 guineas in fees!

In 1963 she received a citation by the Canadian Medical Association for her work in cancer research and in 1968 a medal of service of the Order of Canada.

Dr Trapp was respected by her peers and admired by the many friends she made during her travels and in her work. Throughout the 1940s and 50s she received numerous requests from around the world for advice and information, many of which she forwarded to Dr Evans or the NCIC for their response. Many of Europe's leading radiotherapists (present day radiation oncologists) of the time were frequent correspondents.

In a letter to Ralston Paterson, Director of the Christie Hospital and Holt Radium Institute in Manchester, in August 1948 she wrote: *"Thank you very much indeed for your generosity in sending me a complimentary copy (The Treatment of Malignant Disease by Radium and X-rays). It is a pleasant and instructive reminder of my months in Manchester and I have told you before, they were quite the most rewarding of the many I spent in post-graduate work."*[22]

She maintained a close friendship with Dr Paterson and his wife Edith as witnessed by the extensive correspondence between them on various matters, including grateful thanks from Edith on receipt of a care package of fruit sent by Ethlyn shortly after the war.

In one of her many lectures Dr Trapp spoke in Chilliwack in March 1953 on the birth of cancer services in Canada. *"It was the Canadian Medical Association which initiated organized plans for cancer control in Canada. This was about ten years after the British Empire Cancer Campaign had been founded in Great Britain. The CMA formed its first Cancer Committee in 1933. Subsequently, Cancer Committees were formed in each province — but these were not too active. Then came the King George V Silver Jubilee Cancer Campaign. This was not a phenomenal success financially but it stimulated the interest of the whole country in cancer"*. Although she was very interested in cancer education and research, she said: *"in this consuming desire to discover the cause of cancer we must not lose sight of our immediate problem – the cancer patient, the man or woman or child who has cancer; for as the Chinese say, 'it is better to save one man's life than to build a seven story pagoda.'"*[23]

Writing in December 1956 on the establishment of a cancer centre in Costa Rica, her remarks where prophetic and applicable today. *"My own opinion is that there should be initial centralization as recommended in our report of 1951 with a plan for the development of a certain amount of decentralization in the years to come, after a central institute has become well established. By decentralization I mean the later setting-up of some subsidiary treatment and diagnostic services but always in co-operation with the central institute. This would presuppose an overall plan with integration of records, etc."*[24]

The First Home of the Cancer Clinic

The development of radiotherapy in these early years in British Columbia closely followed the pattern elsewhere in Canada. The first quarter of the century was a time for "cottage radiotherapy" as described by Hayter et al. [25] General practitioners and surgeons had X-rays; witness Poole, de Verteuil and Lockett in Vancouver. Others, like Prowd at St. Paul's and Good at Vancouver General in the early twenties, obtained radium at enormous cost. Although radiation treatment showed great promise, the results of treatment had not been analysed properly, and there were no standards for technique or dosage. [25]

In the second quarter of the century, efforts were being made by Prowd and Harrison to report on, and analyse, the results of treatment. In order to strengthen training and experience, Prowd, Trapp, Harrison and others, made visits to European centres. The need to establish cancer treatment organizations and to centralize radiotherapy to improve outcomes for cancer patients was recognized and pursued in British Columbia as elsewhere.

Prior to the organization of the British Columbia Cancer Foundation the Vancouver General Hospital had recognized this trend to centralization. In July 1930, a report of a Special Committee carrying out a survey of the hospital recommended the establishment of a cancer clinic. *"A committee of the Board should be appointed at once to confer with committees of the Staff, Medical Society, the Health Department and others, upon the consideration of plans for the establishment of active clinics for the diagnosis and treatment of cancer*". Although a Radium Fund was already in existence, efforts to increase the fund began in earnest. In January 1932 the Minutes of the Board record, "*Dr AK Haywood requested permission to start a campaign for the purpose of raising a fund for the purchase of radium for use in the institution. He proposed a "Radium Week" early this Spring and that it would be preceded by a dance to be sponsored by interested ladies*". [26]

In April 1935 Dr Haywood advised the Board that he understood the Vancouver Board of Trade under the Presidency of Mr TS Dixon would shortly launch a province wide drive to erect a Cancer Centre in the Vancouver General Hospital. In this respect Dr Haywood stated that he had already received contributions totaling $24,500 for radium to be used in the treatment of cancer.

It should be noted that TS Dixon was also on the Board of the VGH and perhaps to widen thinking about the cancer centre, arranged a luncheon with the newly formed British Columbia Cancer Foundation (BCCF).

Following the luncheon meeting, the BC Cancer Foundation wrote to the VGH in July suggesting that the "*Radium Fund be utilized through the medium of their organization*". The VGH didn't wish to release the funds and replied, "*the donors had specifically marked it and could not therefore comply with the request though they offered full cooperation of the Hospital with the Foundation*", and promptly renamed the fund "The Vancouver General Hospital Radium Fund"!

In August 1936 the Board asked Dr Harrison to approach the BCCF unofficially to see if the VGH could acquire the radium recently purchased by the Foundation [26]. In December a joint committee of the VGH and the BCCF proposed that, "*an immediate start be made in preparing accommodation for cancer patients and recommends that the Hospital provide a temporary structure to house an extension of the present X-ray Unit of the VGH and that the Cancer Foundation in turn offer to pay the cost of processing Radium and the purchase of the additional*

necessary X-ray equipment."[26] The following March a joint delegation from the VGH and the BCCF visited Victoria to discuss radium in the treatment of cancer. The Provincial Secretary was sympathetic, but indicated nothing could be done in the matter until after the forthcoming provincial elections.[27]

The Board of the Vancouver General Hospital was informed in May 1938 of discussions about the possible installation of a Tumour and Radium Clinic in the Old Internes' Home on 13th Avenue. Mr Dixon explained that at the request of W Twiss, Esq., Chairman of the BC Cancer Foundation, he had called the Executive of the Hospital to meet the Executive of the Cancer Foundation with *"respect to the main problem surrounding the putting to work of 1 gram of radium that was being processed through the generosity of a benefactor who had donated $50,000."*[24] Mr Dixon then laid on the table a statement which disclosed that a possible agreement between the Hospital and the BC Cancer Foundation was left in the hands of Dr BJ Harrison on behalf of the Foundation, and the Secretary of the Board on behalf of the Hospital, to prepare costs for one year's operation. These operating costs were to be submitted to the Board of Directors, after which the Cancer Foundation would be informed as to the limits to

Fig 14. The original British Columbia Cancer Institute at the corner of Heather Street and 11th Avenue in the house built in 1911 by Frank C Sewell.

which the Hospital would go to assist the Foundation in their work.

The Secretary's Report [27] advised that the Old Internes' Home on 13th Avenue would not be as suitable for such a "Tumor Clinic" as the Old Internes' residence at the corner of 11th Avenue and Heather Street. The report went on to state that it was recommended that a formal agreement be drawn up between the Foundation and the Hospital.

It was suggested the agreement include the following:

1. The Foundation pay costs of alteration of the building at 11th Avenue and Heather Street, presently estimated at $2,500;
2. The Foundation pay the cost of furnishing and equipping the said Building at a cost of approximately $8,000;
3. The Foundation provide the necessary finances to pay for all employees both medical and lay, specifically engaged to work in the Clinic and such employees to be paid directly by the Foundation;
4. The Foundation pay the cost of laundry at current prices;
5. The Foundation pay the cost of meals supplied to employees of the Clinic at the rate of 20c per meal;
6. The Foundation pay the Hospital for the cost of supplies to the Clinic on requisition of Dr BJ Harrison;
7. The Foundation pay the cost of installation and operation of telephone locals from the Clinic to the PBX in the Hospital;
8. The Foundation pay for the cost of maintenance, repairs and renewal of equipment;
9. The Hospital donate the following:
   a. Rent.
   b. Heat, light and power.
   c. Maintenance, repairs and renewals of grounds and buildings.
   d. Services of Dr BJ Harrison as Executive Head of the Clinic to the extent of a maximum of two working hours of each day.

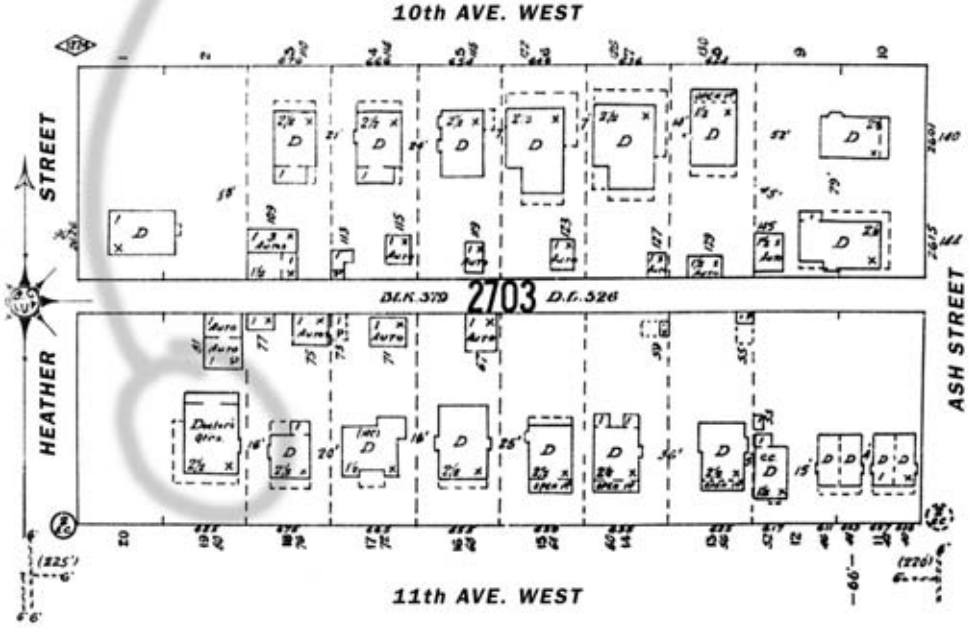
The Secretary's Report went on to advise it was estimated that the value of the services to be given to the Clinic for a period of one year was between $4,000 and $4,500, and such services could only be duplicated elsewhere at a much higher cost.

A clause in the Report dealt with *"such Clinic patients as may need hospitalization in the Hospital (VGH)"* and another "*which would make its terms null and void should Dr B.J. Harrison be no longer a Director of the Clinic*".

The Report generated much discussion. Exception was taken to the clause dealing with tumor patients who may subsequently require the services of the Hospital. "*It was feared that once it became generally known that radium was processed and in use at a Tumor and Radium Clinic attached to this Hospital there would be an influx of patients from all parts anxious to obtain the benefits processed radium would afford.*" [27] This was a concern even though radium was in regular use downtown at St. Paul's Hospital. There was also concern about the clause regarding Dr Harrison. Both clauses were removed from the final agreement. [27]

And so, in 1938, the stage was set for housing of the British Columbia Cancer Institute with agreement between the Vancouver General Hospital and the British Columbia Cancer Foundation. One year later the Foundation asked that the contract be extended for a three-year period, but the VGH preferred to keep it on a yearly basis.

1938
The first home of the BCCI at the corner of Heather Street and 11th Avenue.



The city block bounded by Heather and Ash Streets and 10th and 11th Avenues which over the next fifty years gave way to the progressive expansion of the BCCI, the A. Maxwell Evans Clinic and the Vancouver Cancer Centre. (Permission by the Insurers' Advisory Organization Inc.)

References for Chapter 1

1. X-ray treatment. Vancouver Daily World 1902; 8(April 9):4. (Vancouver Public Library, Special Collections)
2. Gosnell RE. A history of British Columbia. Victoria, B.C.: Lewis Publishing Co; 1906. p. 547. (Vancouver Public Library, Special Collections)

2a. Anonymous. Obituary: Poole A. Can Med Assoc J 1911;1: 915.

3. Vancouver General Hospital, Board Minutes. (City of Vancouver Archives ADD MSS 320, Series A Vol 1.)
4. Executive Director Fonds, Secretary's Correspondence, 1902- 1914. (BC Medical Association Archives).
5. Perkins JD. Personal communication 2001.
6. Trapp, Ethlyn. Personal correspondence (City of Vancouver Archives 513- F-1 File 4)
7. Counting the years unto the year of jubilee: commemorating the Fiftieth Anniversary of St Paul's Hospital. Vancouver: St. Paul's Hospital; p. 51. (Vancouver Public Library, Special Collections 362.1 S14I)
8. Xrays. Vancouver Province, Saturday Magazine 1938; (Jan 29):1. (City of Vancouver Archives 535-D-5 File 32)
9. Wylie D, Lentle B. Radiology at Vancouver Hospital and Health Sciences Centre. In: Aldrich JE, Lentle BC, editors. A new kind of ray. Vancouver, BC: University of British Columbia; 1995. p. 167-170.
10. Keith, WD. St. Paul's Hospital: The history of the medical staff 1920-1940. Vancouver, B.C.: Office Assistants; p. 57. (Vancouver Public Library Special Collections 362.1 K285)
11. Keith, WD. St. Paul's Hospital: The history of the medical staff 1920-1940. Vancouver, B.C.: Office Assistants; p. 71. (Vancouver Public Library, Special Collections 362.1 K285)
12. Anonymous. C Wesley Proud MD FRCPC FACR. In: Aldrich JE, Lentle BC, editors. A new kind of ray. Vancouver, BC: University of British Columbia; 1995. p. 254-255.
13. Goodman G. The evolution and development of radiation oncology in BC. In: Aldrich JE, Lentle BC, editors. A new kind of ray. Vancouver, BC: University of British Columbia; 1995. p. 175-178.
14. Keith, WD. St. Paul's Hospital: The history of the medical staff 1920-1940. Vancouver, B.C.: Office Assistants; p. 51. (Vancouver Public Library, Special Collections 362.1 K285)
15. Ibid., p. 52.
16. Haddon G. Personal correspondence to HH McIntosh. (City of Vancouver Archives 535-D-5 File 32)
17. Anonymous. Obituary: Good JW. Can Med Assoc J 1926; 16(1):283.
18. Harrison P. Personal communication 2000.
19. Ibid.
20. Harrison, BJM. A textbook of roentgenology – the roentgen ray in diagnosis and treatment. Baltimore, MA: William Wood & Co; 1936.
21. Brown E. Vancouver fights cancer. Vancouver Province, Saturday Magazine 1938; (Jan 29):1. (City of Vancouver Archives 535-D-5 File 32)
22. Trapp, Ethlyn. Personal correspondence. (City of Vancouver Archives 513- F-1 File 1)
23. Ibid. (City of Vancouver Archives 513- F-1 file 2)
24. Ibid. (City of Vancouver Archives 513- F-1 file 4)
25. Hayter CRR, Ege GN, Fitzpatrick PJ. Rays of hope: The establishment of radiation oncology in Canada 1895-1976. In: Aldrich JE, Lentle BC, editors. A new kind of ray. Vancouver B.C.: University of British Columbia; 1995. p. 46-47.
26. Vancouver General Hospital, Board Minutes (City of Vancouver Archives ADD MSS 320, Series A Vol 7, Vol 8.)
27. Ibid.

Chapter 2
Early Days of the British Columbia Cancer Institute 1935–1952

A Pressing Medical Emergency

During the nineteen thirties there was growing concern about the "cancer problem" across Europe, Central Canada and the Prairie Provinces. British Columbia lagged behind. In response, the British Columbia Medical Association appointed a special committee to investigate the situation. Cooperation was sought from the Health Bureau of the Vancouver Board of Trade, and the Greater Vancouver Health League. On 25th March 1935 six men, two from each organization, met to consider the problem. They were Dr GF Strong and Dr HH Milburn of the BC Medical Association, Mr WC Ditmars and Mr WJ Twiss representing the Board of Trade, and Mr NC Levin and Dr BJ Harrison from the Health League. They recommended a province-wide organization be formed "*to institute a concerted drive against this malady.*" [1] The British Columbia Cancer Foundation was incorporated under the Societies' Act of the Province of British Columbia on the 21st May 1935.

In order to garner more public support the Board of Trade called a luncheon to be held in the Italian Room of the old Vancouver Hotel under the chairmanship of Mr TS Dixon, President of the Board of Trade. Invitations were sent to seventy-nine prominent lay and medical community leaders of

Fig 15. Hotel Vancouver at the corner of Georgia and Granville Streets circa 1935. Site of the luncheon in the Italian Room, to "open a new era", attended by 39 of 79 prominent lay and community leaders invited to "meet a pressing medical emergency". (Reproduced by permission of the Fairmont Hotel Vancouver).

whom thirty-nine attended on Wednesday June 12th 1935 at 12:30pm. Dr GF Strong was asked to give a resumé of the present situation. He pointed out, "*the great lack of facilities for the treatment of cancer — that British Columbia is the only province, Prince Edward Island excepted, which has no public supply of radium.*" He impressed upon the meeting the need for "*diagnosis and treatment; education of the medical men and the public; and clinical research. Technical details would be handled by a sub-committee of specialists, three of whom are Dr C.W.Prowd, Dr B.J.Harrison and Dr E.Trapp.*" [2]

Twenty-three people were nominated to form the executive committee of the British Columbia Cancer Foundation. Sixteen of these were not even present at the lunch! Dr Prowd spoke on the need for a Cancer Institute. His remarks included, "*This organized effort was going to meet a pressing medical emergency and statistics show that the death rate from cancer in British Columbia is the highest in Canada. To meet the cancer problem the Province should have an efficient Cancer Institute, and to provide this and carry out an effective educational programme will require at least $500,000.*" Speaking on behalf of the General Hospital, Dr AK Haywood said, "*In the General Hospital, the number of cancer patients was appalling. Modern equipment had been secured within recent years, and is now not adequate to keep pace with the number of cases being referred for treatment by the doctors.*" He went on to recommend, "*that a Cancer Institute be established in Vancouver, and offered to turn over to the Cancer Foundation a sum of money which he has in trust for a radium fund for the General Hospital.*" Just before the meeting adjourned at 2pm, Mayor GG McGeer had the last word, "*a new era will open up, as soon as dividends are paid in human contentment, happiness and peace.*" [2]

The aims and objectives of the Foundation set out at that time were the collection and distribution of funds and the improvement of diagnostic and treatment facilities for cancer patients throughout the province. These were to be achieved through the establishment of one fully equipped treatment centre with ancillary consultative and follow-up centres at various points across the province. In October officers were elected. The first Honorary President was the Lieutenant-Governor, Mr JW Fordham Johnston; the Honorary Vice President, Mr TD Patullo, the Premier of the Province; and the President Mr EW Hamber. [3]

Ambitious Fund Raising Efforts

In the summer of 1936 The Board of Governors of the newly formed British Columbia Cancer Foundation was enthusiastically searching for funds to establish a clinic. Letters were written to all the Insurance companies in Vancouver seeking support in the following manner: *"As you will see in the attached brief, the Foundation is affiliated with the British Empire Cancer Campaign and the main effort of the organization is to bring British Columbia into line with other Provinces in Canada in the provision of diagnostic facilities for early treatment. A great deal of preliminary work has been accomplished, and under enabling legislation of the British Columbia Government, the Foundation is now in possession of a substantial supply of radium which we are anxious to make available at the earliest possible moment by the provision of suitable accommodation and equipment".*

The accompanying brief left no doubt as to the enthusiasm and expectation of those first Governors. It included:

"OUR OBJECTIVE and
OUR IMMEDIATE PROPOSAL

Our objective is $600,000 for a provincial Cancer Institute of 50 beds, organized, equipped and managed to give prompt diagnosis and adequate treatment to cancer patients from all parts of the province and through constant and continued effort to provide funds by donation, grants and bequests for the maintenance of such Institute.

Our immediate proposal is for $150,000 to establish the first unit of 12 beds, permitting of provincial-wide organization of the cancer problem and providing for the diagnosis, needed treatment, the necessary follow-up and social services for cancer patients. This immediate proposal does not impair our ultimate objective and provides for immediate organization and treatment with the limited facilities at our disposal until the complete objective is realized." [4]

Dr Harrison and Dr Prowd made a strong appeal to the Vancouver Life Manager's Bureau for $100,000 to support the establishment of the Institute. The letter and attached brief, along with visits by various Governors, was sent to all insurance companies including Canada, Confederation, Crown, Dominion, Great West Life, Imperial, London, Manufacturers, Mutual, North American, Sun and New York Life. Many expressed support, but explained that they had already contributed to the cancer cause through their head offices back east! The effort did not produce anything but kind words.

A meeting of the Governors on December 1st 1936 led to a bill from the Hotel Vancouver for $41.40 which included $25 for twenty coffees at $1.25, twenty canapés at 25 cents each, C.O.D. of $7.90 and $3.50 for cigars and cigarettes.

Radium Purchased on a Promissory Note

Early in 1936 the Directors of the Foundation had learned that 3.5 grams of unprocessed radium had come onto the market. On March 17th 1936, a committee under the chairmanship of Dr CW Prowd met the Premier, TD Pattullo, the Minister of Finance and the Provincial Secretary to request co-operation in the purchase of the radium at a price of $30,000 per gram. The price of radium had fallen from $70-100,000 per gram thanks to the discovery of radium in pitch-blende ores near Great Bear Lake. [5] On March 21st the Board of Governors of the BCCF passed the following resolution to comply with the terms of the BC Government Order-in-Council guaranteeing the purchase of the radium. "*Resolved that the Board of Governors purchase three and one-half grams of radium at a price not to exceed the sum of $105,000 and that the purchase be financed by the issue of a promissory note to the Dominion Bank in the sum of $105,000 or such lesser amount as may be required with interest thereon at the rate of 5% per annum as well as after as before maturity and that the Provincial Government be requested to guarantee the due payment of principal and interest on the said note or any renewals thereof. The radium to be insured against all risks. In consideration of the guarantee by the Province, the Board undertake to redeem the promissory note as early as practicable from the proceeds of the subscriptions, grants or bequests to the British Columbia Cancer Foundation and in any event within five years from the date hereof. The radium is to be kept within the Province of British Columbia and held by the British Columbia Cancer Foundation in trust for the Province until such time as the said promissory note and the interest thereon are discharged in full by the makers.*" [6]

The radium was purchased and arrived in Vancouver in May, 1936. The total amount of radium was 3,533.14mgms and it was stored in the vaults of the Dominion Bank. The Bell-Irving Insurance Agencies Ltd insured the radium for $210.00 per annum.

The prevailing business conditions in November 1937 led to the postponement of a province-wide appeal for funds until the following year. However, a private appeal was considered to raise sufficient funds to process the available radium into needles and tubes suitable for clinical use. The Foundation was unable to pay rent for office space, which had been provided by Mr RP Baker. The members of the Foundation could not agree on what should be done with the radium. Frustration was expressed at the many differences of opinion and set-backs that had been encountered in the previous two and a half years.

The Board Minutes of December 30th 1937 included the following resolutions. "*Whereas the B.C. Cancer Foundation was organized in May 1935 for the purpose of establishing a central institute for the control and treatment of cancer and whereas upon the strong representations from the Governors of this Foundation, the Government of the Province of British Columbia guaranteed the loan of $105,000 for the purchase of 3½grams of radium and whereas the B.C.Cancer Foundation has not deemed it wise to proceed with a general public appeal for funds on a sufficient scale, either to carry out the original purpose of the Foundation or to repay the loan from the Government and in consequence the Foundation has no funds to continue the interest payments on the loan after December 31st: BE IT RESOLVED That the Government be so advised and BE IT FURTHER RESOLVED THAT THE B.C.Cancer Foundation shall not cease to work towards carrying out the original objectives of its Founders.*" *Further resolved "That a letter of appreciation and thanks be sent to His Honour the Lieutenant Governor (Mr E.W. Hamber) for his most generous help to the Foundation by the payment during the past year of interest on the loan for the purchase of radium.*"

Progress a "Great Disappointment"

The Committee on the Study of Cancer of the British Columbia Medical Association was supportive of the Foundation from the outset and especially in 1937, 1938 and 1939 and the early war years. Dr Trapp was its chairman in 1941 and Dr A Maxwell Evans in 1948. Under president Dr AY McNair and secretary Dr Ethlyn Trapp, the following resolution was approved on November 22nd 1937 and forwarded to the Foundation. "*WHEREAS the Committee on the Study of Cancer of the British Columbia Medical Association in 1935 brought to the attention of certain lay groups the urgency of the cancer situation in B.C. and recommended that a provincial wide organization be formed to undertake the raising of the necessary funds to establish a Cancer Foundation for British Columbia AND WHEREAS to date our facilities for treating Cancer are grossly inadequate and the urgency for better means of Cancer treatment is being more and more apparent as time goes on BE IT RESOLVED THAT the Committee respectfully urge that a provincial wide campaign to raise funds be undertaken with the least amount of delay.*" [7]

Five months later the Committee expressed its frustration in the lack of progress "*Some three years ago the Cancer Committee of this Association initiated a movement which resulted in the formation of the BC Cancer Foundation, whose main objective was the unification of activities in the field of Cancer Control in British Columbia under the one organization. This included the establishment of a central Cancer Institute and subsidiary Cancer Centres elsewhere in the Province as the plan developed. The plan was in accord with the recognized better ones in effect in some European countries, notably Sweden, where cancer treatment is admittedly more advanced than it is on this continent. Unfortunately the progress made by the BC Cancer Foundation has been a great disappointment, and we find our problem about as it was three years ago.*" [7]

Drs BJ Harrison, CW Prowd and Ethlyn Trapp were appointed to work with three members of the Foundation to supervise the use of the irradiation facilities supplied to the Cancer Foundation.

The medical directors of the Foundation at that time, (Drs Milburn, Thomson, Trapp and Harrison) were opposed to the radium being processed and made available to hospitals around the province as had been suggested.

The Minister of Finance for British Columbia responded to the Board's resolution of December 1937 on April 13th 1938, that the Government expected the Foundation to meet its obligations with regard to radium. Faced with this demand, the Directors agreed to establish a campaign for funds, in cooperation with the Cancer Division of the BC Medical Association and the Canadian Medical Association Department of Cancer Control, to discharge their obligations.

The Anonymous Bequest

Fig 16. The Donor Plaque

In 1938 a bequest of $50,000 from an anonymous benefactress, however, provided the catalyst to create the Institute by allowing one gram of the radium previously purchased to be prepared for use in treatment. The bequest included a number of conditions. [8] The money was to be spent in four ways: $30,000 for one gram of radium held in the Dominion Bank, $10,000 for processing it, $9,000 for purchasing and equipping the house on Thirteenth Avenue granted by the Hospital and $1,000 for alteration necessary to convert it into a suitable unit.

The bequest gave direction for these expenditures to be under the direction of Dr JW Thomson and Dr BJ Harrison. It also indicated that the unit be under a Director and Assistant Director who would be honorary, that surgeons could use the radium provided it was "under the direction and at the discretion of the Radiologist". In recognition of this seminal donation a plaque was placed at the entry to the clinic. The wording caused some concern, but with the aid of the Chairman of the Department of English at the University of British Columbia (UBC), a suitable inscription was arrived at including a quotation from 1st Corinthians Chapter 3, verse 13.

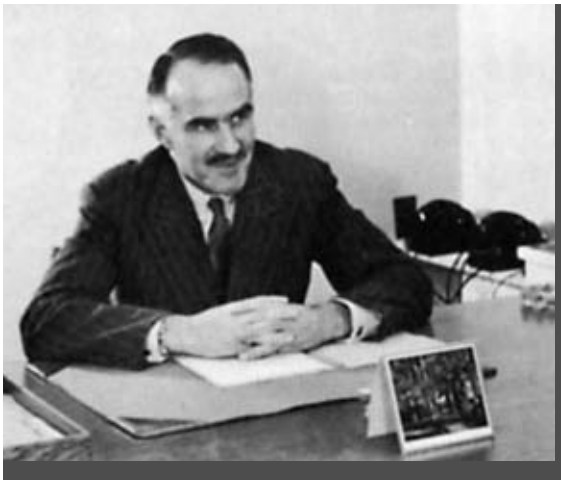
In May 1938 $30,189.95 worth of the radium was sent to New York and then to Belgium to be processed into 188 needles and 82 tubes of various strengths. The radium content of the needles and tubes was verified in Ottawa on their return journey to Vancouver. The Thirteenth Avenue site was deemed not suitable for the clinic. The first home for the treatment centre was made possible by Vancouver General Hospital's offer to make available the former intern's residence at the corner of Heather St, and 11th Ave. and to supply heat, lighting and nursing services. [6] Alterations to the building including carpentry, plumbing, electrical work, an oil burner and linoleum on all floors was estimated at $2,914. [9]

Plans to Open the Institute

With an expectation of raising funds to pay the overdue interest on the radium and various incidental bills, plans were set to open the Cancer Institute on the afternoon of Saturday, November 5th 1938. The BC Medical Association was invited to submit nominations for consulting staff composed of representative medical men from various sections of the province and an attending staff composed of local members of the Association from the various branches of medicine. There followed considerable discussion as to where exactly the Institute fell in the medical scheme of things. In particular there was concern about "pay patients" and "indigent patients" and the fees to be charged for radium treatment. In January 1939 fifteen names were selected from a panel of names provided by the BCMA to form the first Honorary Attending Staff. The following July, twenty nine were selected and named to the Honorary Consulting Staff. As to fees, the representative of the BCMA wanted a reasonable fee charged for radium treatment. The bequest had made it clear that indigent patients were to be treated free. The level of fees was finally left in the hands of the Directors of the Institute.

Shortly before the opening of the Institute the following staff appointments were made in October: Radium Therapist – A Maxwell Evans; Part Time Medical Men – Frank C Hebb and JA MacMillan; Radium Nurse – Dorothy Findley.

Advertisements for the position of full time



Dr AM Evans 1907-1976

A Maxwell (Max) Evans was a medical graduate of McGill in 1932 who undertook a three-year internship at Montreal General Hospital. He was Surgical Registrar at Mount Vernon Hospital for Cancer in England from November 1935 to May 1937. He obtained the Diploma of Medical Radiology and Electrology (DMRE), from the University of Cambridge in 1937 and was Resident Medical Officer at the Radium Institute, London, England from October 1937 to January 1938, and assistant Radiologist at Addenbrooke's Hospital, Cambridge from February 1938 to June 1938.

He was appointed Radium Therapist to the British Columbia Cancer Institute in 1938, Medical Superintendent the following April and Medical Director on his return from Military service at the end of the War. He served as a Major in the 6th Canadian Field Hospital including time in Tripoli and as part of the Allied offensive in Italy. He was married in Italy and he and his wife had two sons.

Fig 17. Dr A. Maxwell Evans. Radium Therapist and Medical Director of the British Columbia Cancer Institute.

radium therapist had been placed in various journals and sent by letter to institutions and hospitals across North America and Europe. They indicated that the radium therapist would be immediately responsible to the Director; that the Foundation had 3½ grams of radium of which 1gm was processed and that there would be two part time medical officers. Several applications were received, but it was evident that Dr A Maxwell Evans had had the most training. He was appointed by letter from the Honorary Secretary G M Shrum on October 17th 1938.

"*Upon the recommendation of Dr B.J.Harrison you were appointed the full-time Radium Therapist for the Institute on the following basis. Salary $100.00 for the period October 1, 1938 to November 1, 1938 and $4,000.00 per year thereafter.*" [10]

The part time medical assistants were JA MacMillan from Woodfibre, B.C. and FC Hebb of Vancouver at salaries of $100 per month and Radium Nurse Findley at a salary of $125 per month.

Upon his return to Canada, he was awarded Specialist Certification in Therapeutic Radiology by the Royal College in July 1945 having "given satisfactory evidence of proficiency in this specialty". The certificate was signed by GE Richards, Chairman, Committee in Radiology.

He was appointed an Assistant in the Department of Surgery, Vancouver General Hospital in 1947.

With the establishment of the Medical School at UBC, Clinical Faculty were chosen from the staff of the VGH and in 1954 he was promoted to Clinical Assistant Professor.

AM Evans was known to be abrupt and aggressive, a shy man, somewhat insecure, respected but not popular outside the Institute [11]

He retired in 1971. Following his death on February 20th 1976 a tribute to him and his work appeared in the Annual Report of the British Columbia Cancer Foundation. The following are extracts from the tribute. *"The key to his success was his total belief in centralization of resources and his ability to implement the necessary policies with the solid backing of the Foundation. So there evolved the 'Cancer Team' with multidisciplinary special treatment clinics and participation of permanent and consulting staff. Throughout the Institute's overall organization there was 'team work for people' through kindness, clinical skill and care.*

So successful was he with this approach that he generated a meaningful sense of contributing to 'patient care' to each member of the total staff (medical and voluntary) and a 'work environment' was transformed into a very 'human dwelling'. Evidence of this was the affectionate reference to him as 'Father' by many members of the staff. Research and Education were not forgotten, but he considered they were not a first priority in a Cancer Service. Max was not an academic himself but had great respect for those who were. He admired great teachers and enthused over their abilities in their fields. During his tenure in office he co-ordinated six continuing Medical Education Courses on Cancer for Practitioners throughout the Province. He surrounded himself with able people and in his later years enjoyed recounting tales of the many personalities who helped him during the creation of the Institute. It would be untrue to suggest that Max did not experience any of the vicissitudes of life, but he had the character to rise above them. He enjoyed a reputation for having a fiery personality but, 'as a good wine mellows with age' so too must he have done, for it was seldom obvious. He was a man of character, a proud man, a man with courage, with imagination and of strong will. He was decisive at the turning point in history of cancer treatment in British Columbia and discharged his task without excitement or fanfare." [12]

The Clinic Opens

The British Columbia Cancer Institute clinic opened on Saturday, November 5th 1938. The occasion was recorded in The Vancouver Sun the same day in rather flowery prose under a full-page heading.

"Precious Radium Needles Arrive; Cancer Clinic to Begin Work on Monday, Ceremonies Today Mark Realization of Dreams, Clinic Staff Takes Extraordinary Precautions for Handling of Curative, but Deadly Element"

The following passages are excerpted from the Sun report by James Dyer. *"Ten tiny needles, each less than an inch long – gramophone needles, they look like. Ten passports to surcease from human suffering to freedom from the great scourge of mankind – cancer. They lay on a leaden shield in the still unfitted laboratory of Vancouver's new cancer clinic.*

This afternoon, at three o'clock, Hon. Eric W. Hamber, lieutenant governor of British Columbia, formally opened the clinic, a building which formerly housed the Internes' Home, and Hon. G.M.Weir, minister of health, unveiled a plaque honoring "the unknown" donor of $50,000 which permitted the early opening of the clinic.

The clinic, under Dr. A.Maxwell Evans, will open for business on Monday.

The first patient, from Alberni, already has an appointment for Wednesday.

But the "Day" so far as the staff is concerned was Friday, when the 270 needles came back from a long trip to Belgium. The radium came into the building quite casually, in the arms of Dr G.M.Shrum, honorary secretary of the B.C. Cancer Foundation. There were eight small wooden boxes, wrapped in brown paper and carefully sealed. Dr Shrum dumped the boxes on a laboratory bench, seized a screwdriver and pried a box open. Within were innumerable wrappings of paper, and in their midst — multum in parvo — a small round lead box. And within this with more wrappings, the ten needles, first of the 270 to see the light in their permanent home.

To Nurse Dorothy Findley, who, with one other nurse, a secretary and two part-time diagnosticians, will assist Dr Evans at the start, went the honor of being the first to handle the precious slivers. Miss Findley wore rubber gloves to protect her hands. She picked up a pair of six-inch long forceps and delicately lifted the needles one by one. Laid them upon a temporary lead plaque. Then Dr B.J.Harrison, radiologist of the Vancouver General Hospital, and director of the clinic, whisked out a powerful magnifying glass and bent to examine the slivers. Each has a number. Each was checked with the numbers on the label on the wooden container. The radium needles will be kept in a small, compact safe which has been specially constructed. Lead-lined, it is about two feet long, a foot and a half


THE VANCOUVER SUN—Vancouver's Own Newspaper—SATURDAY, NOVEMBER 5, 1938

day Mark
f Dreams

Precautions for
Deadly Element

Very Tiny, Very Valuable

'Where is it?' Dr. B. J. Harrison (in white), radiologist of the Vancouver General Hospital, and director of the B. C. Cancer Institute, is asking Dr. G. M. Shrum, honorary secretary of the B. C. Cancer Foundation, as they assist in the unpacking. That which Dr. Harrison holds in his forceps, and which Dr. Shrum seeks to identify with a powerful glass, is a tiny platinum needle, worth about $60. Below, in the tray, are more of the tiny radium-bearing slivers.

120 Foxes Shot
By Rustlers in
Fur Farm Raid

Leave Pelts Behind When
Stolen Car Is Wrecked

By Canadian Press

STARBUCK, Man., Nov 5.—Police today searched for masked rustlers who, Thursday night, stole S. E. Baldwin's auto and trailer and then ruthlessly killed 120 foxes.

The robbers were forced to abandon their catch when the trailer overturned near Starbuck, 20 miles southwest of Winnipeg.

Baldwin estimated his loss at $10,000, despite the fact that he recovered the pelts.

Bullet holes in the skins and killing of the animals prior to the regular pelting season accounted for the loss.

Police termed the raid one of the worst of its type since the old days when cattle rustlers roamed the Western plains.

25th Wedding

Fig 18. Dr Shrum (left) & Dr Harrison examine the newly arrived radium (From the Vancouver Sun, Saturday November 5th 1938).

Fig 19. The radium mould used to successfully treat the Institute's first patient, a 70 year-old parson from Port Alberni. The mould is held in the BCCA Archives. The channels in which the radium needles were fixed during treatment can be seen on the face of the mould.

high. Yet it weighs 1200 pounds and it took a derrick to get it into the second floor laboratory."

The article went on to describe the aspirations of the Foundation and its future plans.

The first patient from Alberni, mentioned in the Vancouver Sun article, was a retired 70-year-old parson with a biopsy-proven squamous cell carcinoma of the lip successfully treated with a radium mould. He wore the mould for 35 hours over 5 days. Dose was expressed as 1400mg.hrs with a skin surface dose of 4900r. The patient died eight years later of a cerebral haemorrhage with no evidence of recurrence of his lip cancer.

The second patient, a 39-year-old woman from Chemainus, with a carcinoma of the buccal mucosa was referred to Dr Harrison at the VGH for 220KV X-ray treatment.

In the last two months of 1938, the first two months of operation of the Institute, thirty-eight patients were seen at the Institute. Sixteen had disease too advanced for treatment or did not have cancer. Thirteen were referred to the Vancouver General Hospital for X-ray therapy (not available at the Institute until 1945), and nine received radium treatment. Most of the latter were skin lesions, one a vulvar cancer and one a carcinoma of the cervix.

As an example, a basal cell carcinoma of the cheek was treated using a radium sorbo plaque, 3.5 cms in diameter with a treating distance of 1cm. Five 10mg needles were placed around the periphery and one 2mg needle in the centre.

The plaque was worn for a total of 53.5 hours over 14 days to deliver a dose of 6045r. The lesion was controlled but eight months later a new lesion arose close by. This was treated by a radium needle implant using six 10mg needles implanted for 4.5hours.

In reviewing history we are constantly reminded of how little some things change. One of the first patients seen at the Institute in 1938 was recommended to undergo mastectomy. Her general practitioner wrote in desperation on January 18th 1939: "*I have applied to have this lady admitted to Vancouver General or St. Paul's Hospitals, so that such treatment could be done. I have not been able to have either hospital accept her, and only today, St. Paul's Hospital say they are full and cannot help, so the matter remains, still in the air. It seems to me that if the public is to be educated along a cancer conscious line, then our treatment facilities must be radically improved.*" [13]

The War Years

On April 17th 1939 the Board of Management of the BC Cancer Institute appointed Dr Evans as Medical Superintendent of the Institute and he was asked to assume the duties formerly carried out by the Honorary Director and the Honorary Assistant Director. As a consequence Dr BJ Harrison and Dr JW Thomson were recommended for appointment to the Attending Staff.

In accordance with international practice for radium workers, Miss Findley, the head nurse, was offered one months' holiday per year. To cover Miss Findley's vacation, Dr Evans was authorized to engage a full-duty nurse at a salary not exceeding the minimum requirements of the Registered Nurses' Association of BC ($80.00 per month, plus three meals a day and laundry).

In July 1939, 100mgm of radium was loaned by the BCCI for one year at a cost of $200 to St Joseph's Hospital in Victoria. When renewed a year later for $100, Sister Mary Alfreda RN of St. Joseph's announced that Dr K Bibby was in charge of the radium. In September 1940, Dr Trapp contacted Dr Frederick O'Brien of Boston Mass, to confirm that Dr Bibby was qualified to use radium. [9] Later in the year the Sister Superior of St. Joseph's reported the loss of a 10mgm needle! The Institute filed a claim against the Halifax Fire Insurance Company for the loss and received $295.50 in settlement. [9] On his return to the Institute in November 1945 after war service, Dr Evans wrote to St. Joseph's Hospital to ask what methods were undertaken to find the lost radium and to return that which they still had.

On December 22nd 1939 negotiations were completed with the Canadian representatives of the

Fig 20. The entrance to the first clinic on 11th Avenue at the corner of Heather and Eleventh

Johnson Matthey Company of London, England, to purchase 2,517.28 milligrams of the Institute's remaining radium at $22.50 per milligram in Canadian funds. This allowed $53,480.80 to be applied to the loan at the Dominion Bank.

The early years of the war provided considerable financial hardship to the Institute. In the summer of 1940 in an effort to raise funds, a grand Symphony Concert was arranged for Saturday August 17th. The concert was held in the Malkin Bowl at 8.30pm. WH Malkin was the incumbent president of the BC Cancer Foundation. The Park Board donated the use of the Bowl and 4,000 chairs. There were 500 tickets at $2 each, 500 at $1.50, 2,000 at $1 and 1,000 at $0.50. In the event of rain, the concert was to be held in the Forum at a rent of $250. $400 rain insurance was obtained at $10.48 per hundred. The Provincial Government cancelled the amusement tax on the concert! The Vancouver Symphony Orchestra and Mr Jan Cherniavsky donated their services. The Kitsilano Boy's Band assisted the Orchestra and received $25 to cover expenses. Mr John Brownlee, baritone of the Metropolitan Opera received $500 and return plane fare from Hollywood. The Vancouver Daily Province the following Monday reported a large and highly appreciative audience and described John Brownlee the gifted Australian baritone's performance as a gratifying success. The records of the Foundation do not report the financial outcome of the event.

In the late summer of 1940, Dr Evans left for military service overseas, whereupon Dr Ethlyn Trapp was appointed Acting Medical Superintendent at a salary of $233.33 per month with Dr ICC Tchaperoff as her full time assistant at a salary of $100 per month. However, he left soon after to join the Royal Canadian Army Corps. Dr Tchaperoff was born in England and graduated from Cambridge University and trained at St. Thomas's Hospital in London. After the war he went to St Joseph's Hospital in Victoria later to be head of radiology. He died at the young age of 50 in 1954. [14]

Dr Trapp's title was changed to Medical Director in September 1943. Dr Trapp asked Dr Margaret Hardie to join her on a part time basis on September 4th 1942.

In 1940 the cost of operating the Institute was listed as about $825 per month with revenue from all sources of about $400! The minutes of the Executive Committee of the BCCI in 1940 record that 317 patients were registered in the year and that monthly expenditures totaled $9,153.77 for the year. This included salaries of $7,253.07, wages of $720, telephone expenses of $141.70, insurance of $294 and estimated office and clinical expenses of $365 and $380 respectively. The Board of Management of the Institute, in facing these financial woes, recommended the following plan:

a. *Arrangements be made to receive new patients on Tuesdays and Fridays only.*
b. *That the services of the part time nurse be dispensed with and a consequent extension of the work of the full time nurse and secretary be arranged.*
c. *That the services of the assistant radiologist be dispensed with and that a part time medical intern be engaged. In this connection it is understood that a possible arrangement might be arrived at whereby the part time medical intern would be lodged and fed by the Vancouver General Hospital and spend half time at work on the wards of the Vancouver General Hospital.* [16]

It was predicted that these modifications would result in a saving of $100-125 per month, but that within a year, further funds would have to be found to carry on. The Board of the Foundation accepted the recommendations but went further and suggested that each Governor of the Foundation contribute $20 per annum to the operating expenses of the Institute for the duration of the war and that the Provincial Government be asked to make up the emergency deficit of $5,000 per year.

In September 1940 the BCMA recommended, "*that the activities of the British Columbia Cancer Institute be limited to treatment of malignant conditions.*" Dr Trapp, who was also on the Board of the BCMA, immediately had them change the recommendation and accept that "*certain non-malignant cases should be treated by radium at the Institute.*" [17]

From the beginning, the Honorary Attending staff provided huge support to the Institute with attendance at weekly clinics and advice from various medical specialties. An evening study group was instigated to examine the cancer problem in its surgical, radiotherapeutic and medical aspects, in particular as they affected the British Columbia Cancer Institute, and to lay down guiding principles for the treatment of cases in the Institute. In February 1941, a dentist was added to the Honorary Attending Staff to help in removing oral sepsis in cases of cancer of the mouth, to develop special applicators for holding radium and to construct prostheses.

Ever aware of the dangers of war, Dr Trapp reported in May 1942, "*For Air Raid precautions the radium safe and the radium is now stored in the basement fireplace.*" [18]

In May 1943, rather than purchase a camera, Miss Agnes Roberge was asked to take photographs

Dr MFB Hardie 1898-1984

Margaret Florence Burridge (Mardi) Hardie was born in St John NB and grew up in Victoria where she received her early education. She obtained a Teacher's Certificate and taught school in Victoria for several years. Dr Hardie graduated from the University of Toronto in 1924 with an M.B. and earned her Big "T" as the champion women's tennis player. Due to health reasons and raising a young family, she did not return to medicine until 1942, when asked by Dr Trapp to come and help out at the BC Cancer Institute. Dr Hardie undertook some intern duties at the Vancouver General hospital while working at the BCCI and passed her L.M.C.C. in 1944. This was quite an accomplishment considering the years since graduation, working and running a busy household with two teenaged daughters and a seven-year old boy.

Dr Hardie took a special interest in gynecological cancer. In the early 1950s she studied in Manchester, England and Upsala, Sweden. She successfully wrote her specialist examination in therapeutic radiology in 1953 at the age of 55. She ran the gynecological service at the BCCI until her retirement on December 31st 1961. For many years Dr. Hardie drove to the Okanagan Consultative Clinics in all kinds of weather. This was a great service to the local doctors and their patients. It allowed patients to be followed in their own community and often prevented needless travel. She was a long time supporter of the BC and Yukon Division of the Canadian Cancer Society (CCS). Early on she became aware of the emotional and family needs of women and especially young women with ovarian and cervical cancer. To this end she was instrumental in starting the first Patient Services Program of the CCS. Dr Hardie was chairperson of the CCS Patient Services Committee for many years.

On retirement she and her husband Rod went around the world on a freighter. At the Club Med in Agadir, Morocco they became bridge champions of North Africa. The language was French of which they knew little. On return they moved to their home "Yellow Cedars" at Yellow Point on Vancouver Island. [15] (Information provided by Dr Hardie's son-in-law Dr Richard Beck)

of cancer patients at a cost of $10.00 per month. A photographic department was eventually established in February 1947.

From the outset it was recognized that X-ray treatment as well as radium would be necessary to establish a viable Institute. By 1940, funds had been raised to purchase X-ray equipment, but it was felt that no action should be taken until the Board of Management had definite assurances *"that sufficient funds would be available to assure the continued operation of the Institute during the period of the war."* [19] However, in August 1941 it was decided to proceed with the acquisition of X-ray equipment. The case was put to the Honorable John Hart of the provincial government and on February 23rd, 1942 the Provincial Health Officer responded by letter that *"a sum of money of approximately $18,000 has been placed in the budget of the Health Department for the present fiscal year to assist in the control of cancer but that any items charged against it must be ordered before March 31st, 1942."* [20] On March 9th the Board of Management of the Institute and the Honorary attending staff reiterated the need for X-ray therapy and that *"in view of the fact that a 400KV machine is to be installed at the General Hospital a 220KV machine would be preferable at the Institute."* [20] On March 19th the chairman of the Foundation, Mr WH Malkin and Dr Trapp met with representatives of Victor X-ray Corporation and the Ferranti X-ray Company to receive quotations. Dr Trapp, Dr Harrison and Dr GM Shrum, Head of the Department of Physics, University of British Columbia, recommended the purchase of a Maximar "250" Therapy X-ray unit, manufactured by the Victor X-ray Corporation, for $8,825.00 with various cones, a hydraulic couch, physics equipment and structural modifications to a total of $14,593.75. This recommendation was accepted by the Board of the Foundation on March 30th and presumably forwarded to the Government the following day. However, the recommended X-ray machine was not purchased.

Financial difficulties persisted and in February 1943, the Premier of the Province, John Hart, agreed to a grant of $4,000 to the Institute for the remainder of the fiscal year. A grant for the following year was not forthcoming and the Premier suggested, *"the Institute should try to carry on with its own resources."* [21]

No further forward in acquiring X-ray equipment, in March 1944, Dr Trapp offered to transfer her own equipment from her private office to the Institute. It was suggested that if she did she should be appointed full-time Medical Director for the duration of the war or until Dr Evans's return. Before completing this arrangement a further approach to government was made in July including the following submission. *"Had the war not intervened it is possible that a complete cancer service might have grown from the original Institute in the course of a few years. Nevertheless, in spite of our limitations we have been able to provide, since our opening, diagnostic and treatment facilities for some 2000 patients from all parts of the Province. We have given 1,986 radium treatments and referred 600 patients for x-ray therapy. We have been advised by our Honorary Attending Staff that it will be necessary to provide certain extra facilities. We are, therefore, asking the Provincial Government to purchase an x-ray equipment which can be immediately installed in the present Institute. This machine would be the property of the Provincial Government, placed on loan to the Institute."* The same report of 1944 included the first indication of the eventual establishment of the BC Cancer Agency. *"It is our hope that the Government of British Columbia may eventually undertake the control of cancer as has been done in the case of tuberculosis and venereal disease. If and when such a scheme is initiated, the Cancer Foundation is prepared to withdraw from the active treatment of cancer, to cooperate with the Government as an auxiliary or in any other way and to continue to use our endowments and income in the interests of cancer through education and research."* [22]

X-ray Therapy is Added to Radium

Fig 21. The clinic's first X-ray machine.
A megalithic two headed 400KV Picker unit designed to treat two patients at once. Later described as a "constant worry, designed in good faith, on a wrong premise".

Dr GF Amyot, on behalf of the Government, was entirely in sympathy with the request for X-ray equipment. On hearing this, the Board of Directors recommended that new X-ray equipment be purchased for the Institute by the Provincial Government and that Dr Trapp's offer be declined and she be asked to continue in her present capacity as part-time Superintendent. [23] A recommendation was made for purchase of the Picker 400KV machine as being most suitable for the needs of the Institute — the chief advantage being that it could treat two patients at the same time!

In November 1944 the Board made representations to the BCMA and Col. Wallace Wilson, Command Medical Officer, Pacific Command, to have Dr Evans released from military service in order that a full time radiologist be at the Institute as soon as the new X-ray equipment was installed. The Department of National Defence refused the request. However, with the end of hostilities in Europe in May 1945, Dr Evans returned to resume his position as Medical Director on October 1st.

In November he pointed out that the radium had not been checked for damage or leakage since 1938. Dr Harold F Batho was appointed as physicist at $1.50 per hour to undertake this work. In 1949 he was placed on salary, marking the first employment of a BCCI physicist.

Agreement was reached that patients should be charged a minimum of $25 and a maximum of $100 for deep X-ray treatment.

Delay in operation of the Picker 400 KV machine was reported in November 1945 because of the breakdown of a transformer.

Dr Evans strongly advised the Board of the Foundation to obtain from the Picker Corporation definite assurances of adequate servicing and replacements. The first patient was treated on November 29th. By January 10th it was reported that 15 patients had received 212 treatments.

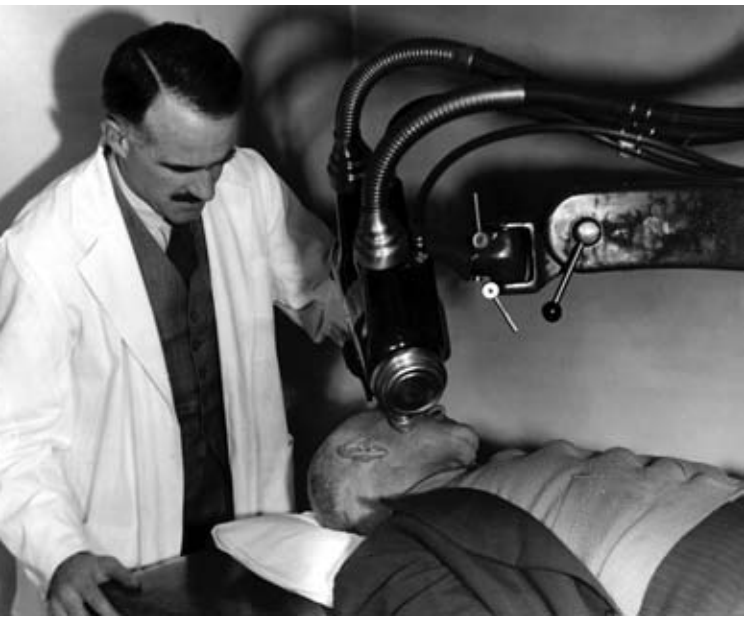


Fig 22. Dr Evans positions the 120KV X-ray unit for treatment of a skin cancer. Operational from 1947 until 1977, in its later years it "looked like a brave old soldier, with tape and bandages controlling an ever present oil leak".

By the following summer Dr Evans and Dr Trapp were recommending the purchase of a superficial X-ray therapy machine at a cost of $3,300, and a 220KV X-ray therapy machine at a cost of $10,500 from the Picker Corporation.

The 120KV superficial X-ray machine was operational in 1947 and the 220KV machine by the following year. (The superficial unit gave yeoman service until its replacement by a Philips machine in November 1977. For the last years of its life the 30 year old superficial machine looked like a brave old soldier with tape and bandages controlling the ever present leak of oil from its extremity.)

Funds for this equipment, and the necessary additions to the building, were made available from the Foundation's first province-wide campaign for funds which raised $264,315 in 1946. [3]

The need for access to hospital beds was reaffirmed in 1945. Various alternatives were considered, including acquisition of an army or airforce hospital, construction of a temporary building or renting an adjacent house. The outcome, however, was that four beds were to be requested from the Vancouver General Hospital in the Semi-Private Pavilion. A month after the first bed was acquired on December 11th 1945, 17 patients had occupied beds, 9 receiving radium, 5 diagnostic procedures and 3 surgery. Nine were private patients and 8 were non-pay.

Strenuous efforts during the early part of 1946 were made to tidy up the Institute's financial position, improve the collection of fees, and regularize accounting methods. Mr JM Warren was appointed Business Manager on August 1st for a three month probationary period, and stayed 29 years.

Fig 23. Dr Evans. On return from the war, the proud owner of an Austin 8 Tourer.

The Need For Expansion

With the acquisition of further equipment and the increase in patient numbers from 757 in 1946 to 907 in 1947, (subsequently 1049 in 1948 and 1130 in 1949), there was a clear need for more space. Various avenues of expansion were explored, including the renting of an adjacent house at 675 West 11th Avenue. The cost of altering the building was to be limited to the creation of a suite in the basement for the owner and painting the upstairs. Perhaps fortunately, the owner did not agree to the offer.

Faced with this impasse, further deliberation of the Temporary Housing Committee led to a recommendation "to construct a new building of suitable size and design". At $4.25 per foot, the building was expected to cost $35,000. Construction began on August 6th 1947 and was expected to be completed by December 31st. The contractor, however, submitted a subsequent interim estimate of $43,740. The difference was accounted for by $9,000 for built-in equipment not included in the original estimate, and by additional costs and unforeseen and unpredictable material costs!

When officially opened to glowing reviews on March 31st 1948, the final cost, including all extras to the contract, was $68,355.92, almost twice the initial estimate.

Fig 24. The first new building seen from 11th Avenue. Photographed at a later date it was built in 1947 at a cost of $68,355.92. Estimated at $4.25 per sq foot the final cost was $8.30 per sq foot.

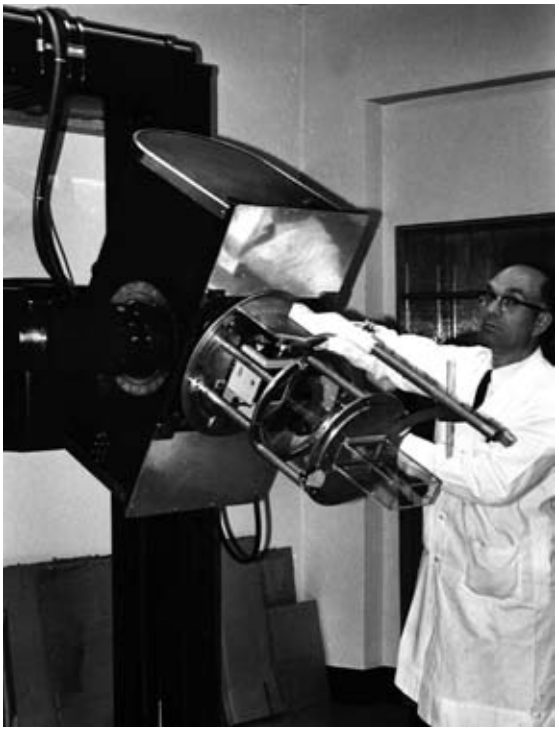


Fig 25. Miss JD McNabb positions a patient on the 260KV unit (above). Installed in the original house in 1949, the unit was later converted to a simulator that Jack Brydle, in charge of the Machine Shop, is demonstrating (right).

In October 1947 a patient being treated for mouth cancer swallowed a radium tube that had to be recovered surgically. The patient was presented with a bill for $1,100 that he submitted to the Institute. After some discussion the Insurance Company agreed to pay.

Dr Evans mentioned the use of supervoltage and the development of teleradium in January 1948. He indicated that these advances would require the services of a fully qualified physicist. In April he informed the Board that there was already "*a waiting list of patients who are to receive treatment on the 400KV machine.*" [24]

In June 1948 Dr Evans informed the Executive Committee (renamed from the Board of Management in January 1945), "*that the 400KV therapy machine donated by the Provincial Government in 1945 has been a constant worry. It is now considered to have been designed, in good faith, on a wrong premise. It is designed to treat two patients at one time in separate rooms. It has been found impossible to get uniform radiation in the two rooms.*" No satisfactory solution for the problem was known. Furthermore, "*No changes would solve the chief problem of the tube. It is considered that two tubes a year will be necessary.*" [25] He went on to inform the committee, "*that last week there had been a waiting list of patients to be treated. If one of the machines should break down, there would be real hardship worked on all x-ray patients.*" He recommended the purchase of a 260 or 220KV machine to be installed in the southeast corner of the old building. The Canadian Cancer Society donated $14,000 for the purchase of a 260KV machine that was installed in February 1949.

With the increase in patients and the acquisition of more equipment, not only was there a need for more space, but also for more staff. By March 1950, the Institute employed forty-nine people and was

recognized by the American College of Surgeons in a compilation of "Institutions Conducting Cancer Clinics Which Are Approved By The College".[26]

When Dr Trapp was acting Medical Superintendent she had asked Dr Margaret Hardie to join her on a part time basis on September 4th 1942.

Dr LG (Lucy) Ellison was appointed to the staff on February 10th 1947 and Dr RG Moffat as Associate Radiotherapist on March 21st 1949. Dr Moffat was named First Associate Director in November 1954. Dr RD Nash was appointed Assistant Radiotherapist effective November 21st 1949. Advertisements had been placed for the post in July 1949 and applications were received from several trained British radiotherapists who later went on to positions of prominence in the specialty, but the position was offered to Dr Nash from Sudbury, Ontario.

Dr Ellison, a forceful personality, had two powerful influences on the BCCI and later the BCCA in her forty year association with the clinic. She provided a valuable clinical resource in the care of breast cancer patients and developed a special interest in the use of hormone therapy. Her second major contribution was to medical records. She was responsible for the Institute's first comprehensive database of patient information in the form of punch cards. She oversaw the maintenance of these records with an almost military authority. Along with three of her general physician colleagues she became a member of the Division of Radiation Oncology at the time clinical associates were absorbed into the clinical divisions.

Dr GM Crawford was appointed on April 21st 1950. Dr Nash was made Assistant Director in 1953 and Second Associate Director in November 1954. Nash was a "*character, a thin man, rather swarthy with thick horn-rimmed spectacles, who could be brusque and sharp on the telephone, but underneath with a heart of gold. An avid baseball fan, often with the radio on in his office broadcasting the play-by-play of a pennant game*".[27] He resigned in 1959 to leave for the greener pastures of Palo Alto and Berkeley where he practiced for ten years before his death.

From November 7th 1938 to December 31st 1951, 8,978 new patients were admitted to the Institute,

Fig 26. Drs Evans, Nash, Hardie and Moffat consider a clinical X-ray.

Fig 27. Drs Lucy Ellison and Glen Crawford. The cake that Glen is sampling reads "out with the old".

of whom 5,817 were found to have cancer. The other patients had a variety of benign conditions considered suitable for radiation treatment and the remainder were referred for surgery.

Funding for the Institute came from Federal and Provincial Government sources, and from campaign funds and bequests etc from the British Columbia Cancer Foundation, the Canadian Cancer Society, various volunteer bodies such as the Imperial Order Daughters of the Empire (IODE), The Order of the Eastern Star (OES) and the Women's Auxiliary. Funding also came from payment of fees by those patients who could afford to pay.

The Hospital Insurance Act, introduced in 1948, provided for in-patient care. In a letter to Dr HH Milburn, Chairman, Committee on Economics of the BCMA, dated September 27th 1949, Dr GF Amyot, Provincial Health Officer & Deputy Minister of Health wrote,

"*From date of the commencement of the new medical care program, that is March 1st 1949, the Health Branch Department of Health and Welfare, will reimburse the Cancer Institute for the care of all persons receiving public assistance and entitled to coverage under the medical care program. In other words, no charges for diagnostic or radium therapy by the Cancer Institute in all its Branches will be charged against the medical fund of $14.50 per capita. It is understood, that all other medical care of these persons suffering from cancer provided in the homes, physician's office, or in the hospital, will be paid for out of the Social Assistance Medical Service Fund.*" [28]

Dr Evans was not pleased with this, his thoughts being reported to the BCMA by Dr FL Whitehead, Executive Secretary of the Council of the Physicians and Surgeons of BC: "*we (the BCMA) of the profession are aiding and abetting the Cancer Institute to be taken over by the Government. The Government was paying to the Cancer Institute on a case per case basis for the Welfare people and has been doing so in the past. They are lately paying exactly the same as they were doing before.*" [29] In respect to patients receiving radium treatment in hospital without charge, there were five hospitals giving radium treatments under the BC Hospital Insurance Plan in 1950. The Federal Government cancer grant (established in 1948) was given to the provinces on a population basis and had to be matched by the Provincial Government. Another condition of the grant was that the Provincial Government had to submit a programme

Fig 28. Miss Findley and Dr Evans discuss a problem.

for the whole province that met with approval from the Federal authorities. The British Columbia Cancer Foundation was accepted by the Provincial Government as the organization around which the programme was built. The cancer grant could not be used to construct buildings.

The Canadian Cancer Society donated $15,000 in support of postgraduate training. In March 1949 this funding was dispensed as follows:

1. Dr HF Batho, physicist, to undertake a five-month tour of cancer centres in England, Europe, USA and Canada;
2. Miss DM Findley RN Supervisor of Nurses, a four-month tour of England, Sweden and the USA and to be representative to the International Nursing Convention in Stockholm;
3. Miss Joan Goodall RN, X-ray technician, one year's training at the Holt Radium Institute in Manchester, England;
4. Miss FA McDonald RN, two months at the Memorial Hospital, New York and Miss FH Campbell two months at Victoria, Toronto and Regina in statistical departments.

All X-ray technicians at this time were registered nurses. Dr Evans made his views clear concerning this preference in a letter to Dr NS Lockyer of Victoria much later in November 1957. *"As you probably know, all our radiotherapy technicians here are trained nurses. They have always been such since the Institute first opened. I must admit, I do not know whether your technicians are nurses but it is my feeling that they should be and that when you happen to get a replacement for your present technicians, you should make a real effort to have nurse-technicians."*

Fig 29. X-ray Technicians all RNs. Dorothy Findley is seated in the centre, Joan Goodall (left) and Florence McDonald (right). In the back row, Marge McBain is extreme left and Jean Richardson, stands extreme right. In between on the back row are HA Dawson, JD McNabb and NAR Dady. Joan Goodall, Radiotherapy Technician from October 1947 to May 1958, left the Institute to work under the Columbo Plan in Burma to aid in the setting up of a Cobalt and Radiotherapy Treatment Centre in Rangoon. Florence McDonald succeeded Miss Findley on her retirement in 1962. When Miss McDonald retired in 1969 the responsibility for nursing and the radiotherapy technicians was separated. Miss J Dawes became Director of Nursing and Mrs Richardson Director of Radiotherapy Technicians.

The First Clinics Across the Province

In May of 1948, an Expansion Committee was formed and reported in November that *"it had always been the aim of the Foundation to have one central unit for the treatment of cancer with diagnostic units throughout British Columbia. Such a plan was drawn up by Dr Simeon T Cantril in 1946 and has been followed in general."* The first proposal of the Committee was to send Dr Evans to survey diagnostic and treatment facilities in all provinces west of and including Ontario. Secondly, that a diagnostic cancer clinic be established in the Interior of British Columbia. The first such clinics were established in Penticton, Kelowna and Vernon in 1949, followed by Kamloops and in 1950, Nelson, Trail and Cranbrook. After the opening of the first four clinics, which were being held monthly and alternate months in Kamloops, the name was changed to Consultative Cancer Services. The next year Prince George and Prince Rupert were added. The addition of Nanaimo in 1953, Chilliwack and Abbotsford in 1956 and Dawson Creek in 1959 brought the total of these Consultative Clinics to thirteen. Creston was added in 1967, Terrace and New Westminster in 1970.

The Building Grows

At the same time, in the late 1940s, the Foundation was looking to purchase two properties adjacent to the Institute and to approach the Vancouver General Hospital authorities with regard to the possibility of acquiring the present Institute site, which up to that time had been leased from the VGH. A house, immediately to the east and adjacent to the Institute, 675 West 11th Avenue, was purchased in March 1949 with the intent to convert it into a nursing home to provide 16 beds to accommodate patients undergoing radiotherapy at the British Columbia Cancer Institute. The nursing home opened on December 14th 1949. Within weeks it was reported, "*The acquisition of these beds has increased the efficiency of the Institute a great deal. As a matter of fact, we could use twice the number of beds if they were available.*" [30]

Dr OH Warwick, Executive Director, National Cancer Institute of Canada had surveyed the needs of the province for cancer services at the request of the Deputy Minister. His report suggested that the BC Cancer Foundation direct the Cancer Program in this province, as well as oversee the Cancer Control Grant of the Federal Health Grants, along with the matching provincial funds designated for this purpose. He also suggested that the Director of the Division of Vital Statistics, Department of Health be consulted in the setting up of vital statistics as emanating from any clinics operated by the BC Cancer Foundation. This was considered essential if the problem of Cancer in the future years in this province was to be properly assessed. In accepting the recommendations, the Minister of Health and

Fig 30. The Heather Street building extension. circa 1951. The houses behind the building fronting on 10th Avenue were successively purchased and demolished to provide for future expansion. The "Building Committee" had "tried to look ahead 20-30 years in the basic construction". This allowed two additional floors to be added in 1959.

Fig 31. The excavation underway for the tunnel beneath Heather Street designed to link VGH Heather Pavilion and the BCCI.

Welfare indicated that since the governments were now providing a large sum for the diagnosis and treatment of cancer, the policy should be that diagnosis, radio-diagnosis and radiotherapy, including the use of radium, should be free at all clinics operated by the BC Cancer Foundation. However, the Board was reluctant to accept this.

Reporting in April 1949, a committee to examine the needs for future expansion presented a strong view that the Institute should have its own facilities separate from the Vancouver General Hospital and concluded: "*In short, it is the considered view of the Committee that better treatment for the individual patient, lifting of patient morale, initiative in research, freedom of expansion in keeping with new discoveries, economy in operation, minimization of capital costs, ease in finance, Provincial-wide acceptance and maintainance of accounts to meet Government requirements all demand that the Institute maintain its physical integrity as well as its separate corporate existence.*" [31]

The committee further recommended that a firm of architects should be appointed to prepare plans for the erection on the Foundation property of a building two stories high, plus a solarium on the roof, so as to provide 50 beds, primarily for radiological treatments.

Because of the desire to be separate from the Vancouver General Hospital, the first requirement for the Foundation was to obtain title to the existing Institute from VGH. This was achieved by purchasing the lot behind the hospital's Intern's Residence, which was then transferred to the VGH in exchange for the title to the Institute property.

Tenders for the new building came in considerably higher than expected. $553,000 was available but the lowest tender was $651,645, which with architect fees etc. would bring the total to $716,645. Scraping together additional commitments from the IODE, Department of Health, Canada, and the Canadian Cancer Society, it was decided to proceed on the basis that "*foundations and bearing walls etc. were so constructed that in the future, floors could be added to the proposed building to make continued expansion practicable.*

More space and facilities were absolutely necessary to overcome the crowded and unsatisfactory conditions prevailing now. The Building Committee had tried to look 20 to 30 years ahead in the basic construction of the building." [32] Construction began on May 21st 1951.

Author's Note
The Nuclear Age

For most cancer patients, the nuclear age began with radioactive cobalt and the betatron. However, the search by physicists to split the atom more easily led to the need to accelerate particles at much greater speeds. In the 1930s the electrostatic generator, which created enormous electric charge and the cyclotron, which accelerated particles in a circular fashion were developed.

The former was an early high-energy machine and the latter produced neutrons and later pions, which were pioneered in Vancouver.

The betatron used a powerful magnetic force. Developed in 1941, the first treatment was carried out by its inventor, WD Kerst, on one of his graduate students with a brain tumour. These instruments were cumbersome and expensive compared to the more versatile cobalt and linear accelerators.

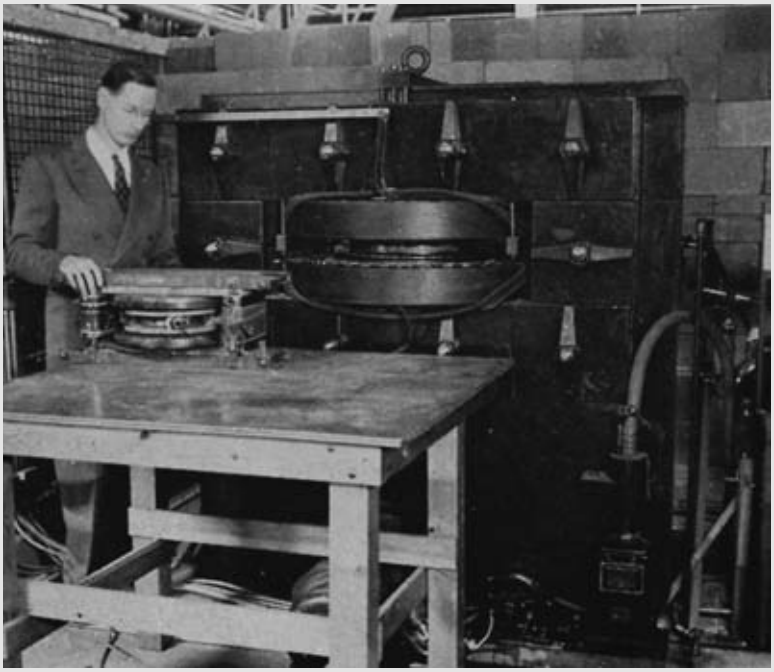


Fig 32 WD Kerst with the prototype betatron built at the GE Research Labs in Schenectady in 1941 (From The Trail of the Invisible Light, Grigg, ERN, p341 with permission of Lea & Febiger)

Cobalt Teletherapy

Cobalt (mixed with Silver) is the mineral that gave its name to the mining boomtown in Northern Ontario. Cobalt was used in the ceramic industry, in the development of jet engines, in the manufacture of cutting tools, and as cobalt 60 in radiation treatment. During the Second World War, cobalt 60 was produced at the Canadian heavy-water reactor at Chalk River, Ontario. Following the war, two teams of researchers set to work to develop a radiation treatment machine. Dr Harold Johns and his team at the University of Saskatchewan used a cylindrical source. They completed the first radiotherapy unit on August 18th 1951. The second team of engineers at the federally supported Eldorado Mining and Refining Limited, in cooperation with Atomic Energy of Canada, and Dr Ivan Smith at London's Victoria General Hospital, worked to produce a commercially viable unit. This unit, the Eldorado A, treated its first patient on October 27th 1951. The Vancouver unit, the second commercial unit to be manufactured, began treatment a year later.

Linear accelerators (Linacs)

Microwaves produced by a Klystron (developed by the Varian brothers in Palo Alto, California in 1938), so important in radar, TV, communications and the kitchen, are the source of the beam on which electrons are accelerated to high speed. The electrons are carried forward like a surfer on the crest of an ever-accelerating wave and are made to strike a target and emit high energy X-rays. Able to rotate around its axis, and with a fully maneuverable treatment couch, the maneuverability of the linear accelerator, allows treatment to be delivered with great accuracy. The first medical linac was installed at the Hammersmith Hospital in London in June 1952; the first American linac at Stanford in 1955. The first linac treatment in Vancouver was in December 1978.

Cobalt Ushers in the Megavoltage Era

In his report to the Board on September 7th 1949, Dr Evans wrote, *"A great deal of interest is now being centered round the use of radioactive cobalt in the form of what has been called a "bomb". This will eventually replace radium for this type of treatment and will be much cheaper. I believe consideration should be given to the use of radioactive cobalt and the use of radioactive isotopes. The latter should be used in co-operation with the BC Medical Research Institute and the Medical School of the University of British Columbia. Last week, I attended a series of lectures on the use of radioactive isotopes at the University of California in San Francisco and was very impressed by what I saw, especially the moving pictures of the atomic bombs exploding at Bikini and the destruction at Hiroshima. Such an awe inspiring demonstration of what*

Fig 33. Vancouver's first Cobalt unit, Eldorado A. The world's second commercial unit. Miss Findley, Dr Evans and Dr Batho prepare a patient for treatment. Dr Harold Johns in Saskatoon had built the first cobalt treatment unit in August 1951. Dr Ivan Smith in London Ontario, supported by The Eldorado Mining & Refining Co. Ltd., produced a commercially viable unit in October 1951.

an atomic bomb can do gives one a healthy respect for the various rays the physicists have produced for us. Any programme, therefore, which is set up to administer isotopes must be done with the greatest care." [33]

As the plans for the new building were proceeding, attention turned to the new equipment that would be required. In April 1950 Dr Evans reported that "*it is proposed to have the latest form of radiation equipment, such as supervoltage X-ray therapy equipment, a Cobalt 60 Beam Therapy apparatus and possibly a Betatron.*" [34] The following April, the choice had been made and a Cobalt 60 Beam Therapy apparatus was ordered at a cost of $44,000 with an additional $1,430 for accessories and annual maintenance of $5,000, which would include replacement of the cobalt source every five years. Cobalt was preferred to a Million Volt General Electric unit that was twice as expensive needing tube replacement at an estimated annual cost of $6-7,000.

In the interim, a Westinghouse 250KV constant potential X-ray therapy machine had been proposed in May 1951 for $17,428 including 3% provincial tax. The price was $2,000 more than that quoted 4 months earlier. Later in the year attention was turned to a GE 250KV and a Picker 270KV machine at $17,000 and $22,000 respectively. This was done because of potential servicing problems with the Westinghouse machine, and led to the purchase of the Picker equipment.

Early in 1952, the small room on the third floor of the old building, part of the original house which had been used as a nurses' lounge, was refurbished for the housekeeping and maintenance staff. Dr Stewart Jackson recalls, that shortly after arriving in Vancouver in November 1974, on visiting the maintenance staff in the room they called the "penthouse", an older visitor in his seventies arrived, just to look at the room where he had been born.

At the beginning of 1952, with expected expansion of the Institute's staff and equipment, it was recognized that the responsibilities of management were widening and a larger and more active executive body was required. With added membership, the Executive Committee of the Institute was changed to that of the Executive Committee of the British Columbia Cancer Foundation. The budget for 1952-1953 was set at $272,860 and included $226,128 for the Institute, $34,204 for the Boarding Home, $5,328 for the Consultative Cancer Services and $7,200 for the Victoria Cancer Clinic. The budget was submitted to Victoria for approval and subsequent submission to Ottawa.

The Cobalt 60 Unit, ordered from the Eldorado Mining and Refining (1944) Limited, arrived in September 1952. It was hoped to have it in operation by the end of October. This was the second commercial cobalt unit in the world; the first was installed in London Ontario in October 1951. Six month's salary at a total cost of $1,500 was set aside for the necessary measurements on the Cobalt Unit to be undertaken by Physics staff. Assisting with its installation was a young physicist, Raymond Bush, who would later study medicine and become Director of the Princess Margaret Hospital in Toronto.[35]

By the end of December 1952, twenty-eight patients had received cobalt treatment. When word spread early in 1953 that the BCCI had cobalt treatment available, Dr Evans received correspondence from patients and physicians asking if it would be helpful for them. If so, it was asked, could the treatment be provided in Vancouver? Many enquiries came from Washington, Oregon, and elsewhere in Western Canada. Most of the clinical situations were far advanced, and cobalt offered no advantage. Dr Evans later described the advantages of cobalt as "*Skin reaction is a great deal less than on medium volt X-ray therapy machines. The absorption of X-rays in bone is less…this is a great advantage in cancer of the mouth, where the X-rays pass through the mandible. There is less tendency for bone damage at a later date with cobalt. It cannot be stated conclusively that better survival figures will be obtained from the cobalt.*" [36]

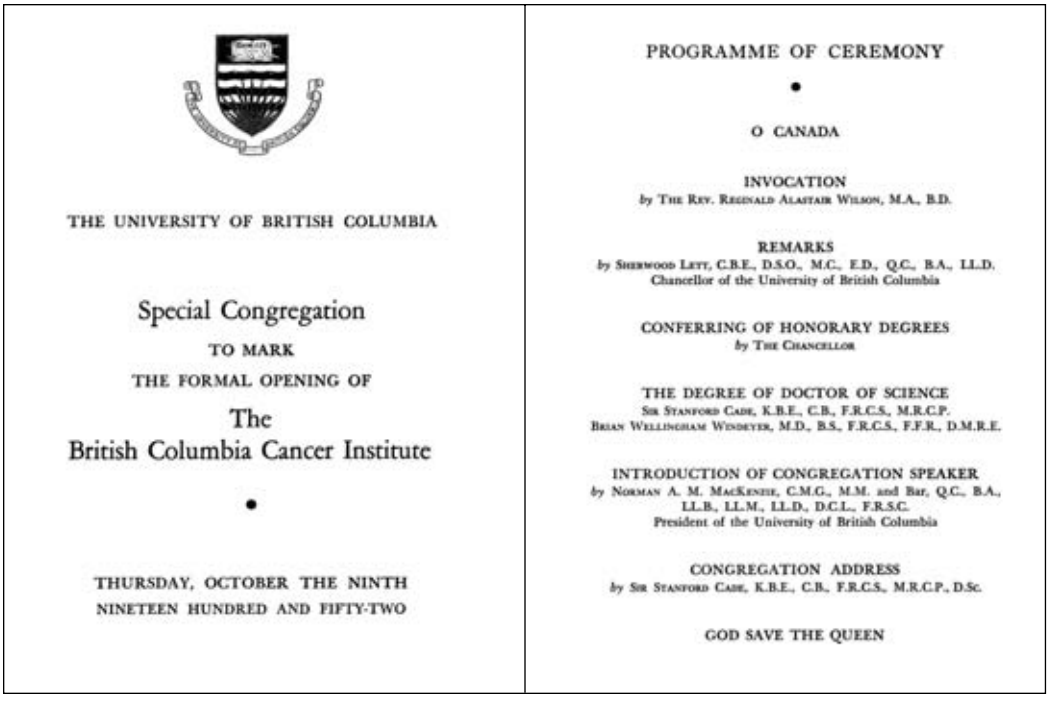
The Heather Street Building Opens

Plans were completed for a grand opening of the new building in October 1952. Sir Stanford Cade and Professor Brian Windeyer had accepted invitations to take part in a refresher course as part of the ceremonies and be present at the official opening. The University of British Columbia agreed to a suggestion by Dr Evans to confer honorary degrees on the two dignitaries. It was expected that the building would be ready for occupancy by April 30th 1952, even though the elevator would not be installed by then, nor would the Cobalt 60 Beam Therapy Unit. As a result of strike action in the summer, there was even concern that the building would not be completed in time for the official opening. However, all was ready in time. The official opening ceremonies took place at a public meeting in the ballroom of the Hotel Vancouver on Monday 6th October. The programme was opened at 8:15pm with an invocation by Sir Francis Heathcote. Members of the platform party were asked to wear black tie. Dr JJ McCann, Minister of National Revenue, gave an address in place of the Honourable Paul Martin who was unable to attend. The Lieutenant Governor declared the building open. The Kitsilano Boy's Band played during the evening. The President and Past Presidents of the Foundation were hosts at a reception in the Social Suite of the Hotel after the public meeting. Thursday October 9th was set aside for the conferring of honorary degrees by the University of British Columbia on the two guests from Britain. The following citations were delivered at the convocation.

SIR STANFORD CADE

Mr. Chancellor, I have the honour to present for the degree of Doctor of Science, honoris causa, *Sir Stanford Cade, a most distinguished surgeon, medical administrator and research scientist, who manages to combine a rare faculty for creative research with that of recognizing and stimulating the research capacities of others. The author of many publications dealing with surgery and the use of radium, he has played a pioneer's – and more than a pioneer's – part in the world-wide attack against the ancient and terrible scourge of cancer. As a scientist he has given gener-*

Fig 34. Sir Stanford Cade receives the honorary degree of Dr of Science from the Chancellor of the University of British Columbia.
In his congregation address Sir Stanford spoke of "Cancer — a Challenge to Mankind".



THE UNIVERSITY OF BRITISH COLUMBIA

Special Congregation

TO MARK

THE FORMAL OPENING OF

The

British Columbia Cancer Institute

•

THURSDAY, OCTOBER THE NINTH

NINETEEN HUNDRED AND FIFTY-TWO

PROGRAMME OF CEREMONY

•

O CANADA

INVOCATION

by THE REV. REGINALD ALASTAIR WILSON, M.A., B.D.

REMARKS

by SHERWOOD LETT, C.B.E., D.S.O., M.C., E.D., Q.C., B.A., LL.D.
Chancellor of the University of British Columbia

CONFERRING OF HONORARY DEGREES

by THE CHANCELLOR

THE DEGREE OF DOCTOR OF SCIENCE

SIR STANFORD CADE, K.B.E., C.B., F.R.C.S., M.R.C.P.
BRIAN WELLINGHAM WINDEYER, M.D., B.S., F.R.C.S., F.F.R., D.M.R.E.

INTRODUCTION OF CONGREGATION SPEAKER

by NORMAN A. M. MACKENZIE, C.M.G., M.M. and Bar, Q.C., B.A., LL.B., LL.M., LL.D., D.C.L., F.R.S.C.
President of the University of British Columbia

CONGREGATION ADDRESS

by SIR STANFORD CADE, K.B.E., C.B., F.R.C.S., M.R.C.P., D.Sc.

GOD SAVE THE QUEEN

Fig 35. The official congregation programme to mark the opening of the British Columbia Cancer Institute.

ously of his own knowledge and energy; as a medical administrator he has co-ordinated and directed the efforts of others throughout the Commonwealth and Empire. Like the fabled Prometheus, his hands wield for mankind's sake the potent and mysterious elemental fires, and it is our pleasure at this time to offer the unconstraining shackles of honorary membership in this University, to this Titan among surgeons, and pioneer in a rapidly developing frontier of human welfare.

BRIAN WELLINGHAM WINDEYER

Mr. Chancellor, I have the honour to present for the degree of Doctor of Science, honoris causa, *Brian Wellingham Windeyer, Director of the Meyerstein Institute of Radiotherapy and Professor of Therapeutic Radiology in the University of London. A graduate of the Medical College of the University of Sydney, Dr. Windeyer has had a brilliant career as research scientist and as pathfinder in medical education. Possessed of exceptional qualities of imagination, mind and heart, he has devoted those qualities to the development of a new branch of medical teaching, to the training of humane scientists, and to the alleviation of human suffering. In honoring him, the Senate of this University wishes to pay tribute to a medical scientist of great distinction, and a teacher of exceptional quality; and to recognize the contributions he has made in his life and work to the academic and practical use of radiotherapy.*

In his convocation address to the University of British Columbia, Sir Stanford spoke of "Cancer- a Challenge to Mankind". He described cancer as "*disordered life; an abnormal growth, monstrous in the unhappiness that follows in its wake…*" Sir Stanford commented on "*the word 'cancer' being coined by Hippocrates in 400 B.C. and that its existence had been recorded in the Ebers Papyrus as long as 3500 years ago.*"

Dr Cade went on to cite the family of Napoleon to exemplify hereditary cancer. "*The most notorious example of a familial tendency is that of Napoleon, who died at St Helena from cancer of the stomach.*

His father, Charles Bonaparte, his grand-father, Joseph Bonaparte, his brother Lucien and his three sisters, Pauline, Caroline and Eliza- all died of cancer of the stomach. It has been said that from his grandfather Napoleon inherited, not only a delicate oval face, blue-grey eyes, good looks and dictatorial tendencies but also a predisposition to cancer of the stomach." [37]

In describing the choice of treatment for cancer he went on to say "*It is this complexity which dictates the need for an Institute closely allied to a general hospital and preferably part of an University.*

Only this combination of University, Hospital and special Institute can provide the varied talent, the specialized knowledge, the technical facilities which form the team needed to offer the best possible chance to the cancer patient." The Congregation was followed by a tea for 500 guests prepared by the Women's Auxiliary and a tour of the Institute. Plans for entertaining the special guests included Mr HS Foley entertaining Sir Stanford Cade during the week before the opening while Professor Windeyer was visiting his brother in Duncan on Vancouver Island.

The past presidents of the Foundation, the Vancouver Medical Association, Mr and Mrs Frank Ross, and the University, hosted various social occasions during the week, which included a very successful refresher course for members of the medical profession.

The week concluded with Cade and Windeyer attending a special meeting of the Board of the Foundation where they were asked for their opinions on the Institute. Sir Stanford Cade in his opening remarks emphasized, "*That we could rest assured that the British Columbia Cancer Institute was the best equipped in Canada both technically and spiritually.*" [38] For immediate attention he stressed the need for beds. Professor Windeyer in his remarks said, "*we had a good show because we had good people.*" [35] He also stressed the need for beds. He was impressed with the happy relations between the Institute and general surgeons, but felt relations with Ear, Nose and Throat (ENT) and Orthopaedics could be improved.

The Building Committee was asked what it intended to do with the plaque at the old entrance of the Institute. The Committee considered replacing the original plaque to the anonymous donor by a bronze plaque at the new entrance. However, the relatives of the donor were not happy with this plan and it was still under consideration at the time of the opening.

The Staff Grows

At the close of the "early days" and with the opening of the new clinic the staff numbered 52 including four radiotherapists with certification, two full-time physicians and two physicists. The technical staff included eleven radiological technicians, five registered nurses in the Out-Patients Department, four registered nurses in the Boarding Home, laboratory staff, a clinical photographer, two qualified social workers, medical records and statistical clerks (who abstracted data from the clinical records onto cards for future statistical analysis), and stenographers.

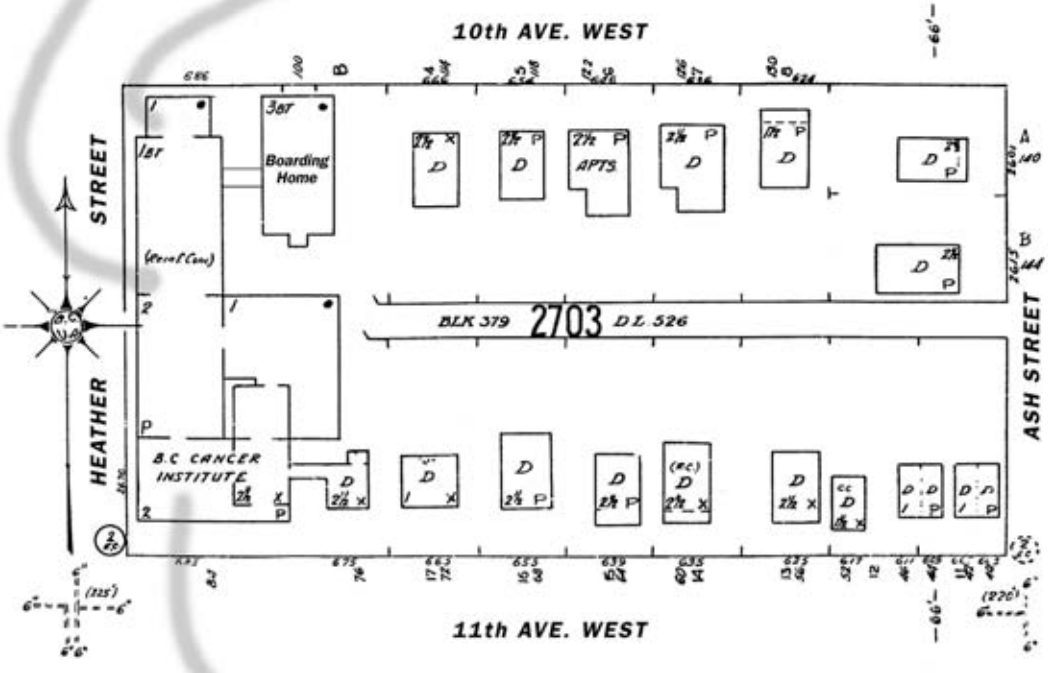
Fig 36. The staff of the British Columbia Cancer Institute circa 1952, pictured in front of the Healther Street entrance of the newly opened expansion. Miss Findley and Dr Evans are seen on the back row under the "C" of Cancer.

References for Chapter 2

1. British Columbia Cancer Institute. Brochure to commemorate the opening of the new building. Vancouver, B.C.: British Columbia Cancer Institute, 1952. (BC Cancer Agency Archives)
2. BC Cancer Foundation, Minutes 1935 (Jun 12). (BC Cancer Agency Archives Box 7, UI 200)
3. BC Cancer Foundation, Annual Report 1970, Report of the Director. (BC Cancer Agency Arhives)
4. BC Cancer Foundation, Campaign Committee. British Empire Cancer Campaign 1935-1947. (BC Cancer Agency Archives Box 40, UI 1198, File #1)
5. Brown E. Vancouver fights cancer. Vancouver Province, Saturday Magazine 1938; (Jan 29):1. (City of Vancouver Archives 535-D-5 File 32)
6. BC Cancer Institute, Board of Management and Honorary Consulting Staff, Minutes 1939 (Sept 20). (BC Cancer Agency Archives)
7. BC Medical Association. Committee on the Study of Cancer, Minutes (B C Medical Association Archives)
8. Anonymous bequest. (BC Cancer Agency Archives Box 8 UI 270)
9. BC Cancer Institute, Board of Management, Minutes 1938-1941. (BC Cancer Agency Archives Box 19 UI 928)
10. Correspondence regarding first staff appointments to the Institute, 1938-39. (BC Cancer Agency Archives Box 20 UI 938)
11. Boyes DA. Personal communication 2001.
12. BC Cancer Foundation, Annual Report 1975.
13. BC Cancer Institute, Medical Records 1938 (Nov/Dec) (BC Cancer Agency Surrey Warehouse)
14. Beck RE, Personal communication 2001.
15. Anonymous. Obituary: Tchaperoff IC. Can Med Assoc J 1954; 71:508.
16. BC Cancer Foundation, Board of Directors, Minutes 1941 (Jun 20). (BC Cancer Agency Archives Box 24, UI 992, Box 25 UI 997)
17. BC Medical Association correspondence 1938-1943. (BC Cancer Agency Archives Box 19, UI 928)
18. BC Cancer Institute, Honorary Attending Staff, Minutes 1942 (May 11). (BC Cancer Agency Archives Box 3, UI 101)
19. BC Cancer Institute, Board of Management Report to the Board of Directors, BC Cancer Foundation 1940. (BC Cancer Agency Archives Box 19, UI 928)
20. Ibid. 1942 (Mar 30)
21. BC Cancer Foundation, Board of Directors, Minutes 1943 (Apr 13). (BC Cancer Agency Archives Box 24, UI 992; Box 25, UI 997)
22. BC Cancer Foundation, Board of Directors, Statement to the Minister of Health, July 10, 1944. Correspondence (BC Cancer Agency Archives Box 24 UI 992; Box 25, UI 997)
23. BC Cancer Institute, Board of Management, Minutes, 1944 Aug 3, Volume II. (BC Cancer Agency Archives Box 20, UI 938)
24. BC Cancer Foundation, Board of Directors, Minutes, 1948 (Apr 29) and 1948 (Nov 19). (BC Cancer Agency Archives Box 24, UI 992)
25. BC Cancer Institute, Executive Committee, Minutes, 1945-48, volume III. (BC Cancer Agency Archives Box 20, UI 950)
26. Anonymous. Institutions conducting cancer clinics which are approved by the College. Bull Am Coll Surg 1949 (Dec).
27. Goodman GB. Personal communication 2001.
28. Mayot GF. Correspondence. Letter to Dr. HH Milburn, Chairman, Committee from Dr. G.F. Amyot, Deputy Minister of Health, 1949 Sep 27. (College of Physicians & Surgeons of BC Archives File #174)
29. College of Physicians & Surgeons of BC, Council, Minutes, 1949 Oct 1. (College of Physicians & Surgeons of BC Archives File # 156)
30. BC Cancer Foundation, Minutes, 1950 Mar 17. Report of the Medical Director of the BC Cancer Institute. (BC Cancer Agency Archives Box 24, UI 992)
31. Report to the Board of Directors BCCF regarding the BCCI, April 21, 1949. (BC Cancer Agency Archives)
32. BC Cancer Foundation, Board of Directors, Minutes, 1951 Apr 27. (BC Cancer Agency Archives)
33. BC Cancer Foundation Board of Directors Minutes, 1949 Sep 7. Report of the Medical Director, BC Cancer Institute. (BC Cancer Agency Archives)
34. Report of the Medical Director to the Attending Staff April 21, 1950. (BC Cancer Agency Archives)
35. Goodman G. The evolution and development of radiation oncology in BC. In: Aldrich JE, Lentle BC, editors. A new kind of ray. Vancouver, BC: University of British Columbia; 1995. p. 176.
35. Report of the Medical Director to the Board of Directors, November 25, 1954. (BC Cancer Agency Archives)
36. Congregation Address; Special Committee, The Official Opening, Oct 9,1952. (BC Cancer Agency Archives)
37. BC Cancer Foundation, Board of Directors, Minutes, 1952 Oct 10. (BC Cancer Agency Archives)

1952

1966



1947

The city block bounded and the site of clinic extensions between 1947 and 1966. The 1966 photograph shows the Boarding Home added in 1955 and the Radiotherapy extension as well as the two floors added in 1959.

Chapter 3
British Columbia Cancer Institute 1953–1974

Centralization of Radiation Therapy Services

Although the British Columbia Cancer Foundation's (BCCF) avowed intent, supported by many, was to centralize cancer services, particularly radiotherapy, this was far from achieved in the 1950s and 60s.

With the establishment of cancer grants by the Federal Government in 1948, the BCCF was recognized as the agent for cancer control in the province. However, certain hospitals, with X-ray facilities and radium already in place, were allowed to continue offering treatment.

When St Paul's Hospital requested a 250KV machine in 1950, certain stipulations were made. The following points were agreed to: that records be made available to the Institute; that systematic follow-up be carried out; that fully qualified radiotherapists would treat; and that St Paul's would not expand its outpatient radiotherapy services. When a further request was made in June 1957 to replace a machine that St Paul's had purchased in 1935, the Department of Health asked them to review the original conditions set out in 1950. Surprisingly no record of these conditions could be found by the hospital.

On this occasion, before recommending any purchase, the following terms were laid down between the Foundation and the officials of St Paul's Hospital whereby closer co-operation between the two organizations would take place:

"1. *That twice weekly clinics shall be held at the Hospital at which clinics a radiotherapist from the Hospital and a radiotherapist from the Cancer Institute shall be present for the purpose of reviewing new and old cases of malignant disease;*
2. *That the opinions resulting from consultation at these clinics shall be given to the doctor referring the case;*
3. *That the patients seen at such clinics for whom radiotherapy is recommended shall be treated at the Hospital or at the Cancer Institute depending on the type of radiotherapy facilities required;*
4. *That follow up on all such cases shall be carried out at the Hospital;*
5. *That medical records on such patients seen at the Hospital shall follow the pattern of those done at the Cancer Institute, this to include the routine of follow-up procedure;*
6. *That a duplicate case history of such patients shall be prepared by the Hospital and shall be kept at the Cancer Institute;*
7. *That the services of special clinics held weekly at the Cancer Institute shall be made available to the Hospital – i.e., Nose and Throat Clinic, Clinical Meeting, Lymphoma Clinic, Head and Neck Clinic, Gynaecological Clinic and Breast Clinic;*
8. *That the Physics Department of the Cancer Institute shall supervise radiation protection at the Hospital and shall calibrate the x-ray therapy equipment at the Hospital as required;*

9. *That the purchase of all radiotherapy equipment for the Hospital shall be made only after consultation between representatives of the Hospital, the Foundation and the Health Branch of the Provincial Department of Health and Welfare;*
10. *That the terms of this agreement shall be reviewed at yearly intervals or earlier if necessary;*
11. *That this agreement may be terminated by either party by giving notice in writing to the other party to that effect."* [1]

Dr Evans later met with Dr Madill, director of the Department of Radiology at St Paul's, and determined that there was only need for the one piece of equipment installed in 1950 and if it broke down it could be repaired within three days. The consultative clinic services at St Paul's were never put in place. Radium continued to be used especially for carcinoma of the cervix and uterus. Both Dr Trapp, until she joined Dr Sadler at The Royal Columbian Hospital in New Westminster, and Dr Madill at St Paul's, carried out the treatments. Although Dr Madill had graduated from the University of Alberta in 1931, it was not until 1950 that he received certification in diagnostic and therapeutic radiology.

In January 1953, the Board of Directors of the Royal Columbian Hospital in New Westminster asked for funds to extend cancer services and therapy. The request was made on the grounds that the hospital possessed therapy units, (both deep and superficial), that New Westminster patients attending the British Columbia Cancer Institute were inconvenienced, and there was a natural desire of doctors in New Westminster to follow their patients as closely as possible. In response, the Institute offered to send a radiotherapist to tumour clinics to assess the needs in New Westminster. Dr Nash attended on Wednesday mornings, but patients were not seen at the clinics and no statistics were compiled. Within a year, the Royal Columbian Hospital had employed both Dr Trapp and Dr Sadler as radiotherapists and now wanted to treat the majority of New Westminster patients. Dr Sadler had an active practice in the treatment of benign conditions especially plantar warts. Most were treated with 300-350r that could be repeated once or twice at a fee of $5.00 per session. In addition, keloid scars, bursitis and arthritis were treated by X-rays. Treatment of the occasional skin cancer, postoperative breast cancer, as well radium for cervix cancer, was used until Dr Sadler's retirement in 1969. Both Dr Sadler and Dr Trapp carried radium in the trunk of their cars from hospital to hospital for use in their clinical practices. [2]

Dr Olive Sadler was born in Ottawa in 1898 but grew up in Victoria. She obtained a BA from the University of British Columbia in 1919 and a masters degree in bacteriology and chemistry in 1921. She was married and widowed at an early age. Dr Sadler turned to medicine in the late 1930s, qualified from McGill in 1940 and interned in San Francisco. She received certification in therapeutic radiology in 1949 following three years training in various centers in the United States. In addition to her career as a physician, she was actively involved in the Canadian Federation of Medical Women, the Red Cross, St. John Ambulance, the British Columbia Medical Association, the Anglican Church, the Vancouver Art Gallery and the Society for the Prevention of Cruelty to Animals. [3] Dr Sadler died in September 1975 at the age of 77.

The British Columbia Cancer Foundation continued to maintain that treatment of malignant disease should be centralized as far as possible. It was felt that more publicity relating to the procedures available at the Institute would be beneficial, that the lack of beds was a serious drawback, and that more statistical information should be gathered before any direct or indirect support of treatment at the Royal Columbian Hospital be given.

Nothing more was heard until March 1960 when the Board of the Royal Columbian Hospital wrote requesting support and funds including:

1. *Recognition of the Therapy Unit at the Royal Columbian Hospital;*
2. *Degree of cooperation necessary to assure the best possible treatment for all patients suffering from malignant disease;*
3. *Financial support in the expansion and maintenance of the Unit.*" [4]

The response of the BCCF Executive Committee was exactly the same as that which they had proposed to St. Paul's Hospital two years before. It was also pointed out that, "*the amount of work to be done for malignant cases at the Royal Columbian Hospital did not justify extension of its radiotherapy department beyond its present scope.*" [5]

The Royal Columbian Hospital did not accept the eleven points proposed but rather wanted vacation coverage for Dr Sadler. The Foundation advised a delegation from the Royal Columbian Hospital that, "*financially we are unable to help due to the constant problems within our own budget and in the face of the Foundation's five year plan for expansion in the interests of centralization so that cancer sufferers would have the best equipment and personnel available to them.*" [4] In June of 1964 the Hospital, having purchased a replacement for their 400KV machine that had become obsolete, requested support from the Foundation. The hospital was also asking for financial assistance from the BC Hospital Insurance Service to permit installation and operation of the new machine. The Foundation replied that they had no authority to "recognize" or "approve" any institution as having any particular status or standard in the field of medicine.

In the fall of 1953, the Trail-Tadanac Hospital had also asked for funding for a replacement 250KV X-ray therapy machine. The existing equipment had been installed in 1938 and it was questionable whether it would withstand a move to the newly built hospital. Upon recommendation of the radiologist, Dr FL Wilson, Miss Eidt, Superintendent of the Hospital, asked for purchase of a 250KVP Constant Potential Unit. The Expansion committee of the BCCF responded in a report to the Board in September 1953. "*The committee is fully aware that the general policy of the foundation is against the wide dispersion of therapy services and that supporting this request may make it difficult to refuse help to other hospitals. Points in support of the request, however, are:*

1. *The great distance which patients have to travel from the Kootenays to Vancouver for treatment.*
2. *The hospital already has a therapy machine and the new one would be used in a similar manner for superficial and some deep x-ray and palliative treatment.*
3. *The hospital has a qualified Radiotherapist.*
4. *The hospital intends to use an x-ray therapy machine in any event.*

After further discussion, it was duly moved, seconded and carried that the expansion committee reaffirms the policy of centralization for treatment of malignant disease as set out by the British Columbia Cancer Foundation: however, due to the local circumstances that radiotherapy has been established for some time in the Kootenays and is under a qualified radiotherapist, this committee supports the continuation of such a service as at present in existence and recommends that a portion of the cost of new equipment requested be provided by cancer grants (it should be clearly understood that this portion of the purchase from the cancer grant be relative to the number of malignant cases so treated)." [6]

Radiation treatment in Trail can be traced back to the early part of the century. Dr WA Coughlin, born in Russell Manitoba and a graduate of the University of Manitoba in 1908, studied radiology at the Mayo Clinic in 1911-1913 and brought back to Trail the first modern X-ray machine. Following the Great War he took further training in Oxford from 1917-1920. He practiced, until his death in 1951, in the CS Williams clinic in Trail, where superficial X-rays were used to treat eczema, acne and the thyroid. Dr Frank W Wilson, born in Vancouver, son of a physician, qualified from McGill and

undertook radiology residency at the Royal Victoria Hospital, Montreal from 1945-1947. He was the first Trail physician to receive certification from the Royal College, obtaining certification in Diagnostic and Therapeutic Radiology in 1947. Dr Wilson practiced in the CS Williams clinic and delivered radiotherapy using orthovoltage radiation. Radiotherapy in Trail ended with his retirement in 1971. Dr Wilson died in 1982[7]

The Vancouver General Hospital continued to offer X-ray treatment for benign conditions and the occasional malignancy until the 1960s. On at least one occasion Dr Sadler attended with Dr GG Smith to carry out a radium insertion for a patient with stage II cervix cancer. The VGH records at that time were type written and provide evidence of more careful follow up of patients.

In January 1962, the Administrator of the Kelowna General Hospital wrote enquiring about the possibility of including a Radiotherapy Department in a building programme being considered for the hospital. Dr Evans met with the medical staff and explained the need for a sufficient population base for radiotherapy. The hospital agreed that no provision for radiotherapy services would be made at the present time.

In 1966, the president of the medical staff of the Royal Inland Hospital in Kamloops, Dr HOL Murray, wrote to Dr Evans suggesting that Kamloops would be the natural site for a third cancer clinic in the interior of the province. The Executive reiterated its view that a third cancer treatment centre would be dependent on a minimum population of 500,000, stating "*the matter be reviewed from time to time and that in all probability a third cancer treatment centre might be justified in five years time.*" [7]

With the retirement of Dr Madill from St Paul's in 1968 and Dr Sadler from the Royal Columbian at the end of 1969, both institutions found themselves unable to maintain a radiotherapy department and accepted that their patients would need to come to the BCCI for treatment. Dr Evans established a weekly clinic at the Royal Columbian Hospital and made arrangements with the Canadian Cancer Society, BC and Yukon Division, for transport to be provided for New Westminster patients coming to Vancouver.

And so it was that centralization came about, not through acceptance of the Foundation's centralization policy, but from a lack of funding and the retirement of radiotherapists who had continued private practice for thirty years after the opening of the British Columbia Cancer Institute. Almost all the requests for funds and support that the Foundation received from outside hospitals were denied because the Institute itself was always short of funds. Every cupboard and chair, every piece of equipment, however small, had to be sanctioned by the Foundation's highest committee. Requests for leave of absence by physicians and physicists to attend scientific meetings and the attendant expenses had to be approved, not by the Director, but by the Executive Committee of the Foundation. Victoria stayed within the aegis of the Foundation and centralization of services, not because it was the capital city, but largely because of the perseverance of Dr HH Murphy. (See Chapter 5)

Centralization referred to radiotherapy. With the exception of major surgery in gynaecology, and to a lesser extent ENT, surgical services were never centralized. Drug therapy, as it became available, was from its inception, prescribed not only in the BCCI and the Victoria Clinic but also throughout the province.

During the 1990s, the process of centralization of radiation treatment in just two centres began to be reversed with radiation based cancer clinics opening in the Fraser Valley (1995) and the Okanagan (1998).

Full centralization of radiation and drug therapy programs in BC was not officially established until 1997, when central administration and responsibility for policy and practice was centralized within province-wide Radiation and Systemic Therapy Programs.

Review of the Organization of Therapy Services

Throughout the 1950s, several multidisciplinary weekly clinics were established involving the attending staff and the radiotherapists. The ENT clinic on Monday morning was initiated in the fall of 1951, the Gynaecology and Lymphoma clinics, the Head and Neck clinic on Thursdays in 1954. The first combined Breast clinic began in October 1957 and the Urology clinic in 1959. A Gastrointestinal clinic was added in 1975.

The Minutes of the Honorary Attending staff from 1955 though 1957, however, reveal unease. There was criticism expressed from outside doctors. It was frequently felt that Institute patients were being directed into the hands of the Vancouver General Hospital staff. It was also felt that, from time to time, there was unfair distribution of consultative work. The service provided by the attending staff was given "*entirely without remuneration*" and some "*discontent was becoming evident.*" A committee was established "*to gather together information regarding the monetary value of professional work done by the attending staff of the British Columbia Cancer Institute.*" At the same time the number of patients receiving treatment by X-rays or cobalt was on the decline from 1275 in 1955 to 1115 in 1957.

As a consequence, Dr Ralston Paterson of the Christie Hospital and Holt Radium Institute in Manchester, England, was asked, "to review the Foundation's organization of therapy services". Dr Trapp's friendship with Ralston Paterson is evident in their correspondence prior to his visiting the BCCI in October 1957.

Paterson wrote on the 4th February 1957,

"*I have had a very warm and cordial invitation from J.H.Lamprey The President of your British Columbia Cancer Foundation, to visit. The reasons are;*

a. *Participant in post-graduate course to the Medical profession.*
b. *Survey of the Foundation's organization of therapy services.*

I wonder if you could let me know purely informally and unofficially

1. *Are you behind this invitation or is it spontaneous?*
2. *Can you give me any ideas as to what the real task would be?*" [8]

Trapp responded on the 9th of February,

"*Your letter of February 4th arrived yesterday and I am going to find it difficult to answer. Too much background — problems building up over a period of years — anyway I will begin with your questions.*

1. *I am not behind the invitation in the sense you mean. The idea that somebody from the outside could be a help in smoothing out a difficult situation and so improving the services of the Institute really came from organized medicine, specifically the Board of Directors of the British Columbia Medical Association. When it was put to Max [Evans] by his Board of Directors he asked to have you — a suggestion which I naturally supported as did the other medical members of the Board. At the same meeting it was suggested that a Canadian Doctor might be asked to accompany you — somebody familiar with the Canadian scene such as Harold Warwick or Clifford Ash.*
2. *The real task is I think improving public relations — i.e. with the rest of the Medical Profession. The number of patients admitted to the Institute has been falling off, and this disturbs the Board of Directors as well as the Provincial Department of Health which underwrites 80 to 90% of the running expenses of the Institute.*

The present crisis was precipitated by the forced resignation of the Associate Director, Bob Moffat, who had been vocally critical of the Radiotherapy as practiced at the institute — and also the Medical Manage-

ment of patients — His letter of resignation was quite specific on these points. As you may guess, a clash of personalities was also involved. The over all result has been unhappy working conditions at the Institute and a discontented Honorary Attending Staff (about 150 specialists, mostly surgical.)"

In a follow up letter on May 3rd, Dr Trapp further wrote,

"*I have procrastinated about this letter because I hardly know what to say. The difficulties at the Institute have been building up over some years and came to a climax when Dr Moffat* [chapter 3 p 65] *resigned stating he had been prevented from doing his job in a conscientious fashion. One of his main complaints was that he was doing follow-up examinations and little treatment and that Dr Nash on the other hand was doing most of the treatment and practically no follow-up. There were other complaints and a clash of personalities. Finally Max delivered an ultimatum and said if Bob didn't resign he would and so Bob did. Then Bob took the matter to the B.C. Medical Association through one of its sections. Following this, Mr. Lamprey, the President of the Foundation met with the Board of Directors of the B.C. Medical Association and there were subsequent meetings with his own Board. The outcome of all this was Mr. Lamprey's letter to you.*

I, myself, am in no position to give an opinion about the radiation therapy at the Institute because I have had no connection with it since 1945 when I resigned to give the job back to Max on his return from Overseas. Since then my association has been as a member of the Board of Directors and of the Honorary Attending Medical Staff so that I am only at the Institute to attend their respective meetings. Perhaps this will explain why it is difficult for me to help you." [8]

After spending five days at the Institute, Dr Paterson attended the BC Cancer Foundation Board meeting on October 11th 1957 and his remarks were reported as follows; "*he felt privileged to visit with the members of the Foundation and to observe the work done here. He congratulated the members on the magnificent Institute which they had established and of which they could be very proud. There were many facilities here which others in England and elsewhere could envy. He himself was extremely jealous of some of these facilities. There were some aspects of the service which were not yet complete but doubtless the Board was fully aware of them.*

He was very pleased to see the integration between the Cancer Society and the Cancer Foundation, the one undertaking the education of public and professional people, the other sponsoring the active treatment of the cancer patient.

He said he would like to make certain proposals to both the Executive Committee and the Board of Directors. These were made in no spirit of criticism but rather as an analysis of the work of the Foundation which they were setting out to accomplish. The first suggestion was that it would be worthwhile to have a Medical Policy Committee which could review the position from time to time and could work out medical proposals which might come to the Directors. The second concerned the work of the Foundation as a whole where two activities had been undertaken – that of cancer diagnosis and that of treatment. It seemed to Dr Paterson that these two activities should run as separate departments. He felt that the Radiotherapy Department should be a separate unit from the Diagnostic Department and should be the main function of the Institute. At present, the Institute had a very fine radiotherapy unit, including chemotherapy and hormone therapy. The equipment was excellent and radiotherapy should continue to be the primary work of the Foundation.

Radiotherapy, according to Dr Paterson, was a branch of medicine which needed to be centralized. However, such centralization must be instituted gradually. Good work was being done at other hospitals at the present time. While it would be an advantage to have such centralization, unification must proceed slowly.

The quality of the work would make centralization inevitable. The work of the radiotherapy service at the Institute was very good but Dr Paterson felt that there were some things which could be improved. In the internal organization of the Institute, he had made suggestions to the Director in view of these needs. He felt that more senior staff was needed. Too much work was now expected from the present staff. Also hospital beds were badly needed. As the situation was at present, it did not make for good working conditions. Dr Paterson strongly recommended more staff and more beds. He felt that coverage of the outside areas of the Province by Cancer Clinics should be reviewed. These should be thought of as radiotherapy clinics where consideration of radiotherapy for the patient was the prime concern. He congratulated the Foundation on the consultative cancer services which they had established.

In conclusion, Dr Paterson said he intended no criticism whatever in these remarks but rather he wished to stimulate the Foundation to do more. He said that the Institute could and must offer first class radiotherapy to the whole community." [9]

Following Paterson's visit Dr Evans reported to the Eighteenth Annual Meeting of the Attending Staff on November 25th 1957,

"*May I now refer briefly to Dr. Ralston Paterson's visit here in October. As a result of some opinions and a letter that I wrote to Mr. JH Lamprey, the President of the British Columbia Cancer Foundation on November 27th 1956, the Directors decided that it would be profitable if some outside expert was invited to review the operations of the Foundation. Accordingly Dr Paterson was invited to spend five days with us. Dr Paterson submitted a report containing recommendations to Mr. Lamprey. One of these recommendations concerning a Medical Policy Committee is now being acted upon. The others are not being dealt with at the moment. At a meeting of the Executive Committee of the Foundation held last Wednesday, November 20th 1957, it was decided that before making any changes in our organization or structure, I should spend six weeks during January and February 1958 visiting cancer centers in Great Britain, the United States and Canada. The object of the trip being:*

1. *To look into administration and the methods of handling patients.*
2. *To learn about new developments in radiotherapy.*
3. *To look for two radiotherapists to meet our present and future needs.*" [10]

No further comment was made except for an announcement that, arising out of Dr Evans' visit to the UK, Dr GB (George) Goodman had been appointed as a replacement for Dr Moffat who had resigned in January 1956.

Dr Moffat moved to Edmonton where he was active in nuclear medicine and a founding member of the Society of Nuclear Medicine. His photograph appeared on the cover of the Twenty-fifth Anniversary publication of the Journal of Nuclear Medicine in April 1984 (See below). Dr Moffat qualified in 1934 in Manitoba and after five years in general practice, trained in radiotherapy, receiving DMRE Cambridge in 1942. After his retirement in 1974 Dr Moffat returned to Vancouver and died in January 1990 at the age of 81.

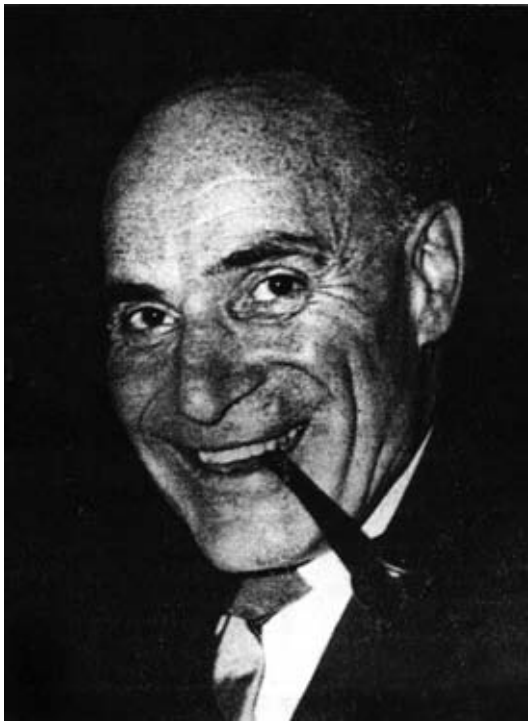


Fig 37.
Dr Robert Moffat

British Columbia Cancer Institute: Treatment Results 1946-1954

The analysis of five year results of patients treated from 1946 to 1954 was published in 1961 by Evergreen Press Ltd in Vancouver as: *British Columbia Cancer Institute: Treatment Results-1946-1954; Policy-1961*: Author A Maxwell Evans, Director, British Columbia Cancer Institute; Clinical Assistant Professor, Department of Surgery, University of British Columbia.

The book recorded the 5 year crude and corrected survival rates by anatomic site for 5,685 patients treated by radiation alone or following surgery between January 1946 and December 1954. An additional 1,869 patients were seen for follow up only. The results were tabulated and general comments made regarding each site. The use of radiation was mentioned, but the book offered scant information relating to technique, dose or fractionation. However, the case distribution and patterns of referral

Fig 38. The Radium Room. Nurse Technician Dora Greenwood (King) prepares to place a radium needle in the lead and steel transporter held by Florence McDonald in preparation for transfer to the operating room.

were clearly evident. In addition, at the completion of each of the book's twenty chapters, the treatment policy of the Institute as practiced in 1961 was described. Some more information regarding radiotherapy practice was included in these sections of the book.

The crude 5-year survival rate for the 5,685 patients treated between 1946 and 1954 was 51%.

The following are some examples of treatment results and recommended policies included in the book.

Breast Cancer

Eight hundred and sixty eight patients were listed with a crude survival rate of 48% at 5 years. Of the 538 who underwent radical mastectomy all but 28 also received radiation. The policy recommended in 1961 arose from a joint surgical and radiotherapy clinic initiated four years previously. If clinically operable, with no palpable axillary nodes, and a positive biopsy on rush section, radical mastectomy was to be done. If glands were palpable, biopsy of the apex of the axilla and internal mammary chain was recommended. If these were positive radiation alone was recommended. No dose or fractionation prescription was given.

Skin Cancer

The 1,876 patients with skin cancer represent one-third of all patients described. Those treated by radium had a surface mould or interstitial implant. The dose used being *"in the order of 6500r in 7 days"*. The majority of patients were treated with 100KV X-ray therapy to a dose of 3600-4000r in 5 to 10 days. (Although most skin cancers are now treated by non-radiotherapeutic means, if radiation is used, the dose chosen using X-rays has changed little in 50 years).

Gynaecological Cancers

Female cancers appeared prominently in the statistics for these early years. Five hundred and sixty-six cervix cancer patients, 142 endometrial and 121 ovarian cancer patients were listed.

For cervix cancer the crude five-year survival rate ranged from 74% for stage 1 to 10% for stage IV patients, with an overall crude survival at five years of 50%. Most patients (442) received both radium and X-rays whereas 83 received radium alone.

Analysis of the radium dose used, placement of the radium or stage of the disease failed to show any association with subsequent complications.

The 1961 policy for cervix cancer described the radium treatment as three insertions at 0, 7 and 21 days using 50mg of radium in the uterine applicator and 30 or 40mg in each of the vaginal applicators. Each insertion was of 24 hours duration. Direct readings of dose in the bladder and rectum were

Fig 39. Three radium tubes in a bakelite container made to conform with the "ovoid" shape designed to fit in the vaginal vault and deliver radiation dose in accordance with the "Manchester system". The strings attached make for easy removal from the vagina at the completion of treatment.

Fig 40. The Heyman technique. Kay Stanyev RN,RTT prepares radium for the Heyman capsules to be attached to the rack below her left hand.

taken and the dose to the anterior wall of the rectum at the level of the cervix was kept below 5500rads for the three insertions.

The total dose to point A (a standard reference point 2cm above and lateral to the cervical os) was approximately 5500rads.

Cobalt beam therapy to the pelvis was given after the radium was completed using anterior and posterior split fields with a 5cm central separation to a dose of 3500rads in 4 weeks.

Present day treatment is similar with the exception that remotely handled caesium is used rather than radium and high energy photons rather than cobalt.

For endometrial cancer, the policy in 1961 consisted of preoperative intrauterine radium using the Heyman technique (in which multiple sources are packed into the uterus) with 2 insertions 10 days apart. Vaginal radium was used in one of these insertions.

The surface dose in the uterus was in the order of 3400rads. Four to six weeks after the second radium treatment total hysterectomy and bilateral salpingo-oophorectomy was carried out.

Patients treated initially by surgery should have had post-operative vaginal vault radium, but no dose prescription was mentioned.

The majority of patients with ovarian cancer had advanced disease reflected in a 5-year crude survival rate of 33%.

Lung Cancer

Twenty-four of the 212 lung patients were female. Only 5 patients survived 5 years. This included 2 of 115 treated by radiation alone.

Forty years later almost as many women as men would require radiation treatment for this disease.

Fig 41. The "Pin and Arc" technique. Here being used on the Eldorado 8 cobalt unit in the treatment of lung cancer. Student Technician Ortiz, Nurse Greenwood (King), Dr Coy, Physicist Carolyn Stevens and Dr Evans from left to right.

Mouth and Upper Aerodigestive Tract Cancer

Of 834 patients, 424 had lower lip cancer almost all of whom were treated by radiation alone. Two hundred and forty of the lip cancers were treated by radium needling. 10mg needles were used inserted horizontally and 5 or 10mg needles were used for crossing the ends of the implant. The dose at 0.5cm from the plane of the implant was 2000-2300r delivered in a time of 4 to 4½hours. 147 patients treated

Fig 42. The chair in which patients received cobalt treatment for head and neck cancer using parallel opposed fields. With the advent of accelerators patients were treated lying on the treatment couch.

by X-rays received 200KV with lead protection for the teeth and a dose of 4000-5000r in 2 to 4 weeks. In 1961, the majority of patients were treated with 220KV X-rays, although the occasional patient was treated using radium. At this time low intensity needles were preferred using the Paterson-Parker system for calculation of dose delivered.

Floor of mouth, tongue and buccal mucosa lesions were treated, where possible, with radium by mould or implant to a dose of 6000rads in 7 days. Tonsillar cancer was treated by parallel opposed fields, at first using 400KV, but after 1952, cobalt therapy was preferred. The dose used was 5000-6000r in 5 to 6 weeks. The results were poor, but half of the patients had stage IV disease. Patients were treated seated in a special chair and the cobalt applicator positioned by a seating constructed on the mould room immobilization device. Using 400KV the dose prescribed was 5000-6000r in 5 to 6 weeks. Following the introduction of cobalt the dose was increased to 5500-6500r in 5 to 7 weeks.

Of the 34 patients with nasopharyngeal cancer, 17 were Chinese, one born in British Columbia.

Only 5 of 38 laryngopharyngeal patients, and 28 of 59 laryngeal cancer patients survived 5 years.

Lymphoma and Leukaemia

63 patients with Hodgkin's disease were described with a 5 year survival rate of 30%. Radiation treatment was by 220KV X-rays to a dose of 1500 to 3000r given in 2 to 4 weeks. "*High dosage was not aimed at*." In the 1961 policy, regional therapy to the abdomen or thorax using the "trunk bridge" technique was included.

163 patients with various forms of non-Hodgkin's lymphoma and 64 patients with leukaemia were listed. In the 1961 policy, local X-ray therapy was mentioned for chronic lymphocytic leukaemia and "*total body radiation, preferably with radioactive phosphorus, may be used in cases showing moderate enlargement of lymph nodes, liver and spleen.*" For chronic granulocytic leukaemia, X-ray therapy to the spleen given over a 2-4 week period was recommended, aimed at reducing the white count to 10,000. Chemotherapy for leukaemia included chlorambucil, 6-mercaptopurine, amethopterin, triethylene-melamine, A.C.T.H., cortisone, meticorten and myleran.

Inpatient Beds

The need for beds had been expressed as early as 1945. The Boarding Home had provided 14 ambulatory beds since December 1949 (not the sixteen originally planned) and the Vancouver General Hospital had provided access to 20 hospital beds. Writing in December 1953, Dr Evans described how: "*It was the original intention that the Boarding Home would be used for patients who needed a minimum amount of care. It soon became apparent, however, that there were so many ill patients who required a bed during treatment that they had to be put into the Boarding Home because no hospital accommodation could be found for them. In 1950 an agreement between the British Columbia Cancer Foundation and the Vancouver General Hospital was entered into whereby the Vancouver General Hospital would provide 30 staff beds for British Columbia Cancer Institute patients undergoing radiotherapy. Due to the acute bed shortage in the Vancouver General Hospital, it was agreed in 1952 that only 20 beds would be used.*" Dr Evans suggested additional beds be provided in the new building of the BCCI for "*ambulatory and bed*" patients and the VGH continue to provide beds for those requiring "*anaesthetic for radium procedures and more elaborate nursing service.*" An alternative would be "*that all radiotherapy facilities be provided in the new building — this would entail the provision of an operating suite and anaesthesia for radium cases, more nursing and orderly service to look after the acutely ill patient.*" [11]

Fig 43. The Boarding Home circa 1956. Mrs EM Mercer RN tends to a patient. When the Lieutenant Governor's cook became a patient *"he now had an entirely different opinion of the Boarding Home and what it meant to patients"*.

The Honorary Medical Staff, The Board and influential visitors all recommended hospital level beds for the Institute. In January 1954, the Government turned down a further request from the Foundation for financial support for hospital beds under the control of the Institute. The Government indicated that it was faced with new demands for support from every side and was having to scrutinize every phase of its finances very closely. This led the Chairman of the Building Committee, FH Brown to comment "*There is no doubt that Provincial Government taxation has reached its absolute limit – it is far higher on a per capita basis than that of any other province.*" [12]

The evolution of the Boarding Home to a nursing home, then to a hospital, involved financial concerns which at times pitted the Institute against the Provincial and Federal Governments, the British Columbia Medical Association and the Attending Medical Staff. The Boarding Home began as a place to lodge out-of-town patients. Patients requiring nursing care were admitted to the Vancouver General Hospital. With increasing pressure on these beds, some sicker patients were admitted to the Boarding Home.

Despite the Government's reluctance, the increasing demand for beds led to plans being laid for adequate boarding home facilities and a request for funding was made to the Canadian Cancer Society in 1953. The aim was to replace the existing boarding home which had been opened in December 1949 in the house adjacent to the east wall of the original clinic on 11th Avenue.(see chapter 2 p47)

The new boarding home was to be erected on 10th Avenue at the northeast corner of the existing property, four stories high with provision for 36 beds. In an effort to control costs it was suggested that an elevator was not necessary. Fortunately this suggestion was overruled. The new Boarding Home had to be licensed with the provincial government. It was chosen to retain the designation of the previous Boarding Home as a private hospital named the BC Cancer Institute Private Hospital.

The official opening was on November 23rd 1955 with Bishop Gower delivering a prayer of dedication. The new boarding home was opened by Mrs Phyllis

Fig 44. The Boarding Home is officially opened by Mrs Phyllis Ross, mother of Canada's 17th Prime Minister and wife of the Lieutenant Governor. Bishop Gower waits to give the dedication.

Ross, mother of Canada's 17th Prime Minister, wife of the Lieutenant Governor, the Honourable Frank MacKenzie Ross. Mrs Ross was a formidable woman, and no friend of Dr Evans. Indeed, there are indications they disliked each other.[2] Mrs Ross had raised the money for the Boarding Home but did not want it to be a part of the BCCI, a part of Dr Evans' domain. So the building was connected to the clinic with a short but symbolic passageway.

Patients who could pay were charged a nominal $3.50 per day! The Boarding Home and its two nurses were praised after the Lieutenant Governor's cook became a patient. Both the L-G and his wife had been impressed by the excellent attention the patient had received and he indicated to Miss Findley, the head nurse, *"he now had an entirely different opinion of the Boarding Home and what it meant to patients".*[13]

[Author's Note. Forty-five years later the daily charge to patients in the Canadian Cancer Society Lodge in Vancouver was $32].

Little changed until late 1960 when the Foundation received criticism for continuing to operate the Home as a nursing home rather than solely as a boarding home. If it were to revert to its original function, more hospital beds would have to be found. Twenty beds had been made available on the top floor of the Boarding Home but there were no funds to operate them. Two years later the federal Minister of Health was approached to try and obtain funding for these beds. The Honourable Paul Martin replied, outlining a proposal by the Government "*to extend Hospital Insurance coverage to the thirty-six bed area in the boarding home subject to all out patient treatment at the Institute and the Victoria Cancer clinic being handled on the basis of $1.00 per treatment day.*"[14] This proposal raised all sorts of potential concerns. The Medical Policy Committee of the Institute felt it best to refer the proposal to the Attending Staff, the BCMA and the BC Division of the Canadian Medical Association. No one had a problem with funding the in-patient beds, but everyone opposed the daily fee of $1.00 for out-patients. Nevertheless, the pressure for beds was such that the Foundation felt it had no alternative but to accept the Government proposal in September 1964, with the hope that the additional twenty beds would be opened by the first of the year.

The federal Minister of Health, Mr Martin, wrote on February 3rd 1965, "*negotiations have been satisfactorily completed to establish the B.C. Cancer Institute as a hospital facility, and completion of preparations by the Foundation to make the third floor operational for boarding home care of cancer patients is sanctioned*". On February 15th Mr Lyall, The Hospital Finance Manager BC Hospital Insurance Service, wrote, "*an Order-in-Council has been approved designating the British Columbia Cancer Institute as a hospital facility effective from March 1, 1965.*" The following steps were outlined,

"1. *Coverage of eligible in-patients in the 36 beds on the first two floors will become effective March 1, 1965. $1.00 per day will be chargeable to the in-patients.*
2. *We will advise you of the approved standard ward per diem rate before March 1, 1965. (Actual per diem cost was $24.00). Of the approved rate $1.00 per day should be billed to the patient, except those who are recipients of Social Welfare and who have a valid identity card, in which case this Service is billed at the full per diem rate.*
3. *It is understood that the third floor area will be placed in operation as soon as possible to provide boarding facilities for certain out-patients. These boarding patients plus other out-patients are to be charged effective March 1, 1965 on the basis of $1.00 per treatment day.*
4. *The same $1.00 per treatment day charge is to apply to outpatients of the Victoria Cancer Clinic.*"[15]

In April 1969 the beds on the top floor were approved for coverage through the BC Hospital Insurance Scheme.

Radiotherapy Fees

At the same time, concerns were raised about the Institute providing free radium treatment in the Vancouver General Hospital for those who could pay, putting private practice radiotherapy at a disadvantage. In 1951, the Institute had decided that it would not charge for radium treatment to be in line with other hospitals such as St Paul's that owned radium and had been able to give free service since the inception of the BC Hospital Insurance Service. Dr Trapp, a member of the Executive Committee, was strongly opposed to free service. She felt, "*The practice to be unjust to private radiotherapists and, in principle, to be against the policy of free enterprise; one more freedom which had been taken from the people.*" [16] Despite strenuous efforts by those wanting change, the matter was resolved in December 1955 when the federal Minister for the Department of Health and Welfare wrote, "*after reviewing the situation, the Department does not approve of a change in the practice of making no charge for radium services to Institute patients while in hospital.*" [17]

Some confusion remained as evidenced by the following situation. A woman from England visiting her son had radium treatment in the Vancouver General Hospital and had to pay full charges to the hospital, and in addition was billed by the Institute for the radium treatment. Had she been treated in St Paul's, she would have had the radium charge included in the per diem rate. The matter was resolved when the charges for professional services provided by the Institute to the mother of a practicing doctor in this city were written off to Courtesy Service.

In response to a request from the BC Division of the Canadian Medical Association regarding fees charged, Dr Evans replied describing the radiotherapy fees in place as those published in the Minimum Schedule of Fees of the BC Division of the CMA, April 1954. He mentioned that at a recent meeting of the Canadian Association of Radiologists a schedule for all types of radiotherapy had been approved. When a patient was admitted to the Institute, he or she was interviewed by a qualified social worker to assess their ability to pay. According to that assessment, the patient was classified — "pay; part-pay; or non-pay". Each new patient was charged a consultation fee of $15 which was in addition to any fee for diagnostic or treatment services. In the case of the patient who could pay, one half of this fee was credited to the Attending Medical Staff Fund. Concern had been expressed that the Medical Services Association should only pay medical fees to doctors in private practice and that by paying the Cancer Institute this reflected unfavourably on the private practice of radiotherapy. Furthermore, the MSA and other pre-paid plans should not pay the Institute for services rendered to insured patients.

In July 1958 Dr Evans wrote, "*65% of patients are in the non-pay category. No distinction is made between insured and non-insured patients. A financial arrangement was made with the Government of the Province of British Columbia to balance our budget. For the fiscal year, 1957-58, our total cost of operations was $389,228. Revenue from patients' fees was $72,167, and we received from the Provincial-Federal Governments $317,061. Breaking down the income from Patients' fees further, it was found that of the $72,167, $39,990 was received from pre-paid insurance plans. Of this amount, $17,097 came from the M.S.A. and $15,080 from other pre-paid plans. If the M.S.A. were advised not to pay our accounts, it would soon become known to other pre-paid plans and we would, in fact, lose in the order of $32,000 a year income which is nearly half of our present income*

from patients' fees. Under these circumstances we would have to rely to a great extent for this money on the Provincial Government who would then be paying most of the operating costs of the Cancer Institute. It would be quite within the bounds of possibility that the Government might take over the entire operation and offer free radiotherapy to all patients in British Columbia. The effect of this would be that it would curtail the private practice of radiotherapy because I would not imagine that most patients would want to pay for services that they could get free of charge." [18]

The issue of payment to the Attending Medical Staff for consultations given on patients in the Institute was finally settled in October 1965 with the Foundation agreeing to pay for individual consultations on a fee for service basis.

The cost of an individual radiation treatment was estimated as at least $10.00 in 1962, with the proviso that no accurate accounting had been done, and if it had the figure might be a great deal higher.

Salaries

From the beginning of the BCCI the medical and physicist staff had been salaried rather than fee-for-service. At first monthly, or even hourly in the case of the first physicist, annual salaries became the norm. Each year Dr Evans requested salary rates for the coming year from the Board of the BCCF. It was then the custom for Dr Evans to draw a slip of paper from his suit pocket, place it in an envelope, and offer it to each of the medical staff and Dr Batho, the chief physicist. Money was always tight, and one year, the story goes, that Dr Evans told Dr Nash "*there was no money to provide an increase in your salary, but, instead, we have agreed to promote you to associate director and you can share the toilet in my office.*" [19] Dr Nash was appointed second associate director in 1954, joining Dr Moffat, whom we assume must also have shared the same toilet.

By 1960 three salary ranges were in place:
Radiotherapist and Chief Physicist,
$10,000 - 14,000;
Assistant Director or Senior Radiotherapist,
$12,000 - 16,000;
Director, $14,000 – 18,000.
The Director of Nursing remained on a monthly salary of $500.

Physicians continued to be salaried until an option for contract work was negotiated in 2000, when 16 of 42 radiation oncologists in the province elected to resign as agency employees, incorporate and work on contract. The remainder continued on salary.

Daily Life of the Institute

Early in 1953, it became necessary to repackage radium supplies at the Institute. This was necessary because the 10mg needles, which were direct-filled, were deteriorating, causing leakage. They were replaced with cell-filled needles. The repackaging, along with the purchase of an additional 152mg of radium, cost $15,435.80, although Atomic Energy of Canada Ltd. (AECL) gave a credit of $5,922 for radium returned.

Dr Evans made representation to the Civil Service Commission in 1953 requesting that they set up classifications and salary ranges for radiotherapy technicians, including senior and supervisory positions. No such classification existed, and salary ranges appeared to be quite inadequate in relation to salaries paid registered nurses immediately on graduation compared to that of radiotherapy technicians who required the additional two years of training.

By May 1954 adequate salary adjustments were arrived at and backdated to January 1st 1954.

However, the government declined to be involved in a pension scheme for Institute employees. The issue of a pension plan was again raised in 1956 and the firm of WM Mercer Ltd was asked to suggest a suitable type of plan. It was introduced on Septem-

Fig 45. Nurse Technicians gathered in the Conference Room. Florence McDonald holds a patient's chart and Joan Goodall is on her left.

ber 1st 1957 and transferred to the Municipal Plan in 1960.

The Institute Committee recommended that approval be given to train two technicians for a two-year period at a cost of $7,935.64 and asked the Canadian Cancer Society and the Department of Health and Welfare to provide the funds. Payment of $317 per month to Dr JA Ireland, part-time diagnostic radiologist, led to suggestions that consideration and further study be given to the question of having all diagnostic x-ray work done at the Vancouver General Hospital.

The year 1955 saw approval of a five-day week for Institute employees who no longer had to work on Saturdays, and ten statutory holidays which included the Queen's Birthday and Dominion Day. Fifteen years later, in March 1970, the work week was reduced from 40 to 37.5 hours.

In 1957 the policy governing Courtesy Service was amended. Previously, 100% free service was given to members of the Attending Medical Staff, Institute employees and their dependents, with 10% free service to outside doctors and nurses but no free service was extended to clergymen! As of January 1st 1957, services at the Institute were to be given free of charge to all medical doctors, all clergymen and all practicing nurses.

A 280KV X-ray therapy machine was installed in the new building in 1953. At the same time, plans were put in place to extend the Radiotherapy Department in order to house a second cobalt unit and an additional treatment room for future treatment units. The number of X-ray and cobalt treatments had increased from 1,238 in 1953 to 1,426 in 1954. Cobalt was preferred over 2MV X-ray equipment on the grounds that the initial cost was less and replacement parts would be less expensive. It was predicted that cobalt would eventually replace the 260, 270 and 400KV machines. The 120KV unit would be kept for skin cancer and the 250KV machine for the leukaemias.

Discussions began in September 1958 concerning the possibility of changing the name of the Institute. It was thought by many that the word "cancer" might be omitted. Over the ensuing months several names were suggested including, "The Prince Philip Institute", "The Prince Charles Institute" and "The Heather Street Institute", but in the end it was elected to leave the name unchanged.

After ten years at the Institute, Dr Nash, the Associate Director, resigned in June 1959, and moved to California. Dr John Gibson was appointed Associate Director on his move from Regina in July 1960.

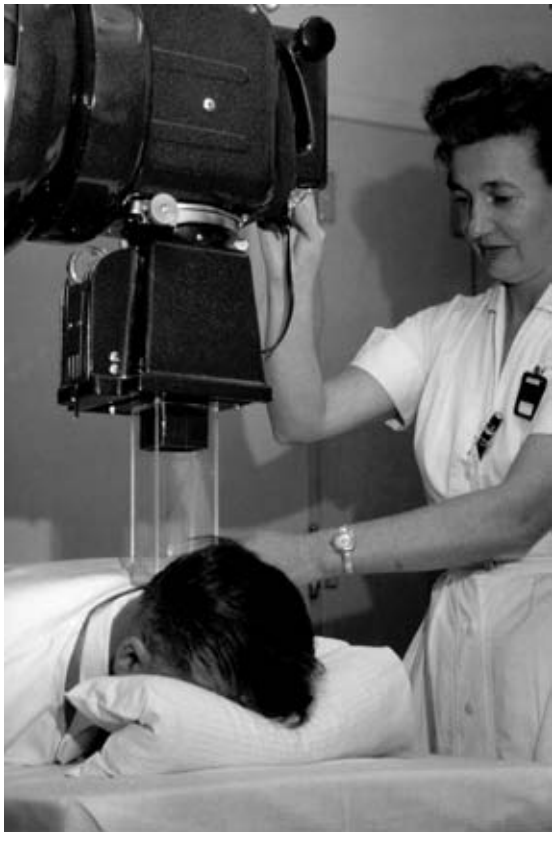


Fig 46. The 280KV unit. Rose O'Reilly RN,RT positions a patient for treatment.

Fig 47. Mr Ray Allen. In charge of the Mould Room and skilled at prosthetics.

In 1961 Mr Ray Allen, a qualified dental technician trained in England, was appointed to be in charge of the Mould Room. He subsequently received training in Birmingham on beam direction devices and was also skilled in making prosthetic devices. The Mould Room he created and its standards were the envy of many who visited the Institute and later the Agency.

After moving to Dentistry, where Mr Allen was able to concentrate on prosthetics and reconstructive procedures, he was replaced by Heather Drake.

Funding for equipment was becoming increasingly difficult to realize. Following the inception of government grants, Foundation funds were no longer used for the purchase of equipment.

By the year 1956, the operating budget had reached a point where there were not sufficient funds from the grants for both equipment and operations. The Foundation had to consider a change in its policy with respect to the purchase of equipment.

In November 1960, Dr Evans commented *"the largest part of the operating expenses of the British Columbia Cancer Institute comes from the Federal and Provincial Governments in the form of the matching Cancer Grant; this is because most of the patients cannot pay for the services they receive here. However, I should mention that the amount of money received from patients who can pay has been rising over the past few years, this is largely due to the existence of the pre-paid medical plans and I hope as time goes on the Institute will have to rely less and less on financial assistance from the two Governments. If the British Columbia Cancer Institute is cut off from pre-paid medical plan funds, we would have to look to Government for more money which is the last thing that any of us want."* [20]

The British Columbia Cancer Institute was designated a hospital facility by the Hospital Insurance

Fig 48. The Heather Street Façade. Two stories now added circa 1969.

Fig 49. The frame building which housed the first Boarding Home beds is demolished to make way for expansion in an easterly direction to house new Cobalt units in the early 1960s.

Service in 1965, providing hospital insurance coverage to inpatients and a year later to outpatient radiotherapy.

The building programme initiated early in 1959, added two floors to the existing building which now provided enlarged facilities for Cytology, the Clinical Laboratory, a Diagnostic X-ray department, a patient examining area, the Medical Records department, the Business Office, the Social Service department, and an unstaffed Library was housed in the "doctors lunch room" in the lounge of the old house. The librarian David Noble, was hired in 1976 and retired 26 years later.

Three house lots east of the building on 10th and 11th Avenue had to be purchased, each at $25,000-$30,000, to make room for the expansion and a car park.

At completion, there would be a substantial addition to the Radiotherapy department to house a second cobalt unit.

The idea of a linear accelerator had been dropped early in 1960 and instead, two cobalt units were planned. The first was the Theratron F which had a rotational capability.

Fig 50. The second cobalt unit, Theratron F with rotational capability.

Fig 51. Mrs Richardson, Director of Radiotherapy Technicians demonstrates the treatment features of "Cobalt 2" the Theratron F. to Kay Bailey, Sandy Gardiner and Monica Clark.

Fig 52. The completed Heather Street Building. Bottom left behind the big tree is the Boarding Home and above, between it and the car park is the Radiotherapy extension with four cobalt treatment rooms. Eleventh Avenue is open from Heather to Ash Streets.

The Five Year Plan

Early in 1962, Dr Evans presented a "five year plan" to the Executive. It included a third cobalt unit for Vancouver and a cobalt unit for Victoria in 1963. The plan also called for a supervoltage machine, possibly a linear accelerator, for Vancouver. There would be a need for more beds and replacement of the frame building that housed Medical Records, Physics, Radium Room and the Staff Lounge. By 1965, a fourth cobalt unit would be needed and more space for parking. The cobalt units Eldorado Super G and Eldorado 8 were installed in 1963 and 1968.

By January 1968, Dr Evans was suggesting that in six or seven years time, consideration would need to be given to a third treatment centre somewhere in the interior of the province and that a decision would soon have to be made for plans to proceed with a 200 bed hospital. [21]

Miss Findley, the Institute's long standing head of nursing and radiotherapy technicians, retired at the end of 1962 and died on September 16 1972. Miss Florence McDonald succeeded Miss Findley, and on her retirement in 1969, the joint responsibility for nursing and radiotherapy technicians was separated into two positions. Mrs J Richardson, the incumbent supervisor, was made Director of Radiotherapy Technicians and Miss J Dawes, Director of Nursing.

The Foundation renamed itself The British Columbia Cancer Treatment and Research Foundation in April 1967, to take into account an increasing interest in the need for research and the addition of a research floor within the Institute. At the same time, steps were taken to purchase various properties in a move to acquire the entire block bounded by Heather and Ash Streets and 10th and 11th Avenues.

Dr VE (Vivien) Basco was hired in September 1964, as a research assistant to introduce lymphangiography to the Institute, a skill she had learned in England. She was appointed to the staff as a Paediatric radiotherapist in April 1967. Dr RO (Dick) Kornelsen joined the Physics staff from Ottawa in 1967 and took over as head the following year when Dr Batho left to work on the Tri Universities Meson Facility at the University of BC (TRIUMF) project. Dr AD (Albino) Flores joined the staff in 1971.

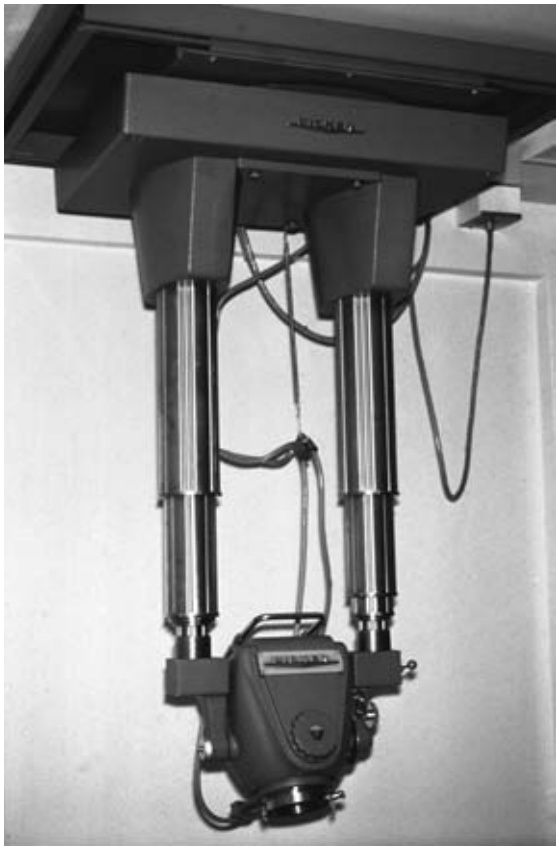


Fig 53. The Caesium unit preferred to a linear accelerator that was *"a complicated piece of equipment"*.

Approval was given in September 1973 to hire a secretary to work with the five radiotherapists and four residents. Dr John Probert, who had been working at Stanford, joined the staff early in 1974, in part to carry out preclinical work for TRIUMF. His University appointment was as Honourary Associate Professor of Paediatrics. Dr Probert chose Vancouver over offers from Toronto and Leeds.

The 260 and 250 KV machines were taken out of service in 1969, and the space was adapted to receive a caesium unit purchased by the Order of the Eastern Star (OES) at a cost of $16,500. Following his tour of centres in Britain early in 1958, Dr Evans had noted the trend toward linear accelerators but felt that, "*it was a complicated piece of equipment needing a large amount of space and staff to operate it which would be out of the question for the Cancer Institute.*" However, he was impressed with the possibilities of caesium which he was able to install a decade later. [22]

Hyperbaric oxygen had been introduced through the generosity of the Order of the Eastern Star (OES) who had provided a hyperbaric tank. Dr Evans had asked Dr Peter Coy, appointed to the staff from Manchester in June 1963, to visit Winnipeg in February 1964 to investigate the possibilities of hyperbaric oxygen. He reported in favour of testing the approach. However, it was obvious that daily treatment would be difficult and it was elected to use two fractions weekly.

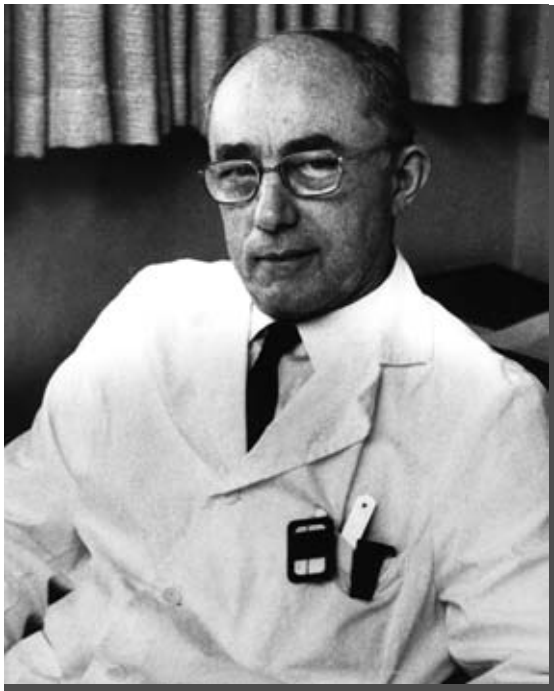
Patients had to be in the hyperbaric chamber for thirty minutes for full oxygen saturation to be reached and remain in the chamber for treatment. Dr Coy and a technician spent lunch breaks in the chamber with two or three patients. The chamber was wheeled into the cobalt treatment room and the patient treated through the glass wall of the chamber. For opposed fields the patient had to be rolled over and repositioned for the second treatment field. Some sixty patients were treated over the next three years, but, as the patient load increased time for this difficult and time consuming treatment, as well as a lack of obvious benefit, lead to it being discontinued. [23]

Concern About the Lack of Radiotherapists

On January 24th 1962, Dr Evans wrote to Dr JF McCreary, Dean of the Faculty of Medicine at UBC, about his concern at the lack of Canadian radiotherapists. *"All the radiotherapy centers in Canada in order to fill their compliment are obliged to employ radiotherapists from other countries, mainly from the United Kingdom. This in itself is, of course, not a bad thing but it does indicate that there are an insufficient number of Canadians in the specialty of radiotherapy. I think there are two basic reasons for Canadian doctors not taking up radiotherapy. One is monetary, in that the radiotherapist does not fare as well as his diagnostic radiological colleague, and secondly, sufficient publicity has not been given to this question. I would like to enlist your assistance in this matter and I wonder how we can publicize*

Fig 54. The Radiotherapy Staff circa 1968. Standing Left to Right, Dr Coy, Winifred Jones (Waterhouse), Emmie Ortiz, Margeret Saunders (Boyes), Betty McVey, Janet Pinder (Fox), Ann Johnson, Joyce Britton, Elizabeth Hurley, Dr Boyes, Dr Flores, Dora Greenwood (King), Dr Goodman. Seated Left to Right, Dr Basco, Rita Fisher, Dr Gibson, Ann Stephenson, Florence McDonald, Rose O'Reilly, Dr Evans, Pat Gillard, Marge McBain, Jean Richardson, Lorna Robinson, Dr Crawford.

the specialty of radiotherapy, particularly among medical students." [24] Three weeks later he wrote to Dr LE Ranta, Assistant Director Medical at the Vancouver General Hospital in a similar vein. "*I am writing to you concerning the possibility of the British Columbia Cancer Institute securing the services of a junior interne as of 1st July, 1962. The reasons for my request are two-fold. First, I have been concerned for some time about the fact that very few Canadian doctors take up the specialty of radiotherapy. There are probably a number of reasons for this but one of them certainly is that young medical graduates during their first interne year in Vancouver seldom have the opportunity of participating in the work of the B.C.Cancer Institute before they have made up their minds as to what specialty they might like to enter into. It appears to me that this would be one method of, at least, providing the Interne Staff with some knowledge of radiotherapy. Secondly, I feel that as radiotherapy is an integral part of the treatment of malignant disease,*



Dr JMW Gibson 1915-1994

Dr John Gibson was born in Paisley, Scotland and educated at the University of Glasgow graduating BSc in 1935 and MB ChB in 1938. His medical career began during the Second World War in the Royal Army Medical Corps. He served for two years in Britain and four years in India where his previous training in infectious diseases stood him in good stead. He attained the final rank of lieutenant colonel.

Dr Gibson trained in radiotherapy at the Christie Hospital in Manchester and obtained the DMRT in 1947 and FFR in 1952.

From 1950 –1957, he held the post of consultant radiotherapist at the Christie Hospital. In 1957 he immigrated to Canada and became Senior Clinic Associate at The Allan Blair Memorial Clinic in Regina.

Dr Gibson obtained certification in Therapeutic Radiology in 1959 and in 1960 came to Vancouver as Associate Director of the British Columbia Cancer Institute. In 1971, on the retirement of Dr Evans, he was made Director of the Institute and Medical Director of the British Columbia Cancer Treatment and Research Foundation. Dr Whitelaw replaced him as interim Director in November 1974.

Dr Gibson continued as a member of the staff of the Division of Radiation Oncology until his retirement in 1979.

Fig 55. Dr JMW Gibson

on an equal basis with surgery, internes should be instructed in this specialty." [24]

Mr RW Underhill, President of the British Columbia Cancer Treatment and Research Foundation (BCTRF), wrote in his annual report in 1970, "*Much effort has been spent during the year to endeavour to increase our staffing of radiotherapists. There seems to be a dire shortage throughout the world and we hope that in time the medical profession will be able to come up with a solution. Recommendations have been made to the Faculty of Medicine at the University of British Columbia to set up a department of radiotherapy and a decision regarding this has been left in abeyance pending study of Dr Williams' report on cancer care by the Government and medical authorities. The need is urgent and it is hoped that the situation will be recognized and acted upon.*" [25]

A detailed and comprehensive review of workloads and salaries of radiotherapists across Canada was undertaken in September 1973. Workload statistics showed that for the BCCI and the Victoria Clinic there was one radiotherapist per 550 patients. This was compared to a National Cancer Institute recommendation of one per 200. It was suggested that this "*seriously hampers our efforts for recruiting qualified and experienced radiotherapists and is a deterring factor in attracting suitable candidates for training in radiotherapy.*" [26] Salaries in BCCI ranged from $26,000-38,000 compared to $35,000-49,632 in Ontario.

Dr Evans, having retired in 1971, was retained as a consultant to the Foundation on an annual basis. At a dinner held at the UBC Faculty Club on June 17th 1971, an award in his honour was presented to him with the following terms of reference, "*The A Maxwell Evans Award has been established to honour the first Medical Director of the British Columbia Cancer Treatment and Research Foundation, for his distinguished service and contribution to cancer treatment in British Columbia. The object of the award is to give young members of the medical profession an opportunity to acquire a wider knowledge of cancer in medicine and the career potentials available in the cancer field.*" [27]

Dr Evans was succeeded by Dr JMW Gibson as Medical Director of the BCTRF and Director of the BCCI.

By 1973, the number of new patients admitted had risen to 2,995. The staff included seven radiotherapists, five radiological physicists, a director of nursing, a director of radiotherapy technicians and sixteen radiotherapy technicians.

Transition from the Institute to the Agency — The "Williams Report"

In July 1969, in response to a recommendation of the BC Medical Association, the provincial Minister of Health asked the Medical Advisory Committee of the British Columbia Hospital Insurance Service to appoint a special advisory committee to report on the present and projected facilities for the care and control of cancer in British Columbia. The committee, under the chairmanship of Dr DH Williams, Associate Dean, Faculty of Medicine UBC, included two government officials, a family physician from Port Alberni, a surgeon from Kelowna and Dr RE Beck, grandson of BC's sixteenth premier, Sir Richard McBride, representing the British Columbia Cancer Institute. The committee received submissions from a variety of interested individuals and organizations and met ten times between December 1969 and September 1970. The conclusions of this committee were set out in the "Williams Report" [28].

The first half of the Report consisted of platitudinous remarks regarding the Government, BC Cancer Treatment and Research Foundation, Canadian Cancer Society, BCCI and National Cancer Institute of Canada. The second half included 49 recommendations. The main thrust of the Report was to establish a "Comprehensive Coordinated Cancer Control Program" with special emphasis on education, epidemiology, prevention and research. It envisaged the BCCI being renamed the "British Columbia Cancer Centre" with expanded radiotherapy services and facilities. It also suggested that when the population reached 500,000 an interior centre with radiotherapy be established and when the Greater Vancouver-Fraser Valley population reached 1,750,000 a second lower mainland facility be considered. Recommendations that were never adopted included creating a UBC Division of Radiotherapy in the Department of Radiology and a Division of Oncology in the Department of Pathology. The committee's views on administration were hard to understand. They suggested an Executive Director with advanced training and experience in business administration and organizational coordination in the health field and two Medical Directors. One Director for Treatment Services and one for Control Services including education, epidemiology, prevention, research and regional services.

The report was released on a confidential basis to the BCCTRF in December 1970. It was felt that, although the report called for the expansion hoped for by the Foundation, the deliberations had delayed matters for over two years. The report included a recommendation to establish a "Ways and Means Committee" under the chairmanship of Dr Williams, which, over the next two to three years, would guide the transition of the BCCI from the Foundation to the government. The Committee first met on April 26th 1972. Membership included three representatives from the provincial government, three from the Foundation, one each from the Canadian Cancer Society BC and Yukon Division, UBC Faculty of Medicine, BC Hospital Association and the BC Medical Association. Dr Williams outlined the projected Cancer Control Programme. It was agreed that the British Columbia Cancer Treatment and Research Foundation be approached to form the nucleus of cancer control in the Province. In May 1973 it became known that the government was considering the establishment of a University Hospital at the Shaughnessy Hospital site and if this should happen the Institute might move there. The Minister of Health, the Honourable Denis Cocke, had great plans for a first class facility with an emphasis

on ambulatory care, teaching and research, encompassing the Children's Hospital, Obstetrics and Gynaecology, the Cancer Institute and others. It would be renamed the BC Medical Centre. In August the Minister indicated that, *"he intended to establish a B.C.Cancer Control Agency under a Provincial Advisory Council which would become a major component of the B.C. Medical Centre. With the B.C. Cancer Institute transferred to the Cancer Control Agency there will then exist a complete, unified integration of planning and administration for Provincial cancer control by the Medical Centre's new Cancer Control Agency. This integration will take place not later than July 1, 1974."* [29]

The radiation oncologists were concerned about some of the developments, especially as they had not been included in any of the discussions. They prepared a "Position Paper' which they submitted to Dr Williams, The Ministry, the BC Medical Centre, the University and various other bodies. In it they pointed out their special position in the care of cancer, requested representation on the Minister's Cancer Control Task Force Committee, BC Medical Centre and Agency senior committees and stressed the need for funding, equipment and staff. [30]

The Cancer Control Agency of British Columbia was formally established by means of the "Tripartite Agreement" dated October 11th 1974 between Her Majesty the Queen in right of the Province of British Columbia as represented by the Minister of Health, the British Columbia Cancer Treatment and Research Foundation and the Cancer Control Agency of British Columbia.

The Agreement provided for the "Institute Operations" (the BCCI, the Victoria Cancer Clinic and the consultative clinics) to form one of the two basic operational components of the Agency, the other to be devoted to education, epidemiology, prevention, regional programs and research. Further, the Agency would be integrated with the British Columbia Medical Centre and a permanent relationship would be established between the Foundation and the Agency so that human and material resources of the Foundation would continue to be committed to the support of cancer treatment as well as research. TRIUMF and the McGavin Building (housing the Research Centre) were excluded from the Agreement. The document indicated that public expenditures in the area of cancer care and control would be very substantially increased. The Minister agreed to pay the Foundation $2,000,000 on the understanding that $1,900,000 be donated to the Agency to provide immediate expansion of the Institute buildings and anything left over to be used for new construction on the Shaughnessy site. The remaining $100,000 was to be used by the Foundation to provide scholarships and bursaries for persons studying or training in the cancer control field in British Columbia.

Schedule E appended to the Agreement included the medical staff that should be appointed to the Radiotherapy Department: one therapeutic radiologist for every 250 new patients, two for consultative clinics and one to work to prepare TRIUMF for future radiation treatment.

References for Chapter 3

1. BC Cancer Institute, Report of the Director to the Annual Meeting of Attending Staff 1958 Nov 10. (BC Cancer Agency Archives)
2. Boyes DA. Personal communication 2001.
3. Canadian Medical Association Journal 1975; 113; 1075
4. BCCF Executive Committee Minutes 3 Vol IX, 4 Vol X. (BC Cancer Agency Archives)
5. Ibid. (BC Cancer Agency Archives)
6. Report to the Board of Directors, September 23 1953. (BC Cancer Agency Archives)
7. BC Cancer Foundation, Executive Committee, Minutes 1966 Sep 28; Vol XII. (BC Cancer Agency Archives)
8. Correspondence. (City of Vancouver Archives File 513-F-1, File 4)
9. BC Cancer Foundation, Board of Directors, Minutes 1957 Oct 11. (BC Cancer Agency Archives)
10. BC Cancer Institute, Report of the Director to Annual Meeting of Attending Staff 1957 Nov 25. (BC Cancer Agency Archives)
11. Evans AM. BC Cancer Foundation, Correspondence 1960. (BC Cancer Agency Archives)
12. BC Cancer Foundation, Building Committee Report, 1954 Jan 14. (BC Cancer Agency Archives)
13. BC Cancer Institute, Report of the Director to the Annual Meeting of Attending Staff 1960 Nov 14. (BC Cancer Agency Archives)
14. BC Cancer Foundation, Executive Committee Minutes Vol X, 1963 Apr 24. (BC Cancer Agency Archives)
15. BC Cancer Foundation, Executive Committee Minutes Vol XI, 1965 Feb 24. (BC Cancer Agency Archives)
16. BC Cancer Foundation, Executive Committee Minutes 1954 Nov 17. (BC Cancer Agency Archives)
17. BC Cancer Foundation, Executive Committee Minutes 1955 Dec 14. (BC Cancer Agency Archives)
18. BC Cancer Foundation, Executive Committee Minutes 1958 July (BC Cancer Agency Archives)
19. Goodman G. Personal communication 2001.
20. Evans AM. BCCF Correspondence 1960. (BC Cancer Agency Archives)
21. BC Cancer Treatment and Research Foundation, Executive Minutes, Vol XIII 1968 Jan 24. (BC Cancer Agency Archives)
22. BC Cancer Foundation, Board Minutes, 1958 Mar. (BC Cancer Agency Archives)
23. Coy, P. Personal communication 2001.
24. Evans AM. Correspondence 1962. (BC Cancer Agency Archives)
25. British Columbia Cancer Treatment and Research Foundation, Annual Report 1970.
26. BC Cancer Treatment and Research Foundation, Executive Committee, Minutes Vol XIV 1973 Sep 26. (BC Cancer Agency Archives)
27. BC Cancer Treatment and Research Foundation, Executive Committee, Minutes Vol XIII 1971 Jun 23. (BC Cancer Agency Archives)
28. The Williams Report, Dec 1970. (BC Cancer Agency Archives Box 7, UI 243)
29. BC Cancer Treatment and Research Foundation, Executive Committee, Minutes Vol XIV 1973 Nov 19. (BC Cancer Agency Archives)
30. BC Cancer Treatment and Research Foundation, Executive Committee, Minutes Vol XIV 1974 Feb. (BC Cancer Agency Archives)

Author's note
Medical Directors BCCI, CCABC & BCCA and Heads of Radiation Oncology, with Provincial Responsibility

AM Evans*	Radium Therapist BCCI Medical Superintendent BCCI	Oct 1938-Apr 1939 Apr 1939-Jul 1940
E Trapp*	Acting Medical Superintendent BCCI Medical Director BCCI	Jul 1940-Sep 1943 Sep 1943-Sep 1945
AM Evans*	Medical Director BCCI	Oct 1945-Jul 1971
JMW Gibson*	Medical Director BCCI Head Radiation Oncology	Jul 1971-Oct 1974 Nov 1974-Sep 1976
JM Whitelaw	Acting Director CCABC	Nov 1974-Dec 1974
T Hall	Director CCABC	Dec 1974-Dec 1976
DA Boyes*	Director CCABC	Jan 1977-Apr 1987
VE Basco*	Acting Head Radiation Oncology CCABC	Sep 1976-Feb 1977
SM Jackson*	Head of Radiation Oncology CCABC/BCCA	Feb 1977-Sep 1995
D Klaassen	Director/CEO BCCA	Jul 1987- Jan 1994
D Carlow	CEO BCCA	Jan 1994-Sep 2000
T Keane*	Provincial Program Leader Radiation Therapy	Oct 1995-
S Sutcliffe*	CEO BCCA	Sep 2000-

Radiation Oncologists marked with an asterisk

Chapter 4

The Division of Radiation Oncology CCABC-BCCA and The Department of Radiation Oncology VCC 1974–1996

The First Linear Accelerators

The provincial Cancer Control Agency of British Columbia was created on October 31st 1974 under the directorship of Dr Thomas C Hall. The first recorded minutes of the Department of Radiotherapy in Vancouver were dated 23rd December. Those present at the meeting were Drs Gibson (chairman), Goodman, Coy, Douglas, Fairey, Jackson and Probert, (Crawford and Flores were absentee staff members). Just three weeks after joining the staff from Britain, Dr Jackson offered to act as secretary and take regular minutes, something that had not previously been done.

A recurring theme in those minutes throughout the next several months was the need for improved facilities and equipment. A linear accelerator was already planned but by early 1975 the urgent need for a treatment simulator was evident. Even with the ongoing discussions about moving the clinic to the Shaughnessy site, the staff was anxious that this should not delay the acquisition of a second linear accelerator and a simulator. In June, an equipment committee was formed to advise on the type of accelerator, its energies, its cost and siting. The committee recommended a 6MV linear accelerator with electron capability as first choice, and a high-energy photon machine for the second accelerator. At the same time Dr Boyes had raised with Dr Hall the question of remote handling of radiation sources for gynaecological treatments.

For the next several months there was confusion

Author's Note
Name changes and designations

The Cancer Control Agency of BC (CCABC) was established in 1974 as a provincial cancer service. The name was changed to the British Columbia Cancer Agency (BCCA) in 1990 in response to criticism of the use of the word "control". Various "CCABC Divisions" were formed with provincial responsibility, including Radiation Oncology. The Divisions were replaced by "Programs" in 1996. The Division of Radiation Oncology had a "Head", who was also the Head of the Department in Vancouver. The Victoria Clinic, and each subsequent clinic, had its own Head of Radiation Oncology. The Division Head was also the Head of the Division of Radiation Oncology in the Department of Surgery at the University of British Columbia. The clinic in Vancouver, first called the British Columbia Cancer Institute (BCCI), was renamed the A. Maxwell Evans Clinic in 1976 and the Vancouver Cancer Centre in 1995.

as to whether there was approval for a simulator, whether funding had been budgeted for, and what were the right channels to approach the government. Almost in desperation, Dr Hall, the Director, was invited to the radiotherapy staff meeting to hear the Staff's frustration first hand. On 20th February 1976, Dr Hall promised to move "*heaven and hell*" to obtain the additional equipment. Unfortunately, what had been overlooked was that the electrical supply to the building needed for the simulator and the water flow to cool higher energy accelerators was insufficient. It was necessary to approach BC Hydro to increase power input to the building to 12,000 volts.

In May, Mr Don Thomson, the newly appointed Associate Director with responsibility for administration, also attended the Staff meeting to attempt to clarify matters. (Mr Thomson had replaced Mr Warren the comptroller, who had retired the previous May. A dinner had been planned to mark Mr Warren's twenty-nine years of contribution to the BCCI, but the site had to be changed to the UBC Faculty Club when the female members of the staff complained about the University Club as a venue for the occasion!) Mr Thomson explained that the Agency Board had approved the simulator and the second accelerator and that various manufacturers could be approached for up to date costs and suggestions for siting the equipment. The government, through BC Hospital Programmes, had already received three separate submissions for the equipment. At this time the Staff were meeting weekly to press their concerns.

Late in the summer, on recommendation of a further sub-committee, it was agreed that the second linear accelerator should be a Siemens Mevatron 12 with 8MV photon energy and 3-11 MeV electron energies [1]. The recommendation was made for the following reasons:

1. It was the only machine currently available with an electron energy as low as 3MeV to allow treatment confined to the body surface;
2. It had an 8MV photon energy;
3. It was the lowest priced of the machines considered;
4. Delivery time was three months;
5. The physical specifications of the machine met the clinical requirements;
6. Siemens had a West Coast American factory that would be able to provide satisfactory servicing needs.

Fig 56. The first linear accelerator arrives. "Big Red" from California, an expert in moving heavy equipment in tight spaces, prepares to move the EMI 4 into the radiotherapy department in Vancouver.

In November, the BC Minister of Health approved building space for the simulator and the second linear accelerator, subject to satisfactory planning arrangements. The Minister wrote:

"in reference to the addition to the radiotherapy area for the provision of a simulator and linear accelerator I would entertain a submission from your Agency so the request may be properly evaluated. The submission of a simple plot diagram showing the areas concerned, the affect on future expansion, square footage involved, type of construction, method of financing, and a simple description of what activities will transpire in the space requested, would be most useful." [2]

The reader may ask, "With all this mention of a second linear accelerator, what happened to the first?" Rather than travel to England to compare accelerators and make a recommendation, Dr Goodman and Dr Kornelsen went to Palo Alto and were convinced that there was no need to go to Europe. Consequently, an order was placed to purchase a 4MV linear accelerator from SHM in California in late 1973. In June 1975, optimistically, it was expected "soon".

In October 1977 it was reported that its arrival was delayed 90 days, the responsible manufacturer having changed to EMI and it was undergoing redesign. It finally arrived in June 1978, five years after the order was placed! Due to erratic line voltage from the Hydro supply, a voltage regulator had to be purchased, delaying treatment of the first patient until December.

The room in which it was housed had originally been built for a cobalt machine. To conform to radiation safety requirements the direct vision window was replaced with television observation of the patient and some of the walls were thickened by the addition of concrete blocks. These alterations certainly did not add to the ambiance of the room.

To improve the room's appearance, Dr Jackson and Steve Iker, the evening maintenance man, bought tongue–in-groove cedar from Windsor Plywood, paid for out of petty cash and covered the concrete on one wall. It seemed better than nothing and it's still there!

The Radiological Advisory Committee approved the simulator and second accelerator in June 1977, but the Functional Programme prepared to indicate how the equipment would be housed suffered cuts

Fig 57. The first patient to be treated on Vancouver's first linear accelerator. Behind Ann Burgess (facing) and Sharon Davies (Allman) is the tongue-in-groove cedar wall bought from Windsor Plywood with petty cash and designed to cover the unsightly concrete blocks added to the wall to improve radiation safety outside the treatment room.

Fig 58. The same "Big Red" prepares the Siemens Mevatron 12 for its move from 11th Avenue to the extension created in 1980 for this accelerator and the TEM Ximatron 3 Simulator.

by Hospital Programmes in Victoria. Planning continued. A simulator was chosen (the TEM Ximatron 3), and by March of 1978 it was suggested that the Phase 1 expansion to house the equipment might be completed by April 1979.

Discussions about replacing the aging cobalt equipment continued. In March 1979 it was decided to replace Cobalt 2 (Theratron F) with an isocentric 4MV linear accelerator. Cobalt 1 (Eldorado A), in service since 1952, had its ball race fail in May preventing rotation of the treatment head. [min25, 37]. When this could not be repaired attempts were made to move the treatment head by fitting an extended handle to provide greater leverage, and later adding a motor. These efforts enabled the unit to limp along until it was decommissioned in the spring of 1981.

(Author's Note: From March 1979 to June 1992 the minutes of the Radiotherapy Staff Meetings in Vancouver, now held in the BCCA archives, were referenced numerically and in the text are marked [min ##].)

The Mould Room, primarily involved in the construction of devices to assist in the accurate delivery of radiation treatment, moved to the basement of the old BCCI building, the previous home of the Order of the Eastern Star volunteers, on a weekend in March 1979. The ceilings of the Mould Room and the adjacent area of Radiotherapy were torn down on March 12th. It was April 1980, however, before Siemens could begin installing equipment in the new building.

The Siemens Mevatron 12 was accepted on the 24th July 1980 and decommissioned fourteen years later on January 7th 1994.

Fig 59. Pam de Silva (Left) and Merlyn Edwards position a patient for treatment on the first high energy accelerator, the Siemens Mevatron 12.

The Changing Face of the Agency

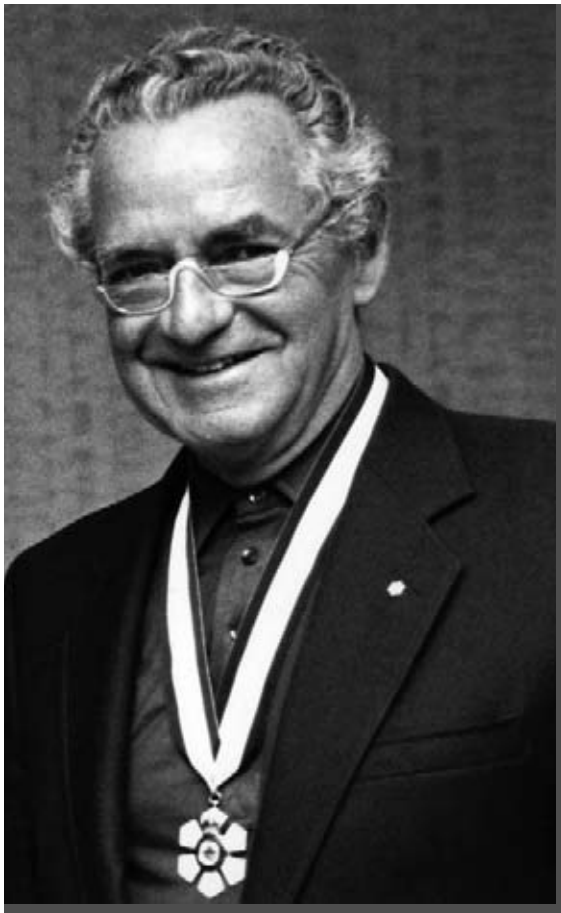
While these events were unfolding, other issues were shaping the clinical face of the Agency and influencing the careers and lives of individuals.

In September 1975, Dr Hall indicated his intention to create new academic appointments in Surgery, Paediatrics, Pathology, and Radiation Oncology, as Associate Directors of the Agency. He envisaged the Associate Director for Radiation Oncology being responsible for Radiotherapy, Clinical Physics, and Radiobiology. Later that year he also established five "S.O.S." clinical groups, the forerunners of the Tumour Groups.

In response to growing concern of the medical staff with the chain of command and organization of the BCCI within the Agency, as well as a decline in morale, the Board of Trustees passed the following resolutions at their meeting on August 25th 1976, "*that in honour of the late Dr A. Maxwell Evans, the founder of the Institute, it would be appropriate at this time to change the name of the facility known as the B.C. Cancer Institute to the A. Maxwell Evans Clinic.*" And it was further resolved "*that the announcement of the change of name and the appointment of Dr George Goodman as Medical Director of the A. Maxwell Evans Clinic be made simultaneously and that a letter to this effect be sent to the Ministry.*"

Although Dr Hall had introduced clinical tumour groups, foreseen the eventual establishment of "Programs", encouraged government to view the Agency as a truly provincial organization with expansion funding of $15 million, matters did not improve. A telegram from the chairman of the Board was sent to Dr Hall asking for his resignation while he was away at a WHO meeting in Switzerland, and Dr Hall resigned on December 1st 1976.

Dr Boyes, the newly appointed Director, reported the following April that, "*The Provincial Government had accepted in principle the functional program for the new development which involves 100 beds with supporting laboratory and other facilities.*"[3]



Dr DA (David) Boyes 1925-

Born in Vancouver Dr Boyes graduated in medicine from Queen's University in 1949; interned at the VGH and did rural general practice in Ganges on Salt Spring Island from 1950-1952.

He undertook residency training in Obstetrics and Gynecology at VGH from 1952-1956 and obtained Royal College certification in Gynecology in 1956. He spent five months in late 1956 early 1957 studying in the lab of Dr Ruth Graham. While in private practice in obstetrics and gynecology in 1957, he was Assistant Director of the BC Cytology Laboratory.

Dr Boyes received the John S McEachern Memorial Fellowship of the Canadian Cancer Society in the fall of 1957 and during 1958 spent four months in Europe studying gynecology, cytology, colposcopy and colpomicroscopy.

Dr Boyes joined the BCCI in 1960 for two years training in radiotherapy. He spent one year at the Christie Hospital in Manchester in 1960, living in Mottram St. Andrews near Macclesfield. He was appointed Radiotherapist in Charge of Gynecological Radiotherapy at the BCCI in 1962. Dr Boyes obtained the DMRT in 1961 and CRCPC in Radiotherapy in 1962, FRCSC in 1973 and FRCOG in 1977.

Along with the pathologist, HK Fidler, he established one of the World's leading cytology services and published widely on gynecological cancer and cytology. As an advisor he was in demand by many countries in establishing cytology programs.

Dr Boyes was made Clinical Professor of Obstetrics & Gynaecology at the University of British Columbia in 1977. In recognition of his contribution to teaching gynecologic residents throughout his career, a large group of ex-residents who had trained under him, founded the "David Boyes Society" with its annual academic meeting in 1974. He was appointed Director of the CCABC in 1977. He received the Terry Fox Medal in 1983. In 1989 the Canadian Medical Association presented him with their highest award, the FNG Starr Award. In January 1989 he was named an Officer of the Order of Canada and in 1990 received the Order of British Columbia.

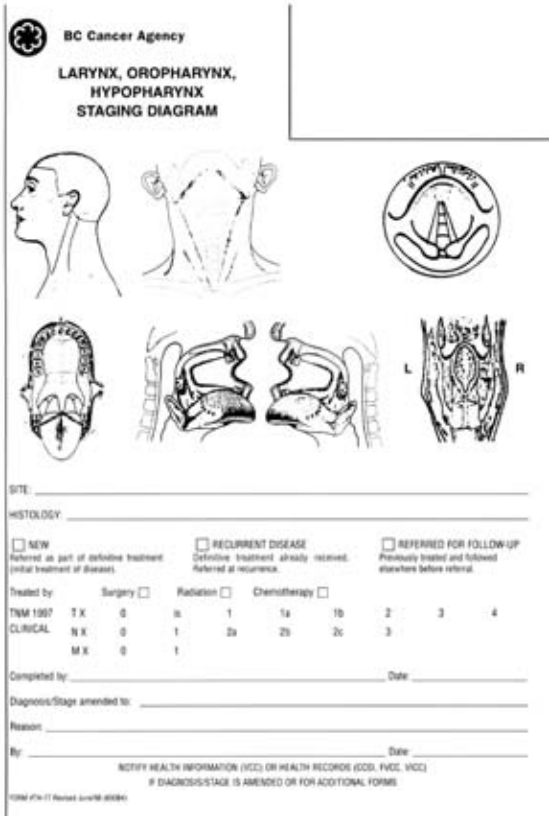
Upon retirement in April 1987, Dr Boyes remained in demand as Chairman of various B.C. provincial committees, including those on Medical Genetics, Tissue Transplant and Medical Ethics and Soil Remediation in False Creek as well as the government's Special Waste Advisory Committee.

Fig 60. Dr DA Boyes wears the medal of the Order of Canada.

In May 1975, an institutional survey of computer needs had been established. Members of the radiation oncology staff felt that the patient record should be computerized, at least in part, for statistical purposes. Computerization of patient follow up and call back was also recommended.

The staging committee had determined in 1977 that all patients should have their disease classified and staged according to the UICC TNM system. Prior to this date a variety of staging systems was in use. [4]

In order to make it clear on the definition in use at the time, staging sheets were produced that had to be completed for each patient.


BC Cancer Agency

LARYNX, OROPHARYNX, HYPOPHARYNX STAGING DIAGRAM

L R

SITE:

HISTOLOGY:

☐ NEW Referred as part of definitive treatment (initial treatment of disease).

☐ RECURRENT DISEASE Definitive treatment already received. Referred at recurrence.

☐ REFERRED FOR FOLLOW-UP Previously treated and followed elsewhere before referral.

Treated by: Surgery ☐ Radiation ☐ Chemotherapy ☐

TNM 1997	T X	0	is	1	1a	1b	2	3	4
CLINICAL	N X	0	1	2a	2b	2c	3		
	M X	0	1						

Completed by: Date:

Diagnosis/Stage amended to:

Reason:

By: Date:

NOTIFY HEALTH INFORMATION (VCC) OR HEALTH RECORDS (CCO, FVCC, VCC) IF DIAGNOSIS/STAGE IS AMENDED OR FOR ADDITIONAL FORMS

Fig 61. An example of a staging sheet used to indicate the diagnosis and stage of disease prior to treatment. A synopsis of the TNM Classification is printed on the reverse.

The staging sheets, created for each tumour site or tumour group, consisted of anatomical diagrams and a space to include the site and pathology of the condition and its TNM classification and stage. The diagrams were compilations of those used at the Christie Hospital, Manchester, many of which had in turn been taken from those used by Dr Baclesse in Paris.

The form was designed to be signed by the responsible oncologist with additional space for corrections to be made if information came to light from investigations undertaken prior to the initial treatment. The reverse side of the sheet contained a synopsis of the staging system in current usage. It was understood that if the UICC system were modified, the staging sheet would also be altered to reflect that change.

In the summer of 1976 a committee was struck to consider the question of sabbatical leave. It was 1995 before this became a reality for radiation oncologists!

The introduction of a dental plan for professional staff on January 1st 1977 was welcomed.

In May 1977, Dr Fairey suggested that a petty cash fund be established. The staff agreed to contribute $10 each to get it started. This was the forerunner of the Radiation Oncology Amenities Fund (established in1982) that in future years helped support Residents' Day and other worthwhile endeavours.

Later that year, in October 1977, concern was raised about legal coverage. The Agency administration assured the staff that they were covered by the general policy of the Agency for all activities relating to Agency affairs. This coverage was considered by some staff members to be insufficient. For those, individual insurance through the Canadian Medical Protective Association could be purchased at staff cost, as the Agency was not prepared to pay for additional insurance.

In January 1979, the steps on the salary scale initiated at the start of the Agency were reduced. It was also proposed that only the first three steps would be automatic, the higher steps would be attained through merit [min 90]. This latter proposal was abolished in subsequent agreements.

Dr EM Brown joined the staff from Saskatoon in January 1977.

She provided a unique and hard working perspective to the Department for the next ten years.

The following obituary in the CCABC News Letter describes her activities and contributions to Oncology.

Dr EM Brown 1921-1987

Dr Esther Brown was admitted to the hospital unit on Thursday May 21, almost immediately slipped into a coma and died peacefully on May 26.

Dr Brown was born in Moose Jaw, Saskatchewan in 1921. She attended medical school in Manitoba and graduated MD in 1945. For a short period thereafter, she served as a Captain in the Canadian Army Medical Corps.

She then entered training in radiotherapy at the Saskatoon Cancer Clinic and became one of the first truly Canadian trained radiation oncologists and since those early days has held a special place in Canadian Oncology. Dr Brown held specialty qualifications in radiotherapy in both Canada and America and also the special examination in Nuclear Medicine of the American Board of Radiology. For twenty-three years she was Radiation Oncologist to the Saskatoon Cancer Clinic during which time the use of Cobalt 60 in radiotherapy was pioneered.

At fifty-two years of age she re-entered university and obtained a Masters in Business and Health Care Administration at the University of Saskatchewan College of Commerce. She then served as Director of the Saskatoon Cancer Clinic from 1973 to 1976.

She left Saskatoon to join the Cancer Control Agency of British Columbia in 1977 and until her retirement just four short months before her death, she played a significant role in the Division of Radiation Oncology.

During her career in Saskatoon, she and her husband, Dr Dougald Blue, a pre-eminent urologist in that city, provided exemplary and often unique care for patients with urological cancer. Her experience and the respect of her urological colleagues allowed her to pursue this interest in Vancouver.

During her ten years at the Agency, her unique style left a lasting mark on the Urology Tumour Group. Her close co-operation with the urologists of the province set an example for all of us to follow.

Fig 62. Portrait of Dr Brown drawn from photographs by Diane Rickson her long time secretary and friend.

Dr Brown held various positions on national committees of the Canadian Association of Radiologists, the National Cancer Institute and the Canadian Cancer Society.

As a young woman, Dr Brown was an accomplished figure skater and speed skater and an active badminton player. Those activities were curbed by her rheumatoid arthritis but she continued to skate until very recently. A woman of many talents, she held a pilot's license and only let her plane be flown back to Saskatoon in recent weeks. She owned two Cadillacs; one won in a raffle, and showed an enduring attachment to her possessions and loyalty to her many friends.

Her untimely death is all the more tragic in that it was at the hands of a disease which she had spent her life fighting and came just a year after the death of her sister. Our sympathies are extended to her many friends.

In her usual manner, Dr Brown left strict instructions. Her body has been interred with that of her husband in her beloved Saskatchewan. She asked that donations in her memory be made to the Esther Brown and Dougald Blue Award in Uro-Oncology, c/o the British Columbia Cancer Foundation. This fund is to provide educational fellowships in Uro-Oncology in both B.C. and Saskatchewan. It has been established in honour of both Dr Brown and her husband and will provide a lasting memory of the contribution they made to the care of cancer patients in this country.

Two other lasting memories of Dr Brown are found in Dianne Rickson's excellent portrait done from photographs that hangs in the fourth floor lounge in the Vancouver Clinic, and the Dr Esther Brown Fund established from the major part of her estate bequeathed to the Agency.

The terms for the utilization of the bequest were listed in her Last Will and Testament as follows.

"To fund the purchase of equipment or buildings or capital projects that are to be used in the day to day routine care of patients particularly in the department of radiotherapy. Such funds may be used as part payment of or for such equipment or buildings or capital projects or as part of matching funds or otherwise as the medical director or directors and the board of directors as the Cancer Control Agency of British Columbia in their absolute discretion determine. In the event there is no medical director the senior medical officer or officers shall act as though they were the medical director or directors. It is my wish that in making a decision that the opinion of the medical directors of the various departments which may be concerned from time to time be taken into consideration."

The estate proceeds were placed in a designated purposes fund and benefited from the favourable interest rates of the early 1990's. A committee was formed to make recommendations to the Board of the Agency concerning the utilization of the funds. The committee consisted of the Head of the Division of Radiation Oncology to be Chairman, one other radiation oncologist, a physician from another Agency division, the Director of the Agency and an Agency Board member who shall also be a member of the Executive Committee of the BC Cancer Foundation.

Despite written and verbal testimony from friends of Dr Brown that she had intended the funds to be used for the benefit of patients at the Vancouver Clinic, legal opinion sought by the Board, was that all present and future clinics of the Agency should be eligible to apply for funds. The committee was therefore expanded to include a representative radiation oncologist from each of the Agency's clinics.

The fund has provided huge support to patient care already amounting to almost $2,000,000 by the year 2000. Some $500,000 has been committed to radiotherapy treatment planning, $975,000 to the brachytherapy program, $60,000 to patient education videos and $420,000 to assist in the delivery of radiation treatment.

In the spring and summer of 1976, Dr Probert left to be in charge of a radiotherapy centre in Auckland, New Zealand, and Dr Lockyer retired from the Victoria Clinic. Dr Douglas left clinical practice to undertake BCCF funded research and developmental work with pi-mesons. Additions to staff included Dr JR (Jim) Brown and Dr CJH (Chris) Fryer in 1977, Dr NJS (Nick) Voss and Dr M (Mohamed) Manji in 1979 and Dr CM (Charles) Ludgate and Dr CA (Clive) Grafton in 1980.

Dr Brown, MB ChB (Manchester), FRCR, was trained at the Christie Hospital in Manchester. A capable and caring oncologist, with a special interest in Head and Neck cancer, described by one of his referees as a "man with a heart of gold", Jim could be aptly described as a character. Things started badly when the then Director, Dr Hall, mistook his application for a staff position to be from another Dr Brown. However, he was offered the position and arrived in Vancouver simultaneously with Dr Hall's departure. Jim had a cutting wit and little time for authority. On a trip to the U.S. he sent a postcard of Alcatraz to his boss in Manchester with the inscription "Wish you were here." Later on a visit to Inuvik his postcard of a Northern Mother with her child in her arms was sent to the medical director which stated, "Come home, we need you, Eskimo Nell." His chart annotations were sometimes colourful yet descriptive. For one head and neck cancer patient, successive visits brought the following comments "back on the garlic again", "Foetor Garlicus", "Continue with multi-vitamins and, I guess, garlic". As part of a new patient's assessment, Dr Brown noted: "Additionally, patient has been a snuff chewer for the last 50 years and demonstrates pre-malignant change within the mucosa of the lower lip; a colourful scene, together with the carious teeth and black semi-chewed snuff." In a note for a patient with testicular cancer who had enquired about fertility, he wrote "Incidentally, the only pregnancy Mr. R has been aware of was Dr Basco's own at the time of his treatment." On his leaving the Agency in 1982 his only comment on his notification of termination form was "Disenchantment unfortunately".

Projections were also being formulated for future staffing needs. Dr Stewart Jackson, who was appointed Head of the Division of Radiation Oncology by Dr Boyes in February 1977, indicated that he would ask for four additional radiation oncologists in 1978 and that 20 radiation oncologists would be needed in the Province by 1981.[5] In 1978 there were 11 radiation oncologists in Vancouver and 2 in Victoria, which increased to 13 in Vancouver and 3 in Victoria by 1982.

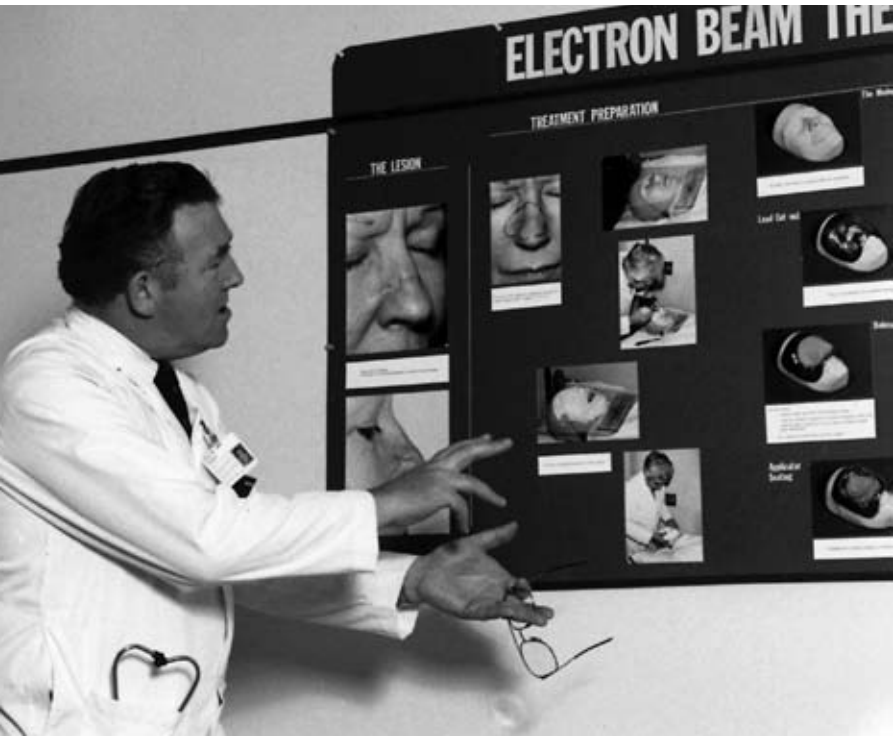


Fig 63. Dr SM Jackson explains the planning of an electron beam treatment.

Dr SM Jackson 1936-

Dr Stewart Jackson was born in Preston, Lancashire. A Foundation Scholar at Manchester Grammar School, his medical training was at the Victoria University of Manchester, The Manchester Royal Infirmary and the Christie Hospital and Holt Radium Institute. His doctoral thesis was on the "Local Recurrence of Breast Cancer". Following four years as Consultant Radiotherapist at the Christie Hospital he emigrated to Canada in November 1974 to take up a position as a Senior Radiotherapist at the British Columbia Cancer Institute. This was within one month of the formation of the Cancer Control Agency of British Columbia.

In February 1977, he was appointed Head of the Division of Radiation Oncology, a position he held until 1995. Following a sabbatical taken in the Department of Health Care and Epidemiology at the University of British Columbia he continued in clinical practice until his retirement in July 2000.

Throughout his tenure as head he strove to attract capable radiation oncologists from Canada and elsewhere, and to train and appoint the best residents to staff positions.

The quality of the staff and the regard in which they are held in the medical community across the country and abroad is a testament to the success of those efforts.

Since 1977 sixty-one residents were admitted to the training program, twenty of whom have been appointed to staff positions in British Columbia. He was responsible for initiating the annual Radiobiology course shared by Seattle and Edmonton in 1980.

Dr Jackson created the annual Residents' Day in 1986 with its regular format of scientific presentation by residents, which later included Fellows and trainees in Radiobiology and Physics. The Residents' Day Award for the best scientific presentation has been given at a formal dinner the same evening (see Chapter 7).

In 1977 he designed and introduced the first staging forms with their diagrams and TNM and BCCI staging systems summarized on the reverse. Many have been updated over the years, but their routine use continues. He introduced the Radiotherapy Database in 1984, which has since registered every radiation treatment given in the province, and forms part of the most comprehensive population based radiotherapy database available. Through discussions with staff, standard guidelines for treatment with radiation were established and formulated in the Radiotherapy Techniques Manual. During his term in office the province acquired twenty linear accelerators. He liked to be the first to use new equipment. He treated the first patient on a linear accelerator in Vancouver, the first selectron and microselectron patients and the first patient treated by pi-mesons at TRIUMF.

With the help of Dr Peter Froud of Kingston, and later Victoria, he was responsible for creating the Canadian Association of Radiation Oncologists in 1987 and was elected its first President.

Fig 64. Dr SM Jackson circa 1977

He also served as President of the Canadian Oncology Society.

A North Shore resident with a love of the coastal scenery he built a remote summer cottage in the Jervis Inlet with the aid of his family. A keen golfer he established the Agency's annual Golf tournament in 1978.

Anxious to retain the historical importance of radiation oncology in British Columbia he willingly accepted the request to compile this history with the help of David Noble the Librarian to the BCCA.

At the beginning of 1981 responsibility for certain aspects of the work of the Division were formalized in the creation of three individual "Programs". Dr Fairey became Director of Residency Training, Dr Basco, Program Director of Undergraduate Teaching and Dr Goodman, Program Director of Pion Clinical Research [min156].

Early in 1981 the Agency had adopted the concept of staff appraisal and various forms were proposed.

The staff was distinctly cool to the idea but Dr Jackson satisfied the requirements by adopting a policy of "Forward Planning Interviews". These annual meetings between himself and individual staff members allowed appreciation of the individuals' aims and achievements and planning of future directions to the mutual benefit of the staff member and the Division.

These Forward Planning Interviews were largely confined to the Vancouver staff although a couple of visits to Victoria were made to compliment the work of Dr Coy with the Victoria Clinic members.

The staff was notified in December 1980 that the clinic was obliged to have a radiation oncologist on call and that the doctor concerned would assume legal responsibility for the patients. [min141, 150]

In February 1981 the linear accelerators had their designations changed to a numerical term rather than the manufacturers' name and the machines' energy. For example, LA1 (EMI 4), LA2 (Siemens Mevatron 12) and LA3 (ATC 4). [min151] This custom of naming the accelerators in numerical sequence remained in place until 1999.

Fig 65. The Radiation Oncologists circa 1981. Standing left to right Drs Fryer, Manji, Hadzic, Voss, Flores, Ludgate, J.Brown, Fairey, Grafton, Basco, E.Brown. Seated L to R. Drs Goodman, Jackson and Crawford.

The First Selectron West of Glasgow

In early 1975 Dr Boyes had raised with the Director of the Agency, Dr Hall, the question of the remote handling of radiation sources for gynaecological treatments in the interests of staff radiation safety.

In October the same year, Dr Goodman suggested that a committee of the radiotherapy staff be established to report on high intensity devices for afterloading in radiotherapy. Dr Gibson asked Dr Boyes and Dr Kornelsen to join him in forming the committee. However, it was not until October 1977 that the committee made a recommendation. In response to a report prepared by Dr Fairey, the preference was for low-dose afterloading with both the Selectron and the Curietron under consideration. In November 1978, the choice was made for the Selectron, with a six-channel unit capable of treating two patients simultaneously in Vancouver and a single three-channel unit for Victoria. These were the first units west of Glasgow in the United Kingdom to be sold by the Dutch manufacturer, Nucletron. The Vancouver unit arrived in August and was installed in West 7 in the Vancouver General Hospital. The Selectron delivered its first treatment on October 15th 1979 and by the end of the month all gynaecological insertions had been transferred from radium to the Selectron which uses caesium as its radiation source. The applicators carried 2.5mm spherical pellets, those containing radioactive caesium distributed amongst non-active dummy sources to create a standard radiation dose distribution within the patient.

The Selectron was designed and built to exacting Dutch standards but an unforeseen problem came to light early in 1981. Three post-hysterectomy patients who had been treated with vaginal ovoids in the summer of 1980 developed mucosal damage and tissue necrosis at the vaginal introitus. A review of the radiographs taken at the time of the insertions appeared satisfactory.

At least one of the patients had described unusual pain during the treatment. Although it was never possible to be certain of the cause of these unfortunate occurrences, it was concluded that over time, it was likely the grip of the ovoid on the applicator had loosened and the ovoid had come off the applicator during treatment.

The loss of the ovoid had presumably placed the applicator and the active sources in close contact with the tissues of the lower vagina.

This explanation fit the description by the nursing staff that, as the applicators were being removed from the patient at the completion of the treatment, the ovoids appeared to become dislodged from the applicator.

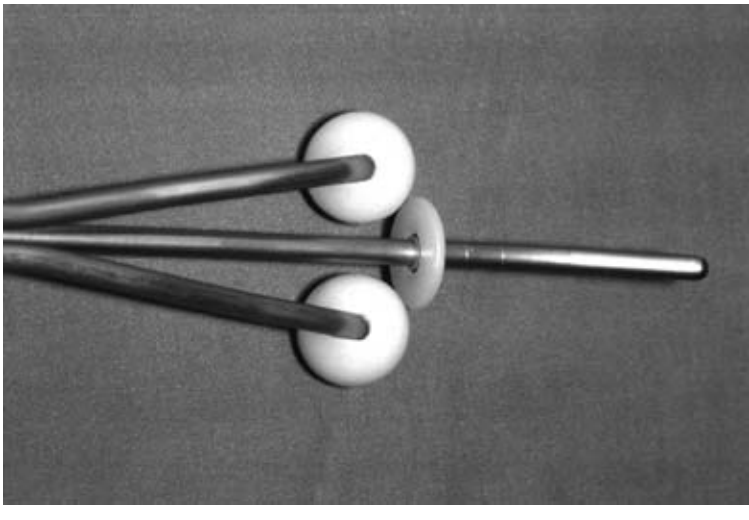


Fig 66. The Selectron applicator designed for remotely handling caesium sources under computer control.

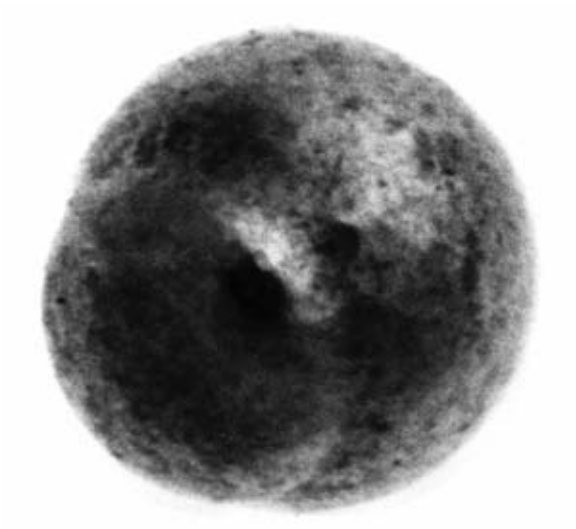


Fig 67. The stainless steel 2.5mm pellet containing radioactive caesium. One of many active sources interspersed with dummy sources to act as spacers in delivering planned radiation treatment. This source demonstrates the weakened weld that caused distortion and treatment interruption

To prevent the ovoids coming loose in the future, the Physics staff fitted them with a stainless steel screw that could be tightened against the applicator.

The equipment then functioned almost problem free until the summer of 1983 when, on occasion, individual sources became stuck on transfer to the patient, resulting in an interruption in treatment. The cause was eventually traced to the welds used to seal the caesium within the individual steel sources.

The material used for the weld was softer than that for the rest of the casing. Over time, with constant contact between sources, the weld was pushed out of shape and protruded from the surface of the casing.

This alteration in shape caused intermittent transfer problems. The Physics and Machine Shop personnel were able to restore the shape until the manufacturer produced new sources with stronger welds allowing the faulty sources to be replaced.

For the first six years, the Selectron was housed in the VGH but was repatriated to the newly expanded clinic and hospital unit in March 1985.

In September 1986, towards the end of EXPO 86, Vancouver hosted a very successful 4th Interna-

Fig 68. The Selectron on the 5th floor of the 10th street building following its repatriation from the Vancouver General Hospital where it had been housed since its acquisition in 1977. The patient is prepared for treatment of cervical cancer following insertion of the applicators.

Fig 69. The microselectron delivering a surface applicator treatment. A single high intensity iridium source passes though the catheters under computer control to rest for a few seconds over the desired treatment area.

tional Selectron Users Meeting. There were over 200 registrants with seven sessions on "Gynaecological Aspects", and one each on "Interstitial Uses" and "New Developments".

The meeting was held in the Pan Pacific Hotel completed that year in time for EXPO and the social events were graced with exceptional September weather.

A harbour cruise, a "west coast" barbecue at the Museum of Anthropology at UBC, and visits to EXPO revealed Vancouver at its best.

The meeting generated a profit of $16,000 that, with the approval of Nucletron, allowed creation of a "Selectron Users Fellowship", money from which would support educational travel to increase knowledge of brachytherapy.

In late 1988 a high dose rate microselectron became available and was later purchased with monies provided by the Esther Brown Designated Purposes Fund [min999]. The microselectron uses a small high intensity iridium source that can be positioned under computer control within a catheter or catheters inserted in the tissues or body cavities. Treatment sessions last only a few minutes and do not require the patient to be anaesthetized.

The microselectron has found particular use as a boost to external beam treatment in oesophageal, nasopharyngeal and lung cancers.

In June 1992 Dr John Hay was appointed Head of the Brachytherapy Program within the Vancouver Cancer Centre with responsibility through the Department Head for all aspects of brachytherapy within the clinic.

Neutrons Under Consideration

Early in 1978, the possibility came to light of TRIUMF at UBC, in cooperation with Atomic Energy of Canada, acquiring a neutron-generating cyclotron. Position papers were generated and interest was shown by the radiation oncologists, with the proviso that clinical expansion at the A. Maxwell Evans Clinic should not be compromised by a neutron facility on campus. Dr Jackson and Dr Kornelsen visited the Cyclotron Corporation in San Francisco and reported back on the CP 42 Neutron therapy unit. They felt it would meet most of the specifications. They stressed that there were several problems to be considered with treatment using neutrons. The therapy head of the unit was known to become radioactive during treatment with some escape of radiation from decay of short-lived isotopes. Because of this, technicians would not be able to enter the treatment room for at least a minute following exposure of the patient. Even then the exposure rate would be 20 millirads per hour from the induced radiation, a serious potential leukaemogenic risk. Also during treatment there would be total body exposure outside the treatment field regardless of field size. Even with the small fields used in head and neck cancer, this might result in a total body dose of some 100rads. A third concern was the degree of penumbra at the edge of neutron fields. These and other issues surrounding cost and feasibility led to the project foundering with a consequence that neutrons were not pursued further.

Dentistry

Early in 1976 correspondence between Dr AE Swanson, dental surgeon, and Dr Hall came to the notice of the radiotherapy staff. The staff supported Dr Swanson and had already recommended a dental hygienist with dental supervision for patients with head and neck cancer. Dr Smith, a senior dentist in the Department of Dentistry at UBC had written to the Dean of Dentistry with a proposal for better dental care of radiotherapy patients. In January 1977, Dr Boyes, the Acting Director of the Agency, announced the establishment of the post of head of Dentistry to the Agency. Dr Jackson chaired the Search committee.

In September Dr Peter Stevenson-Moore was appointed head of the Department of Dental Oncology. The position was half time with responsibility for pre-treatment dental care and emergency restorative dental work especially for head and neck patients. In addition, in conjunction with Mr Ray Allan of the Mould Room, preventative treatment related to radiotherapy, education and prosthetics, would be undertaken. Within three years Mr Allan expressed the view that prosthetics was moving more to maxillofacial work and to a branch of Dentistry rather than Radiotherapy. He requested to be transferred to be a member of the dental staff rather than radiation oncology.

From Technicians to Technologists to Therapists

Two months into his headship, Dr Jackson was invited to an open meeting of the technical staff of the Radiotherapy Department of the A Maxwell Evans Clinic. He was met with a long list of problems that the staff felt was leading to poor morale, a lack of job satisfaction and poor patient care.

The concerns were brought to the attention of the radiation oncologists. With the minutes of regular meetings of the technicians being forwarded to Dr Jackson and through him to the medical staff it was hoped that matters would improve.

Mrs Jean Richardson retired as "chief technologist" in September 1978 and was succeeded by Mrs Janet Fox and later Mrs Gloria Sherstan who retired in 1994.

Fig 70. Mrs Jean Richardson admires a gift at her retirement tea. Her replacement, Janet Fox is with her.

In 1982 some tensions were occurring between those technicians with RN qualifications and others who did not hold dual qualifications.

The Administration was attempting to define its position regarding the need for technicians to have RN qualification. The oncologists were divided on the issue [min244].

The outcome was that a Registered Nursing qualification was no longer deemed a requirement, although a small financial benefit was paid to those who held it.

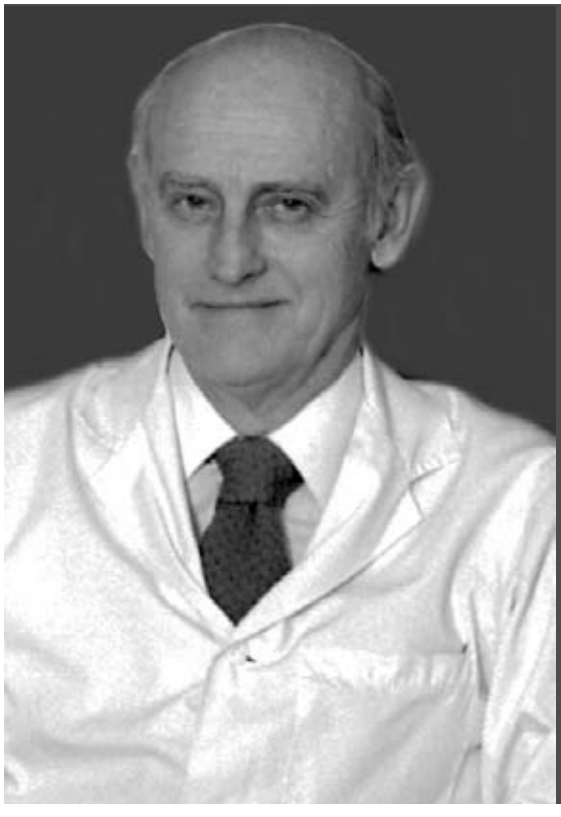
In 1983, Sharon Davies (Allman) was appointed Director of Education for Radiotherapy Technicians. A year later the issue of Nurse Clinicians in the Radiotherapy Department was raised. Up to this time nursing duties had been provided by the technicians who held dual qualifications of RN and RTT.

Fig 71. Gloria Johansen (later Mrs Sherstan) holds the Dupont Essay prize awarded by the BCAMRT.

The Radiotherapy Techniques Manual

Various staff meetings in 1976 included discussions on the management of breast cancer and head and neck malignancies. Separate meetings were arranged to discuss and formulate policy. These led to the formation of the Radiotherapy Techniques Manual. The manual contained guidelines regarding radiotherapy technique, dosage and fractionation for various disease sites. Efforts were made to update these guidelines from time to time. The first to be written in 1979 were for testicular tumours (updated in 1994) and the second in 1980 prostate cancer (updated in 1988 and 1993). Head and neck guidelines were written in 1982 and updated in 1995. The guidelines for breast cancer, orbital tumours and lung cancer were updated twice. In all, sixteen sites were covered with the last update in 1995. In 1993, regular meetings to discuss techniques were enhanced by the inclusion of the radiation therapists (previously technicians or technologists).

Actual clinical practice in breast and prostate cancer in relation to the timing of the written guidelines was examined in 1999 [6]. Over the years, changes in the treatment of breast cancer followed the recommendations of the written guidelines. The initial fractionation of 16 treatments in three and a half weeks originated with Dr Glen Crawford. He had been trained in Sheffield and spent the majority of his career in the management of this disease.



Dr GM Crawford 1921-1990

Born in Thedford, Ontario he graduated from the University of Western Ontario in 1947. He interned at St Paul's 1947-1948 and was then in general practice on Lulu Island until 1950 when he joined the BCCI as a locum while Dr Ellison was on maternity leave. Deciding to specialize in radiotherapy, he trained with Dr George Blomfield in Sheffield, England from 1951-1954.

Dr Crawford obtained the DMRT(London) in 1954 and subsequently was certified in Therapeutic Radiology from the Royal College. His principal clinical interest was in the care of patients with breast cancer. He was chairman of the Breast Tumour Group and for many years carried out the Consultative Clinics in the Kootenays and the Okanagan. The attendance and comments made at his retirement dinner in May 1984 attested to the warm regard in which he was held by his many friends and colleagues.

Breast Cancer

In the early years, post-mastectomy radiation treatment for breast cancer was commonplace and consisted of treatment to the internal mammary region and the medial supraclavicular fossa. With the advent of breast conservation surgery, treatment to the post biopsy breast became increasingly common. The practice of 16 treatments delivering a dose of 44Gy continued, whether by cobalt or low energy accelerator. As new staff members were added who had been trained elsewhere, a move to five weeks treatment was made. However, careful analysis of local recurrence rates and cosmetic outcomes compared to published data indicated no advantage to the longer fractionation and three weeks remained the preferred guideline for most patients. The benefits of treatment in three weeks were later confirmed in a randomized trial from Ontario[7]. Longer fractionation was recommended, however, for patients with post-biopsy complications, poor surgical results, or for those with large breasts. Post mastectomy treatment was restricted to those with specific indications. In the early days of chemotherapy combined with radiation, there was concern that the combination might produce increased pulmonary side effects and to avoid this, the dose of radiation was consequently reduced by 10%. These fears proved unfounded and full dose was soon reinstated. The advantage of maintaining the use of radiation in combination with chemotherapy in post-operative situations in which there was more extensive local disease or positive lymph nodes was confirmed in randomized trials published simultaneously from British Columbia [8] and Denmark in 1997.

Head and Neck Malignancies

Guidelines for head and neck cancer contained a recommendation for radical radiation treatment that remained unchanged throughout. It consisted of a daily fraction size of 2.4Gy given five times a week to a total dose of 60Gy in 5 weeks. This was a dose and fractionation rarely used elsewhere. It was initiated when Dr Flores

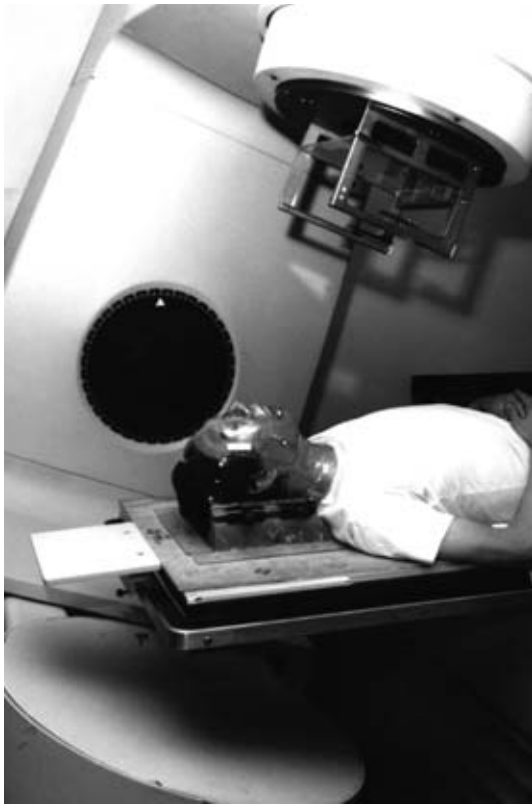


Fig 73. Patients treated on a linear accelerator lie on a treatment couch. Treatment accuracy is assured with the use of an individualized treatment shell or mould and field definition and wedges of the linear accelerator to provide radiation dose homogeneity throughout the treatment volume.

and Dr Coy were unhappy with Dr Evans's fractionation for larynx cancer of 60Gy in 6 to 7 weeks. They wanted to maintain the dose of 60Gy but in the shorter overall time of 5 weeks [9].

Dr Jackson and Dr Coy having been trained in Manchester, and Dr Keane later from Toronto, found this radical dose schedule practical and effective. During the 1990s, under the influence of U.S. practice, 2Gy fractions became more common.

Other than slight reductions in acute reactions, no difference in long term outcomes have been shown between 2 and 2.4Gy daily fractions.

Dr AD Flores 1937-

Born in Peru he was educated at the San Maros University in Lima obtaining B.Sc. in 1956 and M.D.,M.B. in 1964. Following four years residency in General Surgery and Oncology at the Instituto Nacional de Enfermedades Neoplasicas in Lima he came to Vancouver to train in radiotherapy in 1968. His residency was supported by the Shane Fellowship. He received certification in Therapeutic Radiology in 1970 and FRCPC in 1972 and was appointed Clinical Professor in the Department of Surgery UBC in 1993. He left to work as consultant in Radiation Oncology at King Faisal Specialist Hospital in Riyadh in 1993 and retired in 1999.

Dr Flores was an extremely hard working clinician with a major interest in head and neck cancer. He was also involved in the treatment of anorectal cancer and a pioneer in the intracavitary treatment of oesophageal tumours. His surgical training contributed to his excellent manual skills. He worked closely with his colleagues in Surgery, Gastroenterology and Medical Oncology.

Despite his busy clinical practice he found time to carry out extensive retrospective analyses of treatment outcomes, wrote many papers and several book chapters mostly on the treatment of oesophageal cancer.

Fig 74. Dr A (Albino) Flores. The stern look belies his warmth and caring for his many patients.

Prostate Cancer

Radiation treatment for prostate cancer was uncommon until the early 1980s. Its increasing use in British Columbia grew in step with its popularity in the United States. Between 1985 and 1996, 7,667 patients were treated in British Columbia and an additional 1,272 were referred to Washington State for treatment between 1991 and 1996. The number of patients treated annually in British Columbia peaked at over 940 in 1994[6]. In an attempt to reduce the pressure on the department as the numbers of referrals grew, a decision was made to reduce the number of treatments for each patient from from 5 to 4 per week. In 1985 the policy was to treat the whole pelvis or the prostate to a dose of 52Gy. Four years later practice had reverted to 5 treatments per week. In contrast to breast cancer, practice in prostate cancer often preceded the changes made to the guidelines. In 1993 the guidelines called for treatment to the prostate alone but later included the use of 2Gy fractions to a total dose of 60-66Gy. By the mid 1990s over 80% of patients were treated with this fractionation. In response to public pressure, prostate implants with radioactive iodine seeds were introduced in 1999.

Central Nervous System Tumours

The treatment of central nervous system tumours was highlighted by randomized trials of superfractionation and pion versus photon therapy for glioblastoma. These trials are described in Chapter 7.

Treatment of the cerebrospinal axis using a combination of 4 and 10MV photons developed in 1981 replaced the previous cobalt technique. The junction of the spinal and brain portions of the treatment volume was blurred by the use of a movable block to eliminate overdosage .

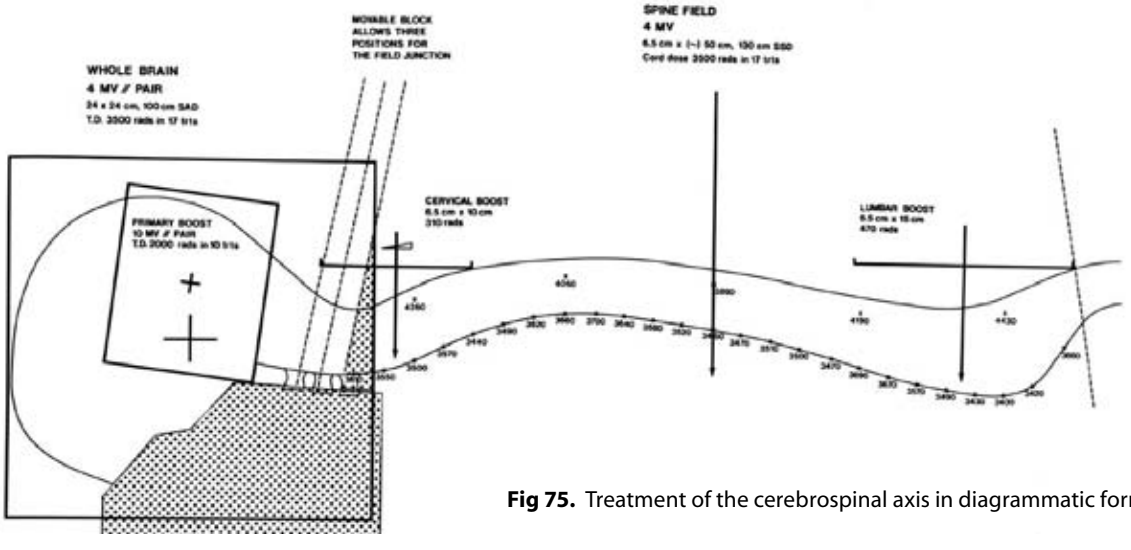
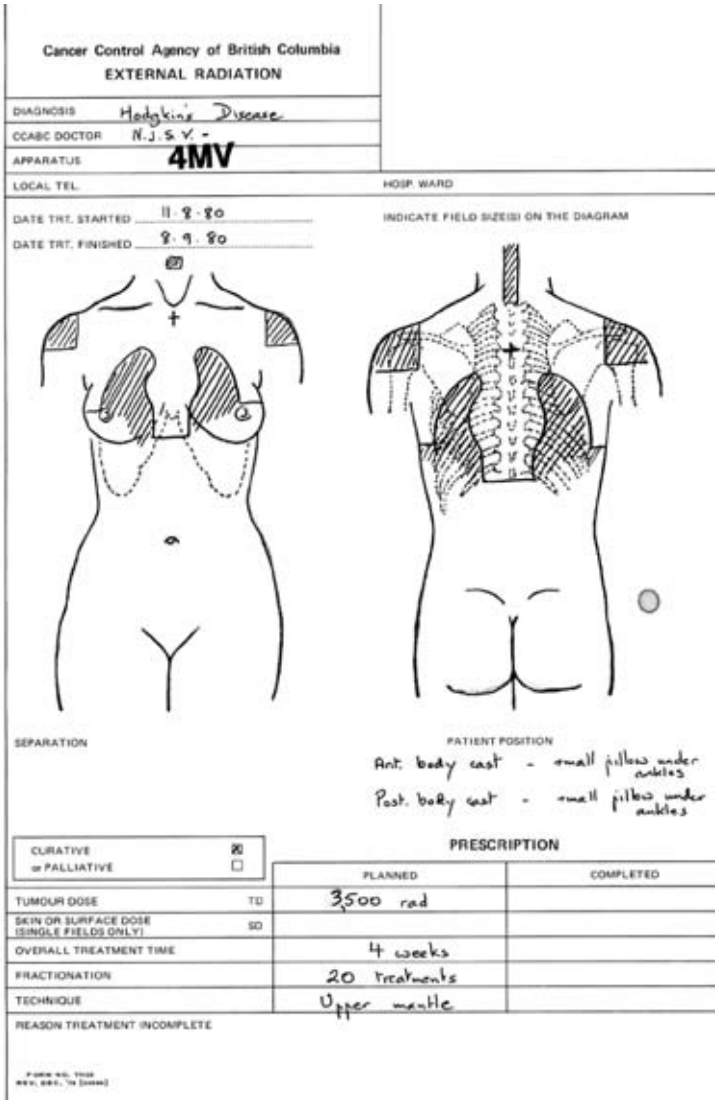


Fig 75. Treatment of the cerebrospinal axis in diagrammatic form.

Lymphomas

Since the introduction of lymphangiography and the Mantle technique by Dr Basco in the 1960s, the department has been a leader in the management of Hodgkin's Disease and the Lymphomas. Immobilisation for the Mantle technique was achieved by the use of half body casts. The anterior and posterior body casts were also involved in the dosimetry calculations using Moiré topography. Dentistry and the use of fluoride eliminated dental caries, one of the disabling and distressing side effects of the early Mantle treatments.


Cancer Control Agency of British Columbia
EXTERNAL RADIATION

DIAGNOSIS Hodgkin's Disease
CCABC DOCTOR N.J.S.V.
APPARATUS 4MV
LOCAL TEL.
HOSP. WARD
DATE TRT. STARTED 11.8.80
DATE TRT. FINISHED 8.9.80
INDICATE FIELD SIZE(S) ON THE DIAGRAM
SEPARATION
PATIENT POSITION
Ant. body cast - small pillow under ankles
Post. body cast - small pillow under ankles
CURATIVE ☒
or PALLIATIVE ☐

PRESCRIPTION		PLANNED	COMPLETED
TUMOUR DOSE	TD	3500 rad	
SKIN OR SURFACE DOSE (SINGLE FIELDS ONLY)	SD		
OVERALL TREATMENT TIME		4 weeks	
FRACTIONATION		20 treatments	
TECHNIQUE		Upper mantle	

REASON TREATMENT INCOMPLETE

Fig 76. The Mantle technique for treating Hodgkin's Disease shown on the face sheet of the Radiotherapy Prescription.

Palliation

The palliation of symptoms, especially pain, is an important role for radiation treatment. The standard radiation treatment for pain at the BCCI and subsequently at the BCCA was 20Gy in a total of 5 daily treatments, sometimes given in 4 treatments to avoid extending treatment over a weekend. Randomized studies from the United Kingdom compared single treatments to other fractionations in the palliation of pain and found no significant difference in results. Single treatments were included in the guidelines, especially for outpatients and those in whom more fractions would be disruptive to their overall care.

Cancer of the Cervix

The treatment of cervical cancer changed little over the years. The standard practice has been a combination of external beam therapy and intracavitary radiation. The external beam treatment, initially cobalt, was replaced later by high-energy photons thereby reducing the dose to superficial structures. The intracavitary treatment was three standard insertions at one and two week intervals. As treatment was delivered in three rather than two insertions, the change to the remotely handled caesium sources of the Selectron was achieved with little change in dose rate. The change to remote afterloading using the Selectron was important in eliminating staff exposure to radiation and because of the similarity in dose rate was achieved without the complications experienced in Manchester. The standard insertion includes an intrauterine tube with 4-6 sources and two vaginal ovoids with 3 or 4 sources each to give a dose at point A of 1550cGy at approximately 100cGy per hour.

Total Body Irradiation (TBI)

Used in the haematological diseases to support allogeneic bone marrow transplantion, it is thought to aid in killing residual malignant cells and in reducing graft versus host disease. Using cobalt, the beam is designed to sweep the patient. A beam flattener is used to allow for the change in "Source to Skin" distance. Tissue compensators are individually designed to reduce dose and protect the patient's lungs.

Fig 77. Total Body Irradiation (TBI) using cobalt. The phantom patient is used to verify the dose to be received.

The Radiotherapy Database

With the introduction of the CyCare computer system in 1984 came the opportunity to computerize treatment summaries for all patients receiving radiation treatment in the province. This in time lead to a comprehensive database that could be used to monitor workloads for machines and personnel. More importantly it gave rapid access to groups of patients with different stages and different pathology that would later allow analysis of outcomes, an essential to improving patient care. The Breast Outcome Unit in the 1990s made extensive use of this database.

The initial concept was to create the database with basic demographics, site, stage, and pathology for all patients. On this base could be layered information pertinent to subsets of patients.

Those receiving radiation treatment would have a separate basic summary created. This was designed to record the start and end date of each course of treatment given in each clinic. The intent of treatment (palliative, radical, or adjuvant), the radiation oncologist, the region treated, technique, modality, dose and fractionation including frequency (o.d, b.i.d. or weekly) were included as well as whether or not the treatment was completed as planned. The definition of technique included certain procedures such as "Mantle", but more often, technique was noted as the number of fields and the use of wedges, shielding, and bolus. Modality included the radiation type, energy, and equipment. The initial expectation was that more complicated treatments or approaches might be caught at a second level of data collection. However, with the exception of an attempt to do this in gynaecology and later with prostate implants this did not happen. As treatments became more complicated with the use of multiple energies and more variables, the originally designed approach was increasingly tested and modifications had to be made to keep pace with these changes. Nevertheless, the database has captured information on all radiation treatments given in Agency centres. By the end of the year 2000 the database had recorded over 121,000 radiation treatment courses for the patients of the province.[10]

Expansion an Ever Present Practice

Planning for expansion of radiotherapy services was an ever present endeavour. In 1976, Dr Boyes asked for input into expansion plans for the Institute. The radiation oncologists were of the opinion that we should plan for a new patient population of 5,500 per year in Vancouver, and that when that number was attained, plans should already have been prepared to open a third radiotherapy centre in the province. It was considered most likely that the population to support the new centre would be in the Lower Fraser Valley [11]. It was also stressed that in the Phase 1 expansion under consideration, there must be space for a third linear accelerator. In preparation for these expansion efforts, plans were underway in April 1977 to purchase a lot adjacent to the parking lot of the BCCI building.

In discussions on further expansion of the main clinic, it became evident that, to conform with radiation protection issues for non-radiation workers and the general public, the roof over the four central units in radiotherapy, including the new 4MV accelerator to replace Cobalt 2 (Theratron F), would have to be made thicker. Most of the area would require an additional 23 inches of concrete on the roof. The work was completed in the fall of 1980 and, since much of the work was done outside treatment hours, no unit was closed for more than five days.

In addition to the 4MV unit this expansion included the Siemens Mevatron 12 accelerator with photon energy of 10MV (not 8MV as originally envisaged), and three electron energies of 3,7 and 11 MeV, and the first simulator. This first high energy machine required significant excavation and expansion to the east of the existing radiotherapy department.

Government architects pored over the plans before giving approval to proceed, and they only required two changes. One was to change an angled toilet so placed for easier disabled access to a more conventional position and the second to remove a cassette pass-through from the simulator dark room!

The addition of electrons allowed the develop-

Fig 78. Construction begins on the 1980 extension to house the first simulator and high energy accelerator.

Fig 79. The Siemens Mevatron 12 and the moving couch technique designed to radiate the total body surface using 3MV electrons.

ment of a technique for treating mycosis fungoides (Fig 77). It was based on a method developed in Manchester and involved a moving couch which was drawn under the low energy electron beam. Two passes were made with the patient supine and two prone.

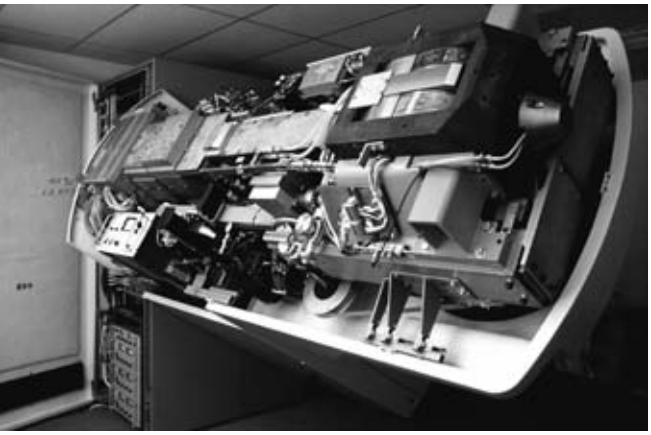
The couch was tipped 5 degrees to the side to allow treatment of the whole body surface. The eyes were protected. Subsequent adjustments to the technique by Dr Voss improved the dose distribution.

The higher photon energy improved the dose distribution for pelvic treatments, especially for prostate and gynaecological cancers.

In planning for the expansion of the main clinic (Phase 3) the Professional Advisory Committee had voted against the inclusion of a Special Procedures Unit and Post-Anaesthetic Recovery Room. The radiation oncology staff was up in arms at this suggestion and passed the following motion at its next meeting.

"The Division of Radiation Oncology believes that a Special Procedures Unit and Post-Anaesthetic Recovery Room should be regarded as high priorities

Fig 80. The Vancouver Centre, A Maxwell Evans Clinic facing 10th Avenue. The top two floors housed inpatient beds



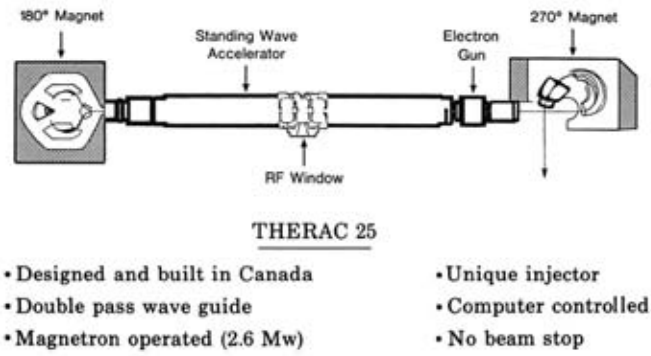


Fig 81. The covers removed from the wave guide of the Canadian manufactured Therac 25 linear accelerator and a diagram of the unique double pass standing wave accelerator.

and have preference over areas such as a Centralised Cytology Laboratory, which might better be housed outside the AMEC." [min139] As it turned out, they were included, but so also was the Cytology Laboratory!

Included in the next phase of the expansion was a parkade and provision for a high-energy linear accelerator. Under consideration were the Therac 25, the Siemens Mevatron 77 and the Varian Clinac 20 [min173]. The AECL Therac 25 was chosen as the fourth accelerator and shipped from Ottawa in October 1984. It was available for treatments with photons by the following summer and electrons of 7,10,13,16 and 19 MeV energies were available by September 1985.

The Therac 25, manufactured by Atomic Energy of Canada (AECL), was a unique machine. In order to maintain a reasonable length of the wave-guide and yet produce high-energy photons, a double pass system was developed.

The electrons passing through the wave-guide as they were being accelerated were turned through 360 degrees to continue their acceleration as they returned to the target. To produce photons the beam had to pass though a target and beam flattening filter. If these were not in place the electrons could be used as a treatment beam. During its life in Vancouver over the next thirteen years, this machine proved to be efficient and useful, particularly for pelvic treatments in prostate and uterine cancers, and in the provision of high-energy electrons for use in a variety of clinical situations.

However, elsewhere there were major problems that eventually led to AECL abandoning the accelerator business. Serious incidents came to light in 1985 in Georgia and in Hamilton, Ontario, and in March and April 1986 in Tyler, Texas, that resulted in massive overdose to patients. It is to the credit of the Physics and Electronics staff in Vancouver that on 15th April 1986 the conditions that created the overdose situation were recognized. By moving the "CURSOR UP" key before the computer had confirmed a photon treatment was prescribed, the beam type could be changed from photons to electrons without bringing the target and flattening filter into place. This could result in the delivery of a very high dose rate of electrons rather than an expected photon treatment.

The risk was averted in Vancouver by first removing the "CURSOR UP" key and two weeks later by installing an in-house "Treat Mode Verify" system which used a separate hardware mechanism to

detect the position of the target and flattening filter. If this position and the beam energy did not agree, the beam was disabled. This system was offered to Yakima in Washington but was declined, however, they too suffered an overdose occurrence the following January.

Thereafter, AECL required the installation of a system based on the principles established in Vancouver. Due to the ingenuity of our Physics and Electronics personnel the Therac 25 was trouble free in Vancouver until being replaced in June 1994 [12].

Approval for a second simulator was received in June 1985. Space was at a premium, but it was squeezed into the old locker room opposite the mould room. Accepted in January 1989 the Kermath TSL-XY simulator remains in use for palliative treatments.

Winifred Searle, Dr Jackson's faithful executive secretary and Office Manager for the department retired in 1986. Before accepting the position in Radiation Oncology she had held positions with a Judge, the Dean of the Faculty of Medicine at UBC and the Director of the CCABC. Her experience and wisdom were invaluable to the Vancouver Department and the Division of Radiation Oncology. These same attributes of good sense and efficiency were maintained by Susan Broadbear who continued as Office Manager and later Program Asssistant.

Fig 82. Dr RO (Richard) Kornelsen, Head of Physics, checks a patient on the couch of the Therac 25.

Goals, Objectives, Rules and Regulations

In November 1983 the Division created its "Goals and Objectives".

1. ***Service***

   To provide a leading role in the assessment and management of all patients referred to the CCABC.
   To provide a balanced assessment of the place of radiation therapy in the management of patients referred to the CCABC.
   To provide an exceptional radiotherapy service to the people of British Columbia.
   To provide medical care and management of patients during and after radiotherapy.
   To be available for consultation as required in UBC hospitals and in consultative clinics and associated hospitals throughout the province.

2. ***Education***

   To provide a three-year residency training programme in Radiation Oncology leading to FRCPC in Therapeutic Radiology.
   To provide a two-year training programme in Radiation Technology leading to certification in RTT.
   To provide teaching in oncology to medical students at all levels at UBC.
   To provide teaching to nurses in various branches of the Health Service.
   To provide teaching in oncology and radiation oncology to residents in several UBC training programmes, including Surgery, Medicine, Paediatrics, Gynaecology and Dentistry.
   To provide education to the public though the popular media and lay organizations, including the CCS, about causes, diagnosis and treatment of cancer, and to promote continuing education to doctors through Agency courses, Continuing Medical Education, UBC and various post-graduate meetings.

3. ***Research***

   To cooperate with the CRC in fundamental research in radiobiology and all aspects of basic oncological research.
   To undertake the clinical evaluation of new methods of radiation treatment.
   To evaluate the results of radiation treatment in BC.
   To evaluate the place of radiation treatment in association with surgery and/or chemotherapy.
   To develop new and improved methods of radiotherapy in BC.
   To promote the prevention, early diagnosis and improved treatment of all forms of cancer.[13]

The language of the goals was modified slightly from time to time and one sentence in Service was added, (*To advise the Board through the CEO of the future needs of Radiation Oncology in the Province*), but was otherwise unaltered. In May 1986, guidelines for reporting unusual occurrences on the treatment machines were introduced. Any single daily treatment with a 25% or greater error in daily dose should be reported, as should any sequence of events that led to an overall error of more than 5% in the dose. [min671]

In 1987, Rules and Regulations for the Division of Radiation Oncology were prepared which contained definitions for the various staff positions including the Division Chairman, the Section and Program Heads, the Manager of Radiation Therapists, The Supervisor and Senior Radiation Therapists and the Program Coordinator of the School of Radiation Therapy, which remained in place until the establishment of the Radiation Therapy Program in 1996. The Regulations which were updated annually until 1995 included the terms of reference of the various Divisional and Departmental committees which included; The Education Committee (est.1976); The Promotions Committee, UBC (est. 1981); The Educational Advisory Committee, School of Radiation Therapy (est. 1984); The Quality Assurance Committee (est.1985); The Research Coordinating Committee (est.1987); The Dr Esther Brown Committee (est.1989) and The Divisional Council (est.1995).

By January 1985 the staffing situation appeared more promising. Dr John Hay was due to join the staff from England and Dr Frances Wong and Dr Ethan Laukkanen would complete their fellowship and residency and also become staff members. The latter moved to Victoria the following year. Dr Graeme Duncan and Dr Ivo Olivotto completed training in 1988 and Dr Dorianne Rheaume and Dr Karen Goddard came on staff in 1989. Dr Edward Kostashuk left to be Head of Radiation Therapy in Saskatoon in 1990 returning as Director of the Fraser Valley Cancer Centre in Surrey in 1993. Dr Wong was appointed Head of Radiation Oncology in Surrey in 1993 in preparation for the clinic opening in 1995. Clinic physicians were assimilated into the Divisions in 1985.

The entire Vancouver clinic became smoking-free on April 15th 1987.

Fig 83. The Vancouver Clinic Radiation Oncology staff circa 1986
Standing left to right ; Drs Chu, Manji, Cairns, Grafton, Ludgate, Olivotto, Wong, Acker, Hay, Kostashuk, Vernimmen, Brown E, Voss, Lam, Fryer, Matheson, Kim-Sing. Seated left to right; Flores, Fairey, Basco, Jackson, Goodman.

Additional Clinics and Burgeoning Technology

Fig 84. The first of the Varian Clinac 2100C linear accelerators enters the building from Heather Street.

The Agency created an "Additional Facilities Committee" in 1988 under the chairmanship of Dr Fairey to examine the need for further oncological services in the province. The radiation oncologists discussed the various choices and at that time believed that a third clinic situated in the Lower Mainland provided the best option (the same recommendation they had made in 1976).

In October 1987, Dr Jackson reported to the staff that he had made the following equipment and staffing proposals to the Director and the Board [min847]: "*By 1991, two extra linear accelerators and a third clinic would be required with a total number of 32 Radiation Oncologists in B.C. This number would be extended to four extra linear accelerators plus a fourth clinic to be available with a total of 42 Radiation Oncologists by 2001.*"

The two extra accelerators were Varian machines (Clinac 2100Cs) which, along with a new home for the School of Radiation Therapy and the Jambor Education Room, came to occupy the South West corner of the Vancouver Centre building. The accelerators were commissioned in June 1991.

Two years later Dr Jackson reminded the staff that these two machines would be scheduled to close for upgrading in late September.[14] This was required for the installation of portal imaging.

Following these developments, the Siemens Mevatron 12 was to be replaced, as was Linac 3. This meant that for the next one and a half years, the department would be short at least one machine.

The Siemens machine was decommissioned in January 1994 and replaced with a Varian Clinac 2100C/D dual energy (6 and 10 MV) accelerator

Fig 85. The Varian Clinac 2100C (Linac 6) installed in 1991. Dr. Jackson observes radiation therapists Betty Wyatt, Janine Powell and Kerry McDonald set up a patient for treatment.

with multileaf collimation. It became available for treatment on October 17th 1994. Multileaf collimation allowed for shaping the radiation field without the need for poured blocks and their positioning, by hand, by the radiation therapist, in the beam.

As such, it proved useful in treatment designed to be confined to the prostate, and eliminated the need for arc therapy as an option in this disease.

In April 1996, the Division received $500,000 to allow recommissioning for stereotactic radiotherapy on this machine. The low energy accelerator (ATC 4), replaced by a Varian machine (Clinac 600C3) operating at 4MV, began treatments on September 11th 1996. Its capability of dynamic wedging allowed replacement of fixed wedges which had previously been placed by hand.

As it became necessary to consider replacement of the low energy accelerators [LA1(EMI4) and LA5(SHM Therapi-4)], it was evident that the rooms in which they were housed were unsuitable for present day equipment.

The first ever accelerator in Vancouver, the EMI-4, was finally decommissioned on January 15th 1998, the SHM Therapi-4 having been taken out of service eight months previously.

Dr Jackson had proposed, and after consideration the architects agreed, that two accelerators could be housed in the space occupied by the Physics Department. Physics and Electronics could be relocated above the vaults. To fit the space available and to continue to provide a range of energies, the machines preferred were a dual energy accelerator operating at 6 and 18 MV (Philips SL20) and a low energy unit at 4 or 6MV (Philips SL75-5). A selection team of physicists, oncologists and radiation therapists reviewed tender documents and made site visits. The radiation therapists expressed a preference for Philips equipment based on its user friendly design, low isocentre, choice of couch features, light clip lock attachment of the blocking tray, and the motorized wedge system avoiding the need for the use of external manually placed wedges.

As a teaching and training facility the group opinion at that time was that it was preferable to have a range of equipment from different manufacturers available in the department. The lower energy unit was initially intended to operate at 4MV but to be compatible with the dual energy machines in the department this was changed to 6MV prior to installation. Whereas 4MV energy had previously been preferred for head and neck cancers and the lymphomas, it was agreed that for many such cases 6MV was entirely satisfactory. Since the machine would be used mainly for the treatment of the breast in breast conservation practice, 6MV was felt to offer advantages over the lower energy.

Author's Note: Equipment costs

1926	Royal Jubilee Hospital, Victoria	X-ray equipment	$4,000
1948	BC Cancer Institute	Picker 220KV	$10,500
1952	BC Cancer Institute	Eldorado A Cobalt 60	$45,430
1977	Vancouver Clinic	Siemens Mevatron 12	$330,810
1984	Victoria Clinic	Philips SL75/14	$850,000
1989	Vancouver Clinic	Varian 2100C 6/10	$1,311,732
1993	Vancouver Cancer Centre	Varian Clinac2100C/D	$1,828,497
1994	Cancer Centre Southern Interior	Philips SL20	$2,071,850
1999	Fraser Valley Cancer Centre	Varian Clinac2100Ex	$1,972,000
2000	Vancouver Island Cancer Centre	Varian Clinac2100Ex	$1,460,000

Noted above are actual costs of selected equipment not including taxes or building or renovation costs.
Costs are for individual pieces of equipment which may have been significantly altered by bulk purchase of several items.

Rounds and Retreats

As part of the Quality Assurance procedures in the department, Machine Rounds were introduced in April 1990[min1214]. These Rounds were intended to provide the whole staff with an opportunity to review sample treatment prescriptions. Although attempts were made to progressively improve the rounds, they were never very successful and were cancelled in September 1991.[min1414 The Agency's CyCare database did not adequately capture treatment complications. The office manager kept a list of significant radiation complications reported by the staff on a voluntary basis.

In January 1990 a Divisional Retreat was held to discuss workload issues and the running of a future third clinic. Dr Jackson summarized the main outcomes [min1196] as, "*There seemed to be a strong sentiment that individual clinics should function fairly autonomously with regard to day to day operations, but that issues of an Agency-wide nature including those related to UBC, the Technologist Training School, Quality Assurance and major equipment purchases, would need to be coordinated through an Agency based mechanism.*"

A second retreat was held on September 25th 1992 at the Vancouver Trade and Convention Centre with staff from the Victoria Clinic present. Discussion centered around five main topics. Issues discussed were prioritized, based on individual balloting on the day of the retreat and subsequently. The three principle recommendations for each of the five topics are included here:

Modifications of guidelines in the Radiotherapy Techniques manual

- Outcome analysis of present techniques is essential. Changes in treatment to be justified by clinical research and outcome analysis.
- No compromise of fractionation to accommodate the waiting list.
- All Agency Radiation Oncologists involved in a single site should meet on a regular basis.

The working day.

- Run an extended day for as many treatment units as possible.
- Opinion was equally divided on "no regular extended hours" and "hourly pay for voluntary evening shift work".

Policy decisions.

- Recognition of Canadian Association of Radiation Oncologists (CARO) standards.
- Universal access to radiotherapy for all patients.
- The Agency and the Government have the responsibility to provide for the best care for all patients in the province. The Radiation Oncologists are responsible to provide the best care for the patients they treat.

Short and long term building, equipment and staff issues.

- Staffing to meet CARO standards.
- Fast track needed equipment.
- Computerization of the booking system.

Clinical trials.

- The Department Head must actively support implementation of clinical trials by providing time for oncologists and support staff.
- Sufficient support staff must be available to support prospective trials and retrospective analysis.
- Positions for Fellows should be maintained and not be seen as purely service.

A follow up meeting for the Vancouver staff included therapists and secretaries and concentrated on Outcome Analysis, Scheduling priorities in Radiotherapy and the running of Patient Review. (Patient Review is the departmental area for the review of patients progress by the radiation oncologists.)

In October 1993 Radiotherapy Day Care was opened on the Fifth Floor, largely as a result of Dr Rheaume's efforts. The area would be suitable for patients waiting for an ambulance, patients who needed to be observed or required dressings, and for those requiring treatment of radiation reactions.

A subcommittee of two oncologists (Dr Charmaine Kim-Sing and Dr Christina Parsons) and several therapists was established in the spring of 1994 to try to clarify the allocation of treatment start dates for different groups of patients. As expected, there was much disagreement and difficulty in arriving at consensus. True emergencies such as spinal cord compression and superior vena cava obstruction were recognized and certain other palliative situations as "Urgent", but there was difficulty with radical treatments. It was recognized that to be eligible for trial protocols some limits on the timing of radiotherapy were implicit. No decision could be made with regard to the relative priorities of the various radical treatments. The issue was raised again in December 1995 because of concern about inconsistent use of the "Urgent" designation. The 1994 proposals were reaffirmed, but it was decided to keep a monthly eye on requests for urgent treatment [15].

The "Waiting List", "Supply and Demand"

Since the 1940s there had been repeated reference to the fact that patients had to wait for treatment. This lead to a whole range of measures to try and combat the problem. There were numerous pleadings to administration and Government to provide equipment, facilities and people. These were often heeded, though only after the event, and just in time for the next round of complaints and requests. The reasons for this ongoing and seemingly unresolvable issue were many. Of course, the population had increased and aged. At one time in the late 1980s the population of British Columbia was increasing at 6% per year. This growth had slowed almost to a stop by the end of the century, however. The population was ageing and more people were living to an age when cancer was more common. Changes in clinical practice had caused the inclusion of radiation treatment in the management of an increasing range of cancers, particularly as a multidisciplinary approach in combination with chemotherapy and surgery.

The two cancers that have amounted to almost 50% of radiation treatment time on the therapy units are cancers of the breast and prostate. Breast preserving surgery includes radiation for both invasive cancer and carcinoma in situ. Had British Columbia not continued the practice of treating most of these patients over three weeks, (instead of the five or more weeks used elsewhere) this would have presented an even greater strain on the system. Through comparison with published data, the Division had established that the results for breast cancer in BC were equal to any elsewhere. Of particular impact on the waiting list had been cancer of the prostate in the elderly male, and the popularity of radiation in its treatment. The North American trend to the use of radiation in prostate cancer probably had the greatest effect on radiotherapy workload. The number of patients treated each year rose from less than 100 in the early 1980s to over nine hundred in the mid 1990s, and has stabalised at about that number. Although treatment was given in four weeks in the 1980s, a desire to comply with American practice led to over 90% of these patients being treated over six to seven weeks by the mid 1990s. Had there not been this change in the management of prostate cancer in British Columbia the waiting list problem would have been much less and supply might have met demand.

So how did British Columbia address these problems? In the previous chapter we have chronicled the building programs and equipment obtained through the efforts of the BCCF and the BCCI. The following passages describe the measures taken since 1974.

Over the years Dr Jackson had made numerous approaches to the Administration, the Board and representatives of the Government, describing the problems facing radiotherapy and the measures needed to address them. It came as a surprise therefore, that in 1992, the chairman of the Board of Trustees, Mr Ireland, suggested that the Board had not been fully informed! Dr Jackson wrote to the chairman on December 2nd, "*Although regrettably I was not present at the MAG AGM, it is my understanding that you made a comment to the effect that the Board had not been made aware of Radiation Oncology requirements early enough to have avoided the present dire situation. If this is a true interpretation of your statement, I respectively submit a listing of the various submissions that have been made by myself on behalf of the Division of Radiation Oncology since the mid 1970s. It is my contention that the Agency administration and the Board, as well as the Government,*

have been made fully aware of the requirements necessary for the provision of Radiation Therapy Services for the patients of this province." This submission included 39 incidents in which Dr Jackson had written or made oral submissions to the Administration, the Board and various Government representatives. In April 1979 he reported to the Board, "*not one of the existing machines has been replaced in the last three decades (except the superficial X-ray machine, which replaced a machine whose installation date was lost in antiquity).*" In March 1980 he submitted to the Board "Equipment Proposals for the 80s" which catalogued the replacements and new equipment required in Victoria and Vancouver. The Board accepted the proposals. In March 1982 he reported to the Board, "*The system is being progressively stretched and I believe we are approaching or indeed may have reached a dangerous situation. In Radiation*

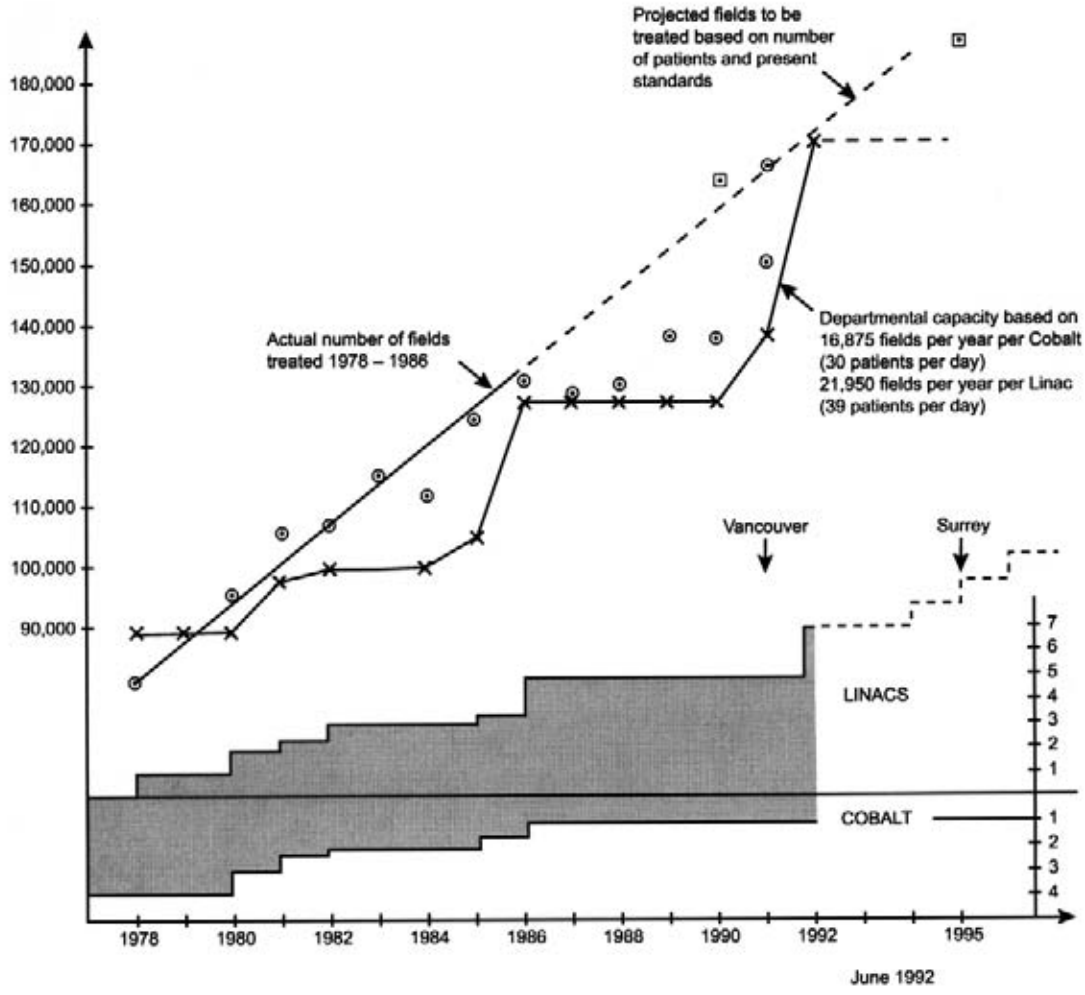


Fig 86. The graph used in the 1980s and early 1990s to highlight to Administration and Government the pressing needs of Radiation Therapy.

Oncology we have done our best to operate within the system, but when we see the system stretched and our own efficiency impaired, there is an understandable impatience." In a submission on "Radiation Oncology Manpower Requirements in BC" prepared in 1985 he pointed out the shortfall in staff by all recommended standards and requested *"An intake of 3 residents per year (which number has formed the basis of our proposals to the Residency Training Committee and the Agency over the past several years), the program would grow to 12 positions in 1988 and would supply the needs of BC alone.*" In October 1986 he presented the Board with "Equipment Proposals for the 90s". As with the report six years earlier the need to replace old equipment and provide new was documented. In Vancouver, six machines would need to be replaced and four additional acquired. In Victoria two would need replacement. In May 1987 as part of a "Radiation Therapy – the Future" presentation to the Board a major part of the presentation dealt with the continuing increase in patient load and the constant battle to keep pace with this increase without falling too far behind in standards of practice. The desperate need for equipment detailed in Radiation Equipment for the 80s and 90s was described. The Board was urged to convince government of the need to acquire this equipment in the immediate future or to find innovative ways of funding that would allow the Agency or its staff to provide the necessary funding.

In November 1991 Dr Jackson prepared "Forward Planning For Radiotherapy Facilities in B.C. 1991-2001" which was approved by the Board and submitted to the Minister of Health the Hon. PA Dueck. At the same time a graph was prepared showing the increase in treatments given in Vancouver in the years 1978-1986 compared to the departmental capacity provided by the existing equipment. Over the next six years the number of treatments fell behind the predicted workload but at the same time, by reason of working extended hours and a reduction in the ideal number of treatments delivered to patients, it exceed the nominal departmental capacity.

The graph (Fig 86) predicted need through to the mid 1990s and how that would be met by existing plans. The graph highlighted how the provision of equipment fell behind need, and yet, even when the provision of equipment caught up with demand, it was destined to fall behind again.

The 1991 Forward Planning Document included the following recommendations and predictions: -

"*The clinic should meet the generally accepted standards which have been established in the US and Canada. To treat patients to the least stringent recommended standards (500 patients/megavolt machine) CCABC requires: -*

15 megavolt machines by 1991, 21 megavolt machines by 2001.

This could be achieved by adding 2 machines immediately in Vancouver and by adding 4 more in the province by 1991 and a further 6 by 2001.

Regarding radiation oncologists, at the recommended numbers of 1/250 patients/year the need was for 32 ROs by 1991 and 42ROs by 2001.

This may be achieved by adding two residents per year to the training program from 89 to 95 and having residents complete the program and join the staff."

(Author's Note: By 2001 there were 21 megavoltage machines in the province and 46 radiation oncologists.)

When asked by Government to further support the numbers requested in the Forward Planning Document, Dr Jackson wrote, "*If we are to improve our standards towards those expected of radiation oncology in Ontario, Alberta and the US and Europe, then we need to further increase our staff over the minimal numbers included in the Forward Planning report. To be substandard to other areas of Canada and the US may be tolerated by some, but to be substandard to Europe is unacceptable.*"

With the increasing patient load and the replacement of equipment with its accompanying construction work, discussion about the need for extending treatment hours into the evening began in the summer of 1979 [min37].

By the fall of 1983 pressures of workload came to a head. The following is extracted from the Staff Meeting Minutes of October 18th1983 [min383]. "*Dr Jackson had already circulated the department with a document explaining the requirement for altering radiotherapy schedules such that patient treatments were accomplished in fewer fractions, to alleviate the workload on the therapy machines. It appears that there are two problems; first, the increase in the total number of patients treated reaching an all-time high in August; secondly, a disproportionate increase in the number of fields or number of fractions given per patient. The basis for the recommendation is that in general, treatments are to be given in four fractions per week.*" Despite concerns, the staff accepted the principle at least as a temporary measure and certainly preferable to the alternative which might have been to exclude some sites or diseases from treatment altogether.

In March 1984, in anticipation of the installation of the Therac 25 (Linac 4), technicians hired to operate the equipment were brought on early to make it possible for two units to work extended hours to 7.00pm. Medical coverage, however, was uncertain [min 425]. With a slight reduction in the workload the introduction of extended hours was deferred. Nevertheless any increase could only be accommodated by longer hours or reduction in fractions, or less radiotherapy for certain types of patients [min 431]. In the face of continuing workload pressures, the need for prioritizing patients in the wait for treatment was raised in September 1985 [min591].

By September 1985 the increase in treatments and the overload on the treatment units causing excessive overtime was resulting in problems for the technology staff [min 582]. The pressure to extend hours was growing. It was pointed out that extending the hours might allow a return to five treatments per week for those sites that had been reduced to four. The battle with the waiting list and workload continued and the issue of shift work was raised again in 1987 [min 817]. But how could physician coverage be provided? Through scheduled shift work for the physicians, or by other means? As a first step, the treatment hours were adjusted to start at 7:30 rather than 8:30am. The following March it was planned for one of the accelerators to extend its operating hours from 5:00 to 7:00pm.

After much discussion at several staff meetings and with the Agency Administration, agreement was reached for reimbursement by sessional pay for those oncologists who volunteered to undertake coverage for an extended evening shift. The hours on one unit were extended to 10.00pm on October 17th1988. Members of the electronics and mould room staff were on call and the duties of the oncologist working the second shift were deemed separate from those of the oncologist on call [min 986], the latter being part of the regular duties of a staff person. Approval from the Government for the addition of two further accelerators came nine months after the start of the extended evening shift. At the first anniversary of extended hours, the senior technologists

from the evening shift extended a vote of thanks to the oncologists for their help over the past year. The shift had to end in April 1990 due to a lack of technologists to staff the machines. Dr Jackson was asked to approach Administration in regards to what advice should be given patients and where else they might be treated if the waiting list became "intolerable" [Min 1218].

As expected there was an immediate rise in patients waiting for treatment from 250 to over 350. Although these "temporary" measures introduced in 1988 had helped, the shortage of technologists had aggravated the situation. Tenders for construction for the sixth and seventh linear accelerators had been opened, but it would be some time before they were operational. There was funding for four more technologists, but at the same time, there was a national shortage. Approval had been received to increase the number of student technologists to eight per year. The questions remained, could the number of treatments or fractions be reduced and could patients be sent to Victoria or out of province? These measures were likely to have a minor impact or be introduced some time in the future.

In June 1990, discussions began with centres in Washington as to what might be appropriate contract arrangements for referring patients for radiation treatment. The Health Ministry was made aware of these discussions but was only prepared to develop contingency plans for future consideration. By closing one simulator, enough technology staff were freed to re-open the evening shift in July. Discussions began about extending the day to 8.00pm. In October the waiting time for some treatments was five to six weeks and the Government was approached to activate the contingency plans. In January 1991, contracts were arranged with the North Puget Sound Radiotherapy Center in Bellingham, and later with the Virginia-Mason Clinic in Seattle. Because of the ease of travel and their physical and social status, most patients who accepted this alternative of treatment in Washington had either breast or prostate cancer and were treated in Bellingham. Between 1991 and 1996, 1,272 patients were referred for treatment in Washington State. Although this arrangement helped it represented only the equivalent workload of approximately one treatment machine in Vancouver. It was hoped to end the Washington referral in December 1995,[16] but referral was not ended finally until April 1st1997. The need for extended hours in Vancouver remained. The waiting list reached 500 in August 1991. When an extended day was once again considered in the fall of 1991 the radiation oncologists were adamant, through their association, the British Columbia Association of Radiation Oncologists (BCARO), that work beyond the regular hours of 8.00am to 5.00pm be remunerated [min1433]. Dr Klaassen, the current Agency Director, attended a staff meeting to hear their arguments. The evening shift ended in October 1992 so that the therapy staff could be moved to the new cobalt machine installed with the express purpose of undertaking Total Body Irradiation (TBI). However, an extended day to 6.00pm continued unabated on as many as six units, the number limited by the available radiation therapy staff.

Sudden Unavailability of Radiation Treatment — The SURT Committee

There were fears that the ageing low energy accelerators might fail, or have to be taken out of service if they became unsafe. The Agency administration through its Quality of Care Committee was warned that there might be a sudden unavailability of radiotherapy. In response the Agency Board struck a broad based task force in October 1993 under the chairmanship of Mrs Anna Linsley, a member of the Board's Quality of Care Committee and President of the BC Cancer Foundation, to recommend what might be done if this happened. The task force became known by its acronym as SURT. Membership included the Chaplain, Colin Johnstone, three patients, a general surgeon and a general practitioner, representatives from radiation therapy and nursing, members of the Board, and health care professionals from outside the Agency. Dr Jackson and Dr Hay represented the radiation oncologists. Outside reviewers who were to receive copies of the minutes were Dr Pearcey in Edmonton and Ms Louise Lalonde, Consultant, Provincial Programs, Hospital Care Division, Ministry of Health.

The Task Force was charged with the ethical question, "Assuming a sudden reduction in radiotherapy capability at the Vancouver Clinic of 15% to 45% which cannot be corrected by managerial intervention, and leaves up to 2,500 cancer patients per year without treatment, how should the Agency and the Government advise the population of the seriousness of the situation and how should the problem be addressed?"

The Task Force met on six occasions for a total of twelve hours between November 23rd 1993 and January 19th 1994 and had wide ranging and interesting discussions. Several issues were considered and debated including:

- Denying either palliative or radical treatment;
- Referring many more patients to the US, dependent on financial ability to pay, severity of illness, age, disease type, patient choice, children with cancer or geographic location within the province;
- Whether or not all patients must be treated;
- Alternatives to radiotherapy, such as mastectomy for breast cancer or morphine for palliation;
- Importance of patient choice;
- Need to give patients a list of options available and to support them in their decision making process;
- The Agency must be able to defend the choices offered;
- Which patients could not easily or cheaply go to Washington or Oregon for treatment;
- Which patients could most easily or cheaply go;
- Referral for treatment elsewhere should be based on fitness to travel, standard or routine radiotherapy proposed and economically provided;
- Both patients and the BC health care system must have confidence in the treatment prescribed elsewhere;
- Need to treat all British Columbians alike;
- Alternatives to radiotherapy, such as radical surgery or chemotherapy;
- Possibilities of mass transportation and mass lodging in the US;
- Stress on the Vancouver Clinic from the need to treat the sickest patients;
- If selection of patients for treatment is necessary, everyone should suffer equally;
- Need to defend the logic of any selection decisions;
- The burden of selection be borne by those most easily able to bear it;

- Need to ensure that the financial burden be no greater for patients referred elsewhere;
- Selection criteria for treatment, such as ability to commute, responsibility for dependents, job or financial jeopardy, type of cancer, gender or fitness;
- Privatization of radiotherapy services in British Columbia;
- Selection by age in patients with breast and prostate cancer requiring radical treatment;
- Importance of proactive public relations approach.

The Committee struggled to resolve these complex issues but did not necessarily support many of them. The following recommendations were unanimously approved:

1. That if treatment was not available in Vancouver, it must be made available in other centers. It would be unethical not to provide treatment if it could be provided elsewhere.
2. That the Agency immediately adopts a proactive position with regard to informing the general public. (This did not occur).
3. That the Government be asked to fast track the installation of the two vaults at the Vancouver Clinic.
4. That if radiation therapy was suddenly unavailable and it became necessary to refer large numbers of patients to the United States, this would be accomplished in accordance with a flow chart.
5. That the Ministry of Health take immediate steps to locate suitable centres in the United States (primarily Washington and Oregon) that would be prepared to accept our patients.
6. That if confirmation of the initiation of item 5 be not available by February 23rd 1994, the Committee be reconvened to make recommendations as to how rationing might be achieved by denying radiotherapy through a p*rocess of priority.*

The flow chart, mentioned in item 4 above, gave the patient the first option of accepting an alternative to radiotherapy or no treatment.

If they chose radiotherapy, nine categories of patients were considered unsuitable for referral to the US:

- those needing hospitalization;
- those with severe symptoms requiring continuing observation;
- socially challenged patients if they chose not to go;
- those for whom treatment was only available in Vancouver;
- those with high risk of major side effects or complications;
- those recently postoperative from major surgery;
- those receiving concurrent chemotherapy;
- those for whom contracts could not be negotiated;
- those over 75 years unless they chose to travel.

The remaining patients could accept treatment in the U.S., but if they refused and they could not commute to Vancouver they would be asked to go. Those who could commute to Vancouver would be evaluated for the degree of hardship imposed if they were asked to go to the U.S. in terms of fitness to travel, effect on dependents and others and the effect on the patient's job and finances. Those with least hardship would be asked to go to the U.S.

If a suitable ranking could not be achieved, patients should be streamed by random selection.

The Minister of Health, Paul Ramsey, responded in a letter dated March 31st,

"*The Ministry of Health considers the replacement of two radiotherapy treatment units at the Vancouver Clinic to be a very high priority. I look forward to receiving the feasibility study for the replacement of these units and working with the Agency to ensure that this project proceeds as quickly as possible. I understand that Dr. Neil Fatin has asked the Agency to outline the*

options for creating additional radiotherapy capacity in British Columbia through extended operating hours at the Vancouver and Victoria Clinics as well as commissioning of the Surrey treatment units. The Ministry of Health will consider contractual arrangements with other centers in the United States if the Vancouver Clinic workload cannot be accommodated through the existing provincial cancer services and Washington State radiotherapy contracts."

In the interval, the SURT Committee was reconvened to determine, in the event of sudden unavailability of radiation therapy and the absence of alternative arrangements having been made, who would be treated and who would not. In reviewing the literature on the subject of denying treatment, the ethicist Dr. Alistair Browne recommended the following criteria for selection:

"*Once Medical Acceptability for treatment as defined by medical professionals is decided, selection is blind to all other factors; it is first come, first served, adjusted by need. If there is an alternative to treatment and the alternative is good, that person receives a low radiation priority. If the alternative to radiation therapy is bad, that person receives a high radiation treatment priority. The experts must tell us which alternatives are good.*"

The committee accepted this method of selection and that it should include three criteria as priorities; life expectancy, medical issues and availability of alternative treatment.

Several months later in September, the Director of the Agency, Dr Klaassen and Anna Linsley, Chair of the SURT task force, wrote:

"*Despite the fact that we will not proceed with a joint public relations strategy, we believe that the planning done by the SURT task force was important and valuable, and it stimulated the Vancouver Cancer Centre to develop a specific contingency plan on how it would operationally deal with this. We also believe that the activities of the committee served to underline the importance of the issue. We have no doubt that it stimulated more rapid approval of both the redevelopment of the bunkers at the Vancouver Cancer Centre, as well as other cancer centres throughout the province of British Columbia.*"

In October 1994, the situation continued to be serious. Despite plans to continue the evening shift, staff raised the question of when the waitlist might become unacceptable [17]. It was suggested that the radiation oncologists might adopt the position taken at the Princess Margaret Hospital, which was, that when the waitlist became too long, a policy be instituted whereby patients would only be seen in consultation if it were felt they could be treated in a timely fashion. This approach was roundly defeated as not acceptable or responsible in British Columbia. In the end it was decided to notify the Agency Board and soldier on! In response, the Board asked why the number of fields used in treatment had increased three times more than the number of treatments. The main reason for this was a change to four field treatments for carcinoma of the prostate rather than rotational arc therapy. Since the four field treatment allowed for shaping of the treatment volume by blocks or multileaf collimation, thereby reducing side effects, there was no wish to change.

Although the staff had recommended that the general public be made aware of the situation, the Board declined to act on the suggestion at that time. However, consideration was being given to a letter to physicians of the province that would include information on new equipment as well as the wait list problems. The letter was never sent.

The Changing of the Guard

In September 1994 Dr Jackson announced his intention to step down as head the following September. By then he would have completed eighteen and one half years as Chairman, Division of Radiation Oncology, BCCA; Head, Department of Radiation Oncology, VCC; Head, Division of Radiation Oncology, Department of Surgery UBC and Head, Division of Radiation Oncology, Department of Surgery, VGH. A dinner was held in his honour on September 6 1995 at the Royal Vancouver Yacht Club. Dr Tom Keane took over these responsibilities. Dr Jackson took a six month sabbatical, enabling him to complete research on tonsil, laryngeal and nasopharyngeal cancers and attend courses in the Department of Health Care and Epidemiology at UBC, before returning to clinical practice. This was the first sabbatical taken by a radiation oncologist since it was first suggested in 1976. Within a year, thanks to the Organizational Assessment and Redesign exercise carried out by the Agency, the Program of Radiation Therapy replaced the Division of Radiation Oncology, a concept first proposed by Dr Hall in 1975.

Early in 1995 a committee established to consider the major equipment requirements for the Interior Cancer Clinic favoured the purchase of Philips machines (subsequently acquired by Elekta). Later that year a Task Force, under the direction of Dr Lorna Weir, was established to examine the simulator requirements for Vancouver. Plans were put in place to rent a mobile simulator to be operational in February 1996 for use during the replacement of the first simulator by a Nucletron-Oldelft Simulix HP machine in the summer of 1996.

At his first staff meeting in October 1995, Dr Keane indicated that all treatments that did not require formal dosimetry were now to be calculated by radiation therapists rather than the oncologists. In November, discussions began to formulate a policy to deal with unanticipated interruptions in treatment. It was hoped that this would be universal throughout the Division but it proved impossible to achieve general agreement across all site groups. It was accepted that for radical treatments, especially in head and neck cancer, two treatments a day given six hours apart would be used to maintain the overall treatment time within planned limits. With the advent of portal imaging, a policy was introduced requiring verification films on the treatment units be taken in order to be able to reconstruct the treatment given. Films would be required and verified before the second treatment on all fields for all radical treatments and on palliative treatments at the discretion of the oncologist. This replaced the previous policy dictating automatic films on custom block treatments.

To try and rationalize the content of the waiting list data and to make it consistent across the three clinics, Dr Keane introduced the use of key dates into the system early in 1996. These included the referral date, the consultation date and the first treatment date which could be obtained from the existing Agency database, but as a new feature, the "ready to treat date" was added. This would have to be specified by the oncologist as the date when all planning and preparatory work would be completed and the patient would be in a position to start treatment [18]. At that stage, a booking on a treatment machine would be made. Wait times for palliative treatments improved but remained lengthy for radical treatments. In June, the staff undertook extensive discussions on how the situation might be improved. It was suggested that some patients requiring palliative treatments be referred to the Fraser Valley

Cancer Centre. Many logistic problems were raised and in any event palliative treatments were not really the problem. Increasing the Washington referrals was an option since the Bellingham program was not being fully utilized. Further extending the treatment day in Vancouver was proposed. "*Before taking a strong position with the government over standards of care and a failure to meet acceptable limits to the wait that patients might experience the Division would have to show that it had made every effort within its power to accommodate patients waiting for treatment and had looked at every reasonable option on behalf of patients*" [19].

The Staff meeting in August was devoted to the waiting list issues. Dr Keane reported: " *Prior to the election, the MOH were supportive of a number of initiatives to eliminate the wait list. These included funding for extended hours, 5th bunkers in FVCC and CCSI, development of expansion plan for 2001. At that time there appeared to be considerable appreciation of the problem, and support from the MOH for immediate action. Unfortunately, since the election, the MOH has backpedaled. There has been no movement on the 5th bunker. No replacement capital has been provided. It has frozen the expansion at VICC as part of a political decision to freeze all spending. It is now time for the Division and the Agency to take a strong position with respect to standards of care. Dr Keane and Dr Carlow (Agency President and CEO) have agreed that Dr Keane will develop a clear position on waiting lists and medical standards. This will be presented to the Board retreat in late September. It is expected that the Board will accept and act on the advice of specialists, i.e. radiation oncologists, to uphold standards.*"

After discussion the staff agreed that it "*accepts the CARO standard of ten working days from referral to consultation and ten working days from decision to treat to treatment start. The Division of Radiation Oncology must do all it can to utilize all resources at each centre. If it is decided to shift patients between centres, it must be co-ordinated. If it is decided to increase the Washington referral numbers the task must be co-ordinated though government funding of a referral office.*" [20]

The Board accepted the need for a standard but asked the Division to reconsider its recommendation of one standard for all diagnoses and stages. They did, and reaffirmed that CARO's standard should be the Agency's standard for all situations.

The Board asked for and received an urgent meeting with the MOH. The meeting was held on October 21st 1996 and the outcome reported as follows, "*The Minister accepts that there is a serious problem and wants to focus on solutions. She was presented with three; increase capacity by extended hours, additional bunkers, and the need to plan for an additional facility probably in the Lower Mainland. The Minister agreed to 10-hour days as a standard across all three centres, and a 6 day-week model limited to Vancouver if required, to proceed with the VICC expansion and to fund accordingly. It is anticipated that the 10-hour days would be in place at least until the opening of the CCSI in Kelowna in April of 1998.*" [20]

Author's Note
Radiation as a Cure

The life expectancy of patients diagnosed with cancer can be extremely variable. It can range from a few months to many years. How then should cure be defined? Perhaps the best way to define it is, "having a patient attain the same life expectancy that they would have had if they had not developed cancer". In some cases, such as cancer of the larynx, this state is reached in 2 or 3 years, whereas in others, like breast cancer, it may be 12 to 15 years. In simple numerical terms "cure" may be assumed to have occurred after a certain number of years, such as 3 years for cancer of the larynx, 5 years for cancer of the cervix and 15 years for cancer of the breast.

In the last decade of the century what did radiation achieve in British Columbia?

- In patients with an early diagnosis of cancer of the oral cavity, oropharynx or larynx, radiation alone resulted in a cure rate of 75%, [1] 70% [2] and 80%[3].
- With more advanced cancers, still regarded as suitable for primary radiation treatment, the addition of salvage surgery maintained a rate of 50% or greater. [4] [5]
- Primary radiation treatment of cancer of the cervix resulted in cure of 95% of stage I cases, 80% of stage II and 40% of stage III and IV.[6]
- In early stage Hodgkin's disease, radiation alone resulted in a cure rate of 82% and, with the addition of chemotherapy, a relapse rate of only 2.5% and an overall survival rate of 94% since1990.[7]
- In early cancer of the nasopharynx (T1T2) a cure rate of 85% was achieved between 1985 and 1994 in Vancouver with an overall survival for all patients treated by radiation of 40%.[8]

Increasingly, combinations of surgery and radiation and or chemotherapy are being employed in the treatment of many forms of the disease.

- The use of radiation treatment postoperatively in colorectal cancer has reduced the incidence of local recurrence in the pelvis, and by so doing may be expected to improve the chance of cure.
- In breast cancer, the addition of radiation to chemotherapy post-mastectomy has shown improved survival rates at fifteen years.[9]
- In testicular cancer the addition of radiation and chemotherapy to surgery has produced cure rates in excess of 80%.

In some situations the use of radiation has reduced the need for major surgery without reducing the expectation of achieving a cure.

- Breast radiation after lumpectomy avoids mastectomy for most patients with early breast cancer.
- Radiation by implant or beam therapy can replace radical prostatectomy in prostate cancer.

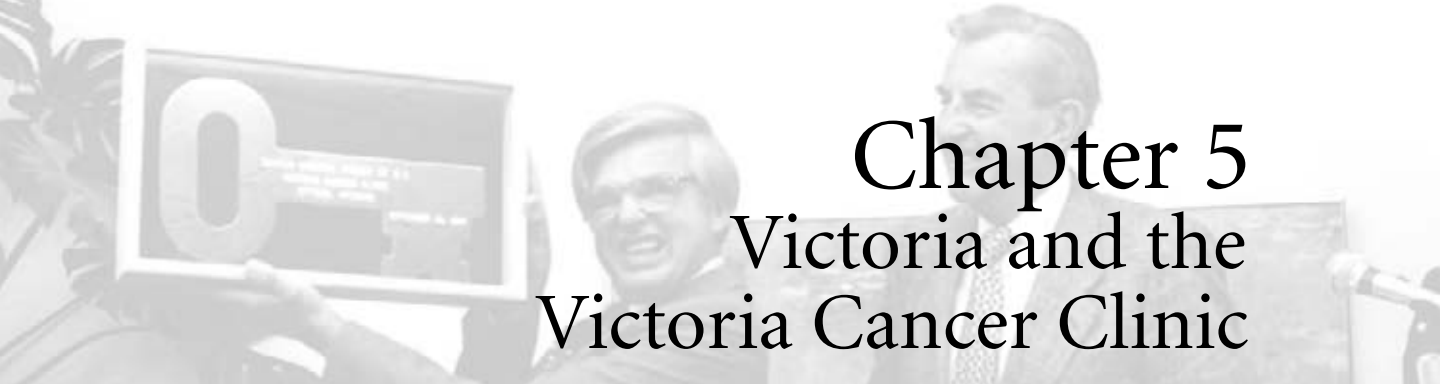
For many patients the relief of symptoms by radiation treatment provides an important role in palliation.

References

1. Jackson SM. T1T2 Oral cavity cancer BCCA PIM 1985-1994, unpublished data.
2. Jackson SM, Hay JH, Flores AD, Weir L, Wong FL, Schwindt C, Baerg B. Cancer of the tonsil: the results of ipsilateral radiation treatment. Radiother Oncol 1999;51(2)123-128.
3. Jackson SM, Hay JH, Flores AD. Local control of T3N0 glottic carcinoma by 60Gy given over five weeks in 2.4Gy daily fractions. One more point on the biological effective dose (BED) curve. Radiother Oncol 2001;59:219-20.
4. Jackson SM. Stage 1-3 supraglottic cancer BCCA PIM 1985-1992, unpublished data.
5. Jackson SM, Weir LM, Hay JH, Tsang VHY, Durham JS. A randomized trial of accelerated versus conventional radiotherapy in head and neck cancer. Radiother Oncol 1997;43(1) 39-46.
6. Wong FLW, BCCA PIM unpublished data (1995).
7. Klasa RJ, Connors JM, Gascoyne RD, Hoskins P, Shankier T, Voss N. Brief chemotherapy (CT) with involved field (IFRT) or extended field (EFRT) radiation after clinical staging (CS 1A,11A) are equivalent and both superior to EFRT alone following laperotomy staging (PS1A,11A) in limited Hodgkin's lymphoma (HL) Abstr. Leukaemia & Lymphoma suppl 2 Vol 42 p51.
8. Jackson SM. Nasopharynx BCCA PIM 985-1994 unpublished Vancouver data.
9. Ragaz J. Jackson SM. Le N. Plenderleith IH. Spinelli JJ. Basco VE. Wilson KS. Knowling MA. Coppin CM. Paradis M. Coldman AJ. Olivotto IA. Adjuvant radiotherapy and chemotherapy in node-positive premenopausal women with breast cancer. N Engl J Med 1997;337(14): 956-62.

References for Chapter 4

1. Cancer Control Agency of BC, Radiotherapy Staff Minutes, 1976 Aug 12. (BC Cancer Agency Archives)
2. Cancer Control Agency of BC, Radiotherapy Staff Minutes, 1976 Nov 4. (BC Cancer Agency Archives) From March 1979 to June 1992 the Radiotherapy Staff Meeting Minutes were referenced numerically and in the text are marked [min##] (BC Cancer Agency Archives)
3. BC Cancer Treatment and Research Foundation, Executive Committee, Minutes Vol XIV 1977 Apr. (BC Cancer Agency Archives)
4. Cancer Control Agency of BC, The Staging Committee Report 1977. (BC Cancer Agency Archives Box 2 UI 86(3))
5. Cancer Control Agency of BC, Radiotherapy Staff Minutes, 1997 Sep 8. (BC Cancer Agency Archives)
6. Jackson SM, Baerg B. Compliance with radiation treatment guidelines in a provincial setting. Cancer Prev Contr 1999;3(3,):196-201.
7. Whelan TJ, MacKenzie RG, Levine M, ShelleyW, Julian J, Grimard L, et al. A randomized trial comparing two fractionation schedules for breast irradiation post-lumpectomy in node-negative breast cancer. Proc Ann Meet Am Soc Clin Oncol 2000: 2a.
8. Ragaz J, Jackson SM, Le N, Plenderleith IH, Spinelli JJ, Basco VE et al. Adjuvant radiotherapy and chemotherapy in node-positive premenopausal women with breast cancer. N Engl J Med 1997;337:956-962.
9. Flores AD. Personal communication 2001.
10. Baerg B. Personal Communication 2001.
11. Cancer Control Agency of BC, A. Maxwell Evans Clinic, Radiotherapy Staff Minutes, 1976 May 27. (BC Cancer Agency Archives)
12. Melsness D. Personal Communication 2001.
13. BC Cancer Agency, A. Maxwell Evans Clinic, Radiation Oncology Staff Minutes, 1983 Nov 22. (BC Cancer Agency Archives)
14. Ibid. 1993 (Jul 12). (BC Cancer Agency Archives)
15. BC Cancer Agency, Vancouver Cancer Centre, Radiation Oncology Staff Minutes, 1995 Dec 11. (BC Cancer Agency Archives)
16. Ibid. 1995 (Oct 16). (BC Cancer Agency Archives)
17. Ibid. 1994 (Oct 17). (BC Cancer Agency Archives)
18. Ibid. 1996 (Jan 15). (BC Cancer Agency Archives)
19. Ibid. 1996 (Jun 10). (BC Cancer Agency Archives)
20. Ibid. 1996 (Aug 12). (BC Cancer Agency Archives)
21. Ibid. 1996 (Oct 21). (BC Cancer Agency Archives)



Chapter 5
Victoria and the Victoria Cancer Clinic

X-rays arrive in Victoria at the close of the Nineteenth Century

The Board of Directors of the Provincial Royal Jubilee Hospital received a letter from Mrs HD Helmken on October 28th 1898, enclosing the sum of $100 "*earned at an entertainment*". [1] This was to be placed in a special account to purchase X-ray equipment. Mrs Helmken was the daughter-in-law of the influential Victoria pioneer Dr JS Helmken. Her husband, HD Helmken, was a member of the provincial legislature for several years. A year later the hospital received $250 from the same source.

In the summer of 1899, an X-ray apparatus, "*not excelled by any other hospital on the Pacific Coast,*" was made for the Royal Jubilee Hospital by Robert Hutchison.[1] Hutchison, who was born in England, came to Toronto in 1887 and then to Victoria in 1889. With his brother, he founded the Consolidated Electric Light Company, said to be Canada's first Edison commercial plant. In addition to building the first X-ray equipment in British Columbia, which he presented to the hospital on June 1st 1899, he had many other "firsts".[2] These included driving the first car from Victoria to Port Alberni in three and a half hours, and the installation of the first illuminated fountain in front of the Legislative Buildings. He also founded Hutchison Brothers & Co. Ltd, which manufactured engines for boats which set Canadian speed records.

New X-ray equipment was purchased in England in 1910, but when it arrived there was no space in the hospital to set it up. However, with the help of The Daughters of Pity and the Women's Auxiliary, a new X-ray room was built the following year off the corridor to the Pemberton Memorial Operating Room. In 1918 the Hospital was considering the purchase of a Chandler-Fisher X-ray unit that Dr Rogers, the Resident Medical Officer and Miss McKenzie, the Lady Superintendent, had seen at a hospital convention in Vancouver. It had the virtue of fitting in the existing X-ray room without the need for alterations. Dr Rogers explained that the machine under consideration was "*fitted with a clock-work timing attachment, so that there could be no possibility of danger from burns, as there might be with cheaper or less up-to-date apparatus*". [3]

Shortly before the Great War, Mr Joseph Graves of the Douglas Lake Cattle Company of Nicola donated funds to the Royal Jubilee Hospital in Victoria for the purchase of radium. [1] Soon after the war Mr Joseph Sayward, of Victoria, made a generous gift which "*brought the supply* [of X-ray machines] *up to the demands of current standards of treatment*". [1] Sayward's father, William Parsons, had come from Florida to California in search of gold in 1849 and on to Victoria in 1857, where he built a successful sawmill at Mill Bay. Joseph was a noted philanthropist, "*a man of considerable wealth, spent*

lavishly of his means in the interests of the poor and needy, the sick and the suffering." [4] Amongst other endeavours he provided the funds, along with James Dunsmuir, to purchase 241 acres from the Hudson's Bay Company to create the beautiful Colwood Golf Links. [5] King George V granted the use of the prefix "Royal" in the year 1931. [6]

In a two-page article published in the Victoria Daily Colonist in 1922, Dr L Kershaw Poynts, Director of the Department of Radiology at both St Joseph's and the Jubilee Hospital, wrote about "The Peculiar Properties of Radium". In the article he stated, "*when the hospital here bought our recent additional supply of radium the price was $300,000 an ounce more than the price was at the time of our former purchase three years ago.*" [7] Although he mentioned, "*that the demand for radium comes from medical circles, where it is being used with increasing success in the war against disease*", he made no comment on its use in Victoria.

In 1926 the Royal Jubilee Hospital initiated changes to the X-ray department made possible by the addition of a new wing to the hospital opened the previous year. The expansion included a piece of equipment costing $4,000 for the treatment of "*deep-seated disease*". This, "*an indication of where the expense of properly fitted X-ray departments arises.*" [8] There was also a room assigned to superficial X-ray treatment and a radium room. The radium cost about $15,000, "*but was good for more than 600 years, whereas the insurance company's estimate of X-ray apparatus period of maximum efficiency is five years.*" Despite the expansion the staff remained the same, consisting of Dr WM Carr, radiologist, two technicians (both of whom were specially trained nurses), one physiotherapy nurse and the secretary. Dr Carr, in an interview with the Daily Colonist, reported;

"*Nowadays various lesions both on the surface of and within the body are treated successfully by application of X-rays.*

A number of diseases of the skin which show little or no response to other methods, heal under this form of treatment. One frequently hears reference to X-ray burns. These are practically unknown today because this work is now rarely undertaken by those who do not understand it. X-ray treatment, when applied to suitable cases, is surprisingly efficient, and in these cases is equaled only by radium." [8]

Fig 87. The Daily Colonist, June 13, 1926.
X-ray Equipment at the Royal Jubilee Hospital for the treatment of deep-seated disease, "an indication of expense in a properly fitted X-ray department".

Bring your own Radium

Dr BR Mooney from Edmonton succeeded Dr HR Nelson as radiologist at St. Joseph's Hospital in 1937. A strong point in his favour was that "*he brought his own radium for the treatment of cancer and related diseases, a first for the hospital*". Born in Windsor, Ontario, Dr Mooney had practiced mainly in Edmonton, at first in general practice but later specializing in X-ray and radium work. [9] He had spent two years in Europe working in London and Stockholm, and with Dr Coutard in Paris. On his appointment he said, "*whether for diagnostic or therapeutic work, the radiological department of St. Joseph's Hospital is first class. The work is well known all over Western Canada, both for treatment work in the hospital and for the splendidly trained radiological technicians they turn out with Sister Mary Berthold in charge.*" Dr Mooney was the father of ten children, and was interested in golf and hunting.

Radium loaned from Vancouver

One hundred mg of radium was loaned to Victoria's St Joseph's Hospital in July 1939 by the British Columbia Cancer Institute (BCCI) at a cost of $200 for one year. When renewed a year later for $100, Sister Mary Alfreda RN of St. Joseph's announced that Dr K Bibby was in charge of the radium. Dr Trapp, acting Medical Superintendent of the BCCI, contacted Dr Frederick O'Brien of Boston, Mass., to confirm that Dr Bibby was indeed qualified to use radium. Later in the year the Sister Superior of St. Joseph's reported the loss of a 10mg needle![see p 35] The Institute filed a claim against the Halifax Fire Insurance Company for the loss and received $295.50 in settlement. [10] On his return from war service to the BCCI in November 1945, Dr Evans wrote to ask what methods were undertaken to find the lost radium and to return that which they still had. This did not happen and the radium on loan to St Joseph's Hospital was still in use in 1951.

St Joseph's Hospital was not the only hospital to have radium escape their care. In 1947 a 67-year-old patient of the BCCI, being treated with a U shaped radium mould for a cheek cancer, dislodged and swallowed a radium tube! Over the next four days the tubes progress through the bowel was followed radiologically. When it lodged in the large bowel, it was removed surgically. None the worse for the interlude, the patient's treatment was later completed. [11]

The Royal Jubilee Hospital lost a radium needle near a treatment vault in 1952. The needle had fallen into a crack and was quickly located by staff of the Pacific Naval Laboratory and recovered by the hospital authorities. [12]

The Victoria Cancer Clinic

On March 31st 1947, Dr Evans visited Victoria to discuss the question of establishing a diagnostic cancer clinic in the city. In July, Dr Strong and Mr Buckerfield of the BC Cancer Foundation and Dr Evans met with Dr HH Murphy together with members of the staff of the Royal Jubilee Hospital, representatives of the Victoria Medical Society and the provincial Department of Health.

Dr Murphy was born in Antrin, Ontario and graduated in medicine from McGill University in 1904. He undertook post-graduate studies in Philadelphia, Edinburgh and London. He practiced in Toronto and Kamloops before moving to Victoria as a radiologist at the Royal Jubilee Hospital. He was a past president of the Medical Society of British Columbia. Dr Murphy was an active and influential spokesman for Victoria as its representative on the British Columbia Cancer Foundation Board, playing a decidedly leading role in the establishment of the Victoria Cancer Clinic. [13] Dr Murphy retired in

Fig 88. The 400KV therapy machine at the Victoria Cancer Clinic. Housed in the Royal Jubilee Hospital in 1945 and retired in 1963 at the opening of a new Victoria Cancer Clinic, part of a $3M expansion to the hospital.

March 1953 and died eleven years later at the age of 83.

The outcome of the July meeting was very positive. It was resolved to undertake "immediate steps" to establish the clinic. The diagnostic clinic in the Royal Jubilee Hospital opened on January 9th 1948 with three patients and twenty interested doctors in attendance. The clinic met every two weeks until April, and weekly thereafter, to give consultations. In 1948, 280 new cases of cancer were admitted to the Royal Jubilee Hospital and 178 were treated in the radiological department. [14] Dr Murphy reported to the BC Cancer Foundation Board that "*the Royal Jubilee Hospital had installed the second deep X-ray unit in Canada in 1921* [he was five years early with his estimate, the machine was actually installed in 1926, Author's Note] *and that radium had been donated to the hospital at that time.* [14]

A 200KV machine had been installed at the Royal Jubilee in 1936, and a 400KV unit in 1945. In contrast to the machine installed at the BCCI, this was designed to treat only one patient at a time. Slung from the ceiling and only able to treat with a direct beam, this was nevertheless an efficient and much-used treatment unit. These machines were not taken out of service until the opening of the expanded Victoria Cancer Clinic in 1963. [15]

Dr Murphy and the medical personnel in Victoria continued to pressure the Foundation for a treatment centre in Victoria.

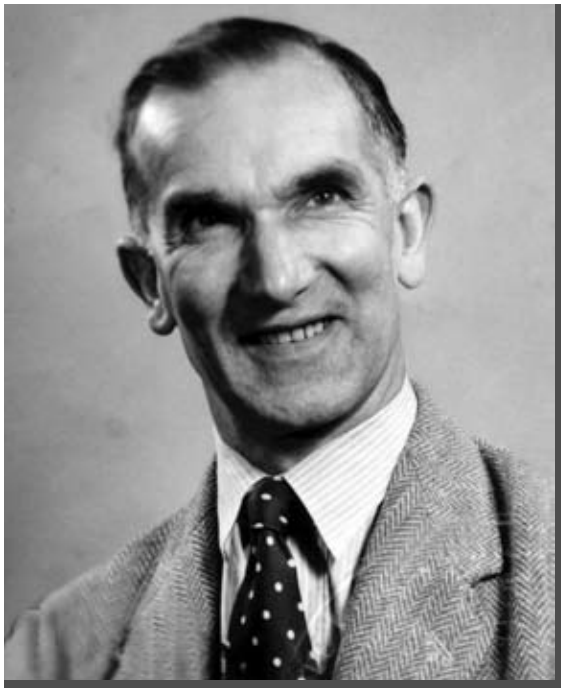
In a report to the British Columbia Cancer Foundation Board in May 1950 [16] he wrote, "*the incidence of malignant disease in Victoria and in the surrounding district is, on account of the age incidence, higher than the average for Canada as a whole. Treatment has been administered with both deep therapy and radium in the Royal Jubilee Hospital for a period of approximately thirty years and for about an equal period in St Joseph's Hospital. This means that the population has grown accustomed to having such facilities available and active therapeutic departments are now functioning in both hospitals.*"

The Board was sympathetic. However, " *the consensus of opinion was that it was not advisable to establish further treatment centres at this time for the following reasons: - 1) This would cause decentralization and thereby defeat the aims and programme of the British Columbia Cancer Foundation. 2) The Campaign funds which the Foundation holds in trust were collected for the specific purpose of establishing one completely adequate treatment centre. Until such time as this has been accomplished, it would be unwise to undertake the establishment of a second centre.*" [17]

In September 1951, Dr Murphy indicated that he had recently retired as Director of the department of Radiology at the Royal Jubilee Hospital, but would carry on as director of the Victoria Cancer Clinic until it was firmly established. He reported that Dr Lockyer, a trainee of the Royal Cancer Hospital in London, had been appointed to the staff of the Hospital in Radiotherapy.

Reporting to the BCCF Executive Committee in December 1952, Dr Murphy explained that the fewer number of patients seen at the Clinic in November was due, in part, to the absence from the Clinic of Dr Lockyer for one week while he went to Winnipeg to write his certification examinations. [10]

The continuous pressure from Victoria, however, must have carried weight with the Board, at least behind the scenes, for in front of 800 people in the Ballroom of the Empress Hotel the Victoria Cancer Clinic, with its own dedicated space provided within the Royal Jubilee Hospital, was officially opened on January 23rd 1952. The President of the BCCF and other representatives of the Foundation were present. Through the efforts of Mr Tomlin, friends in Victoria contributed $400 toward the expenses of the opening.



Dr Norman Lockyer 1915-1993

Dr Lockyer was born in Kent and qualified from St Bartholemew's Hospital in London. Within months, at the start of the Second World War, he married Diana Barnes, a nurse in the Hospital, and joined the Royal Navy. Following the war he spent a short, but enjoyable time in general practice in Bexley Heath, but was then accepted for training in radiotherapy by Dr Ledermann at the Royal Free Cancer Hospital in London.

A short spell of two years in Exeter was followed by an offer of consultant posts in Scunthorpe (Lincolnshire) and Victoria (BC). His wife and he could not decide between the two, but the toss of a sixpenny coin made Victoria the winner. On arrival in Victoria in 1951, he was disappointed to find that the Royal Jubilee Hospital provided him, in addition to the two treatment rooms, only a small room and a long bench outside in the corridor. With patience and good care he provided radiotherapy treatment for patients at both the Royal Jubilee Hospital and St Joseph's, which he visited single handedly once or twice a week, until his retirement in 1976. Allocated three weeks holiday a year, his practice was covered during his vacation by one day a week visits by Dr Evans from Vancouver.[18]

Fig 89. Dr Norman Lockyer.

Following Dr Murphy's retirement, Dr HM Edmison was appointed Chairman of the Victoria Committee (which had supervision over the clinic) and Dr N Lockyer became Medical Director. Dr Edmison, a Manchester graduate, received Canadian certification in both diagnostic and therapeutic radiology in 1945.

In 1954 a 260KV unit, a third treatment machine for Victoria, was installed in St Joseph's Hospital. The Hospital asked for, and received, the part-time services of Dr Lockyer from the Victoria Cancer Clinic to direct radiation therapy of cancer cases in the hospital. It was determined that all radium treatment would now be done at the Royal Jubilee Hospital. X-ray treatment at St Joseph's ended when the expanded Victoria Cancer Clinic opened at the Royal Jubilee Hospital in 1963. Dr Lockyer, and later Dr Coy, continued to visit the hospital at least weekly until the opening of the new Victoria General Hospital.

Cobalt needs a Physicist

Discussions with the Royal Jubilee Hospital were held in March 1957 about where a cobalt unit might be installed. Plans were approved in October for construction of a new Victoria Cancer Clinic. A year later Dr Edmison reported to the Board of the British Columbia Cancer Foundation, *"An unexpected obstacle was encountered in obtaining approval for the use of radioactive Cobalt because of the fact that no radiation physicist was resident in Victoria. This was finally overcome when arrangements were completed for training a suitable candidate in this special type of work and it was agreed that he might divide his activities between the Victoria College and the Victoria Clinic. Unexpected delays have also been encountered in obtaining final approval from the Provincial Government for Federal and Provincial grants which are essential to our building plans previously outlined. The main reason for this is a difference of opinion between B.C.H.I.S. officials and representatives of the Jubilee Hospital in regard to the location of the clinic area in relation to the general plans for hospital expansion. There is reason to think, however, that these differences may be resolved before long."* [19]

To answer the need, Dr Friedman from the University of Victoria was later appointed on a part time basis.

With plans for the new Victoria Clinic building in place, it was proposed that the Victoria Cancer Clinic and the British Columbia Cancer Institute should work toward a central administrative body.

In September 1962, Admiral Hibbard, the Victoria Cancer Clinic representative on the British Columbia Cancer Foundation's Board, requested that the Foundation be responsible for providing a full-time Director for the Clinic. Up to that time the director had been appointed by the Royal Jubilee Hospital.

By December the following year, the Foundation accepted full responsibility for the "*proper and efficient operation of the Victoria Clinic and to exercise control over all expenditures made on its behalf.*"

A $3 million expansion of the Royal Jubilee Hospital, opened in June 1963, included the new, long awaited, Victoria Cancer Clinic. The Clinic housed the promised $40,000 Eldorado G cobalt unit in addition to 250KV and 120KV X-ray machines. A second treatment vault was built for the addition of a future cobalt unit. Delayed for fifteen years, Dr Lockyer and later Dr Coy used the room to administer chemotherapy. [20] In June 1969, Dr Gibson went to Victoria for three days while Dr Lockyer traveled to Vancouver for a refresher visit.

With the retirement of Dr Lockyer in 1976, Dr Coy, who had been in Vancouver since 1963, was appointed Director of the Victoria Cancer Clinic.

With the eventual acquisition of the second cobalt unit, the AECL 780 in 1977, it became necessary to have a full time physicist to comply with regulations and to undertake treatment planning. It was felt that an isocentric cobalt unit would allow comparable treatments to be delivered in both Victoria and Vancouver. Mr Greg Kennelly was seconded to Victoria from Vancouver to provide this support from 1977-1979.

Mrs Sullivan, the head nurse of the Victoria Cancer Clinic since 1957 retired in 1983. Mrs Sullivan gave strong support to the clinic, patients, Dr Lockyer and Dr Coy throughout her 26 years of service and developed a lasting friendship with both her long time colleagues.

In the twenty years after 1963, the patient load increased dramatically and space was at a premium. As temporary measures, a trailer was moved from Vancouver, and two of the older Royal Jubilee Hospital buildings were loaned to the Clinic. The 120KV

Dr Peter Coy 1932-

Born in Bristol, Dr Coy graduated in medicine from the University of Wales in 1956. Following a year in Cardiff he spent three years as a Medical Officer in the Royal Air Force. His Radiotherapy training leading to the DMRT was undertaken at the Christie Hospital in Manchester from 1960-1963. He was appointed staff radiotherapist at the British Columbia Cancer Institute in June 1963. Dr Coy obtained the CRCPC in 1965 and the FRCPC in 1972. He was largely responsible for bringing his old friend, Dr Jackson, to Vancouver from Manchester in 1974. He was appointed Director of the Victoria Cancer Clinic in 1976 and held the post until his retirement in 1993.

Dr Coy held the university appointment of Clinical Assistant Professor in the Department of Surgery, University of British Columbia.

Dr Coy conducted the first prospective randomized trial in the BC Cancer Agency using twice weekly radiotherapy with or without chemotherapy in lung cancer.[21] Throughout his career, he had a special interest in lung cancer, being involved in many national studies and active with the Canadian Cancer Society in promoting services to patients, education and anti-smoking activities. He was instrumental in the establishment of the Victoria Association for the Care of the Dying, and Hospice Victoria. As chair of the Capital Regional District Tobacco Free Task Force since 1989 he has been an important activist in developing the first anti-smoking by laws in the country.

A devoted husband and father of four daughters, he is a keen sailor and outdoorsman.

Fig 90. Dr Coy proudly displays the key to the new clinic.

Fig 91. Victoria's second cobalt machine, the AECL 780.

and 250KV machines were moved into the same room.

A three channel Selectron (see chapter 4) replaced radium for intracavitary treatment of gynaecological cancer in 1980. With the acquisition of remotely handled radiation, radium was no longer used in Victoria. Radium implants were thereafter undertaken in either Vancouver or the Fraser Valley Cancer Centre.

Dr Fetterly from the London Clinic in Ontario joined Dr Coy in 1978. Born in Ontario, he qualified from Queens University in 1946, practicing as a family physician until 1955 when he began two years training in radiotherapy under Dr Ivan Smith in London, Ontario. He spent one and a half years at the Christie Hospital and Holt Radium Institute obtaining the DMRT in 1958. Dr Fetterly was radiation oncologist in London from 1958 to 1978, obtaining the CRCPC in 1958 and FRCPC in 1972.

On coming to Victoria Dr Fetterley expressed the wish to concentrate on clinical practice without the burden of administration, and was highly respected by the many patients in his care over the next decade.

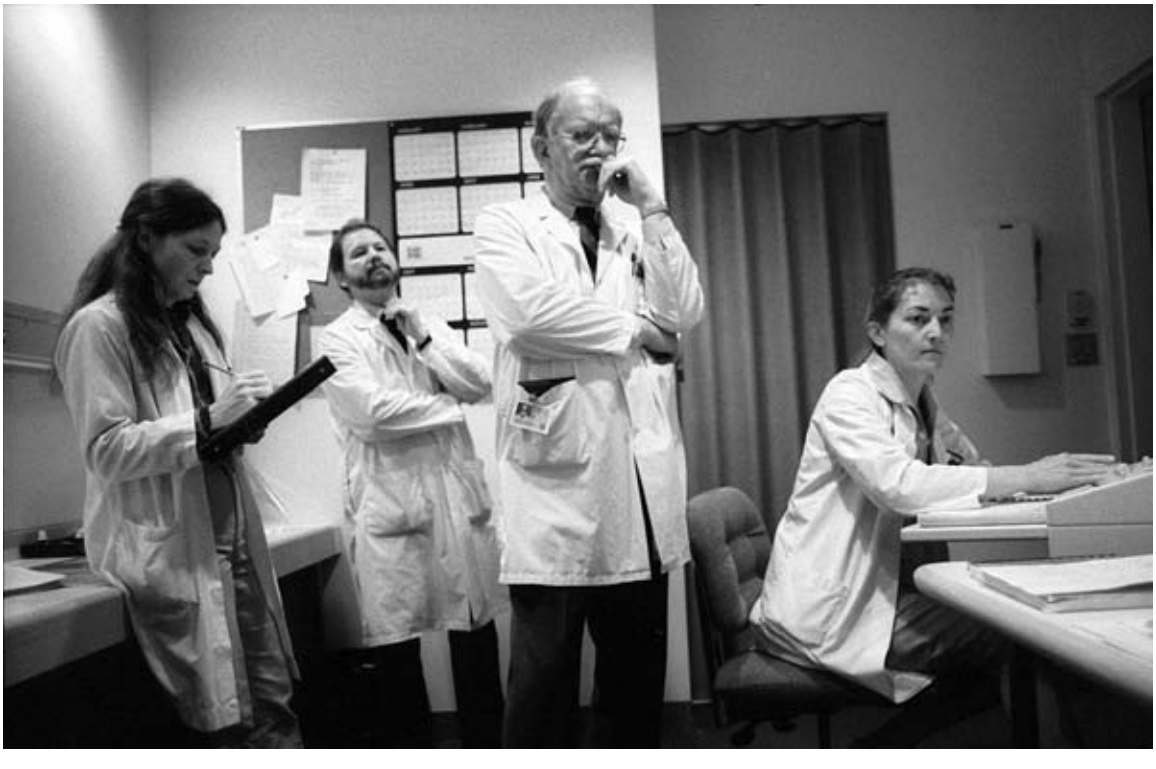


Fig 92. Physicist Wendy Don, Denis Watkins and Dr John Fetterly, take part in a treatment planning session with Joyce Bennett at the computer. Reproduced by permission of photographer Ted Grant (Victoria).

The New Victoria Cancer Clinic

In the early 1980s an expansion of the Cancer Clinic was included in ambitious new plans for redevelopment of the Royal Jubilee Hospital. Unfortunately the hospital plans were too rich for the government. Planning had to start again and now the Cancer Clinic found itself squeezed between two existing buildings. Equipment options were limited to two accelerators, one with electron capability, a simulator, a new superficial X-ray unit and retention of the isocentric cobalt unit.

Orders for the new equipment were placed in April 1984, but in July the Provincial Government introduced an indefinite freeze on all hospital construction!

Construction did not begin until February 1986. The new clinic was officially opened by the Lieutenant Governor the Honourable RG Rogers on September 30th 1987.

To coincide with the opening, the Management Committee of the Cancer Control Agency of BC requested that the Victoria Clinic formalize a Radiation Therapy Committee and that it create terms of reference.

Fig 93. The Lieutenant Governor RG Rogers opens the Victoria Cancer Clinic adjacent to the Royal Jubilee Hospital in 1987.

Fig 94. All hands help "accelerate" the installation of the Philips SL 75-14.

The Clinic Director was to be the Chairman. The radiation oncologists, the Physicist, the Chief Radiotherapy Technologist, the Chief Technologists of Patient Preparation and Treatment Planning, and the Administrator would be members. The committee was to coordinate radiation therapy functions related to Radiotherapy, Physics, Dosimetry and Patient Preparation. [22]

During 1987, two Philips accelerators were installed, the Philips SL 75-5 at 6MV energy and the SL 75-14 at 10MV. The 100KV unit and Philips simulator were installed and the 780Cobalt unit was transferred from the old clinic.

In the interval between the purchase of the accelerators in 1984 and the eventual completion of the building in 1987 the machines had been stored in a warehouse in the UK. Either there, or on delivery to Victoria, the SL 75-14 had been exposed to water damage. The large drum, which caused the larger 10MV accelerator to rotate around its isocentre, had become rusty in storage. The manufacturer was reassuring and considered that the damage could be repaired, but was agreeable to extend the warranty by six months. [23]

Fig 95. The Philips SL 75-5. The water tank on its trolley under the beam is used to carry out physics measurements on the radiation beam as part of the commissioning and acceptance process following installation.

In the early days of the new Clinic the throughput of patients was limited by the logistics of commissioning the 10MV machine which did not become fully operational for over a year. During the transfer to the new clinic, treatments were scheduled to be given four times a week. The existing 250KV machine would be kept operational until electron capability became available on the 10MV machine.

In assigning patients to the new machines, the Radiation Therapy Committee recommended tangential breast treatments, palliative treatments, whole brain and CNS treatments were to be done on the 780 cobalt unit; mantles, four field breast, head and neck and radical lung treatments on 6MV; and pelvic, head and neck and abdominal irradiation on 10MV. Skin treatments would remain on 100KV.[24]

The equipment installed in the new Clinic had been purchased in 1984. The lower energy accelerator a Philips SL75-5 cost $575,000, and the SL75-14 operating at 10MV cost $850,000. The simulator was purchased for $479,120. This equipment was replaced by two 6MV Varian 600C accelerators each costing $1,200,000 and four Varian 21EX accelerators each costing $1,460,000, when the new Vancouver Island Cancer Centre was opened in 2001. The Picker CT simulator cost $1,300,000. The total replacement cost of $9,540,000 was five times that of the equipment purchased sixteen years previously. [25]

When Dr Charles Ludgate joined the staff from Vancouver in 1988 he brought with him his Techniques Book and expressed concerns that there were differences in technique and dose definition in certain areas between the two centres. These were to be discussed with colleagues in Vancouver. Since the equipment in the two centres was different in manufacture and design it was inevitable that there would be differences in the way in which treatment was delivered. However, aspects of the design of the treatment prescription and treatment sheets were coordinated and agreement was reached to define dose prescribed at the isocentre of the treatment

volume. Joint meetings and discussions led to general agreement on dose and fractionation for most tumour sites and diagnoses.

In early 1989 Dr Coy, who was both Director of the Clinic and in charge of the Radiotherapy Department, decided to separate the two functions to give himself more time to address other issues. Terms of reference for the position of Head of Radiotherapy were established with agreement of Dr Jackson, the Head of the Division of Radiation Oncology. Initially the Victoria radiation oncologists decided to rotate the position on a six months basis through Drs Alexander, Ludgate and Laukkanen. After Dr Alexander's term, however, Dr Ludgate assumed the post and held it until replaced by Dr Froud in 1992.

At the March 1992 Radiation Oncology Meeting (now renamed from the Radiation Therapy Committee) the staff agreed to the indications for treatment verification films. They were to be done on all radical treatments and those with field defining blocking in the first two days of treatment and once more during the course of the treatment. Patients with immobilization shells would only require one film. [26]

Fig 96. Shown from left to right are the Physicist Dr Brian McPharland, Dr Coy and Dr Alexander as a radiation therapist positions the patient for treatment.

Waiting lists come to Victoria

In May 1989, the resignation of two radiation therapy technicians in the department, with no immediate replacements in view, meant that certain restrictions had to be introduced. Since there would only be two technicians on each machine, the units would have to be closed for breaks and there would be no late shifts. Instead of the usual 120-135 patients treated per month, this would drop to approximately 106. Suggestions were made to shorten fractionation by treating four days a week or delay in starting treatments. Neither suggestion was welcomed but Dr Coy recommended instead that single treatments be used for palliation. [27]

The staff continued work on bringing the Victoria Techniques manual up to date. Inevitably, because of different capabilities of the equipment in Victoria and Vancouver, the techniques for certain treatments were somewhat different in the two departments. These differences were documented in Victoria, and through discussion and attendance of Victoria staff at techniques meetings in Vancouver, a degree of harmonization of techniques and dose/time schedules was reached between the two clinics.

When Dr Ethan Laukkanen left the Victoria Clinic late in 1989 the radiation oncologist workload fell to the responsibility of 2.5 persons and became a major burden. Matters improved over the next two years with help from Dr Julie Bowen, seconded from Vancouver, and the appointment of Dr Catherine de Metz (Edmonton) and Dr Peter Froud (Kingston).

Closer Cooperation with Vancouver

In the fall of 1990 the Victoria Staff expressed a desire to have a closer working relationship with their colleagues in Vancouver. On Monday, October 22nd, Dr Jackson, Gloria Sherstan, Sharon Davies, Olwen Demidoff and Heather Drake traveled to Victoria to meet for five hours with Dr Coy, Dr Ludgate, Lyn Blenkinsop and Margie Wickheim. At that time there was a national initiative to develop a "Workload Measurement System" (WMS) for radiotherapy. To attempt compliance with this proposed system, both clinics agreed to allocate 20 minutes for pre-treatment scheduling and 8 minutes for scheduled support for technologist attending from mould room or simulator. Both clinics agreed to segregate WMS statistics into four sections, dosimetry, simulator, mould room and treatment. Despite much work on the WMS system by Sharon Davies and others, the system was never brought into routine use. The group discussed ways of harmonizing mould room procedures. Joint projects were considered along with the development of a quality assurance check list.

Of particular concern was the training of radiation technologists. Discussions were underway in Vancouver about the involvement of the BC Institute of Technology (BCIT) in the training of students. In the interim, it was agreed that the didactic portion of the course would continue to be given in Vancouver, but practical training could be carried out in any of the Agency's clinics. A proposal for a Clinic Instruc-

tor in Victoria for the student input in 1991 would be drafted. Canadian Medical Association Conjoint Accreditation approval for the Victoria Clinic would be pursued and a Victoria representative would sit on the Agency RTT Training School Committee.

Where possible it was agreed that technologists should have the opportunity to rotate through all areas of the Department including dosimetry, mould room, simulator and treatment. Discussion took place on Quality Assurance matters and it was felt that those present at the meeting could form the basis of an Agency Radiation Therapy QA committee or working group that would meet regularly to supplement the Division of Radiation Oncology Clinical QA Committee. [28]

In the spring of 1992, concern was mounting about waiting times for treatment, which was due, in part, to a shortage of radiation therapists (formally radiation technologists). With the appointment of Ms Pam de Silva as Victoria Manager/ Radiotherapy in the summer, it was expected that the situation would improve. Patients were expressing concern with the uncertainty about treatment start dates. The lack of a computerized scheduling system was not helping the situation. Even though the wait for treatment was increasing, Dr Coy provided figures that showed that in the period April to August 1991, 556 patients had been treated whereas, in the same period the following year, the number had fallen to 511. Treatment visits had also fallen from 16,986 to 16,146. It was not apparent why an increasing number of patients waiting for treatment was occurring in the face of an observed decline in patients treated. [29]

Dr Froud and Dr de Metz augmented the staff in 1991, but the latter left two years later. Dr Jan Lim joined the staff in 1992 and Dr Stephan Larsson in 1993. With Dr Coy's retirement in 1993, there was a net increase of 2.5 radiation oncologists in the three-year period. Dr Froud, a strong advocate for adequate staffing and equipment for radiotherapy departments, took over as Head of the Department.

Dr PJ Froud 1937-

Dr Peter Froud was born in Wolverhampton, England, and was educated in the city's Grammar School and Brewood Grammar School where he was head boy for the last two years. His medical training was in Bristol and at the Brompton Hospitals in London. Postgraduate training in radiotherapy was undertaken at the Royal Marsden Hospital, the Hammersmith Hospital and the Princess Margaret Hospital in Toronto. Dr Froud obtained the FFR in 1971, and the FRCPC in 1973. After emigrating to Canada in 1971 he worked in Saint John and Kingston. At Queens University, as Associate Professor in Oncology, he was responsible for establishing the Department of Oncology and was a major player in increasing the number of student scholarships in cancer centres in Ontario.

Dr Froud came to Victoria in 1991 and was Head of Radiation Oncology from 1992-1997, and Professional Practice Leader from 1997 until his return to Kingston in 1999. As a strong advocate for adequate resources his leadership in Victoria was effective and welcome.

Dr Froud was influential in the establishment of the Canadian Association of Radiation Oncologists.

Excellence in clinical practice and patient care was always his goal, with a special interest in urologic, gastrointestinal and breast cancer.

Extended hours and a four day week

Throughout 1995 there was a gradual increase in the number of patients waiting for treatment and a troubling increase in the length of time patients, especially those with prostate cancer, were having to wait. This led to a retreat of the Radiation Services group in Victoria and a videoconference between the three centres to look for possible solutions. In May of 1996 funding was received to extend the working day by one hour. In September this was increased to a ten hour work day and the six radiation oncologists offered to each work four days a week to cover the extended hours. [30] This schedule was introduced four months later by which time the number of patients waiting for treatment had grown to 166 of which 137 were fully planned and ready to treat. To further address the problem agreement was reached to have certain patients referred directly to Vancouver for treatment. On January 28th 1997 a letter was sent to all urologists and surgeons in Nanaimo and regions north and west of Nanaimo proposing that patients, with localized prostate cancer and post-menopausal breast cancer patients who had received partial mastectomy for early disease, be referred directly to the Vancouver Cancer Centre for consideration of curative treatment. In the first eight months of this arrangement 38 patients with prostate cancer and 75 breast cancer patients had been referred to Vancouver. [31]

[Author's Note in the four years 1997-2000, 412 breast and 382 prostate cancer patients were referred to the Vancouver Cancer Centre from Vancouver Island for radiation treatment]. [32]

By August 1997 the number of patients on the waiting list had fallen to 123. Ms de Silva moved to the Cancer Centre for the Southern Interior in the fall and was succeeded by Ms Rhonda Coleman.

Although the number of patients on the waiting list was down, prostate patients were waiting up to three months to be seen by a radiation oncologist and a further three months for treatment.

Early in 1996 discussions began with a view to increasing the number of accelerators. These discussions later led to a decision to build a new clinic. In September 1997 the provincial government committed funds for down payments on the radiotherapy equipment for the new building, plans for which were being developed. The Clinic held an open house on Saturday November 22nd .

With the reorganization associated with the establishment of the provincial Radiation Therapy Program, Dr Blood, who had come from Winnipeg two years previously, was named acting Professional Practice Leader for Vancouver Island, following Dr Froud's return to Kingston.

Plans for the new Vancouver Island Cancer Centre included a research floor. The University of Victoria had expressed interest in active collaboration with Radiation Oncology. The "sod turning" ceremony for the new Centre took place on April 25th 1999. With the appointment of Dr Truong in January 2000, protected research time was provided for a radiation oncologist for the first time in Victoria. In the fall of the same year in preparation for the opening of the splendid new centre, Dr Ivo Olivotto was appointed Professional Practice Leader. His staff now included nine radiation oncologists.

References for Chapter 5

1. Murphy HH, Royal Jubilee Hospital, (Victoria, BC) 1957.
2. City pioneer R. Hutchison passes at 75. The Daily Colonist (Victoria) 1947 May 29;19, 3.
3. X-ray apparatus for Jubilee Hospital. The Daily Colonist (Victoria) 1918 Jul 20;7, 5.
4. Well-known citizen and philanthropist died early today. Victoria Daily Times 1934 Jan 30; 1,4.
5. Joseph Sayward of Victoria passes. The Daily Province (Vancouver) 1934 Jan 30;7,4.
6. The History of Colwood. Available at: URL:http://www.city.colwood.bc.ca. Accessed Nov 2001.
7. Peculiar properties of radium. The Daily Colonist (Victoria) 1922 Feb 19;17.
8. Jubilee X-ray section makes sweeping changes. The Daily Colonist (Victoria) 1926 Jun 13;14.
9. Expert radiologist at St. Joseph's has high qualifications. The Daily Colonist (Victoria) 1937 Jul 16;3,2.
10. BC Cancer Foundation, Executive Committee, Minutes 1952 Dec 17. (BC Cancer Agency Archives)
11. Radium swallowed "treasure hunt" in city man's body. The Vancouver Daily Province 1947 Oct 10;1,1.
12. Missing radium needle traced by radiation meter, x-ray film. The Daily Colonist (Victoria) 1952 Dec 12;15,6.
13. Canadian Medical Association Journal. 1964; 91; 774.
14. BC Cancer Foundation, Board of Directors Minutes, 1949 Mar 15. (BC Cancer Agency Archives)
15. Sullivan D. Personal communication 2001.
16. BC Cancer Foundation, Report to the Board by Dr HH Murphy, May 26 1950. (BC Cancer Agency Archives)
17. BC Cancer Foundation, Board of Directors Minutes 1950 Jun 30. (BC Cancer Agency Archives)
18. Lockyer D, Sullivan D. Personal communication 2001
19. BC Cancer Foundation, Board of Directors Minutes 1956 Jan – 1961 Jun. (BC Cancer Agency Archives)
20. Coy P. Personal communication 2001.
21. Coy P. A randomized study of irradiation and vinblastine in lung cancer. Cancer 1970;26(4): 803-807.
22. Cancer Control Agency of BC. CCABC Administrative Policy Manual. Vancouver; CCABC; 1987: p. I-210
23. Cancer Control Agency of BC, Vancouver, Radiation Therapy Committee, Minutes 1987 Jan 6. (BC Cancer Agency Archives)
24. Ibid. 1987 (Jul 8). (BC Cancer Agency Archives)
25. Easton J. Personal communication 2001.
26. Cancer Control Agency of BC, A. Maxwell Evans Clinic, Radiation Oncology Minutes, 1989 Mar 14. (BC Cancer Agency Archives)
27. Ibid. 1989 (May 9). (BC Cancer Agency Archives)
28. BC Cancer Agency, A. Maxwell Evans Clinic, Radiation Oncology Minutes, 1990 Oct 23. (BC Cancer Agency Archives)
29. Ibid. 1992 (Oct 7). (BC Cancer Agency Archives)
30. BC Cancer Agency, Vancouver Island Cancer Centre, Radiation Services Committee Minutes, 1996 Sep 12. (BC Cancer Agency Archives)
31. Ibid. 1997 (Oct 21). (BC Cancer Agency Archives)
32. Baerg B. Personal communication 2001.

Chapter 6
The Radiation Therapy Program: November 1996-

OAR, Organisation Assessment and Redesign

In August 1995 the Agency embarked on an ambitious exercise of "Organisation Assessment and Redesign" (OAR) with the guidance of the consulting firm, Ernst and Young. The process was divided into three phases, Assessment, Redesign and Implementation. Initially, the assessment phase had four teams with radiation oncology representation. These were Clinical Standards (Dr Olivotto), Patient Care Services (Dr Rheaume and Dr Matheson), Information Services (Dr Pickles) and Clinical Standards (Dr Froud). The Agency administration promised a full time equivalent locum radiation oncologist for both Vancouver and Victoria to cover for the time of those involved in the Assessment teams. Dr Nicos Nicolaou, a recent graduate of the training program who was working in Philadelphia, came to Vancouver in October as a locum and provided much appreciated support. In November, Dr Fairey was assigned to the newly formed Communications team to improve dialogue between the medical staff and the teams.

Early in 1996, the five Redesign teams were formed. They were Administrative Process, Patient Information Management, Cancer Control Information & Analysis (Dr Olivotto), Patient Care (Dr Hay & Dr Rheaume) and the Organizational Review Task Force chaired by Dr Fairey.

A major outcome of OAR was the establishment of "Programs" of Systemic Therapy and Radiation Therapy. Programs were new and different from the old divisions in that they had centralized, provincial budget and recruitment authority for most elements and groups within the program. Along with this came an entirely new way of designating senior people in the Programs. The following new titles came into effect in November 1996.

Dr Keane was now designated Provincial Program Leader for Radiation Therapy. At the same time he became Professional Practice Leader (PPL) in the Vancouver Centre. These titles replaced the former "Head of the Division of Radiation Oncology" and "Head of Radiation Oncology" in the Vancouver Cancer Centre. The Program now had added responsibilities for Physics and the radiation therapists, a reporting arrangement originally proposed by Dr Hall in September 1975.

When Olwen Demidoff left the Vancouver Centre to be Radiation Therapy Process Leader (RTPL) at the Fraser Valley Cancer Centre in January 1997, Sharon Allman (Davies) was appointed to the equivalent position in Vancouver. Dr Ellen El Khatib was appointed Provincial Professional Practice Leader in Physics, and Dr Brenda Clark as PPL in Vancouver. Union discussion on job descriptions and the labour adjustment process delayed further implementation of the redesign process for all other radiation therapists and physics personnel.

The Program starts with a Retreat

Eager to start the Program on a positive note, Dr Keane arranged a Program Retreat in January 1996 to be held at Dunsmuir Lodge on Vancouver Island. The agenda included plans for the first year of the Program and for its important academic component.

In the spring of 1997, in an effort to equalize waiting times, arrangements were made for all three clinics to work 10 hour days, and for patients with breast or prostate cancer to be referred from the northern part of Vancouver Island for treatment at the Vancouver Cancer Centre. Funding for the extended hours was provided, in part, from closure of the Washington referral program on April 1st 1997.

The new Philips equipment was installed in Vancouver and training of therapists was underway. Stereotactic treatment capability was being installed on Linac 2.

In June, Dr Keane notified the staff that agreement had been reached with Varian Oncology Systems to undergo a pilot project to introduce the VARiS software into the radiotherapy process in Vancouver. A unique feature of the project was the willingness of Varian to integrate the software with the Agency

Fig 97. The four cancer centre buildings of the BC Cancer Agency. Clockwise from top left: Vancouver Island Cancer Centre*; Vancouver Cancer Centre; Fraser Valley Cancer Centre and Cancer Centre for the Southern Interior.
*(The new Vancouver Island Cancer Centre was opened in 2001.)

information system and CAIS (the electronic patient record system of the Agency). The study was to be in three phases. The first was the integration of VARiS with CAIS. Next was the integration of the treatment planning process using the computerized physics planning system (CAD plan), the Varian linear accelerator (Linac 2) and the Oldelft simulator. The third phase would involve the integration of the Philips equipment with VARiS. These steps were felt to be crucial in the overall redesign of the "radiotherapy process". The first step in the VARiS CAD plan project was to create a treatment planning model design for prostate cancer. The decision to purchase CAD plan for CCSI, and the agreement by Varian to provide software maintenance on an Agency wide basis, moved the Radiation Therapy Program one step closer to the goal of providing a single treatment planning system for all four centres. By the spring of 1999 all the Varian machines in Vancouver had VARiS installed and Somavision, a physician workstation for CADplan, was being introduced.

In September 1997, Radiation Oncology Rounds, that involved radiation and physics staff as well as resident presentations, replaced the weekly resident only rounds.

In the fall the Ministry was approached for funds to install a fifth megavoltage unit in FVCC, a CT simulator in Vancouver and a replacement for the Therac 25. The Therac 25 was decommissioned on March 3rd 1998 after it was recognized that there was a problem with beam flatness that Theratronics indicated could not be rectified. The machine was replaced with a Varian Clinac 21EX in September 1998. At the same time Varian announced an upgrade of the multileaf system from 40 to 80 leaves to be available in 1999, and possibly 120 leaves at a later date.

With only two applicants for resident positions in the coming year, it was evident that staff members would have to be prepared to take first on-call responsibilities. The staff agreed that the residents could reasonably be expected to take 1 in 5 on-call and that a rota would be drawn up for staff to take call when a resident was not listed. Fortunately, Dr Sheehan was able to report in October 1998 that there appeared to be renewed interest in Radiation Oncology from UBC medical students. As many as eight had expressed interest in applying for the program in 1999.

Author's Note
Linear Accelerators of the late 20th Century

Technological improvement has progressed at a pace. The basic principle of electrons accelerated by a wave-guide and made to hit a target and produce X-rays remains the same. However, progressive advances have occurred in design, which make the machines more user friendly for both patients and staff. Computerization has introduced safety features, data control, and automatic set up of treatment parameters. Usually beneficial, computer software faults can be extremely serious. Dynamic (moving) wedges replace manually placed wedges and multileaf collimation, providing remotely controlled beam shaping, largely eliminates the need for staff to lift and position heavy beam shaping blocks. Shaping the treatment volume to that of the tumour, through three dimensional computer planning and Intensity Modulated Radiotherapy (IMRT), creates the possibility of increasing the dose to the tumour while further reducing dose to organs at risk. Portal Imaging allows the treatment field to be visualized in real time.

"The Inner Cabinet"

In March 1999, Dr Keane notified the staff of his intention to form a small group of three people, the Radiation Oncology Advisory Group (ROAG), an "inner cabinet", to provide him with advice on priorities and issues which needed to be addressed at the Vancouver Cancer Centre. After further discussion, the number was increased to four and it was reiterated that this would be an advisory body able to focus the department's discussions on specific issues.

In June, therapists were appointed to "module leader" and "assistant module leader" positions and displacement notices were issued to the "senior therapist" whom they were to replace.

During the summer Dr Keane and Radiation Therapy and Physics staff began preparation for a review of radiation techniques and their applicability to the newer technical capabilities within the department. Following the publication in the literature of a further study confirming the value of single treatments for most palliative situations, Dr Keane wished to bring together the various studies on the matter with the help of a research fellow. This was done with the expectation of developing a Program wide policy for palliative treatment. As with previous guidelines on technique, it was recognized that "*final responsibility for deciding an appropriate prescription lay with the individual radiation oncologist. It is anticipated that variations from the new guideline will be analysed in order to understand areas where further information is required.*" [1]

In the fall, approval for a CT simulator was received and plans began to site it in the area previously occupied by medical illustration. At the same time, funds were also approved to replace the Kermath simulator (Sim 2). Installation of the two CT simulators was completed in April 2000. Protocols were being developed prior to introducing CT simulation for specific disease sites.

Elekta, a company that seemed anxious to maintain a strong commitment to the linear accelerator program, acquired Philips in 1998. Plans were in place to install an integrated multileaf system on the accelerator SL20, which would make all SL machines in the province identical. Work was proceeding with the iCom interface compatible with VARiS.

In December 2000 a Program meeting, involving representation from physics and radiation oncology from each of the four centres, was held to discuss IMRT (Intensity Modulated Radiation Therapy). The conclusion was "*that IMRT would be developed in BC as an experimental radiotherapy intervention, which ideally should be tested in prospective randomized trials against the best conventional non-IMRT techniques.*" [2]

Fig 98. The radiation oncologists of the Radiation Therapy Program at the Vancouver Cancer Centre, circa 2000.
Left to right back row, Drs Sheehan, Morris, Wu, Campbell, Lim, Grafton, Duncan, Sutcliffe, Voss, McKenzie, Tyldesley.
Middle row left to right Drs Parsons, Leung, Goddard, Weir, Keyes.
Front row left to right, Drs Hay, Rheaume, Keane, Kim-Sing, Olivotto.

Fraser Valley Cancer Centre (FVCC) The First Staff Appointments

Following the decision in the early 1990s by the government, in conjunction with the BC Cancer Agency, to create an additional treatment facility, Surrey was selected as the potential site based on population dynamics, and the ability of the host hospital (Surrey Memorial) to support an ambulatory cancer treatment centre.

With an expectation that the clinic would open two years later, medical staff appointments were initiated in 1993. Dr Ed Kostashuk, returning to his alma mater from Saskatchewan, was appointed Director, and Dr Frances Wong, Head of Radiation Oncology. At this time, facility design had been established, selection of equipment undertaken by a broad based team in Vancouver, and formulation of operating estimates and forging of medical links in the South Fraser region were underway. With Dr Marianne Mildenberger and Dr Alex Agranovich in 1994, the four radiation oncologists began to see patients in Vancouver who were from the Fraser Valley catchment region. Along with their medical oncology colleagues (the gang of six), they developed a centre within a centre working in Vancouver, awaiting the opening of the Surrey clinic. They proposed that the clinic's name should be changed from the Surrey Cancer Centre to the Fraser Valley Cancer Centre to better reflect the entire catchment area. A free standing Department of Oncology was established within the Surrey Memorial Hospital which was readily and universally accepted.

The official opening of the Centre was May 12th 1995 with the Minister of Health in attendance. The day before the opening the reflecting pools in the front of the building had been filled with water. Unfortunately, a leaky water connection precipitated a flood of "biblical" proportions with considerable water collecting in the treatment area. Fortunately, all was saved by the strategic use of mops and fans, no harm was done, and the Minister was none the wiser.

The reflecting pools were never filled again with water, and became landscape planters.

The installation of the cobalt unit, three Philips accelerators and the simulator, began during construction and continued after the official opening.

Dr Kostashuk explained that there would be no

Fig 99. An entrance to the Fraser Valley Cancer Centre in Surrey

high-energy photons or electrons until September 1995. In the first months only cobalt and low energy photons were available for treatment. The selectron would not be immediately available, so that most gynaecological patients and others requiring high-energy photons had to be treated in Vancouver. Prior to the opening of the centre, Dr Carson Leong was recalled early from his brachytherapy fellowship in Paris. Of the five radiation oncologists appointed to the FVCC at the time of its opening, one of them would be in Vancouver each weekday. During the first two months, they continued a hybrid practice, holding clinics in both Vancouver and the Fraser Valley Centre.

The first non-BC graduate to be appointed to FVCC was Dr Rajiv Samant. Liked by all the staff, he initiated the centre's annual Christmas skits.

The Fraser Valley Centre staff was not satisfied with the choice of a cobalt unit with a 100cm isocentre because of the increased penumbra it created and made arrangements with Theratronics to have it changed. The unit was removed from the clinic on July 14th 1995 and replaced by one at 80cm SAD (source axis distance, the distance from the cobalt source to the axis of rotation of the machine) that became available for treatment by late August. By the end of the year, all four megavoltage units were in operation. The low dose rate selectron was brought into service in February 1996. Arrangements were made with the Surrey Memorial Hospital for localizing radiographs to be taken in the Diagnostic Radiology department of the hospital. At the same time Dr Agranovich made representation to the Residency Program Director offering to have residents rotate through the FVCC.

Important to the development of radiotherapy in the FVCC was a state of the art treatment planning system. However, the allocated budget for this was inadequate. With the assistance of the BCCA Planning Department, the Health Ministry, budget adjustments and private fundraising, procurement of the CADplan System was made possible. The first such installation in North America, this system became the standard for all Agency clinics. The system required more space than had been provided in the initial plans, but reallocation after the opening of the centre created adequate space in the Radiation Treatment area for Dosimetry, a space it continues to occupy.

The FVCC was not far behind Vancouver in developing a waiting list. Early in 1996 treatment hours were extended to 6.00pm to provide a ten hour day. Although it was hoped to have the microselectron in operation by June this was delayed until January 1997 to avoid having to purchase the costly iridium source before all the necessary ancillary equipment was in place. It later became apparent, however, that a source for the first year of operation was included in the purchase price. The FVCC microselectron was used in 1997, but only for patients with oesophageal cancer. The introduction of a Program requirement to make up for lost treatment days by the use of twice daily treatments was accepted, but modified to include two groups of patients. Radical treatments, with the exception of prostate cancer, would have interruptions of 2 or 3 days made up by twice daily (b.i.d.) treatments. Others would have interruptions allowed of three days or less, but longer delays would require individual consideration.

Following recommendations of the Agency's Organizational Review, new appointments were made early in 1996. Ms Olwen Demidoff moved from Vancouver into the new position of FVCC Radiation Therapy Process Leader. Dr Wong was appointed FVCC Professional Practice Leader in Radiation Oncology. Other staff members were given "developmental" responsibilities: Dr Agranovich and Dr Mira Keyes in developing the resident education program; Dr Mildenberger and Dr Leong in developing research proposals; and Dr Samant and Dr Winkle Kwan a palliative care and external communication program.

Shifting Ground

In February 1996 some concerns were raised with regard to one of the SL20 units. The ground had shifted by a fraction of a millimeter and this had resulted in a small but detectable shift in the isocentre, fortunately, still within the limits of acceptability.

The CT simulator was installed and Dr Leong carried out the first low dose rate brachytherapy tongue implant in March 1997. With increasing pressure from the general public for the availability of prostate brachytherapy in BC, the staff of the FVCC along with those in Vancouver began to make plans.

The "traveling road show" resumed in August 1998, when the genitourinary radiation oncologists, Dr Agranovich and Dr Keyes, initiated regular travel to the Vancouver Centre to perform prostate brachytherapy implants. Some consideration was given to using the HDR microselectron in FVCC, but was quickly ruled out. The Ministry was unwilling to support the FVCC prostate brachytherapy program until Vancouver was well established.

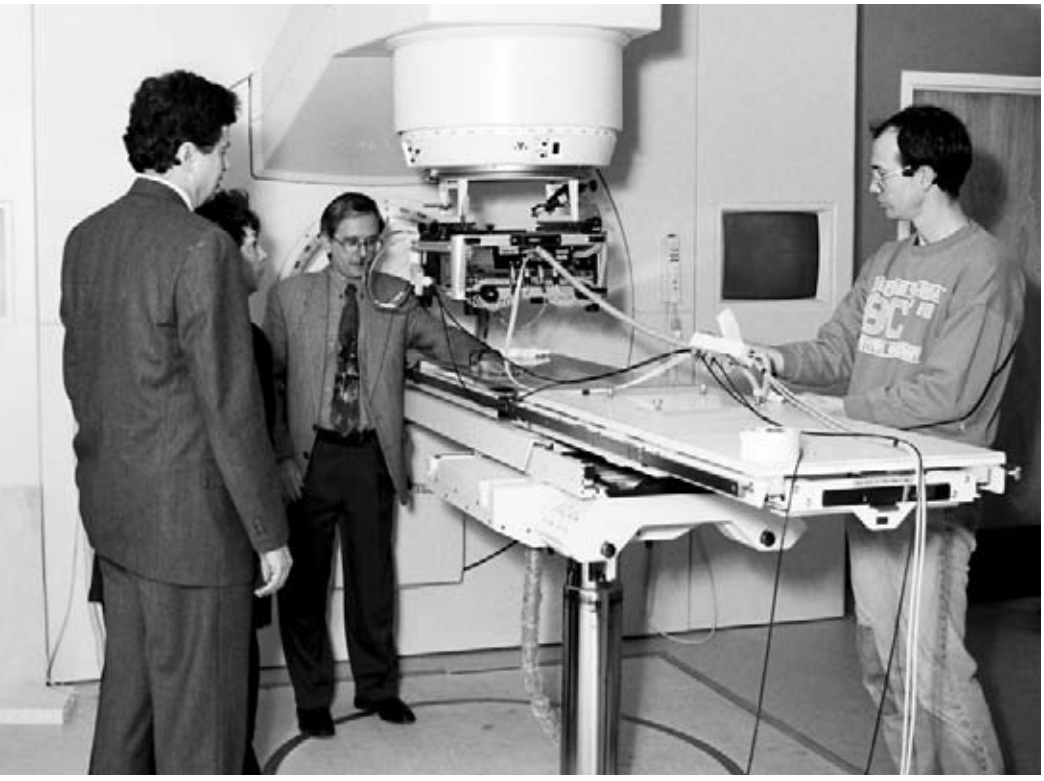


Fig100. The Philips SL75 accelerator was demonstrated for the Provincial Minister of Health, the Hon Paul Ramsey and MLA Sue Hammel by FVCC Director Dr Ed Kostashuk and Philips employee Dave Williams, now on staff at CCSI.

OAR comes to the Fraser Valley

In reporting to the FVCC staff on progress in Organisational Redesign proposed in the OAR task force report of 1996, Dr Kostashuk said "*it appeared that the responsibilities by the various administrative staff as listed in the report above are overlapping and sometimes ambiguous as far as professional practice accountability and risk management and liability are concerned.*" [3]

At the same meeting there was concern expressed that FVCC members of the front line staff were being by-passed and complaints were going to administration without their knowledge.

By March 1998 development of the radiotherapy process included division of workload into three modules: the assessment module under the leadership of a BCNU member; the planning module under a non-contract physicist; and a treatment module under the leadership of an RTT-qualified individual.

The waiting list at FVCC increased in September 1998. Radiation oncologists were encouraged to consider shorter fractionation schedules.

The staff continued to express interest in teaching medical students with the result that three students undertook electives in March 1999. Four summer students were accepted in 2000.

Approval to install a linear accelerator in the fifth bunker at FVCC was received in April 1999. Architects were hired immediately so that the project could get underway. In January 2000, in response to continuing waiting list problems, a Program-wide decision was made to treat 11 hours a day. It was hoped that the fifth megavoltage machine at FVCC would help alleviate the situation. The fifth unit, a Varian 21EX machine, was installed in September and was expected to be operational by January 2001.

Cancer Centre for the Southern Interior (CCSI) The fourth piece in the puzzle

A new era in British Columbia radiation oncology began on April 3rd, 1998 when the Cancer Centre for the Southern Interior (CCSI) opened. The complexities of establishing the CCSI Radiation Program within a full service cancer facility took seven years from concept to reality.

A long and, at times, acrimonious public debate around the recommendation to situate the Centre in Kelowna delayed the project for two years. Strong representations had been made by Kamloops and Prince George as well as Kelowna.

The lead-time in obtaining government funding to acquire the high technology equipment was measured in many months.

In addition the planning for staff in the other oncology specialties such as medical oncology, consideration of the availability of diagnostic expertise in pathology and diagnostic imaging, recruitment of staff in all disciplines, including radiation therapy and medical physics, were major undertakings.

Dr Fairey was appointed Professional Practice Leader, Radiation Therapy for CCSI in June 1997 in preparation for the opening of the centre a year later. Dr Fairey had moved to Kelowna after more than 26 years at the Vancouver Cancer Centre.

One interesting anecdote concerned the installation of the four linear accelerators. The design of the selected equipment provided by the Philips Corporation (now Elekta Inc.) called for the lifting mechanisms of the treatment tables to be installed into deep pits or wells in the foundation of the building. Electric motors controlling the essential movements of these tables were installed several feet below the floor of the building. The CCSI was built near Okanagan Lake and the high water table called for special engineering to stabilise the soil beneath the building. Special engineering was needed to ensure absolute waterproof construction to protect the table pits. As construction was completed, engineers were expecting the building to settle into the subsoil. However, there were many anxious days when it was discovered that, because of the relatively wetter soil, the building was actually tipping in the direction of the lake. The possibility of fracturing the walls of the pits, with subsequent water leakage, was alarming. Fortunately the building righted itself and settled properly on the level, whereupon it is hoped groundwater will never again threaten operations!

And so it was not without considerable growing pains, and an enormous effort on the part of all the original staff from planners to architects, and con-

Fig 101. The entrance to the Cancer Centre for the Southern Interior in Kelowna.

struction supervisors to workers and technicians, that made radiation treatment a reality at the CCSI.

Formal machine safety testing and commissioning by the Medical Physics staff began in 1997. On a warm sunny Friday, April 3rd 1998, the Cancer Centre for the Southern Interior opened as the fourth full service cancer centre operated by the BC Cancer Agency. Although all equipment was not fully operational, radiation treatments began on Monday, April 6th with only three radiation oncologists present out of a planned staff of seven.

Dr William McMillan, and Dr David Hoegler, both from Ontario, joined Dr Fairey. Dr Melanie Reed arrived from Ottawa and Regina in May, Dr Harold Lau from Singapore in June, and Dr Jane Wilson, a BC graduate, in August from a fellowship position in the UK. However, within a month of the opening, patients were waiting 4-6 weeks to see a radiation oncologist.

Nevertheless the laudable collective efforts of these physicians and the team of Ms Pam de Silva, Radiation Process Manager, Dr Allister Baillie, Head of Medical Physics, and Ms Fiona Mitchell, Chief Radiation Therapist meant that the CCSI rapidly came up to speed and was able to provide expert care for all but a few specialised situations.

As with the Fraser Valley Centre, there was interest in medical student teaching and prostate brachytherapy. It was hoped that CCSI staff could be involved in two seminars per year at UBC and be able to offer six-week electives in the clinic, one student at a time. Dr Reed offered to be site director for undergraduate teaching. Dr Hoegler planned to initiate a rapid access clinic in June for patients needing palliative treatment that could be seen, assessed, simulated and treated in one visit. Within three months of opening, there were 53 patients waiting to start radiation who had passed the Ready to Treat (RTT) date. At this time two of the four machines were operational. By September 1998, the RTT number had climbed to 135 despite the fact that all four accelerators were in service and extended hours under consideration

Dr Fairey expressed an interest in starting a CCSI Radiotherapy Techniques Manual involving radiation therapy and physics, which would echo, but not duplicate, the BCCA treatment policies. Monthly rounds were planned in 1999 to focus on radiotherapy techniques and quality assurance. The staff had the foresight to arrange a midday meeting with lunch provided by Zeneca Pharmaceuticals. Some of the centralized administrative bureaucracy of the BCCA was beginning to irritate some of the

Fig 102. The Philips SL20 and its hydraulic couch. The pit to house the mechanism had to be protected from the waters of Okanagen Lake, as its water level was higher than the base of the pit.

Author's Note
Vancouver Island Cancer Centre VICC

The role of the Vancouver Island Cancer Centre in the Radiotherapy Program is covered in the latter part of Chapter 5, in main devoted to the history of radiation treatment on Vancouver Island throughout the century.

oncologists. The oncologists felt that clerical staff could undertake patient triage and other functions. Others, supporting traditional roles, were not so sure, and a uniform system of triage could not be agreed upon.

With the introduction of the VARiS software system in Vancouver designed to provide interface between treatment machines, simulator, physics and other computer networks, CCSI staff members were also looking forward to a VARiS/Elekta interface.

The first resident to rotate through CCSI was Dr Corinne Doll in the fall of 1999.

Dr Baillie the head of Physics, who had been so instrumental in so effectively readying the CCSI accelerators, told the staff that the first upgrade for IMRT would be in June 2000. Some members of the staff were concerned that the technology for IMRT was ahead of plans for its utilization, but Dr Baillie stressed that this was a good time to set up the system for future use. In the summer of 2000, the low dose rate selectron came into use and VARiS was implemented on all machines.

The Cancer Centre for the Southern Interior serves approximately 500,000 people in a huge portion of British Columbia from Hope to the Alberta border and from Quesnel to the American border. Only about 60% of the patients come from within a two hour drive of the Centre, so the logistics of providing cancer consultations and arranging timely planning and subsequent treatment is particularly complicated by the Centre's disparate catchment area. The Centre has risen to this challenge and continues to work on making treatment accessible, timely, and cost effective. Problems around winter transportation and travel distance for patients, and the lack of medical services and expertise in home regions are just a few of the hurdles that challenge the dedicated staff. Radiation oncologists travel regularly to Cranbrook, Trail, Nelson, and Kamloops to support the various regions directly, and to provide patient care and cancer expertise.

The future for radiation oncology at CCSI is exciting and ever challenging. Clinical trials are gradually opening to provide a scientific and academic foundation for the radiation program. It is hoped that interesting new imaging technologies (magnetic resonance imaging and positron emission tomography scanning), and improved treatment delivery (Intensity Modulated Radiation Therapy [IMRT]), will become realities. Expert, high quality cancer care closer to home for the citizens of the southern interior, has been long awaited and is a remarkable achievement.

References for Chapter 6

1. BC Cancer Agency, Vancouver Cancer Centre Radiation Oncology Staff Meeting Minutes 1999 Dec 13. (BC Cancer Agency Radiation Therapy office)
2. Ibid. 2000 (Dec 11). (BC Cancer Agency Radiation Therapy office)
3. BC Cancer Agency, Fraser Valley Cancer Centre Radiation Oncology Staff Minutes 1997 Dec 9. (BC Cancer Agency Radiation Therapy office)

Chapter 7
Academic Radiotherapy

Research

From Cobra Venom to Cytology

In May 1942, the Honorary Attending Staff of the British Columbia Cancer Institute resolved that the firms making cobra venom and stilboestrol be asked if they had any supply available for research work at the Institute. Why cobra venom was requested was not made clear, but stilboestrol was made available by Frosst & Co. In 1944, Dr Sadler began a questionnaire study and periodic examinations of the breast among the nurses of the Vancouver General Hospital. Two years later Dr Trapp delivered a paper on the radiological treatment of cancer of the corpus uteri to the Inter-American Radiological Conference in Havana.

Dr Hardie presented a report to the Honorary Attending Staff in February 1947 on results obtained with testosterone proprionate in the treatment of late cases of mammary cancer. In a further report on March 21st 1949, she described a review of cases with widespread bone metastases treated with testosterone proprionate, and showed that 73% of patients obtained partial or complete relief of pain for a varying length of time. However, this subjective improvement was not paralleled by objective improvement, and only a small percentage was seen by radiographic examination to have recalcification of bone lesions. In a further study underway at the time, oestrogens were being used in post-menopausal patients with soft tissue metastases.

Dr Tchaperoff, who had come to Victoria after the war, requested funds from the Foundation to continue his treatment combining para-aminobenzoic acid (PABA) with X-ray therapy. During his earlier years in England he had published in cancer research and was named by the Earl of Athlone as a member of a team which was to undertake further study on an international scale. His coming to Canada and the Second World War had prevented his joining the team. Dr Cantril, Director of the Tumour Institute of the Swedish Hospital in Seattle, was brought in to investigate Dr Tchaperoff's research proposal, but was not impressed and the funds were denied.

Although Dr Evans published little, and was considered more practical than innovative, he was responsible for bringing many well known academic visitors to the Institute. At the time of the official opening of the new BCCI building in 1952, he arranged the first of six refresher courses carried out over the next eighteen years. At that first course, Sir Stanford Cade and Professor Brian Windeyer were the keynote speakers. A similar course was arranged to coincide with Professor Ralston Paterson's visit in 1957. Attempts were made thereafter to create a triennial refresher course for staff and others interested in oncology. It proved difficult to stick to an exact three year schedule. The noted visitors were often able to include Vancouver in their travels from Europe or Eastern North America on their way to Australasia, or the West Coast of the United States.

Sir Stanford Cade came again in 1961 along with Sir Peter Dixon from London and Dr Arthur T Hartig of Boston Massachusetts. The names of the principal speakers in 1963 are not recorded. In 1966, Professor Hedley Atkins from London, England, Dr RJ Walton from London, Ontario, and Dr LG Israels from Winnipeg were invitees. In 1970 Professor David Smithers of the Royal Marsden Hospital and Dr Boland from New York, were the invited speakers.

In October 1955, Dr Evans reported that, "*the work at the institute was settling into a definite routine and that the medical staff were contemplating an expansion of the clinical research already undertaken. In collaboration with the Committee on Steroids and Cancer of the American Medical Association, Dr Ellison is pursuing a project on the treatment of advanced breast cancer by hormones. Hormones have also been used in a research manner in some cases of carcinoma of the uterus with disseminated metastases. Soon after the cobalt unit came into use in 1952 we decided to try its effect on recurrent carcinoma of the cervix. Unfortunately, the cases treated so far have not revealed too much in the way of encouraging results. Dr Hardie is taking a keen interest in this work and also in all aspects of malignant disease of the female genitalia. I have had in mind for some time that an Institute of this kind treating malignant disease should be more actively engaged in fundamental research where there can be a definite link or association with clinical and research work. The difficulty that arises is that if some organization doesn't offer financial support for this work it will die in its infancy.*" [1]

At the same meeting, the members of the Attending Staff passed a motion following a request from Dr Evans "*That members of the Attending Medical Staff, desiring to use the case histories of Cancer Institute patients in preparing any published paper, collaborate with members of the permanent medical staff of the Cancer Institute and that the publication be a joint one.*"

In a letter to Dr Rocke Robertson, Professor and Head of the Department of Surgery, UBC, in October 1956, Dr Evans raised the issue of research. "*I have thought for some time that the University of British Columbia should have a Committee on Cancer or Cancer Committee; a central body which could lead and guide a comprehensive research programme under the auspices of the University. I would feel that the Committee should be made up of a representative from the following departments; Surgery, Medicine, Paediatrics, Obstetrics and Gynaecology, Pathology, Bacteriology, Pharmacology, Physiology, Zoology, Biochemistry, Physics, Botany, Anatomy, the BC Medical Research Institute, the BC Cancer Institute and others that might be interested.*" The letter fell on deaf ears and no action was taken.

The Executive of the British Columbia Cancer Institute approved payment of the initiation fees and half the annual dues for one academic society for each of the radiotherapists in February 1959.

During the 1960s Dr Boyes published papers on the results of treatment of over 4,000 preclinical cervical cancer patients and on the development of the cervical screening programme in British Columbia. He traveled extensively to advise on screening and the setting up of cancer programmes. Dr Coy wrote on lung cancer and was active in the field both provincially and nationally. Dr Basco introduced the technique of lymphangiography and contributed to the national studies of radiation in Hodgkins Disease. Dr Goodman, in cooperation with the urologist, Dr JB Balfour, published on the results of treating bladder cancer.

Radiation Oncology Research and Development Group

In an attempt to stimulate research, Dr Jackson invited all radiation oncologists, biophysicists and physicists to join in forming a "Radiation Oncology Research and Development Group". The first meeting was held on 11th April 1978, and considered radiation sensitizers, superfractionation of rectal cancer, and tissue compensators. Dr C Fryer presented the final draft of a phase 1 study of the radiation sensitizer, misonidazole at a meeting the next year. The study was accepted and forwarded to the A. Maxwell Evans Clinic Clinical Investigation Committee and the University of British Columbia Human Experimentation Committee.

On May 6th 1982, Dr CM Ludgate reported on 42 patients included in a randomized trial of superfractionation for brain tumours, and Dr AD Flores reviewed 16 patients in the superfractionation trial of rectal cancer. The radiation sensitizer trial was experiencing difficulty in accrual, and its maintenance involved a tremendous amount of work. The superfractionation trials in brain and rectal cancer were proceeding and reported on again in February 1983. The initial misonidazole trial by then had been completed. The meeting concluded with a discussion of future radiobiological research summarized as follows: "*The major part of the meeting was devoted to an open discussion regarding possible future radiobiological research and its relation to clinical practice in radiotherapy in the Agency. Most interest was expressed in relation to investigating cell kinetics and biological effects of combined radiation and chemotherapy. The radiobiologists were particularly anxious that dedicated research time of at least one radiation oncologist be assured and, at the very least, close cooperation and interaction between the radiobiologists and radiotherapists was encouraged. It was confirmed that expertise and facilities were already available for undertaking extensive studies in this field.*"[2]

Much of the radiobiological, physics and clinical research involved with the TRIUMF project is alluded to in a later section of this chapter.

To promote research a policy of providing a half–day per week of protected time for the radiation oncologists was introduced in 1987.

Drs Peggy Olive and Ralph Durand of the Medical Biophysics Department of the BC Cancer Research Centre developed the comet assay in the late 1980s. Single cells from tumours were embedded in agarose on a microscope slide, proteins were removed, and remaining DNA was exposed briefly to an electric current to draw the negatively charged molecules away from the larger fragments.

The fraction of DNA able to migrate was found to be directly dependent on the size of the DNA. This method allowed detection of DNA damage present in individual cells, and was ideal in many respects for examining the heterogeneity associated with solid tumours. The amount of DNA able to migrate away from the nucleus during electrophoresis is proportional to the number of DNA breaks. After irradiation about 3 times more strand breaks are

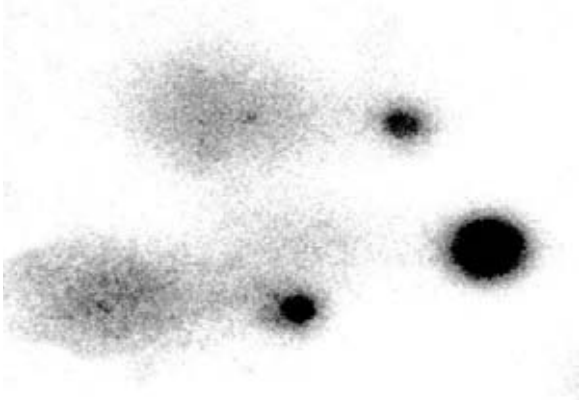


Fig 103. The Comet Assay. Allows the detection of radiation-resistant hypoxic tumour cells in fine needle aspirate biopsies. This figure shows two well-oxygenated tumour cells situated above and below a hypoxic tumour cell.

produced in well-oxygenated than hypoxic cells.

Application of this method to more than 100 fine needle aspirates from a variety of tumour types revealed a wide range of hypoxic fractions in individual tumours with an average of about 15%. By 1991 the method had been shown to be a useful measure of tumor growth fraction and hypoxic fraction in mouse tumour models, and was ready to be tested in the clinic. In collaboration with Dr Jackson, the first clinical comet studies were performed and results were published in 1993.[3,4] Measurement of tumour hypoxia using this method provided the first evidence that radiobiologically hypoxic cells were present (often in large percentages) in many human tumours. However, the Eppendorf oxygen microelectrode had become the established method to measure tumour oxygenation. When Dr Aquino-Parsons performed a comparsion between these methods, good agreement was found, and tumours considered hypoxic based on oxygen electrode measurements were found to contain more than 20% hypoxic cells when measured using the comet assay.[5] Dr Aquino-Parsons went on to compare the comet assay with another method, hypoxia marker binding, using antibodies against pimonidazole that formed adducts only in hypoxic cells. Again a good correlation was observed, and results provided a solid basis for interpreting levels of pimonidazole antibody binding in human tumours.[6] Meanwhile, as hypoxia had become recognized as an important indicator of tumour aggressiveness and propensity to metastasize, efforts were underway to develop endogenous markers of hypoxia that might eliminate the need for electrodes and markers. Dr Aquino-Parsons with Dr Olive compared binding of a cell surface enzyme, CA9, known to be up-regulated under hypoxic conditions, to binding of the hypoxia marker pimonidazole in 18 patients with cervical cancer.[7] Excellent agreement was observed suggesting that in this tumour site at least, CA9 measured in paraffin-embedded tumour sections could provide an adequate indication of hypoxic status.

Several radiotherapy fellows were involved in studies using the comet assay. Dr Roy Ma examined conventional 2 Gy doses in an effort to improve the sensitivity of the comet assay.[8] Dr Trotter compared hypoxic fractions from multiple fine needle aspirations (FNA) from the same tumour and found that a single FNA was representative.[9] Based on Dr Pickles' earlier work, Dr McLaren examined nicotinamide, a vitamin B6 analogue thought to improve tumour blood flow. Nicotinamide was found to be effective in reducing hypoxic fraction.[10] Dr Partridge reported that breathing high oxygen content gases also reduced tumour hypoxia. [11]

Another area of common interest between the BCCA Radiation Oncologists and the Medical Biophysics Department members was the question of tumour growth kinetics, and particularly, accelerated repopulation. With the help of a radiation oncology fellow, Dr Sham, Dr Durand developed and validated an improved technique for measuring tumour cell doubling time in situ with only a single biopsy.[12] When applied to human tumours transplanted into immunocompromised mice, it was found that aggressive tumours could even continue to grow during therapy,[13],[14] indicating that this is a factor to be considered for improving outcomes. These studies were extended in a clinical protocol where Drs Aquino-Parsons and Durand assessed tumour aggressiveness by obtaining sequential biopsies during treatment, finding that a small but significant proportion of tumours contained cell subpopulations that proliferated even during therapy. [15] Early identification of these "problem" tumours has obvious implications for individualizing treatment. They also studied reasons for unusual tumour growth kinetics, and identified non-constant blood flow and lifetimes of oxygen deprived tumour cells as major players. [16],[17] Their ongoing studies will amplify the extent and significance of these observations in patients undergoing radiotherapy.

Peer Reviewed Papers and Randomized Trials

Since the inception of the Agency in 1974, members of the Radiation Oncology Division have been first or second author in 345 peer reviewed papers. A full list of papers published by the members is available in the Bibliography appendix. Only the staff's involvement in randomized trials will be highlighted here. There have been 12 randomized controlled trials authored by staff radiation oncologists over the years.

In the mid 1960s, Dr Peter Coy carried out the first randomized trial involving 194 lung cancer patients. The randomization was between cobalt irradiation given twice a week alone or with intravenous vinblastine half an hour prior to cobalt treatments 1,3,5 and 7. The radiation consisted of 500 rads for each of the eight fractions to a total dose of 4,000 rads. There was no difference in survival at two years. Two patients receiving cobalt alone developed radiation myelitis, a consequence of the unusual fractionation and dose used.[18]

Dr Coy was the lead author in the Canadian Multicenter Trial published in 1988 [19] that investigated the effect of the dose of thoracic irradiation on recurrence in patients with limited stage small cell lung cancer.

In 1977, Dr Jackson proposed a trial to test the need for radiotherapy in post-mastectomy patients who were to receive chemotherapy. With the support of Dr Ian Plenderleith and Dr Joseph Ragaz in Medical Oncology the trial was initiated in 1978. [20] The trial was enthusiastically promoted by Dr Ragaz and strongly supported by radiation oncologists in Vancouver and Victoria. In Vancouver, Drs Clive Grafton, Mohammed Manji and Vivien Basco treated most of the patients. The trial was reported in the New England Journal of Medicine alongside a Danish trial that examined a closely similar question. These two studies received widespread attention since both found evidence for improved survival in the patients who received radiotherapy.

Drs Ed Kostashuk and Ethan Laukkanen were the radiation oncologists in a trial assessing the safety and efficacy of photodynamic therapy in the palliative radiotherapy of inoperable obstructive non small-cell lung cancer. [21]

Dr Charles Ludgate reported on the results of superfractionated radiation treatment in grade 3 and 4 intracranial gliomas in 1988. [22] Seventy-six patients were randomized to receive whole brain irradiation followed by a 10Gy boost to the primary site. Thirty-four patients received standard daily treatment to 40Gy and 42 received superfractionated radiation treated three times a day to a total dose of 47.6Gy. No difference in 5 year survival was found. Early adverse reactions were greater, whereas late reactions were less for superfractionated patients.

In the early 1990s, Dr Frances Wong was involved in two trials with the dentist Dr Joel Epstein. These involved investigating the effect of topical bleomycin on oral leukoplakia and the efficacy of sucralfate in the prevention of radiation induced mucositis. [23][24] Leukoplakia was reduced but the sucralfate did not prevent the development of oral mucositis, although it was thought to have delayed the onset of pain associated with it.

Arising out of a suggestion by Dr Ludgate, that aspirin might reduce the way in which radiation affects small blood vessels, a randomized trial in the radiation treatment of the conserved breast was undertaken. [25] One hundred and eighty six women were randomized to receive either acetylsalicylic acid (ASA) or placebo for one year. No effect of ASA was found on acute or late effects of radiotherapy, cosmetic outcome, as assessed by the patient or the physician, or on the rates of breast recurrence.

In a second paper this cohort of women, who had received breast radiation in the short overall time prescription of 44Gy in 16 daily fractions in three and a half weeks, was found to have an actuarial breast recurrence at 5 years of 6% and acceptable cosmetic outcomes. [26] Ninety-six percent of the patients reported a good or excellent cosmetic result.

In June 1989 debate began in the department about accelerated radiation and how it might be tested in head and neck cancer. This came in response to the proposition that accelerated repopulation might be avoided if the overall treatment time was kept to 3-4 weeks. In an attempt to limit the variables to one of overall time, the trial compared the outcome of 82 patients with stage III or IV head and neck cancer randomized to receive a dose of 66Gy in 33 fractions given once or twice daily, in an overall time of 6.5 weeks or 3.5 weeks. [27] A slight improvement in local control in those receiving accelerated radiotherapy was offset by an expected increase in acute reactions and an unexpected increase in late effects, particularly post surgical complications for those undergoing salvage surgery. The data from the trial has been submitted to a meta analysis reviewing a wide range of altered fractionation treatments that have been used in head and neck cancer across the world.

The randomized trials involving pions compared to photons in brain and prostate cancer, arising out of the TRIUMF project, are described in a later section of this chapter. In the last year of the century, Dr Graeme Duncan reported a quality of life assessment undertaken in the prostate trial. [28]

The University and Teaching

Medical Student Teaching

Dr Frank Fairchild Wesbrook, a physician, appointed in March 1913 as the first President of the University of British Columbia, had, as a personal goal, the establishment of a school of medicine. [29] His wish, however, was not realized for a further four decades. By 1944, the British Columbia Medical Association, the Provincial Government and the University were actively discussing the establishment of a Faculty of Medicine. The same year also saw the appointment of Dr Norman AM MacKenzie as UBC President, an individual who strongly supported the creation of a University Medical School. In 1949, following some controversy over the location of the School and the availability of hospital beds, a compromise was reached, and the Faculty of Medicine was finally established at UBC. The first class of sixty students was admitted in September 1950. Dr H Rocke Robertson was appointed Professor and Head of the Department of Surgery on July 1st 1950.

The first reference to medical student teaching was a report by Dr Evans on October 19th 1955 that the staff was continuing its clinical instruction in malignant disease four times a week to third and fourth year medical students. There is no documentation on how many were instructed and for how long. Medical students in Gynaecology rotations came to the Gynaecology disposition and follow up clinics in the 1960s but otherwise the author

has found no further reference to student teaching until 1977. Beginning in the fall of 1977, third year students attended each Tuesday afternoon for four hours throughout the academic year. Commencing the following year, groups of 3 or 4 students attended each Monday, Tuesday and Friday, each for a period five weeks. At that time there was a keen interest in teaching medical students. The Division had also been asked to provide electives for students in their surgical rotation and seven week summer electives. In 1982 the number of groups each week was increased to four. By 1989, elective rotations of 4 weeks duration were provided for third year medical students.

Several future staff members were first attracted to radiotherapy through medical student teaching and especially the summer electives. Financial assistance for these electives came through bursaries and the A Maxwell Evans Scholarships. Dr Frances Wong was the first summer student followed soon after by Dr Ivo Olivotto. In 1984, Dr Wong produced a booklet for medical students designed to inform them of the possibilities and advantages of a career in radiation oncology.

Clinical skills teaching with examination of the breast in 2nd year had included radiation oncologists since the early 1980s. When this was moved into the first year in 1988 radiation oncologists were also involved as instructors in examination of the head and neck.

Beginning in 1996, the University introduced major changes in the medical school curriculum. The intent was to create a self-directed problem based learning approach similar to that in place at McMaster University. It would mean that all third year medical students would no longer spend time in Radiation Oncology. Staff regretted this change and felt it would be detrimental, not only by reducing the student's exposure to radiotherapy and cancer, but also by limiting the Staff's ability to attract good students to the specialty. [30]

Through the years medical student coordinators for the Division have included Drs Basco, Olivotto, Goddard and Duncan.

The Division of Radiation Oncology in the Department of Surgery UBC

Since the inception of the medical school, radiotherapists (now known as radiation oncologists) have been appointed as members of the Department of Surgery at UBC. It is most unusual for Radiation Oncology to be found within a University Department of Surgery. It is unique in Canada and may not occur elsewhere. So why the Department of Surgery?

A clue is found in a letter Dr Evans wrote in November 1947 to Dr Moffat in Winnipeg encouraging him to join the staff in Vancouver. In the letter Dr Evans refers to their mutual friend Dr George Saxton, a surgeon at VGH and one of 51 members of the Honorary Attending Staff at the Institute. The letter expressed Dr Evans's desire to have a therapy trained person on his staff, thus suggesting his wish to further separate from diagnostic radiology and indicating his close relationship with surgical friends.

In December, just a few weeks later, Dr Evans received a letter from Dr RA Seymour, the acting secretary of the Attending Staff of the Vancouver

General Hospital, "*the Board of Directors at a recent meeting appointed you to the Attending Staff of the Vancouver General Hospital for the year 1948 as Assistant in the Department of Surgery. The Board in directing me to advise you of this appointment, also requested me to point out that for any member of the Attending Staff the ethical requirements shall be those of the Royal College of Physicians and Surgeons of Canada.*" The Chief of the Department of Surgery, Dr TH Lennie wrote on December 29th to congratulate Dr Evans and reminded him "*that the By-Laws of the Hospital call for a 75% attendance at Clinical Meetings.*" Dr Evans replied on the 2nd January 1948 "*I accept this appointment with great pleasure and will do my utmost to fulfill these duties.*" [31]

In keeping with Dr Evans's appointment, the radiotherapists of the Institute became members of the VGH staff in the Department of Surgery. When the UBC Medical School was founded in 1950, the initial Medical Faculty was chosen from the staff of the Vancouver General Hospital which included Radiation Oncologists as members of the Department of Surgery.

In 1952 Dr Evans was invited to the Department of Surgery "Golf and Dinner" event at Quilchena Golf Club. The cost was $7.50!

Dr Evans prepared a brief for Dean of Medicine McCreary in September 1970 outlining the need for a Department of Radiotherapy within the Faculty of Medicine. The matter was tabled by the Faculty Council to await the outcome of the William's report (see Chapter 3). In late 1974, with discussions underway about establishing an Institute of Oncology in the University, the radiation oncologists felt it necessary to explore the possibility of the creation of a Division of Radiotherapy within the UBC Department of Surgery. At the request of the staff, Dr Gibson raised the matter with the then Head of the Department of Surgery, Dr Harrison, but they decided that no change was warranted at that time. When the matter of an Institute of Oncology was again raised in the spring of 1976, the staff reiterated the view that Radiation Oncology should preserve a separate identity. If this was not achieved as a Department of Radiation Oncology, then Division status within the Department of Surgery should be sought. With some concern about the expected delay in any decision being made about an Institute of Oncology, Dr Goodman proposed and Dr Coy seconded the following motion at the Radiotherapy Staff meeting on April 8th 1976, "*Radiation Oncology should seek a recognized position in the University as soon as possible*". Following further discussion at the same meeting, Dr Coy proposed and Dr Boyes seconded a motion that "*The Radiotherapy Staff should seek the establishment of a Division of Radiation Oncology within the Department of Surgery.*" [32] Both motions were passed unanimously. Dr Gibson was asked to approach the Professor of Surgery and the Director of the Agency on behalf of the Radiotherapy Staff. In August Dr Gibson reported that he had had a preliminary discussion with Dr Patterson, the incumbent Head of Surgery. In September Dr Basco replaced Dr Gibson as Acting Head of Radiation Oncology. Nothing further was achieved until the matter was raised again in March 1978.

Dr Jackson, appointed Head of the Division of Radiation Oncology for the Cancer Control Agency of BC in February 1977, established a committee with Dr Basco as chairperson, and Drs Fairey and Fryer as members, to investigate the relationship of Radiation Oncology to the University. Within the month, the committee recommended establishing the proposed Division within the Department of Surgery. Dr Jackson made formal application to Dr Patterson, now Professor and Head of the Department of Surgery and the Division was duly constituted. In time it had the largest membership of any of the divisions of the Department of Surgery, University of BC.

Three years later, at the request of Dr Patterson, a Division of Radiation Oncology was created in the Department of Surgery, Vancouver General Hospital.

Postgraduate Teaching

In 1959 the Institute began the training of two physicians in Radiotherapy. They were Dr David Boyes for a two year program and Dr Alan Macpherson for three years. Both of them were expected to spend a year in England. In support of Dr Boyes, who was already a specialist in Obstetrics and Gynaecology, Dr Evans told the Executive Committee of the BC Cancer Foundation, "*The Institute had the opportunity of training a first-class man and taking him on staff. Good radiotherapists are few in number and not many doctors take up radiotherapy as a career. The Institute could not afford to pass up this opportunity.*" [33] It was planned that when Dr Boyes' training period was over, he would come on staff at the Institute as a radiotherapist, taking a major interest in gynaecology and cytology. To undertake the training programme, the Institute set up two courses of lectures. One a series of 48 lectures in radiotherapy and allied subjects, 36 given by Institute staff and 12 by attending medical staff. The second was a series of physics lectures and laboratory sessions to be given by Dr Batho and his staff.

In 1961 Dr Evans reported that the Institute's 2 year course was recognized by the Examining Board of the Royal College of Physicians of London and the Royal College of Surgeons of England to sit the examination for the Diploma in Medical Radiotherapy, London. The Institute was also accepted by the Royal College of Physicians and Surgeons of Canada for which candidates could sit the specialty examination in Radiotherapy. Despite this claim, the Institute found it very difficult to attract residents. Dr Albino Flores came from Peru for training in 1968, and the first UBC graduate to be enrolled was Dr Randall Fairey in 1970. It was almost a decade later before the next UBC student was attracted to the specialty. However, in the last two decades of the century, the resident training program became highly acclaimed across the country, graduating 13 UBC Medical School alumni into Radiation Oncology. Of the 68 residents the programme trained, 25 have held staff appointments in the Agency at one time or another. The full list of residents forms an appendix to this chapter. Program Directors included Drs Jackson, Kostashuk, Fairey, Duncan, Rheaume and Sheehan.

Dr Gibson indicated his intention to create an Education Committee in February 1976 to deal with matters relating to the training of radiation oncology residents and radiotherapy technicians. The Committee comprised the Programme Director, two members of the radiotherapy staff and a radiotherapy resident. It would concern itself primarily with post-graduate education in Radiation Oncology, but also make recommendations for undergraduate teaching of radiation oncology and be involved in the training of radiation therapy technicians. In September Dr Basco, now acting Head of the Department, invited Dr Fairey to be the staff member responsible for the development and instigation of an educational programme for the residents. The Clinical Oncology course for residents in 1978-79 included lectures given from 8-9am Monday through Thursday involving a co-coordinated course of pathology, general oncology, radiation and medical oncology. Plans were being considered to provide living in quarters while the residents were on call.

Efforts to attract new residents were beginning to be successful. Residents could be expected to rotate through all site teams of radiotherapists at least twice during their training. There were formal lectures and tutorials in physics and radiobiology and the residents were encouraged to undertake research projects in clinical subjects or in conjunction with Physics or BC Cancer Research Centre staff.

The Annual Radiobiology Course

Following discussions between Dr Jackson and Dr Janet Rasey in Seattle, an annual course to help prepare residents for their Canadian Fellowship and American Boards was established. The format was to bring a respected radiobiologist to join with residents from British Columbia, Washington State and Alberta and the host staff, in lectures, discussion and social intercourse. Although aimed primarily at final year residents those from other years also attended.

The first Radiobiology Course was held in Vancouver in April 1980 with residents from the three centres and Oregon. The course rotated annually thereafter through Seattle, Edmonton and Vancouver. Over the years many world-renowned radiobiologists were keynote attendees and speakers, including in Vancouver, Drs Eric Hall, Julia Denekamp, Jack Fowler, Rodney Withers and Richard Hill.

Residents Rounds

Starting in 1979 weekly Residents Rounds were held throughout the academic year. These required the residents to present their research in public and answer questions from the staff. The tradition carried through until 1997. Summaries of the presentations were collected and bound in an annual presentation that is available in the Vancouver Cancer Centre Library. It was circulated to the University Department of Surgery, the Research Centre and Agency senior medical staff. The experience gained in research and public presentation of their work may well have played a part in Vancouver residents being successful in the Canadian Association of Radiologists (CAR) and the Canadian Association of Radiation Oncologists (CARO) meetings.

In 1980 Dr HE Yeung received the Trillium Award from CAR and in 1983 Dr FL Wong was awarded the Oncology Resident Award from CAR. Vancouver

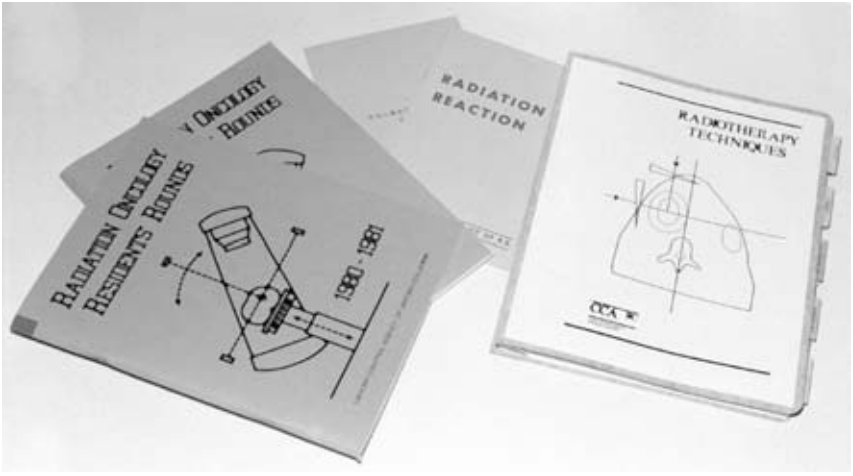


Fig 104. Examples of the yearly compilations of Radiation Oncology Residents Rounds, Radiation Reaction booklets for patients and the Radiotherapy Techniques Manual.

residents won the Canadian Association of Radiation Oncologists Resident Research Paper Award for each of the first seven years that it was awarded.

1987 Dr Glen Jones
Plaque radiotherapy for intraocular melanomas.

1988 Dr Marianne Mildenberger
Prophylactic brain irradiation: Biochemical and histochemical findings in a rat model: Acute,early and late radiation effects.

1989 Dr Michael McKenzie
The use of hyperbaric oxygen in the treatment of osteoradionecrosis of the mandible.

1990 Dr Christina Parsons
DNA content as a prognostic indicator in endometrial adenocarcinoma.

1991 Dr Christina Parsons
Hip prosthesis: An experimentally confirmed correction factor.

1992 Dr Shona Dougherty
Effects of alterations in the expression of endogenously-produced cytokines on the radiation sensitivity of tumour cells.

1993 Dr Shona Dougherty
Molecular mechanisms regulating cytokine-induced tumour cell radioresistance.

In February 1983, it became evident that, in future, residencies would run from mid-year to mid-year which would leave a hiatus between the end of the residency and the written and oral examinations of the Royal College in November and December [min327].

Dr Jackson was anxious to introduce a year of post residency training that would give the residents a further period of practical experience and would also cover a period for which he felt there should be some moral obligation in supporting residents up to the time of their taking examinations. This post residency period would also provide the opportunity to travel to other centres, or pursue a research topic leading to peer reviewed publications. At the time, there were serious funding problems, but the concept was welcomed. It was hoped that the timing of the examinations could be altered and that fellowships for residents who were prospective staff members could be funded either by the Agency or through external funding. [min340]

Residents' Day

The annual Residents' Day was introduced in 1986. The aim was to allow the residents to present research that they had undertaken during the year in a formal academic setting to the entire staff including physicists, radiobiologists, radiation therapists, nurses and others. Retired staff and representatives of the University and Agency administration were invited to attend. The presentations were judged on scientific merit, presentation and ability to answer questions with a clear understanding of the subject. In the evening a formal gathering of staff and their partners, residents and their partners and invited guests, including at different times, radiation therapists, physicists and researchers was arranged. The event was financed through the Radiation Oncology Amenities Fund and was held in a different location each year. These were chosen from a range of exotic Vancouver venues including the Law Courts, the Jack and Sadie Diamond Club at Simon Fraser University, the Vancouver Club, the Royal Vancouver Yacht Club, the Aquarium, the Rendezvous, Cecil Greene House, a Harbour Cruise, the University Botanical Gardens, the BC Pavilion and the Anthropology Museum.

The first Residents' Day in 1986, was held in the Board of Trade Room in the newly completed Pan

Pacific Hotel and was also used as an opportunity to recognize the ten years of service to the Division given by Win Searle as Office Manager and confidant to the Head and staff.

The monies which paid for the first prize came from a somewhat unusual source. Earlier in the year the Nutrition Department of the Vancouver Cancer Centre had arranged a weight loss exercise. Those who entered paid $10 and if they succeeded in losing 10 pounds they would share in the proceeds! Dr Basco and Dr Jackson were both successful and donated their winnings to provide the Residents' Day prize.

With the retirement of Dr Ellison the following year her friends donated over $800 as a retirement gift, which she most generously provided as an endowment to allow the prize to be awarded in perpetuity. The prize is recognized by the University of British Columbia and is listed in the UBC Awards & Financial Aid Guide as follows:

B.C. Cancer Agency Dr. Lucille Ellison Prize-In recognition of Dr. Lucille Ellison's long service to the B.C. Cancer Agency and her devoted care of many patients with breast cancer, an award has been established to provide a book prize for a resident in Radiation Oncology. The prize is awarded to the resident delivering the best presentation at the annual Residents' Day of the Division of Radiation Oncology, in the Department of Surgery.

The recipients of the annual award and their subjects are listed as follows

1986 Dr. Glen Jones
Au-198 Eye-plaque treatment of intraocular melanomas: The CCABC technique.

1987 Dr. Marianne Mildenberger
Neurotransmitter levels after whole brain irradiation in the rat: 1. Acute stage.

1988 Dr. Marianne Mildenberger
Prophylactic brain irradiation: Biochemical and histochemical findings in a rat model: Acute, early and late radiation effects.

1989 Dr. Victor Tsang
An analysis of mantle dosimetry

1990 Dr. Jim Morris
Prostatic adenocarcinoma: Results at 5 years.

1991 Dr. Victor Tsang
Estimation of testicular dose from phantom measurement in para-aortic and pelvic irradiation in the treatment of seminoma at BCCA.

1992 Dr. Victor Tsang
The effect of airspace in the path of an electron beam - specific reference to electron therapy in thyroid cancer.

1993 Dr. David Skarsgard
The use of positioning aids for prostate radiotherapy.

1994 Dr. Howard Joe
An estimation of dose and volume effects of high-dose radiation on pulmonary function.

1995 Dr. Howard Joe
An alternative to mixed photon and electron beams for the treatment of head and neck tumours.

1996 Dr. Scott Tyldesley
Hypoxic fraction in a multilayer cell culture

1997 Dr. Scott Tyldesley
Effects of debulking surgery on radiosensitivity, oxygen tension and kinetics in a mouse tumor model.

1998 Dr. Scott Tyldesley
Thalidomide inhibits the growth of Lewis lung metastasis in C57 mice.

1999 Dr. Corinne Doll
The influence of carbogen breathing on microvascular blood flow.

2000 Dr. Alan Nichol
Uncertainty in stereotactic radiotherapy and radiosurgery dose-volume histogram calculations.

Training of Radiation Therapists

A training programme for radiotherapy technicians was instituted in 1947. The student technicians were all graduate nurses. At the completion of a two-year course, candidates were eligible to sit the examination set by the Canadian Society of Radiological Technicians. For many years Miss Marge McBain acted as tutor in what was essentially an apprenticeship training program.

As the title of those charged with the delivery of radiation treatment to patients evolved from technician to technologist to radiation therapist, so did the training program.

Early in 1977, the radiotherapy medical staff was asked to give a series of lectures on Radiotherapy Principles and Techniques to the radiotherapy technicians in training. Anatomy lectures were given through the Vancouver General Hospital School of Nursing. The School had four students, all RNs, and was housed in a little room in the attic of the old BCCI house. Painted in four colours of purple, the room was adjacent to the maintenance staff's "penthouse". The course lasted two years and the students were paid minimum wage in the first year, and half wage in the second year. Payment to students ended in 1988. The tutor was Ann Johnson who spent about half of her time committed to the School. The School moved to a small room sandwiched between Linac 4 and the parkade with completion of the 1981 expansion. In 1983, Sharon Davies succeeded Ann Johnson and in the mid 1980's the requirement for RN qualifications was dropped.

Dr Jackson wrote to Brian Schmidt, Chief Operating Officer, in June 1989, with a request to increase the number of students to eight and expand the program to 31 months. He also wanted the program to be based at the A. Maxwell Evans Clinic and housed in the South West expansion. An additional clinical instructor was also suggested, with a further instructor requested to be in place at the time the expansion was completed. He also requested that there be one instructor for each of the Agency's clinics to assist in training.

In March 1990 Dr Jackson met with: G Eisler, Dean, School of Health Sciences, British Columbia Institute of Technology (BCIT); Robin Ciceri, Director, Lower Mainland Colleges, Ministry of Advanced Education, Training & Technology; Vickie Farrally, Director, Health Economics and Planning, MOH and R Hutchison, Senior Medical Consultant, Hospital Programs, MOH. The Radiation Technologist Training program was discussed and the need for both increased enrollment and the need to hire additional staff stressed. Dr Jackson subsequently wrote to Dean Eisler with a copy of those portions of the syllabus that might fall under the purview of BCIT. The Agency planned a comprehensive recruitment campaign for students and hired Sigma Evaluation & Training Resources to plan recruitment of eight students for September 1990. In July the School was fully accredited by the Canadian Medical Association for an enrollment of eight students per year.

Sandra Perry took over as head of the program in 1987. In keeping with Agency practice her title changed several times over the next decade. Sandra Perry was the driving force behind the success of the School as it expanded and developed during the last years of the century. The School's complement of eight students moved to its new quarters at the South West corner of the new Vancouver Clinic building, behind the two new accelerators and above the John Jambor room. Laura Bushell was the first tutor to join the programme in its new location. The prerequisites for entry into the programme progressively increased from High School graduation, including Grade 12 in English, Mathematics and

Physics, to completion of first year University, to completion of second year, always with some experience as a volunteer or otherwise in Health Care. By the end of the decade, many applicants already had a University degree prior to being accepted into the program.

Sandra Perry strongly believed in the School and set very high standards for herself, and demanded the same high standards from her students and faculty. She was always prepared to defend a student and get to the root of any student's problems. The success of the School is evident by the excellence of the radiation therapists it produced and the success of students in national examinations as well as the awards won with their research projects. No student failed the final exam and indeed, on seven occasions between 1989 and 1998, students won the annual Mallinckrodt Award given to the student with the highest aggregate mark in the radiation therapy national certification examination. The winners were Patricia Kalley, Paul Yokoyama, Kristine Savage, Kim Evans, Jana Carter, Leigh Barrett and Hardeep Sahota.

The students were expected to undertake research projects, some of which were of very high standard, on four occasions winning the BCAMRT 1st prize for Student Exhibits and twice the CAMRT Philips Rose Bowl. Two examples were "Radiation Therapy Treatment Planning, the Isocentric Compound Angle Treatment" by Patricia Kalley and Tracey Warner, and the 1999 Video "Camp Goodtimes". Stacey Fry and Debra Campbell with a Vancouver Film School student co-produced the video, at a fraction of commercial cost, which has since been used by the Canadian Cancer Society for information and fund raising.

The Canadian Association of Medical Radiation Technologists (CAMRT) voted at its AGM in 1996 that, by the year 2005, all technologists/therapists would need to graduate with a college level degree for entry into practice. Those students who do not graduate from a degree granting program will not be allowed to sit the national certification examinations. In 1996 the advisory committee to the School was reconstituted with a more proactive mandate in areas such as curriculum development, educational objectives with broader representation and more active student participation.

At the turn of the century, enrollment had increased to thirteen with students paying $3,000 tuition fees, and plans to move the program to BCIT were well advanced, in preparation for establishing the required degree granting program.

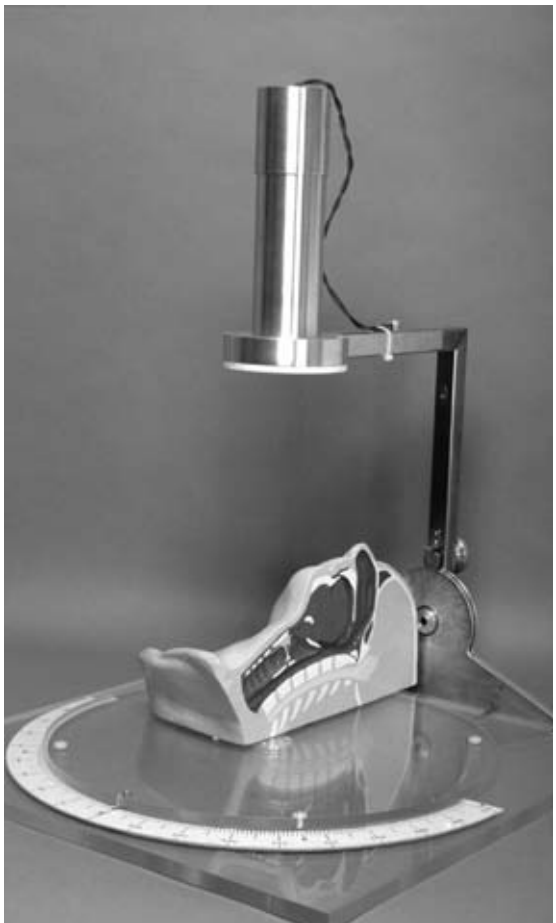


Fig 105. BCAMRT Students Exhibit 1st prize."Radiation Therapy Treatment Planning, the Isocentric Compound Angle Treatment", Patricia Kalley and Tracey Warner.

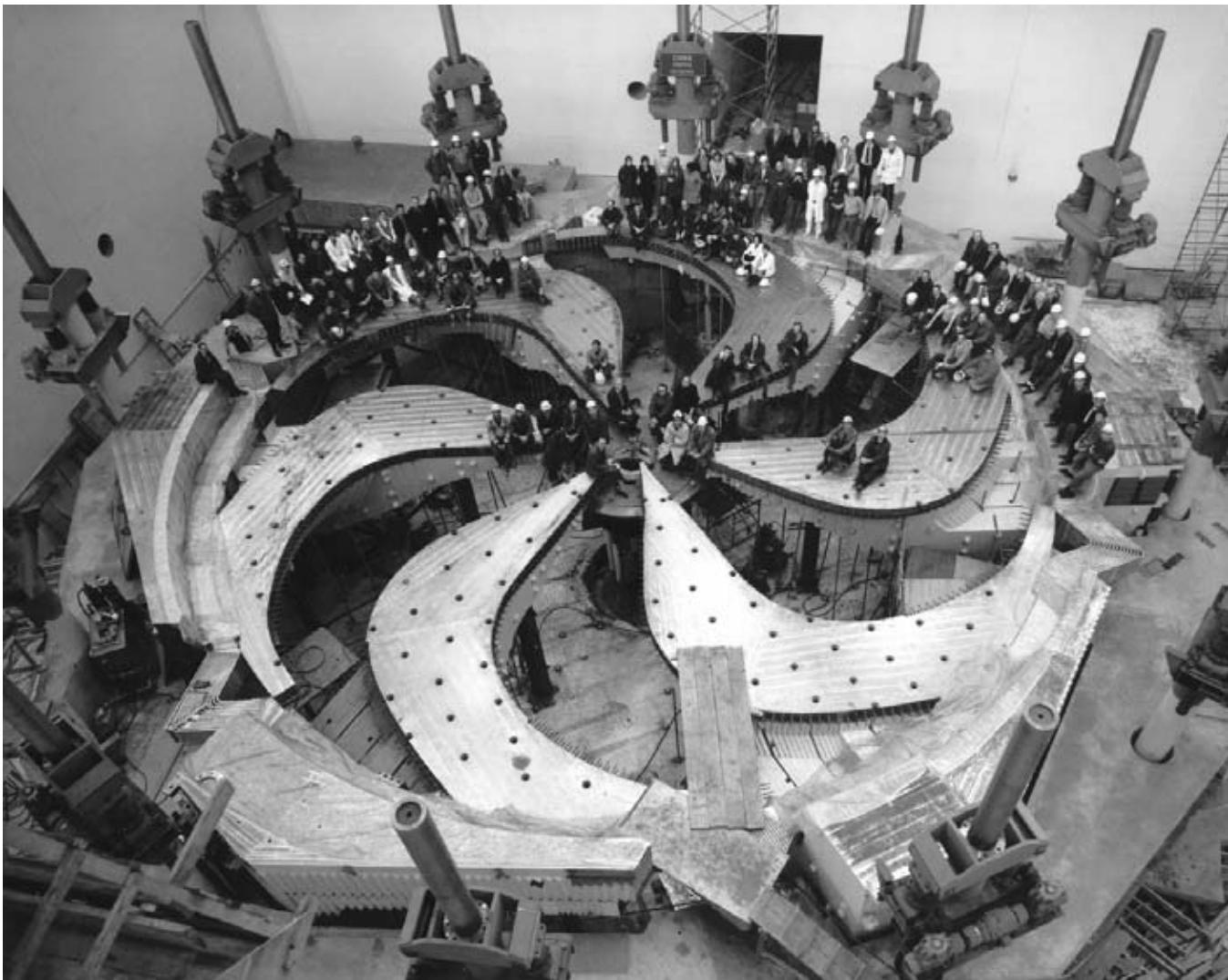
TRIUMF Tri University Meson Facility

The planning of TRIUMF (Tri-University Meson Facility) began in 1965 as a joint project of the University of British Columbia, Simon Fraser University and the University of Victoria, joined later by the University of Alberta.

The construction of the accelerator was assured in April 1968 when an agreement was signed between the four universities and the Atomic Energy Control Board of Canada. $4.5 million was provided by the four universities and $23 million by the AECB, which also agreed to an annual grant of $4 million for the operation of the accelerator.

The UBC physicist in charge of TRIUMF, Dr JB Warren, suggested that a room could be built along the path of the proton beam where mesons could be channeled off into a facility for treating patients. For TRIUMF this was an attractive feature. The prospect of improved treatment for cancer added to an eru-

Fig 106. The TRIUMF cyclotron under construction.



dite Physics Laboratory brought with it more public attention. It would appeal to politicians and those holding the purse strings.

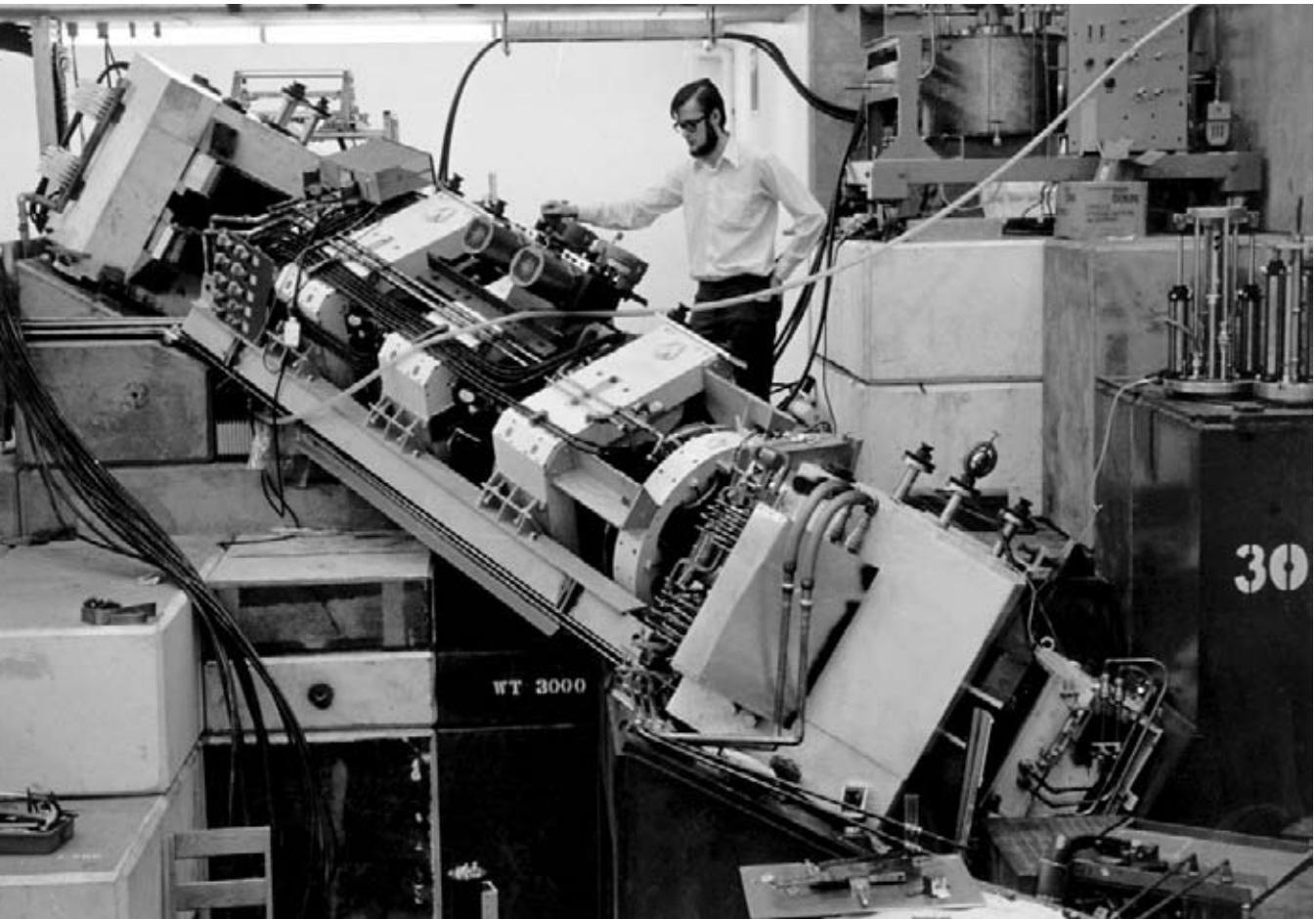
When the prospect of pion (pi meson) therapy was suggested to the British Columbia Cancer Institute (BCCI) and the British Columbia Cancer Treatment and Research Foundation (BCCTRF) it was hard to resist. Here was a facility unique to cancer treatment, one of only three in the world with the pion energy and accessibility to treat patients. The physical characteristics of the pion beam in which energy is deposited in the form of a Bragg peak, and is associated with higher Relative Biological Effectiveness (RBE) and lower Oxygen Enhancement Ratio (OER), gave some expectation that pions should be a better radiation treatment than more conventional beams.

So, without any real appreciation of the magnitude of the exercise to bring pions to the patient in an effective and practical manner, the challenge was accepted.

In March 1969, the National Cancer Institute of Canada granted $16,000 to the BCCI to support a feasibility study of pi-meson radiotherapy. In the spring of 1970 the BCCTRF committed $382,000 matched by the provincial government to allow inclusion of a Biomedical Facility in the overall plans for TRIUMF.

The Biomedical Laboratories at TRIUMF were later named the Batho Biomedical Building in memory of Harold Batho. After many years as senior physicist at the BCCI he moved to TRIUMF in 1968 to be involved in the early physics work, but sadly

Fig 107. Dr Mark Henkleman, physicist, stands by the pion beam.



died in June 1974 before he had chance to see the facility opened and the first treatments given.

Construction of the buildings began in 1969 and was completed in 1971. The accelerator, a sector-focusing cyclotron with its proton and meson beams was completed in 1974. The first full energy beam was obtained on December 13th, and the Facility was officially opened the following year by Prime Minister Pierre Trudeau. The TRIUMF facility was the only one of three negative pi-meson facilities in the world to complete randomized clinical trials.

It was soon recognized that there would be a need for radiobiological and biophysics support and pre-clinical research, in addition to the accelerator and the treatment room at TRIUMF.

The BCCTRF established a Biophysics Department under the direction of Dr Lloyd Skarsgard and provided space by purchasing the old McGavins Bakery on the north side of 10th avenue in June 1972 for $850,000.

The Foundation later sold the portion of the McGavins property facing on to Broadway, keeping the part south of the lane.

Dr Skarsgard was joined by Dr Connie Gregory (Eaves), Dr Branko Palcic and Dr Mark Henkleman. Although they were supported by research grants from NCIC and NRC, the Foundation still had to maintain the building, provide the furnishings, supplemental salaries and computer equipment for TRIUMF a well as an annual budget for Radiobiology and Biophysics.

With the creation of, and change of name to the Cancer Control Agency of BC in late 1974, the BCCTRF reverted to its original title of BCCF and concentrated on its responsibility to the TRIUMF project. The Minister of National Health and Welfare designated the Radiobiology-Radiotherapy Facility of TRIUMF as a "Project of National Significance".

Fig 108. Prime Minister Pierre Elliot Trudeau at the official opening of TRIUMF in 1975.

Preclinical Research

In preparation for the clinical use of pions, the words of Dr R Stone in 1948 were heeded: "*anyone contemplating the use on patients of new radiations… should study the relative biological effectiveness (RBE) of them by late reactions as well as acute early ones*". [34] With these words in mind, it was planned to progress through in-vitro culture irradiations to in-vivo mouse skin RBE assessments to be confirmed later in pig skin and phase 1 human skin studies. The initial tissue culture experiments involved a technique of suspending clonogenic cells in a gel that could be placed within a tube and irradiated longitudinally to replicate the spread out Bragg peak (SOBP).[35]

These experiments suggested an average RBE for pions of 1.4 with reference to 270KV x-rays. Subsequent experiments with murine skin suggested an RBE of 1.5 for clinical use fraction sizes under 4Gy[36].

Fig 109. Three members of the team responsible for preclinical research.
Left to right, Drs John Probert, Connie Gregory (Eaves) and Bruce Douglas.

Dr BG Douglas 1938-

Born in Indian Head Saskatchewan he obtained BSc in Engineering Physics from the University of Toronto in 1961 and MD from the University of Western Ontario in 1967. He interned at the Vancouver General Hospital and was resident in Radiotherapy at the BCCI from 1970 to 1973. He obtained the FRCPC in January 1974 and was Shane fellow for six months in 1974 with Dr JF Fowler at the Gray Lab, Northwood, England. He was a Radiation Oncologist specializing in brain tumours and pre clinical research at TRIUMF from 1974-1981.

In the Tripartite agreement of October 1974, (see chapter 3) the Agency was to provide the equivalent of 1 full-time radiotherapist for "work with TRIUMF preparation." At the outset, the Agency fulfilled this commitment by appointing Dr Probert and Dr Douglas, each of whom was to spend half time on the TRIUMF program: Dr Probert undertook responsibility for the pig studies at TRIUMF and Dr Douglas was responsible for many of the mouse studies. When Dr Douglas resigned from clinical radiotherapy in 1981 arrangements were made for him to continue with his research at the BCCF as principal Investigator on the NCI research grant which supported the TRIUMF Animal Radiobiology Program. He left radiobiology research to go into general practice in 1984.

Dr Douglas notified the Radiation Oncology Research and Development Group in November 1978 and January 1979 of preclinical mouse and pig experiments proposed for the coming year. Dr Douglas radiated 50 pigs in total in order to assess RBE. The late reaction was observed between 2.5 and 4.5 months. Both early and late RBE appeared to be similar at 1.45[37].

In preparation for future clinical studies, Dr Probert and Dr Douglas proposed in April 1975 the treatment of metastatic nodules by pions and conventional therapy to assess and compare skin

Fig 110. The first patient to receive pions, an elderly lady with multiple subcutaneous lymphomatous nodules. The 3.5cm field was positioned through a viewing mirror in the applicator.

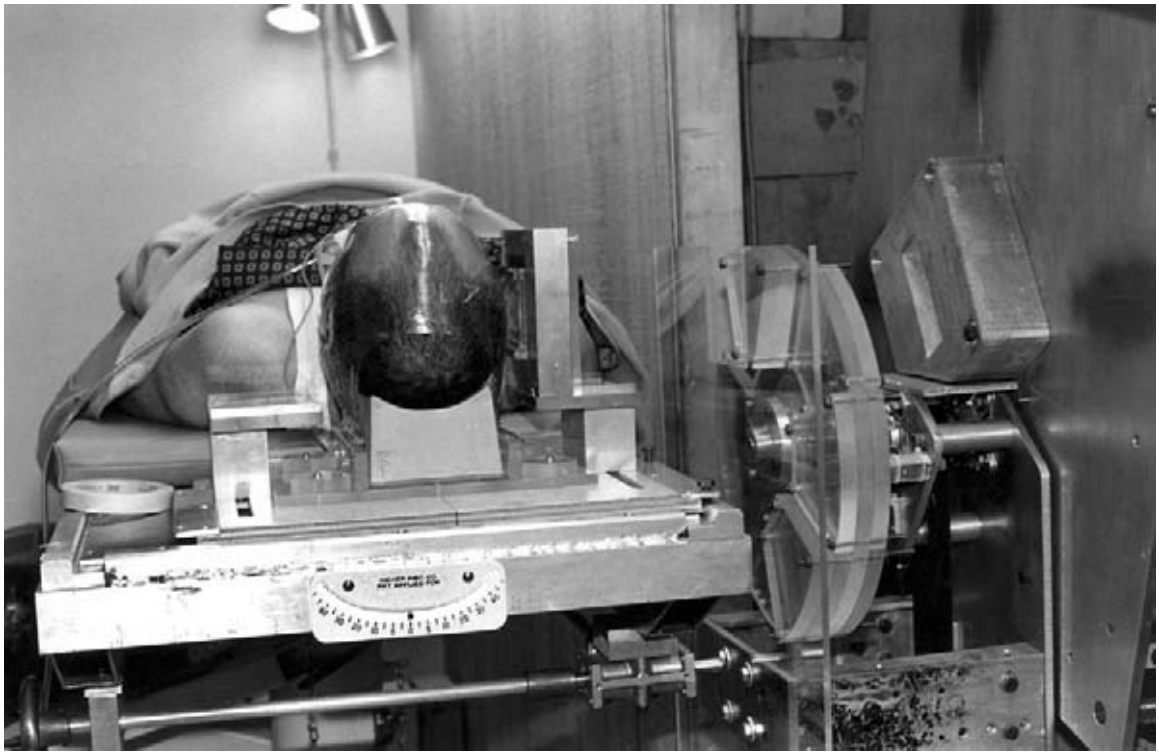


Fig 111. The range shifter was designed to spread out the Bragg peak of the pion beam to provide a useful clinical beam.

reactions. In July 1979 results from animal studies with pions were reported and it was agreed that the initial patients should, if possible, receive one pion field and three X-ray fields and that an RBE of 1.5 be used to calculate the pion dose.

In order to produce a Bragg peak suitable for treatment of a tumour volume, a range shifter had to be introduced into the beamline.

This was done by the use of a circular disk of Perspex milled to varying thicknesses inserted into the beamline and rotated rapidly so that the beam was modulated through several different ranges.

The result was a spread out Bragg peak (SOBP) adequate to cover a desired treatment volume. [38] The RBE varies across the SOBP, which must be shaped to make the effective RBE uniform across the treatment volume.

First Human Treatments

The initial human pion treatments were reported on November 20th 1979, at a meeting of the Radiation Oncology Research and Development Group. The first two patients had completed pion and X-ray therapy to subcutaneous tumour deposits. The initial impression was that the RBE of pions for skin might be less than the 1.5 predicted. These treatments used an applicator with a viewing window to enable the 3.5 cm circular treatment field to be positioned.

At the meeting on February 7th 1980 it was mentioned that human skin nodule experiments would resume in March.

Dr Jackson and Dr Goodman reported on the early skin reactions. It was expected that it would be at least two years before TRIUMF could provide a dose rate that would be sufficient to treat pelvic tumours of 1 litre volume. Dr RO Kornelsen, Head of Physics, described the advantages of a scanning beam and the necessity to develop a computerized couch with motorized movements in three dimensions to properly conduct scanning beam therapy. A unique treatment couch was developed by TRIUMF staff enabling the small fixed field to provide sufficient pion output as the couch moved through up to

Fig 112. The TRIUMF clinical team. From L to R standing Drs R Harrison, Y Takai, G Goodman and L Skarsgaard, seated L to R Drs R Kornelsen, G Lam and TRIUMF Director Erich Vogt.

Fig 113. The computerized couch designed and built by TRIUMF personnel to allow accurate positioning of the patient in relation to the fixed horizontal and angled beam.

32 separate positions and provide a uniform dose to treatment volumes up to 1 litre in size.

By early 1982 the RBE for skin nodules was now put at 1.45. A brain boost treatment with pions was set to start in May with a clinically conservative RBE of 1.6. The preliminary results of the first eight patients treated with this brain boost suggested an RBE for acute effects of 1.5. By February 1983, patients with pelvic tumours could now be treated by pions to a volume of 750cc encompassing the 90% isodose line.

The problems associated with the delivery of pions at TRIUMF led to some most innovative solutions enabling their effective clinical use. The low dose rate led to the development of scanning treatment that required the unique treatment couch. It also resulted in treatment times for pelvic tumours of 30-45 minutes.

The couch also overcame the limitations of the fixed beam, positioned some five feet above the treatment room floor. The prolonged treatment time required immobilization devices that could maintain position over much longer times than were usual in normal clinical practice.

The couch built by TRIUMF staff was fully automated under computer control. For pelvic tumours, the fixed beam, and the need to deliver anterior-posterior parallel opposed fields to avoid treatment through the hips, meant that the patient had to lie on the side for the prolonged treatment time.

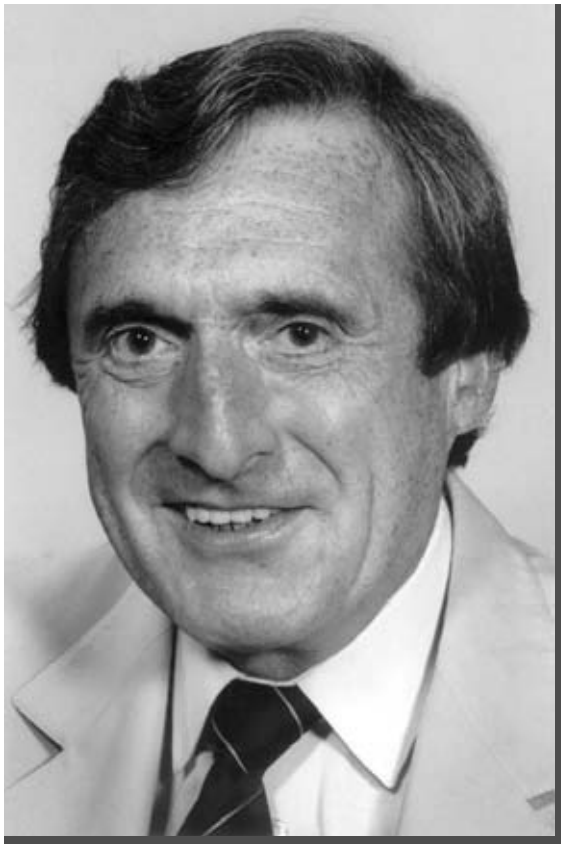
The beam at TRIUMF was available for only 6 months of the year, in two three month periods, limiting the number of patients who could be treated over extended time periods. Since there would be little advantage to a lower daily fraction size using pions, it was elected to treat patients over 15 fractions given 5 days a week from Thursday through Monday to allow maximum patient recruitment.

Preparation for Randomized Trials

In preparing for randomized clinical studies of glioblastoma and prostate cancer, dose escalation studies were carried out in the 1980s. Immobilisation of patients with pelvic tumours was achieved using a custom made urethane foam mould inside an individually constructed shell of rigid polyurethane, with the patient lying on their right side. Daily check films were taken and minor couch adjustments made. A mean displacement of 2.2mm was achieved confirming the accuracy of the method. [39] Dose escalation from 25Gyπ to 37.5Gyπ was carried out on 45 pelvic tumours with a fraction size of 2.5Gyπ treated daily five days a week. The clinical RBE in these patients was estimated as 1.5 compared to previous cobalt treatments for bladder cancer. A similar dose escalation study was undertaken for glioblastoma moving stepwise from 40Gy photon plus a 17.5Gyπ boost to 36Gyπ alone.

For the clinical run at TRIUMF from April 29th to June 20th 1983, treatments would run through the weekend. How to provide staffing created concern. It was hoped that Dr Goodman and the Administration would make every effort to obtain suitable fellowship staff to assist in the clinical research programme at TRIUMF.[min347] At the staff meeting in May the following motion was proposed by Dr Basco, seconded by Dr Fryer and approved unanimously, "*Whereas the Division of Radiation Oncology accepted responsibility for the clinical assessment of pi mesons in the treatment of patients with cancer, and whereas the commitment of CCABC to provide the equivalent of a full-time radiation oncologist for this research project is not at the present time fulfilled, and whereas it has not so far been possible to attract a fellow to work under Dr Goodman in this research, and whereas it has not been possible to attract an external radiation oncologist to cover these responsibilities on Saturdays and/or Sundays at a sessional fee, the current members of staff will accept responsibility for overseeing patients treated at TRIUMF as a temporary measure and on a volunteer basis, provided the Administration of the Agency also accepts their responsibility for staffing TRIUMF and are prepared to provide appropriate remuneration for those members of staff who volunteer to perform this function.*" [min353] Dr Jackson conveyed the motion to the Administration.

Strenuous efforts to find a suitable fellow were unsuccessful. The Agency's position was that the radiation oncologists assigned to duty at TRIUMF were not working outside their commitments to the Cancer Control Agency already covered by salary. The Agency did agree that TRIUMF should be separately staffed as a research project and that funds were available for this. The staff was unhappy but agreed to continue the temporary weekend cover. However, if they did not offer their services to the TRIUMF project it would almost certainly be forced to close.[min 364] In September, Dr HE Yeung, a recent resident and fellow, was appointed on a part-time basis to help Dr Goodman especially with weekend cover.



Dr GB Goodman 1926-

A graduate of the University of Edinburgh Dr George Goodman trained in Nottingham from 1951-1953 obtaining the DMRT. His training continued at the Christie Hospital in Manchester from 1953-1957 and The Western Infirmary in Glasgow before he came to Vancouver as Consultant Radiotherapist at the BCCI in 1958. He obtained the FRCPC in Therapeutic Radiology in 1961. Dr Goodman was Associate Director, BCCI from May 1971- Oct 1974, and Medical Director, A Maxwell Evans Clinic, CCABC from 1976-1981 and Deputy Director, Medicine from 1981-1986. Appointed Clinical Professor in The Department of Surgery UBC in 1982, he was named Head of the newly formed Section of Developmental Radiotherapy within the Division of Radiation Oncology in January 1986 and held this position until his retirement on July 9th 1991.

Dr Goodman was president of the Canadian Association of Radiologists for 1979-1980.

Dr Goodman was Chairman of the Committee in Radiation Oncology and Chairman, Board of Examiners in Radiation Oncology for the Royal College of Physicians and Surgeons of Canada.

He was awarded Honorary Fellowship in the Royal College of Radiologists (UK) in 1979.

Dr Goodman's particular clinical interest lay in genitourinary cancer and the clinical program at TRIUMF. He helped establish the Joint Urology clinic with Dr John Balfour in January 1959. He was director of the clinical programme at TRIUMF responsible for conducting randomized clinical trials in brain and prostate cancer. He was successful in attracting several capable and interesting Fellows to work in The Section of Developmental Radiotherapy.

Fig 114. Dr GB Goodman.

The Section of Developmental Radiotherapy

The Section was created in September 1985 within the Division of Radiation Oncology with Dr Goodman as Head effective January 1st 1986. This was done to strengthen the TRIUMF program as well as other research. The original intention was to include 1.5 radiation oncologists and the TRIUMF fellow.[min 616] Early in 1987 the one half-time position from within the staff was filled. The first TRIUMF fellow was Peter Dixon from the Christie Hospital in Manchester.

The creation of the Section was instrumental in allowing Dr Goodman, with the assistance of TRIUMF fellows drawn from various parts of the world, and the radiation oncologists of the Division, to undertake the only reported randomized clinical trials comparing pions and photons. Not only were the fellows of great help in conducting these studies, their enthusiasm and original ideas helped stimulate the department as a whole. Dr Goodman and the fellows had a special relationship which led to him giving each of them with whom he worked a parting gift which he hoped would be a lasting memento of their time in Vancouver. At the suggestion of the first fellow, Peter Dixon, they each received a suitably engraved carved totem pole by David Nahanee of the Squamish Nation.

The TRIUMF fellows and their city and/or country of origin, 1984-1994.

1984	Peter Dixon	Manchester UK
1985	Maeve Pomeroy	Dublin Ireland
1986	Frederik Vernimmen	South Africa
1987	Christopher Gaffney	Newcastle UK
1988	Dorianne Rheaume	Toronto
1990	Julie Bowen	Toronto
1990	Tom Pickles	London UK
1991	Mario Dimitrov	Bulgaria
1993	Peter Graham	Australia
1994	Isobel Syndikus	London UK

In cooperation with, and funding from the Japanese Government, five Japanese physicians participated in the TRIUMF programme; Yoshihiro Takai in 1990, Hiroki Shirato in 1986, Yasuhiro Ogawa in 1988, Taisuke Inomata in 1991 and Yukio Ohizumi in 1992.

Between 1989 and 1994, the Division attracted eight clinical fellows who provided the same stimulus to the clinical and research progress of the Division as had the TRIUMF Fellows. Two of these fellows, Dr Lorna Weir and Dr Brian Haylock, later accepted staff positions as had Drs Dorianne Rheaume, Julie Bowen and Tom Pickles from the TRIUMF program. The clinical fellows were;

1989	Geoff Newman
1990	Lorna Weir
1991	Brian Haylock
1991	CJ North
1993	Neil Wilson
1993	Yong-Chan Ahn
1993	Jerome Freund
1994	Yiquin Zhang

Following the closure of the TRIUMF experiment and the Section of Developmental Radiotherapy, a clinical fellowship programme under the stewardship of Dr Tom Pickles was established in Vancouver and included the following:

Duncan McLaren and Edward Sham, 1996; Nasser Al-Rhaji and Cai Grau, 1997; Juhu Kamra, 1998; Sarah Partridge and Gillian Campbell, 1999; Holly Campbell, Boon Chua and Joseph Bucci, 2000.

Pion Randomized Trials

Randomized studies involving pions began in 1988. The results were reported nine and eleven years later. The glioblastoma trial consisted of 84 patients randomized to receive either 60Gy photon irradiation in 30 fractions or 33-34.5Gyπ in 15 fractions in three weeks.[40] The lower dose was given when the treatment volume was greater than 500cc. There was no difference in acute or late toxicity or survival between the two groups. The prostate trial consisted of 217 patients with locally advanced disease randomized to receive either 66Gy in 33 fractions or pion radiation of 37.5Gyπ in 15 fractions in three weeks. In both arms there was a slight dose reduction if the planned treatment volume (PTV) exceeded 500cc. Acute bladder toxicity was higher in the pion arm but severe late toxicity was similar. The overall actuarial recurrence rates were the same in both arms. Prostate specific antigen (PSA) relapse was greater in the pion arm.[41]

With the completion of the last patient treatment in 1994, the pion program at TRIUMF ended. In view of the negative results of the randomized studies there are no plans to continue pion therapy. The program did, however, complete the only two randomized studies of pion therapy, and, just as significantly, brought energetic and intelligent young oncologists to Vancouver as fellows, and stimulated internationally acclaimed radiobiology, physics and clinical research.

Dr Chris Fryer was appointed Head of the Section when Dr Goodman retired in July 1991. The following year Dr Fryer left to be a full time paediatric oncologist and Dr Pickles was appointed to succeed him.

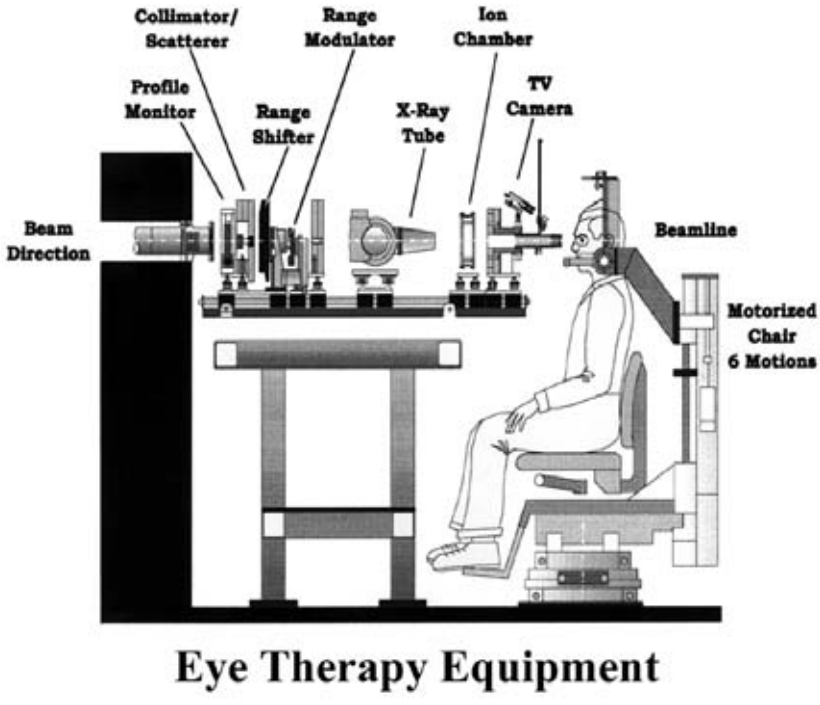


Fig 115. Schematic drawing of the proton eye treatment set up.

Protons

Plans for a proton therapy facility at TRIUMF were first raised in 1987, but were not acted upon due to funding difficulties.

In 1993, the BCCA gratefully accepted a $500,000 donation from the Mr and Mrs PA Woodward Foundation to develop a limited proton program.[38] Because of limitations of cost, space and beam availability it was decided to develop a low energy horizontal fixed beam for the treatment of choroidal melanomas. Two years were spent designing, building and commissioning the necessary equipment to monitor the beam and to provide suitable patient immobilization.

The first patient was treated in August 1995. Six patients were treated during 2000, bringing the total number of patients treated with protons at TRIUMF to 60. The fewer treatments each year reflected the decision to treat fewer of the larger tumours that have been shown to lead to more severe complications. The overall results continue to be encouraging with a 100% local control rate after 4 years of follow up and a serious complication rate, leading to enucleation or neovascular glaucoma of 16% at 4 years.[42]

Due to the limitations of a fixed beam and intermittent availability of the TRIUMF beam, development of a linear accelerator-based stereotactic treatment for arterio-venous malformations and other treatments that require extreme accuracy has been preferred.

Fig 116. The proton treatment room

References for Chapter 7

1. BC Cancer Institute. Report of the Director to the Honorary Attending Staff, 1955 Oct 19, Attending Medical Staff Minutes, 1939-1964. (BC Cancer Agency Archives)
2. Cancer Control Agency of BC, Radiation Oncology Research and Development Group Minutes, 1983 Feb 17. (BC Cancer Agency Radiation Therapy office)
3. Olive PL, LeRiche J, Jackson SM. Growth fraction of human tumors: assays and complications. Semin Radiat Oncol 1993;3(2):90-98.
4. Olive PL, Jackson SM, Durand RE. Predicting tumor response to radiotherapy using the comet assay. In: Paliwal BR, Kinsella TJ, Herbert D, Fowler J, editors. Prediction of response in radiation therapy - radiosensitivity and repopulation. Proceedings of the 4th International Conference on Time, Dose and Fractionation in Radiation Oncology; 1993 Sept 1619; Madison, Wisconsin; Woodbury, NY: American Institute of Physics; 1992. p. 65-77.
5. Aquino-Parsons C, Luo C, Vikse CM, Olive PL. Comparison between the comet assay and the oxygen microelectrode for measurement of tumour hypoxia. Radiother Oncol 1999; 51: 179-185.
6. Olive PL, Aquino-Parsons C. Measuring hypoxia in solid tumors: is there a gold standard? Acta Oncol [in press].
7. Olive PL, Aquino-Parsons C, MacPhail SH, Laio S-Y, Raleigh JA, Lerman MI, Stanbridge EJ Carbonic anhydrase 9 as an endogenous marker for hypoxic cells in cervical cancer. Cancer Res [in press].
8. Olive PL, Durand RE, Jackson SM, Le Riche JC, Luo C, Ma R, McLaren DB, Aquino-Parsons C, Thomson TA, Trotter T. The comet assay in clinical practice. Acta Oncol 1999; 38:839-844.
9. Olive PL, Trotter T, Banath JP, Jackson SM, LeRiche J. Heterogeneity in human tumour hypoxic fraction measured using the comet assay. Br J Cancer 1996;74(Suppl 27): S191-S195.
10. McLaren, DB, Pickles T, Thomson T, Olive PL. Impact of nicotinamide on human tumour hypoxic fraction measured using the comet assay. Radiother Oncol 1997; 45: 175-182.
11. Partridge SE, Aquino-Parsons C, Luo C, Green A, Olive PL. A pilot study comparing intratumoural oxygenation using the comet assay following 2.5% and 5% carbogen and 100% oxygen. Int J Radiat Oncol Biol Phys 2001;49: 575-580.
12. Sham E, Durand RE. Cell kinetics and repopulation mechanisms during multifraction irradiation of spheroids. Radiother Oncol 1998; 46:201-207.
13. Sham E, Durand RE. Repopulation characteristics and cell kinetic parameters resulting from multi-fraction irradiation of xenograft tumors in SCID mice. Int J Radiat Oncol Biol Phys 1999;43:617-622.
14. Sham E, Durand RE. Cell kinetics and repopulation parameters of irradiated xenograft tumours in SCID mice: comparison of two dose-fractionation regimens. Eur J Cancer 1999;35:850-858.
15. Durand RE, Aquino-Parsons C. Intermittent tumour blood flow; implications for therapy. Acta Oncol [in Press].
16. Durand RE, Aquino-Parsons C. The clinical relevance of intermittent tumour blood flow. Acta Oncol [in Press].
17. Durand RE, Sham E. The lifetime of hypoxic human tumor cells. Int J Radiat Oncol Biol Phys 1998;42:711-715.
18. Coy P. A Randomized study of irradiation and vinblastine in lung cancer. Cancer 1970;26(4)803-807.
19. Coy P, Hodson I, Payne DG, Evans WK, Feld R, MacDonald AS, Osoba D, Pater JL. The effect of dose of thoracic irradiation on recurrence in patients with limited stage small cell lung cancer. Initial results of a Canadian Multicenter Randomized Trial. Int J Radiat Oncol Biol Phys 1988;14(2):219-26.
20. Ragaz J, Jackson SM, Le N, Plenderleith IH, Spinelli JJ, Basco VE, Wilson KS, Knowling MA, Coppin CM, Paradis M, Coldman AJ, Olivotto IA. Adjuvant radiotherapy and chemotherapy in node-positive premenopausal women with breast cancer. N Engl J Med 1997;337(14): 956-62.

21. Lam S, Kostashuk EC, Coy EP, Laukkanen E, LeRiche JC, Mueller HA, Szasz IJ. A randomized comparative study of the safety and efficacy of photodynamic therapy using Photofrin II combined with palliative radiotherapy versus palliative radiotherapy alone in patients with inoperable obstructive non-small cell bronchogenic carcinoma. Photochem Photobiol 1987;46(5): 893-7.
22. Ludgate CM, Douglas BG, Dixon PF, Steinbok P, Jackson SM, Goodman GB. Superfractionated radiotherapy in grade III, IV intracranial gliomas. Int J Radiat Oncol Biol Phys 1988;15(5): 1091-5.
23. Epstein JB, Wong FL, Millner A, Le ND. Topical bleomycin treatment of oral leukoplakia: a randomized double-blind clinical trial. Head Neck 1994;16(6):539-44.
24. Epstein JB, Wong FL. The efficacy of sucralfate suspension in the prevention of oral mucositis due to radiation therapy. Int J Radiat Oncol Biol Phys 1994;28(3): 693-8.
25. Olivotto IA, Kim-Sing C, Bajdik CD, Trevisan CH, Ludgate CM, Weir LM, et al. Effect of acetylsalicylic acid on radiation and cosmetic results after conservative surgery for early breast cancer: a randomized trial. Radiother Oncol 1996; 41(1):1-6.
26. Olivotto IA, Weir LM, Kim-Sing C, Bajdik CD, Trevisan CH, Doll CM, et al. Late cosmetic results of short fractionation for breast conservation. Radiother Oncol 1996;41(1):7-13.
27. Jackson SM, Weir LM, Hay JH, Tsang VH, Durham JS. A randomised trial of accelerated versus conventional radiotherapy in head and neck cancer. Radiother Oncol 1997;43(1):39-46.
28. Duncan GG, Philips N, Pickles T. Report on the quality of life analysis from the phase III trial of pion versus photon radiotherapy in locally advanced prostate cancer. Eur J Cancer 2000;36(6):759-65.
29. Westbrook FF. (UBC Library, Special Collections, Faculty of Medicine 1913 Series 1, Box 1)
30. BC Cancer Agency, Vancouver Cancer Centre Radiotherapy Staff Minutes 1995 Sep 11. (BC Cancer Agency Archives)
31. Evans AM. Personal Correspondence 1948. (BC Cancer Agency Archives)
32. Cancer Control Agency of British Columbia, Radiotherapy Staff Minutes 1974-1978. (BC Cancer Agency Archives)
33. BC Cancer Foundation, Executive Committee Minutes, Vol V111 1959 Sept 22.
(From March 1979 to June 1992 the Radiotherapy Staff Meeting Minutes were referenced numerically and in the text are marked [min##])
34. Stone RS. Neutron therapy and specific ionization. Am J Roentgenol 1948;59,771-785.
35. Skarsgard LD, Palcic B, Lam GKY. RBE mapping in pion beams using the gel technique. In: Skarsgard LD, editor. Pion heavy ion radiotherapy: pre-clinical an clinical studies. International workshop on pion and heavy ion radiotherapy: pre-clinical and clinical studies; 1981 July 29-31; Vancouver, B.C. New York: Elsevier Biomedical; 1983. p. 197-209.
36. Lam GK, Henkelman RM, Douglas BG, Eaves CJ. Dose dependence of pion RBE values for mouse foot skin reactions. Int J Radiat Oncol Biol Phys 1981;7:1689-94.
37. Douglas BG, Grulkey WR, Chaplin DJ, Lam G, Skarsgard LD, Denekamp J. Pions and pig skin: preclinical evaluation of RBE for early and late damage. Int J Radiat Oncol Biol Phys 1986;12, 221-9.
38. Pickles TA. Particle radiation therapy of prostate cancer. [MD Thesis] London: University of London; 1999. p. 15, p. 52.
39. Saito T, Kamata R, Urahashi S, Goodman GB, Lam GKY. Three dimensional verification of accuracy of immobilization systems. Radiother Sys Res 1988;5(suppl): 1001-03.
40. Pickles T, Goodman GB, Rheaume DE, Duncan GG, Fryer CJ, Bhimji S, et al. Pion radiation for high grade astrocytoma: results of a randomized study. Int J Radiat Oncol Biol Phys 1997;37, 491-7.
41. Pickles T, Goodman GB, Fryer CJ, Bowen J, Coldman AJ, Duncan GG, et al. Pion conformal radiation of prostate cancer: results of a randomized study. Int J Radiat Oncol Biol Phys 1999;43(1):47-55.
42. Pickles T. Personal communication 2001.

Appendix I – Radiation Oncology Residents

1968-69	Dr Albino Flores
1969-70	Dr Albino Flores
1970-71	Drs Randall Fairey, John Cope, Lois Pinillos
1971-72	Drs Randall Fairey, John Cope, Lois Pinillos
1972-73	Drs Randall Fairey, John Cope, Lois Pinillos, Bruce Douglas
1973-74	Drs Bruce Douglas, Ejub Hadzic, Dierdre Gilchrist
1974-75	Dr Dierdre Gilchrist
1975-76	Dr Dierdre Gilchrist
1976-77	Drs Dierdre Gilchrist, Anthony Campbell
1977-78	Drs Anthony Campbell, Barbara Bienkowska, Mohamed Manji, Francis Hughes, Antonio Garcia Angulo, Jean Evers
1978-79	Drs Barbara Bienkowska, , Mohamed Manji, Francis Hughes, Eddie Yeung, Jean Evers, Anthony Campbell, Edmund Kostashuk, Libni Eapen, Antonio Garcia Angulo
1979-80	Drs Anthony Campbell, Eddie Yeung ,Edmund Kostashuk, Mohamed Manji
1980-81	Drs Barbara Bienkowska, Edmund Kostashuk, Eddie Yeung, Anthony Campbell, Mohamed Manji
1981-82	Drs Barbara Bienkowska, Antonio Garcia Angulo, Jean Evers, Young Lee, Anthony Campbell, Eddie Yeung, Edmund Kostashuk, Francis Hughes, Subba Mylavarapu, Frances Wong
1982-83	Dr Young Lee,
1983-84	Drs Young Lee, Edmund Kostashuk, Frances Wong, Charmaine Kim-Sing, Ethan Laukkanen, Ivo Olivotto, Stephen Ng
1984-85	Drs Frances Wong, Ethan Laukkanen, Ivo Olivotto, Alexander Agranovich
1985-86	Drs Alexander Agranovich, Romayne Gallagher, Glen Jones, Marianne Mildenberger, Gordon Okawara, Ivo Olivotto, Ethan Laukkanen, Stephen Ng, Frances Wong
1986-87	Drs Alexander Agranovich, David Calverley, Graeme Duncan, Romayne Gallagher, Glen Jones, Marianne Mildenberger, Gordon Okawara
1987-88	Drs Alexander Agranovich, Graeme Duncan, Glen Jones, Michael McKenzie, Marianne Mildenberger, James Morris, Gordon Okawara
1988-89	Drs Charmaine Kim-Sing, Nadine Loewen, Michael McKenzie, James Morris, Petra Selke, Victor Tsang
1989-90	Drs Stephen Fitzpatrick, Charmaine Kim-Sing, Nadine Loewen, Michael McKenzie, James Morris, Christina Parsons, Douglas Scott, Petra Selke, Victor Tsang
1990-91	Drs Howard Joe, Peter Lim, Roy Ma, Christina Parsons, Victor Tsang, Mohammad Al-Sofayan
1991-92	Drs Shona Dougherty, Howard Joe, Carson Leong, Peter Lim, Roy Ma, Nicos Nicolaou, Christina Parsons, Victor Tsang, Harold Lau, Mohammad Al-Sofayan
1992-93	Drs Shona Dougherty, Howard Joe (on LOA), Mira Keyes, Harold Lau, Carson Leong, Peter Lim, Roy Ma, Nicos Nicolaou, James Pinilla, David Skarsgard.
1993-94	Drs Shona Dougherty, Howard Joe, Mira Keyes, Harold Lau, Peter Lim, Carson Leong, Roy Ma, John Mah, Nicos Nicolaou, James Pinilla, David Skarsgard, Jane Wilson.
1994-95	Drs Corinne Doll, Shona Dougherty, Howard Joe, Mira Keyes, Harold Lau, John Mah, Mark McLaughlin, James Pinilla, David Skarsgard, Theresa Trotter, Scott Tyldesley, Jackson Wu, Don Wilson, Jane Wilson.
1995-96	Drs Corinne Doll, Shona Dougherty, Mira Keyes, John Mah, Ram Miller, Mark McLaughlin, James Pinilla, Theresa Trotter, Scott Tyldesley, Elaine Wai, Don Wilson, Jane Wilson, Jackson Wu.
1996-97	Drs Fayza Al-Ghanmi, Corinne Doll, John Mah, Ram Miller, Theresa Trotter, Scott Tyldesley, Elaine Wai, Don Wilson, Jane Wilson, Jackson Wu.
1997-98	Drs Fayza Al-Ghanmi, Corinne Doll, Anand Karvat, Ram Miller, Theresa Trotter, Scott Tyldesley, Elaine Wai, Jackson Wu.
1998-99	Corinne Doll, Anand Karvat, Elaine Wai, Elaine Wong, Keith Tankel
1999-00	Drs Hans Chung, Corinne Doll, Valeri Goutsouliak, Anand Karvat, Alan Nichol, Elaine Wai, Elaine Wong, Keith Tankel
2000-01	Drs Hans Chung, Valeri Goutsouliak, Anand Karvat, Alan Nichol, Keith Tankel, David Voduc, Elaine Wong, Douglas Wu.

Chapter 8
Service to Oncology

This short chapter contains examples of some of the significant contributions made by British Columbian radiation oncologists to the general cancer field and to their national organizations.

Cervical Cancer Screening

The Vancouver General Hospital pathologist Dr HK Fidler, Director of the BC Cytology Laboratory, established a pilot project in cervical cytology in 1949. By 1955, it was thought that the value of the technique had been established. A decision was made to determine whether taking cervical smears would appreciably reduce the incidence and mortality of invasive squamous carcinoma of the cervix by annually screening all women over the age of 20 in the province. In 1955, approximately 12,000 cases were screened.

In 1957, Dr DA Boyes, while still in private practice as a gynaecologist, became Assistant Director of the Laboratory. In 1960, Dr Evans offered him two years training in radiotherapy. This included a fellowship studying cytology in Europe and one year radiotherapy training at the Christie Hospital in Manchester. On his return Dr Boyes was placed in charge of radiotherapy for gynaecological cancer at the BCCI. Dr Boyes subsequently led the cytology program through its growth into a world-renowned provincial screening program. The program has been recently described as *"arguably the most successful screening campaign"*. [1] The initial objective was to determine the efficacy of the cervical smear technique in detecting preclinical cancer of the cervix.

Over the next three decades the program grew at a rate commensurate with the population growth in the province. In 1985, 536,800 smears from 465,676 women were examined in the centralized laboratory. In those first thirty years, 26,000 cases of squamous carcinoma in-situ were detected and treated. The incidence of invasive carcinoma of the cervix fell by 78% and mortality declined by 72%. [2]

Screening Mammography Program of British Columbia

In 1987, a subcommittee of the Breast Tumour Group of the CCABC, under the chairmanship of the radiation oncologist Dr VE Basco, was formed to look at the question of early diagnosis of breast cancer in British Columbia. The committee submitted a brief to the Minister of Health in December 1987 outlining a proposal which included the recommendation that an "*arms length*" Society be formed to be responsible for screening by mammography [3]. The report also pointed out that the cost of mammography would be reduced from that presently charged to the Government, and that with early diagnosis and reduction in mortality, the costs of treating breast cancer would be reduced. The Ministry of Health accepted the brief and a pilot program was established to assess costs over a one-year period. The first woman was screened in July 1988. From this small beginning the program expanded rapidly such that, by the end of the 1991 fiscal year, 95% of the women in the province would have access to screening wherever they lived. For her lead in the establishment of the program and her contribution to cancer care Dr Basco was awarded the Order of British Columbia in 1991. Another radiation oncologist with a major interest in breast cancer, Dr I Olivotto, was appointed Medical Leader of the program in December 1996 and served in that position for 4 years. In August 1998, Dr Olivotto increased his involvement in the program to 0.4FTE. These salaried physicians were able to provide such significant leadership, in part, because they had no financial or pecuniary interest but only the wish to promote early diagnosis and reduce the toll of breast cancer on the women of British Columbia. In the 10th year after its inception, the program examined 167,221 women in 1996/97 and had detected 505 cancers.

Dr VE Basco 1935-

Dr Vivien Basco was born in Shrewsbury, a graduate of Birmingham University and received training in radiotherapy in Cambridge and Sheffield, obtaining the DMRT in 1961 and the FRCR in 1963. With her husband's appointment to the Department of Chemistry at UBC in 1964, in order to work in her speciality, she obtained a BCCI Radiotherapy Fellowship, and the following year the Shane Fellowship. Dr Basco, who was appointed to the staff in 1966, introduced lymphangiography to the Institute. In the pre CT era this technique provided valuable information in determining involvement of lymph nodes by tumour in the abdomen. At first responsible for paediatric and lymphoma radiotherapy, she later led the clinical care of patients with breast cancer.

Dr Basco's strong leadership abilities led to her holding many important positions both locally and nationally. She was chair of the Lymphoma Tumour Group 1974-1980 and the Breast Tumour Group from 1982-1990, acting Head of Radiation Oncology, BCCA from September 1976 to February 1977 and Medical Staff Representative to the Board of Directors during the troubling times of transition between Agency Medical Directors. Following her retirement in 1991 she spent several more years as a Government appointee to the Board of the Agency.

As chair of the Breast Screening Committee Dr Basco was instrumental in the formation of the Screening Mammography Program of British Columbia. She was chair of the National Cancer Institute of Canada committees in Hodgkin's disease and Breast screening and was a frequent invited speaker on breast cancer and screening.

Dr Basco was named Primus Inter Pares by the Vancouver Medical Association in 1990 and received the Canadian Breast Cancer Foundation Award and the Order of British Columbia in 1991, retiring the same year as Clinical Professor Emerita in the Department of Surgery, University of British Columbia.

Fig 117. Dr VE Basco.

Hereditary Cancer Program

In 1994, a broadly based interdisciplinary group formed the Hereditary Cancer Task Force. The group had representatives from Medical, Radiation and Surgical Oncology, Medical Genetics, Nursing, Pathology, Epidemiology, Anthropology, Sociology, Ethics, Psychology, Social Work and Cancer Research. Its aim was to develop effective hereditary cancer management in response to new genetic information. There was considerable excitement at the time as the race was on to see which team of researchers would be the first to clone BRCA1, the genetic mutation responsible for the majority of inherited breast and ovarian cancers. BRCA1 was cloned in October 1994, and BRCA2 was cloned in 1995. At the same time the mutations for hereditary non polyposis colorectal cancer were also identified.

In September 1996, funding was received from the Canadian Breast Cancer Foundation for a pilot project in genetic counseling so that individuals from high-risk families could be appropriately counseled regarding their risk of developing breast cancer. Laboratory testing for BRCA1 and BRCA2 mutations was initiated at the Vancouver Cancer Centre. It became evident that individuals who were found to have mutations and had a 56 to 85 percent life time risk of developing breast cancer would need clinical guide lines for cancer prevention, screening and surgical management.

Dr. Charmaine Kim-Sing, a radiation oncologist with extensive experience in the management of women with breast cancer, developed a research interest in breast cancer prevention. She was a co-principal investigator for the large scale North America Breast Cancer Prevention Trial which accrued over 13,000 women who were randomized to either tamoxifen or placebo. Later she was also a co-principal investigator of the second breast cancer prevention trial to study tamoxifen and raloxifene. An advocate of the Screening Mammography Program and keenly interested in new imaging modalities in screening for high risk women, it was a natural progression for her to be appointed the Medical Leader of the Hereditary Cancer Program in January 1998.

The program was charged to develop clinical guidelines for high-risk families with an inherited susceptibility to cancer. Due to limited resources, the BCCA program focused on BRCA1/2 families. Between September 1996 and November 2000, 2,500 individuals were referred to the program, 1,500 individuals (from 1100 families) were seen for genetic counseling. Three hundred and thirty nine received index testing and 85 mutations were detected. One hundred and seventy two underwent carrier testing.

Support for Patient Driven Initiatives in Breast and Prostate Cancer

When Ms Judy Caldwell, a breast cancer survivor and patient advocate, met the founders of the Canadian Breast Cancer Foundation (CBCF) in 1992 she was impressed, and promptly established a BC & Yukon chapter. Dr Olivotto, a strong supporter of this patient driven initiative, was a founding member of the board and the first chairman of the chapter's Medical Advisory Committee. Dr Basco also sat on the board as it was developing and Dr Kim-Sing was a member of the MAC. An annual grants competition was initiated and continues to fund 3-5 breast cancer projects annually in British Columbia. Dr Olivotto was the second chair of the CBCF national Medical Advisory Committee.

In a similar vein, in 1999, Dr Ludgate was instrumental in giving voice to a group of men with prostate cancer on Vancouver Island. He was a founding board member of the Prostate Awareness and Support group (PAS) in Victoria.

Dr Olivotto was a member of a committee established by Health Canada in 1994 to develop national guidelines for the care and treatment of breast cancer. A "Canadian Consensus Document" containing ten nationally written and evidence based clinical practice guidelines was published as a supplement to the Canadian Medical Association Journal in 1998. [4] Versions of the document were made available for the benefit of the public.

The book "*Intelligent patient guide to breast cancer: all you need to know to take an active part in your treatment*" by Olivotto, Gelmon and Kuusk has proven to be popular and helpful to many patients with breast cancer. The book is special in that a radiation oncologist was the driving force behind advice regarding the investigation and treatment of newly diagnosed breast cancer. Dr Olivotto, with David Noble and others, initiated the Breast Cancer Information Project in BC. Based on surveys, feed back and popularity of the book, the CBCF has funded the distribution of an information kit to surgeon's offices to be available to all women with newly diagnosed breast cancer in British Columbia.

National Bodies and Professional Associations

Radiation oncologists from British Columbia have played pivotal roles in the promotion of the specialty through various national bodies and professional associations.

In 1938 the Royal College of Physicians and Surgeons, at the request of the Canadian Medical Association, assumed the responsibility for recognition and certification of specialists in Canada. Until 1971 separate examinations were held at the certification and fellowship levels. A single examination at a new standard was introduced for granting fellowship in 1972. [5] A Specialty Committee of the Royal College was created in the mid-1940s from within the Canadian Association of Radiologists (CAR) to encompass the interests of diagnostic and therapeutic radiology. In 1975 the Royal College, responding to dissatisfaction among some radiotherapists at the inclusion of their affairs in the Committee in Radiology, formed a Committee in Therapeutic Radiology. At its first meeting, with Dr Goodman as chairman, the committee resolved that:

1. The Therapy higher examination should be named Radiation Oncology. From 1976 the examination would include a section on "Clinical Oncology".
2. a. A Division of Radiation Oncology would be established within CAR.
   b. Reorganization for the administration of Radiation Oncology should include a Vice-President and an Advisory Council.
   c. The Vice-President (Radiation Oncology) should be a member of the Executive of the CAR.
   d. The Objectives of the Division (Radiation Oncology) be concerned with education and economics.
3. That only certified Radiation Oncologists (Therapeutic Radiologists) should treat malignant disease with radioactive isotopes.

The change in name was accepted by the Royal College in 1976 in response to a letter from George Goodman (Vancouver), the incumbent Chairman of the Committee in Therapeutic Radiology. [5] The letter included the following:

"*Potential advantages of the term radiation oncologist:*

1. *Radiation oncology indicates the clinical nature of the specialty and the term suggests that other disciplines are involved in the care of cancer patients. It may thereby promote greater effort in formulating interdisciplinary approaches to the management of these patients.*
2. *The clinical implications of the term radiation oncology may lead to a greater interest in this field by clinically oriented, well qualified students, thus enhancing both education, undergraduate and postgraduate, and recruitment into the specialty.*
3. *The term radiation oncology will align Canadian terminology with that of other international bodies.*
4. *The Royal College of Radiologists, UK (June 1975), conducts an examination in "Radiotherapy and Oncology".*
5. *Conforms to the designation "Department of Radiation Oncology" in current use in major university centers in the USA.*"

Dr Goodman was Chairman of the Examining Board in Radiation Oncology for the Royal Collage in 1978 and 1979 and Dr Fairey held the position from January 1985 to May 1988.

"Walk in the snow"!

Prior to the establishment of the Canadian Association of Radiation Oncologists, the radiation oncologists had formed less than ten percent of the Canadian Association of Radiologists (CAR) and felt under represented. With a wish expressed by the majority of radiation oncologists, to strengthen and unify the voice of radiation oncology in an independent organization, the Canadian Association of Radiation Oncologists (CARO/ACRO) was formed in 1987. [6]

Dr Jackson, in 1984 the Radiation Oncology representative to the Canadian Oncology Society (COS), suggested to Dr Froud, the Radiation Oncology representative to CAR, during a stroll on Sherbrooke Street in Montreal (actually in June, and the snow was hypothetical), that the time was ripe for the Specialty to have its own independent voice. The concept was widely accepted by the majority of radiation oncologists and CARO/ACRO was born. Many of the early tenants of the association have stood the test of time: including election of officers by secret ballot; regional representation; full membership of residents and fellows; high selection standards for scientific meetings; annual CARO/ACRO lectureships by oncologists of international standing; and an annual resident awards session. With the increasing stature of the association, it has become recognized both nationally and internationally as the official voice of Radiation Oncology in Canada.

Radiation oncologists from British Columbia have played major roles in both CAR and CARO/ACRO. Dr GB Goodman was President of CAR in 1979. Dr SM Jackson was elected the first President of CARO/ACRO for 1987-1989 and Dr J Hay was President for 1995-1997. Dr RN Fairey was Secretary Treasurer from 1990-1996 and Dr DE Rheaume from

Fig 118. Dr Stewart Jackson, the first president of CARO/ACRO, and Susan Broadbear the association's business manager since its inception.

1998. From its inception in 1987, the head office of CARO/ACRO has been in Vancouver, managed in the capable hands of Susan Broadbear, Office Manager and Program Assistant to the Division of Radiation Oncology, and the Radiation Therapy Program of the British Columbia Cancer Agency. In addition to her administrative contribution to the Association she was responsible for the CARO/ACRO Directory and the Newsletter until the advent of the CARO/ACRO website.

Fig 119. Three of the unique plaques given to CARO/ACRO Annual Lecturers.
The tree-like pattern is really a frozen flash of lightning created by exposing a block of clear plastic to a beam of electrons from a linear accelerator. Electrons with an energy of 13 million electron volts are passed through a 24 mm thick sheet of plastic. The electrons, travelling at 99.5% of the speed of light, penetrate the plastic material to a depth near 12 mm before stopping. After this exposure, the block holds a strong charge which is released by striking one edge of the block with a sharp pointed tool. The block discharges with a flash like lightning and the plastic retains an image of the discharge tracks. Each electron tree is an individual design; like snowflakes no two are the same.

References for Chapter 8

1. Symonds RP. Is screening for cervical cancer effective? Clin Oncol 2001;13:473-475.
2. Anderson GH, Boyes DA, Benedet JL, Le Riche JC, Matisic JP, Suen KC, et al. Organisation and results of the cervical cytology screening programme in British Columbia, 1955-85. Br Med J Clin Res 1988;296(6627): 975-8.
3. Screening Mammography Program of British Columbia Annual Report 1990/91. Vancouver: Screening Mammography Program of British Columbia; 1991.
4. Anonymous. The Steering Committee on Clinical Practice Guidelines for the Care and Treatment of Breast Cancer. Follow-up after treatment for breast cancer. Can Med Assoc J 1998 Feb 10;158(Suppl 3):S65-70.
5. Goodman GB. History of radiation oncologists in the Royal College of Physicians and Surgeons. In Aldrich JE, Lentle BC, editors. A new kind of ray. Vancouver, BC: University of British Columbia; 1995. p. 341-343.
6. Canadian Association of Radiation Oncologists 1998 Directory. Vancouver, B.C.: Vancouver Hospital and Health Sciences Centre; 1998.

Appendix II – Radiation Oncologists 1938-2000

1938-1971	A. Maxwell EVANS
1940-1945	Ethlyn TRAPP
1942-1961	Margaret F.B. HARDIE
1949-1956	Robert G. MOFFAT
1949-1959	Ronald D. NASH
1950-1985	Glen M. CRAWFORD
1951-1976	Norman LOCKYER
1958-1990	George B. GOODMAN
1960-1979	John M.W. GIBSON
1962-1975	David A. BOYES
1963-1993	Peter COY
1966-1991	Vivien BASCO
1972-1993	Albino D. FLORES
1974-1977	John PROBERT
1974-1981	Bruce G. DOUGLAS
1974-	Randall N. FAIREY
1974-1998	Stewart M. JACKSON
1975-1988	John FETTERLEY
1976-1983	Eyub HADZIC
1977-1982	James R. BROWN
1977-1988	Esther BROWN
1977-1992	Christopher J.H. FRYER
1979-1993	Mohamed F. MANJI
1979-	Nicholas J.S. VOSS
1980-	Charles M. LUDGATE
1980-	Clive A. GRAFTON
1981-	Skaria ALEXANDER
1983-1990	Brian ACKER
1983-1989, 1993-	Edmund C. KOSTASHUK
1985-	John H. HAY
1985-	Frances L-W. WONG
1985-1989	Ethan LAUKKANEN
1988-	Graeme G. DUNCAN
1988-	Ivo A. OLIVOTTO
1989-2000	Dorianne E. RHEAUME
1989-	Karen J. GODDARD
1990-1997	Marianne MILDENBERGER
1991-1992	Julie BOWEN
1991-	Lorna M. WEIR
1991-	W. James MORRIS
1991-	Charmaine KIM-SING
1991-	Michael R. McKENZIE
1991-1993	Catherine E. de METZ
1991- 1999	Peter J. FROUD
1992-	Thomas A. PICKLES
1992-1997	Victor T.Y. TSANG
1992-	Jan T-W. LIM
1993-	Finbarr G. SHEEHAN
1993-1999	Brian J. HAYLOCK
1993-	Christina AQUINO-PARSONS
1993-	Stephan N. LARSSON
1994-	Roy M-K. MA
1994-	Peter LIM
1994-	Alexander L. AGRANOVICH
1995-	Carson LEONG
1995-	Hosam A. KADER
1995-	Thomas J. KEANE
1996-	Winkle B. KWAN
1996-1998	Rajiv S. SAMANT
1996-	Paul A. BLOOD
1996-	Howard A. JOE
1996-	Simon SUTCLIFFE
1997-	Eric BERTHELET
1997-	Mira KEYES
1998-	Melanie J. REED
1998-2000	Harold Y.H. LAU
1998-	William G. McMILLAN
1998-	David B. HOEGLER
1998-	Jane M. WILSON
1998-	Donald C. WILSON
1998-	Mitchell C.C. LIU
1999-	Jonn S. WU
1999-	Susan L. BALKWILL
1999-	Milton C. PO
2000-	Pauline T.L. TRUONG
2000-	Scott TYLDESLEY

Appendix III – Publications of Radiation Oncologists

Citations are recorded for work carried out before and during employment in British Columbia.

Acker, Brian

1. Hoskins PJ, Wong F, Swenerton KD, Pike JA, Manji M, McMurtrie E, Acker B, Le Riche J. Small cell carcinoma of the cervix treated with concurrent radiotherapy, cisplatin, and etoposide. Gynecol Oncol 1995;56(2): 218-25.
2. Chaplin DJ, Acker B, Olive PL. Potentiation of the tumor cytotoxicity of melphalan by vasodilating drugs. Int J Radiat Oncol Biol Phys 1989;16(5):1131-5.
3. Chaplin DJ, Acker B. The effect of hydralazine on the tumor cytotoxicity of the hypoxic cell cytotoxin RSU-1069: evidence for therapeutic gain. Int J Radiat Oncol Biol Phys 1987;13(4):579-85.
4. Acker B, Hoppe RT, Colby TV, Cox RS, Kaplan HS, Rosenberg SA. Histologic conversion in the non-Hodgkin's lymphomas. J Clin Oncol 1983;1(1):11-16.

Agranovich, Alexander L.

1. Agranovich A, Berthelet E. Radiotherapy for Colorectal Cancer. Br Columbia Med J 2000;.42(3):139-141.
2. Ang LC, Plewes M, Tan L, Begley H, Agranovich A, Shul D. Proliferating cell nuclear antigen expression in the survival of astrocytoma patients. Can J Neurol Sci 1994;21(4): 306-10.
3. Agranovich AL, Ang LC, Fryer CJ. Central neurocytoma: report of 2 cases and literature review. J Neurooncol 1993;16(1):47-53.
4. Agranovich AL, Ang LC, Griebel RW, Kobrinsky NL, Lowry N, Tchang SP. Malignant rhabdoid tumor of the central nervous system with subarachnoid dissemination. Surg Neurol 1992;37(5):410-4.
5. Agranovich AL, Anderson GH, Manji M, Acker BD, Macdonald WC. Threlfall WJ. Carcinoid tumour of the gastrointestinal tract: prognostic factors and disease outcome. J Surg Oncol 1991;47(1):45-52.

Basco, Vivien E.

1. Haylock BJ, Coppin CM, Jackson J, Basco VE, Wilson KS. Locoregional first recurrence after mastectomy: prospective cohort studies with and without immediate chemotherapy. Int J Radiat Oncol Biol Phys 2000;46(2): 355-62.
2. Ragaz J, Jackson SM, Le N, Plenderleith IH, Spinelli JJ, Basco VE, et al. Adjuvant radiotherapy and chemotherapy in node-positive premenopausal women with breast cancer. N Engl J Med 1997;337(14):956-62.
3. Olivotto IA, Kim-Sing C, Bajdik CD, Trevisan CH, Ludgate CM, Weir LM, Jackson SM, Basco VE. Effect of acetylsalicylic acid on radiation and cosmetic results after conservative surgery for early breast cancer: a randomized trial. Radiother Oncol 1996;41(1):1-6.
4. Olivotto IA, Weir LM, Kim-Sing C, Bajdik CD, Trevisan CH, Doll CM, Lam WY, Basco VE, Jackson SM. Late cosmetic results of short fractionation for breast conservation. Radiother Oncol 1996;41(1):7-13.
5. Kuusk U, Basco V, Rebbeck P. Comparison of partial and modified radical mastectomy in the community setting — "10 years later". Can J Surg 1992;35(4):383-7.
6. Yelle L, Bergsagel D, Basco V, Brown T, Bush R, Gillies J, et al. Combined modality therapy of Hodgkin's disease: 10-year results of National Cancer Institute of Canada Clinical Trials Group multicenter clinical trial. J Clin Oncol 1991;9(11):1983-93.
7. Hislop TG, Burhenne LJ, Basco VE, Ng VT. The Screening Mammography Program of British Columbia: pilot study. Can J Public Health. Revue Canadienne Sante Publique 1991;82(3):168-73.
8. Olivotto IA, Kuusk U, Basco VE. Breast Conservation. Br Columbia Med J 1991;33(9):488.
9. Hassell PR, Olivotto IA, Mueller HA, Kingston GW, Basco VE. Early breast cancer: detection of recurrence after conservative surgery and radiation therapy. Radiology 1990;176(3):731-5.
10. Ragaz J, Goldie JH, Baird R, Rebbeck P, Basco V, Coldman A. Experimental basis and clinical reality of preoperative (neoadjuvant) chemotherapy in breast cancer. Recent Results Cancer Res 1989;115:28-35.
11. Kim-Sing C, Basco VE. Postmastectomy lymphedema treated with the Wright linear pump. Can J Surg 1987;30(5):368-70.
12. Knowling MA, Basco VE. Breast cancer after treatment for osteosarcoma. Med Pediatr Oncol 1986;14(1):51-3.
13. Worth AJ, Basco VE, Grafton CA, Jackson SM, Baird RM, Brown DA, et al. Conservative breast surgery. Br Columbia Med J 1986;28(1):27-29.
14. Basco VE, Coldman AJ, Elwood JM, Young ME. Radiation dose and second breast cancer. Br J Cancer 1985;52(3): 319-25.

15. Thomas JW, Plenderleith IH, Landi S, Basco VE, Clements DV. Bacille Calmette-Guerin as maintenance therapy for non-Hodgkin's lymphoma. Can Med Assoc J 1983;129(5): 439-42.
16. Warren RJ, Sandy JT, Basco VE, Ballantyne GJ. Laparotomy for staging of Hodgkins' disease. Can J Surg 1980;23(5): 492-4.
17. Rogers PC, Basco VE, Ashmore PG, Moyes PD, Chan DM. Solid Tumours in Childhood. Br Columbia Med J 1977;19(4): 134-136.
18. Teasdale JM, Barton E, Israels S, Smith DF, Basco VE. Leukemia and lymphoma. Br Columbia Med J 1977;19(4): 130-134.
19. Teasdale JM, Basco VE. Cancer in children- an overview. Br Columbia Med J 1977;19(4):128-139.

Berthelet, Eric

1. Agranovich A, Berthelet E. Radiotherapy for colorectal cancer. Br Columbia Med J 2000;42(3):139-141.
2. Berthelet E, Shenouda G, Black MJ, Picariello M, Rochon L. Sarcomatoid carcinoma of the head and neck. Am J Surg 1994;168(5):455-81.

Blood, Paul

1. Kirkbride P, Bezjak A, Pater J, Zee B, Palmer MJ, Wong R, Cross P, Gulavita S, Blood P, Lim J, et al.. Dexamethasone for the prophylaxis of radiation-induced emesis: a National Cancer Institute of Canada Clinical Trials Group phase III study. J Clin Oncol 2000;18(9):1960-6.
2. Lobchuk MM. Kristjanson L. Degner L. Blood P. Sloan JA. Perceptions of symptom distress in lung cancer patients: I. Congruence between patients and primary family caregivers. J Pain Symptom Manage 1997;14(3):136-46.
3. Paszat L, Shenouda G, Blood P, Nolan MC, Pater JL, Whelan T. The role of palliative radiotherapy for brain metastases. Can J Oncol 1996 Feb;6(Suppl)1:48-53.

Bowen, Julie

1. Pickles T, Goodman GB, Fryer CJ, Bowen J, Coldman AJ, Duncan GG, Graham P, McKenzie M, Morris WJ, Rheaume DE, Syndikus I. Pion conformal radiation of prostate cancer: results of a randomized study. Int J Radiat Oncol Biol Phys 1999;43(1):47-55.
2. Pickles T, Goodman GB, Rheaume DE, Duncan GG, Fryer CJ, Bhimji S, Ludgate C, Syndikus I, Graham P, Dimitrov M, Bowen J. Pion radiation for high grade astrocytoma: results of a randomized study. Int J Radiat Oncol Biol Phys 1997;37(3):491-7.
3. Pickles T, Bowen J, Dixon P, Gaffney C, Pomeroy M, Rheaume D, Vernimmen F, Goodman GB. Pions-the potential for therapeutic gain in locally advanced prostate cancer: dose escalation and toxicity studies. Int J Radiat Oncol Biol Phys 1991;21(4):1005-11.

Boyes, David A.

1. Morrison BJ, Coldman AJ, Boyes DA, Anderson GH. Forty years of repeated screening: the significance of carcinoma in situ. Br J Cancer 1996;74(5):814-9.
2. Grayston AD, De Luca RV, Boyes DA. Self-esteem, anxiety, and loneliness in preadolescent girls who have experienced sexual abuse. Child Psychiatry Hum Dev 1992;22(4):277-86.
3. Karsai H, Coldman AJ, Gavin D, Brumelle S, Boyes DA, Anderson GH, Benedet JL. Cervical intraepithelial neoplasia in female prisoners in British Columbia, Can Med Assoc J 1998;139(8):733-6.
4. Klaassen D, Shelley W, Starreveld A, Kirk M, Boyes D, Gerulath A, et al. Early stage ovarian cancer: a randomized clinical trial comparing whole abdominal radiotherapy, melphalan, and intraperitoneal chromic phosphate: a National Cancer Institute of Canada Clinical Trials Group report. J Clin Oncol 1988;6(8):1254-63.
5. Anderson GH, Boyes DA, Benedet JL, Le Riche JC, Matisic JP, Suen KC, et al. Organisation and results of the cervical cytology screening programme in British Columbia, 1955-85. Br Med J Clin Res Ed 1988;296(6627):975-8.
6. Anderson GH, Boyes DA. Cervical cancer screening. Lancet. 1987 Aug 8;2(8554):339-40.
7. Klaassen D, Starreveld A, Shelly W, Miller A, Boyes D, Gerulath A, et al. External beam pelvic radiotherapy plus intraperitoneal radioactive chronic phosphate in early stage ovarian cancer: a toxic combination, a National Cancer Institute of Canada Clinical Trials Group Report. Int J Radiat Oncol Biol Phys 1985;11(10):1801-4.
8. Benedet JL, Anderson GH, Boyes DA. Colposcopic accuracy in the diagnosis of microinvasive and occult invasive carcinoma of the cervix. Obstet Gynecol 1985;65(4): 557-62.
9. Fairey RN, MacKay PA, Benedet JL, Boyes DA, Turko M. Radiation treatment of carcinoma of the vulva, 1950-1980. Am J Obstet Gynecol 1985;151(5):591-7.
10. Swenerton KD, Hislop TG, Spinelli J, LeRiche JC, Yang N, Boyes DA. Ovarian carcinoma: a multivariate analysis of prognostic factors. Obstet Gynecol 1985;65(2):264-70.
11. Boyes DA. Status of screening for uterine cancer. Br Columbia Med J 1984;26(11):739-742.
12. Boyes DA. The current status of screening for uterine cancer. Prog Clin Biol Res 1983;132E:483-93.

13. Benedet JL, Murphy KJ, Fairey RN, Boyes DA. Primary invasive carcinoma of the vagina. Obstet Gynecol 1983;62(6): 715-9.
14. Walton RJ, Allen HH, Anderson GH, Boyes DA, Blanchet M, Carmichael J, et al. [Detection of cervical cancer: report of the Canadian Working Group, 1982 [French]. Union Medicale Canada 1982;111(10):856-61, 865-7.
15. Boyes DA, Morrison B, Knox EG, Draper GJ, Miller AB. A cohort study of cervical cancer screening in British Columbia. Clin Invest Med 1982;5(1):1-29.
16. Boyes DA, Worth AJ. Treatment of early cervical neoplasia: definition and management of preclinical invasive carcinoma. Gynecol Oncol 1981;12(2 Pt 2):S317-30.
17. Boyes DA, Worth AJ, Anderson GH. Experience with cervical screening in British Columbia. Gynecol Oncol 1981;12(2 Pt 2):S143-55.
18. Boyes DA. The value of a Pap smear program and suggestions for its implementation. Cancer 1981;48(2 Suppl): 613-21.
19. Miller AB, Klaassen DJ, Boyes DA, Dodds DJ, Gerulath A, Kirk ME, et al. Combination v sequential therapy with melphalan, 5-fluorouracil and methotrexate for advanced ovarian cancer. Can Med Assoc J 1980;123(5): 365-71.
20. Elwood JM, Boyes DA. Clinical and pathological features and survival of endometrial cancer patients in relation to prior use of estrogens. Gynecol Oncol 1980;10(2):173-87.
21. Benedet JL, Boyes DA. Investigation and management of preclinical neoplasia. Br Columbia Med J 1980;22(8): 372-376.
22. Benedet JL, Turko M, Boyes DA, Nickerson KG, Bienkowska BT. Radical hysterectomy in the treatment of cervical cancer. Am J Obstet Gynecol 1980;137(2):254-62.
23. McComb P, Ho Yuen B, Boyes D, White G. Recurrence of metastatic trophoblastic disease after negative, plasma human chorionic gonadotropin beta-subunit assay. Gynecol Oncol 1980;9(1):114-6.
24. Benedet JL, Turko M, Fairey RN, Boyes DA. Squamous carcinoma of the vulva: results of treatment, 1938 to 1976. Trans Pacific Coast Obstet Gynecol Soc 1979;46:105-11.
25. Swenerton KD, Evers JA, White GW, Boyes DA. Intermittent pelvic infusion with vincristine, bleomycin, and mitomycin C for advanced recurrent carcinoma of the cervix. Cancer Treat Rep 1979;63(8):1379-81.
26. Benedet JL, Turko M, Fairey RN, Boyes DA. Squamous carcinoma of the vulva: results of treatment, 1938 to 1976. Am J Obstet Gynecol 1979;134(2):201-7.
27. Swenerton KD, White GW, Boyes DA. Treatment of advanced endometrial carcinoma with tamoxifen [letter]. New Engl J Med 1979;301(2):105.
28. Klaassen DJ, Boyes DA, Gerulath A, Levitt M, Miller AB, Pearson JG. Preliminary report of a clinical trial of the treatment of patients with advanced stage III and IV ovarian cancer with melphalan, 5-fluorouracil, and methotrexate in combination and sequentially: a study of the Clinical Trials Group of the National Cancer Institute of Canada. Cancer Treat Rep 1979;63(2):289-95.
29. Pankratz E, Boyes DA, White GW, Galliford BW, Fairey RN, Benedet JL. Granulosa cell tumors: A clinical review of 61 cases. Obstet Gynecol 1978;52(6):718-23.
30. Boyes DA, Pankratz E, Walliford BW, White GW, Fairey RN. Experience with dysgerminomas at the Cancer Control Agency of British Columbia. Gynecol Oncol 1978;6(2): 123-9.
31. Benedet JL, Boyes DA, Nichols TM, Millner A. The role of colposcopy in the evaluation of abnormal vaginal vault smears. Gynecol Oncol 1977;5(4):338-45.
32. Benedet JL, White GW, Fairey RN, Boyes DA. Adenocarcinoma of the fallopian tube: experience with 41 patients. Obstet Gynecol 1977;50(6):654-7.
33. Benedet JL, Boyes DA, Nichols TM, Millner A. Colposcopic evaluation of pregnant patients with abnormal cervical smears. Br J Obstet Gynecol 1977;84(7):517-21.
34. Boyes DA, Pankratz E, Galliford B, White GM, Fairey RN, Yuen BH. Treatment of trophoblastic neoplasia at the Cancer Control Agency of British Columbia. Can Med Assoc J 1977;117(7):753-6.
35. Turko M, Benedet JL, Boyes DA, Nickerson KG. Pelvic exenteration: 1949-1971. Gynecol Oncol 1977;5(3):246-50.
36. Buskard NA, Boyes DA, Grossman L. Plasma cell leukemia following treatment with radiotherapy and melphalan. Can Med Assoc J 1977;117(7):788-9.
37. Boyes DA, Nichols TM, Millner AM, Worth AJ. Recent results from the British Columbia screening program for cervical cancer. Am J Obstet Gynecol 1977;128(6):692-3.
38. Yuen BH, Cannon W, Benedet JL, Boyes DA. Plasma beta-subunit human chorionic gonadotropin assay in molar pregnancy and choriocarcinoma. Am J Obstet Gynecol 1977;127(7):711-2.
39. Walton RJ, Blanchet M, Boyes DA, Carmichael J, Marshall KG, Miller AB, Thompson DW. [Detection of cancer of the cervix uteri [French]. Union Medicale Canada 1971;105(7): 997-1047.
40. Boyes DA. The annual chest X-ray. Br Columbia Med J 1979;21(6):278-279.
41. Benedet JL, Boyes DA, Nichols TM, Millner A. Colposcopic evaluation of patients with abnormal cervical cytology. Br J Obstet Gynaecol 1976;83(3):177-82.

42. Klaassen DJ, Boyes DA, Gerulath A, Levitt M, Pearson JG, Dodds D, Miller AB. Clinical trials of treatment of ovarian cancer [letter]. Can Med Assoc J 1975;113(8):717.
43. Yuen BH Abbott EF, Benedet JL, Boyes DA. Plaso á-sub-unit HCG assay in diagnosis and follow-up of Gestational Trophoblastic Neoplasia. Br Columbia Med J 1975;17(5): 227-229.
44. Boyes DA, Knowelden J, Phillips AJ. [The evaluation of cancer control measures (author's transl)] [Italian]. Tumori 1974;60(2):171-4.
45. Boyes DA, Knowelden J, Phillips AJ. [Evaluation of cancer-controlling examinations] [German]. Deutsche Medizinische Wochenschrift, 1974;99(3):102-4.
46. Boyes DA, Knowelden G, Phillips AJ. [Evaluation of control measures in cancer] [French]. Bull Cancer 1973;60(1): 83-8.
47. Boyes DA, Knowelden J, Phillips AJ. The evaluation of cancer control measures. Br J Cancer 1973;28(2):105-7.
48. Worth AJ, Boyes DA. A case control study into the possible effects of birth control pills on pre-clinical carcinoma of the cervix. J Obstet Gynaecol Br Commonw 1972;79(8): 673-9.
49. Turko M, Boyes DA, Allan DS. The follow-up of 141 cases of untreated invasive cervical carcinoma. Trans Pacific Coast Obstet Gynecol Soc 1971;39:72-6.
50. Lee M, Boyes DA. The use of quinacrine hydrochloride for the control of malignant serous effusions. J Obstet Gynaecol Br Commonw 1971;78(9):843-4.
51. Yuen BH, Boyes DA. Late gastrointestinal complications in patients irradiated for cancer of the cervix. Am Surg 1970;36(10):642-5.
52. Boyes DA, Worth AJ, Fidler HK. The results of treatment of 4389 cases of preclinical cervical squamous carcinoma. J Obstet Gynaecol Br Commonw 1970;77(9):769-80.
53. Boyes DA. The British Columbia screening program. Obstet Gynecol Surv 1969 Jul;24(7 Pt 2):1005-11
54. Peck JG, Boyes DA. Treatment of advanced endometrial carcinoma with a progestational agent. Am J Obstet Gynecol 1969;103(1):90-1.
55. HoYuen B, Fidler HK, Boyes DA. In situ squamous carcinoma of the uterine cervix. Can Med Assoc J 1968;99(14): 719-20.
56. Fidler HK, Boyes DA, Worth AJ. Cervical cancer detection in British Columbia. A progress report. J Obstet Gynaecol Br Commonw 1968;75(4):392-404.
57. Beck RE, Boyes DA. Treatment of 126 cases of advanced ovarian carcinoma with cyclophosphamide. Can Med Assoc J 1968;98(11):539-41.
58. Nichols TM, Boyes DA, Fidler HK. Advantages of routine step serial sectioning of cervical cone biopsies. Am J Clin Pathol 1968;49(3):342-6.
59. Worth AJ, Boyes DA, Fidler HK. The acceptance of the cervical cytology screening programme in the province of British Columbia. J Obstet Gynaecol Br Commonw1967;74(4):479-86.
60. Rad M, Marczinke I, Boyes DA, Fidler HK. The use of exfoliative vaginal cytology in pregnancy. Am J Obstet Gynecol 1966;94(4):465-70.
61. Fraser BJ, Boyes DA. The benefit of screening for cancer of the cervix in British Columbia. In: Larsson T, Ljungstedt N, editors. Health control in detection of cancer. Stockholm: Almqvist & Wiksell, 1976. p. 215-29.

Brown, JR

1. Stewart JG, Brown JR, Palmer MK, Cooper A. The management of glottic carcinoma by primary irradiation with surgery in reserve. Laryngoscope 1975;85(9):1477-84.
2. Keith RL. Brown JR. Laryngectomy, aphasia, and oral verbal apraxia: report of three cases. Arch Phys Med Rehabil 1975;56(4):174-6.

Coy, Peter

1. Quon H, Shepherd FA, Payne DG, Coy P. Murray N, Feld R. Pater J. Sadura A. Zee B. The influence of age on the delivery, tolerance, and efficacy of thoracic irradiation in the combined modality treatment of limited stage small cell lung cancer. Int J Radiat Oncol Biol Phys 1999;43(1): 39-45.
2. Schaafsma J, Coy P. The effect of radiotherapy on the survival of non-small cell lung cancer patients. Int J Radiat Oncol Biol Phys 1988;41(2):291-8.
3. Arndt K, Coy P. Schaafsma J. Implicit rationing criteria in non-small-cell lung cancer treatment. Br J Cancer 1996;73(6):781-8.
4. Coy P, Hugi MR. The need for better communication about breast cancer. Br Columbia Med J 1995;37(6):392-395.
5. Coy P, Schaafsma J, Schofield JA, Nield JA. Comparative costs of lung cancer management. Clin Invest Med 1994;17(6):577-87.
6. van Netten JP, Mogentale T, Smith MJ, Fletcher C, Coy P. Physical trauma and breast cancer [letter, see comments]. Lancet 1994;343(8903):978-9.
7. Coy P, Hodson DI, Murray N, Pater JL, Payne DG, Arnold A, Kostashuk E et al. Patterns of failure following loco-regional radiotherapy in the treatment of limited stage small cell lung cancer [see comments]. Int J Radiat Oncol Biol Phys 1994:;8(2):355-62.

8. Coy P, Martinez E, Ruiz S, Vazquez JM, Roca J, Gadea J. Environment and medium volume influence in vitro fertilisation of pig oocytes. Zygote 1993;1(3):209-13.
9. Feld R, Pater J, Goodwin PJ, Grossman R, Coy P, Murray N. The restaging of responding patients with limited small cell lung cancer. Is it really useful? Chest 1993;103(4):1010-6.
10. van Netten JP, Ashmead BJ, Parker RL, Thornton IG, Fletcher C, Cavers D, Coy P, Brigden ML. Macrophage-tumor cell associations: a factor in metastasis of breast cancer? J Leuko Biol 1993;54(4):360-2.
11. Vazquez JM, Martinez E, Roca J, Coy P, Pastor LM. Acrosome reaction of boar spermatozoa in homologous in vitro fertilization. Mol Reprod Dev 1993;36(1):84-8.
12. van Netten JP, George EJ, Ashmead BJ, Fletcher C, Thornton IG, Coy P. Macrophage-tumour cell associations in breast cancer. Lancet 1993;342(8875):872-3.
13. Brigden LP, Peck SH, Coy P. The development and implementation of a revised municipal bylaw to control environmental tobacco smoke. Can J Pub Health Revue Can Sante Publique 1993;84(2):118-21.
14. Murray N, Coy P, Pater JL, Hodson I, Arnold A, Zee BC, Payne D, Kostashuk EC, et al. Importance of timing for thoracic irradiation in the combined modality treatment of limited-stage small-cell lung cancer. The National Cancer Institute of Canada Clinical Trials Group. J Clin Oncol 1993;11(2):336-44.
15. van Netten JP, Ashmed BJ, Cavers D, Fletcher C, Thornton IG, Antonsen BL, Coy P, Brigden ML. 'Macrophages' and their putative significance in human breast cancer. Br J Cancer 1992;66(1):220-1.
16. van Netten JP, Coy P, Fletcher C. Cellularity and oestrogen receptor content in breast cancer microsamples. J Clin Path 1990;43(8):698-9.
17. van Netten JP, Racca RL, Armstrong JB, Brigden ML.,Sellers AR, Coy P, et al. An apparatus to retain the spatial orientation of breast biopsies. Anal Cell Pathol 1989;2(1):59-62.
18. Feld R, Payne D, Hodson I, Coy P. Complications of treatment of small cell carcinoma of the lung. Experience from a recent Canadian trial. Antibiot Chemother 1988;41: 204-9.
19. van Netten JP, Armstrong JB, Carlyle SJ, Goodchild NL, Thornton IG, Brigden ML, Coy P, Fletcher C. Cellular distribution patterns of estrogen receptor in human breast cancer. Eur J Cancer Clin Oncol 1988;24(12):1899-901.
20. van Netten JP, Armstrong JB, Carlyle SS, Goodchild NL, Thornton IG, Brigden ML, Coy P, Fletcher C. Estrogen receptor distribution in the peripheral, intermediate and central regions of breast cancers. Eur J Cancer Clin Oncol 1998;24(12):1885-9.
21. Coy P, Hodson I, Payne DG, Evans WK, Feld R, MacDonald AS, et al. The effect of dose of thoracic irradiation on recurrence in patients with limited stage small cell lung cancer. Initial results of a Canadian Multicenter Randomized Trial. Int J Radiat Oncol Biol Phys 1988;14(2):219-26.
22. van Netten JP, Thornton IG, Carlyle SJ, Brigden ML, Coy P, Goodchild NL, et al. Multiple microsample analysis of intratumor estrogen receptor distribution in breast cancers by a combined biochemical/immunohistochemical method. Eur J Cancer Clin Oncol 1987;23(9):1337-42.
23. Feld R, Evans WK, Coy P, Hodson I, MacDonald AS, Osoba D, et al. Canadian multicenter randomized trial comparing sequential and alternating administration of two non-cross-resistant chemotherapy combinations in patients with limited small-cell carcinoma of the lung. J Clin Oncol 1987;5(9):1401-9.
24. Evans WK, Feld R, Murray N, Willan A, Coy P, Osoba D, et al. Superiority of alternating non-cross-resistant chemotherapy in extensive small cell lung cancer. A multicenter, randomized clinical trial by the National Cancer Institute of Canada [published erratum appears in Ann Intern Med 1988 Mar;108(3):496]. Ann Int Med 1987;107(4):451-8.
25. Kostashuk E, Laukkanen E, Coy P. Radiation therapy in lung cancer. Br Columbia Med J 1987;29(1)603-604.
26. Coy P. The Victoria Cancer Clinic. Br Columbia Med J 1987;29(7):399-400.
27. van Netten JP, Coy P, Brigden ML, Gallagher S, Carlyle SJ, Thornton I. Intermediate estrogen receptor levels in breast cancer. Eur J Cancer Clin Oncol 1986;22(12):1543-5.
28. Evans WK, Feld R, Murray N, Pater J, Shelley W, Willan A, Osoba D, Levitt M, Coy P, et al. The use of VP-16 plus cisplatin during induction chemotherapy for small-cell lung cancer. Semin Oncol 1986;13(3 Suppl 3):10-6.
29. Flores AD, Dickson RI, Riding K, Coy P. Cancer of the nasopharynx in British Columbia. Am J Clin Oncol 1986;9(4): 281-91.
30. Murray N, Shah A, Wilson K, Goldie J, Voss N, Fryer C, Klimo P, Coy P, Hadzic E, et al. Cyclic alternating chemotherapy for small cell carcinoma of the lung. Cancer Treat Rep 1985;69(11):1241-2.
31. van Netten JP, Algard FT, Coy P, Carlyle SJ, Brigden ML, Thornton KR, et al. Heterogeneous estrogen receptor levels detected via multiple microsamples from individual breast cancers. Cancer 1985;56(8):2019-24.
32. van Netten JP, Algard FT, Coy P, Carlyle SJ, Brigden ML, Thornton KR, et al. Estrogen receptor assay on breast cancer microsamples: implications of percent carcinoma

estimation. Cancer 1982;49(11):2383-8.
33. Coy P, Elwood JM, Coldman AJ. Clinical indicators of prognosis in unresected lung cancer. Chest 1981;80(4):453-8.
34. Jackson SM, Olivotto I, McLoughlin MG, Coy P. Radiation therapy for seminoma of the testis: results in British Columbia. Can Med Assoc J 1980;123(6):507-12.
35. Coy P, Kennelly GM. The role of curative radiotherapy in the treatment of lung cancer. Cancer 1980;45(4):698-702.
36. Love R, Stewart IF, Coy P. Upper alveolar carcinoma — a 30 year survey. J Otolaryngol 1977;6(5):393-8,1977.
37. Robins RE, McGregor GI, Hendel P, Coy P. Carcinoma of the parotid gland. Am J Surg 1977;134(1):120-4.
38. Coy P, Thomas JW, Hasham N. Lymphocyte transformation in lung cancer patients. J Can Assoc Radiol 1977;28(1):43-8.
39. Robins RE, Shirley D, Coy P. Treatment of oral carcinoma with selective therapy for the individual patient. Am Surg 1975;41(9):538-42.
40. Coy P, Dolman CL. Radiation myelopathy in relation to oxygen level. Br J Radiol 1971;44(525):705-7.
41. Coy P. A randomized study of irradiation and vinblastine in lung cancer. Cancer 1970;26(4):803-7.
42. Grzybowski S, Coy P. Early diagnosis of carcinoma of the lung. Simultaneous screening with chest X-ray and sputum cytology. Cancer 1970;25(1):113-20.
43. Coy P, Grzybowski S. Screening for lung cancer in BC. Br Columbia Med J 1969;11(7)207-208.
44. Coy P, Baker S, Dolman CL. Progressive myelopathy due to radiation. Can Med Assoc J 1969;100(24):1129-33.
45. Coy P, Grzybowski S, Rowe JF. Lung cancer mortality according to birthplace. Can Med Assoc J 1968;99(10): 476-83.
46. Robertson R, Coy P, Mokkhavesa S. The results of radical surgery compared with radical radiotherapy in the treatment of squamous carcinoma of the thoracic esophagus. The case for preoperative radiotherapy. J Thorac Cardiovasc Surg 1967;53(3):430-40.

deMetz, Catherine E.

1. de Metz CE. Starreveld AA, MacLean GD, Turner AR. Cerebral metastases from epithelial ovarian carcinoma. J Can Assoc Radiol 1987;38(3):192-4.

Douglas, Bruce G

1. Chaplin DJ, Douglas BG, Saito T, Skarsgard LD, Lam GK, Denekamp J. Preclinical evaluation of pions in vivo: experience at TRIUMF. Radiother Oncol 1990;17(1):7-15.
2. Ludgate CM, Douglas BG, Dixon PF, Steinbok P, Jackson SM, Goodman GB. Superfractionated radiotherapy in grade III, IV intracranial gliomas. Int J Radiat Oncol Biol Phys 1988;15(5):1091-5.
3. Chaplin DJ, Douglas BG, Grulkey W, Skarsgard LD, Lam G, Denekamp J. The response of mouse epidermis to fractionated doses of pi mesons. Int J Radiat Oncol Biol Phys 1987;13(8):1199-208.
4. Douglas BG, Grulkey WR, Chaplin DJ, Lam G, Skarsgard LD, Denekamp J. Pions and pig skin: preclinical evaluation of RBE for early and late damage. Int J Radiat Oncol Biol Phys 1986;12(2):221-9.
5. Skarsgard LD, Douglas BG, Denekamp J, Chaplin DJ, Lam GK, Harrison RW, et al. In vitro and in vivo studies of the TRIUMF pion therapy beam. Radiat Res 1985;(Suppl 8): S135-44.
6. Douglas BG, Castro JR. Novel fractionation schemes and high linear energy transfer. Prog Exper Tumor Res 1984;28:152-65.
7. Sherlock CH, Burton JD, Roberts FJ, Douglas BG. AIDS and sudden death. Can Med Assoc J.1983:129(10):1079.
8. Goodman GB, Douglas BG, Jackson SM, Kornelsen RO, Lam GK.,Ludgate CM, et al. Pions, Vancouver. Int J Radiat Oncol Biol Phys 1982;8(12):2187-90.
9. Skarsgard LD, Palcic B, Douglas BG, Lam GK. Radiobiology of pions at TRIUMF. Int J Radiat Oncol Biol Phys 1982;8(12):2127-32.
10. Douglas BG, Worth AJ. Superfractionation in glioblastoma multiforme — results of a phase II study. Int J Radiat Oncol Biol Phys 1982;8(10):1787-94.
11. Douglas BG. Superfractionation: its rationale and anticipated benefits. Int J Radiat Oncol Biol Phys 1982;8(7): 143-53.
12. Douglas BG. Implications of the quadratic cell survival curve and human skin radiation "tolerance doses" on fractionation and superfractionation dose selection. Int J Radiat Oncol Biol Phys 1982;8(7):135-42.
13. Lam GK, Henkelman RM, Douglas BG, Eaves CJ. Dose dependence of pion RBE values for mouse foot skin reactions. Int J Radiat Oncol Biol Phys 1981;7(12):689-94.
14. Douglas BG, Henkelman RM, Lam GK, Fowler JF, Eaves CJ. Practical and theoretical considerations in the use of the mouse foot system to derive epithelial stem cell survival parameters. Radiat Res 1979;77(3):43-71.
15. Lam GK, Henkelman RM, Douglas BG, Eaves CJ. Method of analysis to derive cell survival from observation of tissue damage following fractionated irradiation. Radiat Res 1979;77(3):40-52.
16. Douglas BG. Preliminary results using superfractionation in the treatment of glioblastoma multiforme. J Can Assoc Radiol 1977;28(2):106-10.

17. Douglas BG, Fowler JF. The effect of multiple small doses of x rays on skin reactions in the mouse and a basic interpretation. Radiat Res 1976;66(2):401-26.
18. Denekamp J, Stewart FA, Douglas BG. Changes in the proliferation rate of mouse epidermis after irradiat-on continuous labelling studies. Cell Tissue Kinet 1976;9(1): 19-29.
19. Douglas BG, Fowler JF. Fractionation schedules and a quadratic dose-effect relationship [letter]. Br J Radiol 1975;48(570):502-4.
20. Douglas BG, Dagirmanjian R. The effects of magnesium deficiency of ketamine sleeping times in the rat. Br J Anaesth 1975:47(3):336-40.
21. Douglas BG, Fowler JF, Denekamp J, Harris SR, Ayres SE, Fairman S, et al. The effect of multiple small fractions of x-rays on skin reactions in the mouse. In: Alper T, editor. Cell survival after low doses of radiation: theoretical and clinical implications. London: Institute of Physics, 1975, p. 351-61.

Duncan, Graeme G.

1. Duncan GG, Philips N, Pickles T. Report on the quality of life analysis from the phase III trial of pion versus photon radiotherapy in locally advanced prostate cancer. Eur J Cancer 2000;36(6):759-65.
2. Pickles T, Duncan GG, Kim-sing C, McKenzie MR, Morris WJ. PSA relapse definitions — the Vancouver Rules show superior predictive power [letter, comment]. Int J Radiat Oncol Biol Phys 1999;43(3):699-700.
3. Pickles T, Goodman GB, Fryer CJ, Bowen J, Coldman AJ, Duncan GG, Graham P, McKenzie M, Morris WJ, Rheaume DE, Syndikus I. Pion conformal radiation of prostate cancer: results of a randomized study. Int J Radiat Oncol Biol Phys 1999;43(1):47-55.
4. Pickles T, Goodman GB, Rheaume DE, Duncan GG, Fryer CJ, Bhimji S, Ludgate C, Syndikus I, Graham P, Dimitrov M, Bowen J. Pion radiation for high grade astrocytoma: results of a randomized study. Int J Radiat Biol Phys 1977;37(3):491-7.
5. Pickles T, Graham P, Syndikus I, Rheaume DE, Duncan GG, Green A, Marlow C. Tolerance of nicotinamide and carbogen with radiation therapy for glioblastoma. Radiother Oncol 1996;40(3):245-7.
6. Novick GE, Novick CC, Yunis J, Yunis E, Martinez K, Duncan GG, et al. Polymorphic human specific Alu insertions as markers for human identification. Electrophoresis 1995;16(9):1596-601.
7. McKenzie M, Duncan G, Nixon L, MacKenzie G. The British Columbia Cancer Agency: joining the palliative care team. Br Columbia Med J 1995;37(8):538-543.
8. Duncan GG, Rheaume DE. Management of extradural spinal cord compression in malignancy. Br Columbia Med J 1995;37(2):99-101.
9. Rootman J, Duncan GG. Management of Graves' orbitopathy. Br Columbia Med J 1994;36(12):705-808.
10. Duncan GG, Goodman GB, Ludgate CM, Rheaume DE. The treatment of adult supratentorial high-grade astrocytomas. J Neurooncol 1992;13(1):63-72.

Evans, A. Maxwell

1. Evans AM, Moffat RG, Nash RD, Batho HF, Mibus SA. Cobalt 60 Beam Therapy. J Fac Radiol 1954; 5(4):248-260.
2. Evans AM. The treatment of cancer of the larynx. J Can Assoc Radiol 1962;XIII:131-134.

Fairey, Randall N.

1. Reece DE, Nevill TJ, Sayegh A, Spinelli JJ, Brockington DA, Barnett MJ, Klingemann HG, Connors JM, Nantel SH, Shepherd JD, Sutherland HJ, Voss NJ, Fairey RN, O'Reilly SE, Phillips GL. Regimen-related toxicity and non-relapse mortality with high-dose cyclophosphamide, carmustine (BCNU) and etoposide (VP16-213) (CBV) and CBV plus cisplatin (CBVP) followed by autologous stem cell transplantation in patients with Hodgkin's disease. Bone Marrow Transplant 1999;23(11):113188.
2. Kwa W, Tsang V, Fairey RN, Jackson SM, El-Khatib E, Harrison RW, Kristensen S. Clinical use of asymmetric collimators. Int J Radiat Oncol Biol Phys 1977;37(3):705-10.
3. Reece DE, Barnett MJ, Shepherd JD, Hogge DE, Klasa RJ, Nantel SH, Sutherland HJ, Klingemann HG, Fairey RN, Voss NJ, et al. High-dose cyclophosphamide, carmustine (BCNU), and etoposide (VP16-213) with or without cisplatin (CBV +/- P) and autologous transplantation for patients with Hodgkin's disease who fail to enter a complete remission after combination chemotherapy. Blood 1995;86(2):451-6.
4. Reece DE, Connors JM, Spinelli JJ, Barnett MJ, Fairey RN, Klingemann HG, Nantel SH, et al. Intensive therapy with cyclophosphamide, carmustine, etoposide +/- cisplatin, and autologous bone marrow transplantation for Hodgkin's disease in first relapse after combination chemotherapy [see comments]. Blood 1994;83(5):1193-9.
5. Hoskins PJ, O'Reilly SE, Swenerton KD, Spinelli JJ, Fairey RN, Benedet JL. Ten-year outcome of patients with advanced epithelial ovarian carcinoma treated with cisplatin-based multimodality therapy [see comments]. J Clin Oncol 1992;10(10):1561-8.
6. Reece DE, Barnett MJ, Connors JM, Fairey RN, Fay JW,

Greer JP, Herzig GP, et al. Intensive chemotherapy with cyclophosphamide, carmustine, and etoposide followed by autologous bone marrow transplantation for relapsed Hodgkin's disease [published erratum appears in J Clin Oncol 1992 Jan;10(1):170]. J Clin Oncol 1991;9(10): 1871-9.

7. Lohri A, Barnett M, Fairey RN, O'Reilly SE, Phillips GL, Reece D, Voss N, Connors JM. Outcome of treatment of first relapse of Hodgkin's disease after primary chemotherapy: identification of risk factors from the British Columbia experience 1970 to 1988. Blood 1991;77(10): 2292-8.
8. de Smet MD, Buffam FV, Fairey RN, Voss NJ. Prevention of radiation-induced stenosis of the nasolacrimal duct. Can J Ophthalmol 1990;25(3):145-7.
9. Jackson SM, Fairey RN, Kornelsen RO, Young ME, Wong FL. Clinical results in carcinoma of the cervix: radium compared to caesium using remote afterloading. Clin Radiol 1989;40(3):302-6.
10. Olivotto IA, Fairey RN, Gillies JH, Stein H. Fatal outcome of pelvic radiotherapy for carcinoma of the cervix in a patient with systemic lupus erythematosis. Clin Radiol 1989;40(1):83-4.
11. Connors JM, Klimo P, Voss N, Fairey RN, Jackson S. Testicular lymphoma: improved outcome with early brief chemotherapy. J Clin Oncol 1988;6(5):776-81.
12. Connors JM, Klimo P, Fairey RN, Voss N. Brief chemotherapy and involved field radiation therapy for limited-stage, histologically aggressive lymphoma. Ann Intern Med 1987;107(1):25-30.
13. Fairey RN, MacKay PA, Benedet JL, Boyes DA, Turko M. Radiation treatment of carcinoma of the vulva, 1950-1980. Am J Obstet Gynecol 1985;151(5):591-7.
14. Wong F, Fairey RN. Radiation oncology — the misunderstood specialty. J Can Assoc Radiol 1984;35(2):144-8.
15. Benedet JL, Murphy KJ, Fairey RN, Boyes DA. Primary invasive carcinoma of the vagina. Obstet Gynecol 1983;62(6): 715-9.
16. Benedet JL, White GW, Fairey RN. Common errors in the management of endometrial adenocarcinoma Br Columbia Med J 1980;22(1)23-26.
17. Benedet JL, Turko M, Fairey RN, Boyes DA. Squamous carcinoma of the vulva: results of treatment, 1938 to 1976. Trans Pacific Coast Obstet Gynecoll Soc 1979;46:105-11.
18. Benedet JL, Turko M, Fairey RN, Boyes DA. Squamous carcinoma of the vulva: results of treatment, 1938 to 1976. Am J Obstet Gynecol 1979;134(2):201-7.
19. Pankratz E, Boyes DA, White GW, Galliford BW, Fairey RN, Benedet JL. Granulosa cell tumors. A clinical review of 61 Cases. Obstet Gynecol 1978;52(6):718-23.
20. Boyes DA, Pankratz E, Walliford BW, White GW, Fairey RN. Experience with dysgerminomas at the Cancer Control Agency of British Columbia. Gynecol Oncol 1978;6(2): 23-9.
21. Benedet JL, White GW, Fairey RN, Boyes DA. Adenocarcinoma of the fallopian tube. Experience with 41 patients. Obstet Gynecol 1977;50(6):654-7.
22. Boyes DA, Pankratz E, Galliford B, White GM, Fairey RN, Yuen BH. Treatment of trophoblastic neoplasia at the Cancer Control Agency of British Columbia. Can Med Assoc J 1977;117(7):753-6.
23. Brereton HD, Fairey RN, Johnson RE. Successful chemotherapy of advanced non-Hodgkin's lymphoma after relapse following total body irradiation. Int J Radiat Oncol Biol Phys 1977;2(3-4):249-55.
24. Fairey RN, Kennedy BJ. Oncology as a subspecialty? Ann Intern Med 1971;74(3):447-8.
25. Fairey RN, Cwan RJ. A new method for measuring skin surface areas. Can J Surg 1967;10(3):371-8.

Flores, Albino D.

1. Jackson SM, Hay JH, Flores AD, Weir L, Wong FL, Schwindt C, Baerg B. Cancer of the tonsil: the results of ipsilateral radiation treatment. Radiother Oncol 1999;51(2):123-8.
2. Lau HY, Hay JH, Flores AD, Threlfall WJ. Seven fractions of twice daily high dose-rate brachytherapy for node-negative carcinoma of the mobile tongue results in loss of therapeutic ratio. Radiother Oncol 1996;39(1):15-8.
3. Newman G, Calverley DC, Acker BD, Manji M, Hay J, Flores AD. The management of carcinoma of the anal canal by external beam radiotherapy, experience in Vancouver 1971-1988. Radiother Oncol 1992;25(3):196-202.
4. Sikand A, Flores AD, Morrison MD, Durham JS. Design and evaluation of a subclassification system for supraglottic laryngeal cancer [see comments]. J Otolaryngol 1992;21(4):270-5.
5. MacNab TI, Flores AD, Anderson DW. Treatment of paranasal sinus malignancy: the BCCA experience. J Otolaryngol 1992;21(4):244-8.
6. Osoba D, Flores AD, Hay JH, Wong F, Maher M. Phase I study of concurrent carboplatin and radiotherapy in previously untreated patients with stage III and IV head and neck cancer. Head Neck 1991;13(3):217-22.
7. Hay JH, Flores AD. Intraluminal irradiation in oesophageal tumors using the high-dose-rate Microselectron [letter; comment]. Br J Radiol 1990;63(751):583-4.
8. Flores AD. Cancer of the esophagus and cardia: overview of radiotherapy. Can J Surg 1989;32(6):404-9.

9. Flores AD, Nelems B, Evans K, Hay JH, Stoller J, Jackson SM. Impact of new radiotherapy modalities on the surgical management of cancer of the esophagus and cardia. Int J Radiat Oncol Biol Phys 1989;17(5):937-44.
10. Berry B, Miller RR, Luoma A, Nelems B, Hay J, Flores AD. Pathologic findings in total esophagectomy specimens after intracavitary and external-beam radiotherapy. Cancer 1989;64(9):1833-7.
11. Flores AD, Dickson RI, Riding K, Coy P. Cancer of the nasopharynx in British Columbia. Am J Clin Oncol 1986;9(4): 281-91.
12. Goodman GB, Dixon P, Lam GK, Harrison R, Kornelsen RO, Ludgate CM, Flores AD. Preparatory clinical studies of Pi-mesons at TRIUMF. Radiat Res Suppl 1985;8:S279-84.
13. Stoller JL, Flores AD. Intracavitary irradiation for oesophageal cancer [letter]. Lancet 1985;2(8468):1365.
14. Ogrady M, Doyle PJ, Flores AD. Cancer of the tonsil. J Otolaryngol 1985;14(4):221-5.
15. Dickson RI, Flores AD. Nasopharyngeal carcinoma: an evaluation of 134 patients treated between 1971-1980. Laryngoscope 1985;95(3):276-83.
16. Flores AD, Anderson DW, Doyle PJ, Jackson SM, Morrison MD. Paranasal sinus malignancy — a retrospective analysis of treatment methods. J Otolaryngol 1984;13(3):141-6.
17. Blokmanis A, Flores AD, Smith JM, Taylor MT. T3 and T4 carcinoma of the larynx — a retrospective study. J Otolaryngol 1981;10(3):195-8.
18. Doyle PJ. Flores AD. Treatment of carcinoma in situ of the larynx. J Otolaryngol 19776(5):363-77.
19. Stoller JL, Samer KJ, Toppin DI, Flores AD. Carcinoma of the esophagus: a new proposal for the evaluation of treatment. Can J Surg 1977;20(5):454-9.

Froud, Peter

1. Wong R, Thomas G, Cummings B, Froud P, Shelley W, Withers R, Williams J. In search of a dose-response relationship with radiotherapy in the management of recurrent rectal carcinoma in the pelvis: a systematic review. Int J Radiat Oncol Biol Phys 1998;40(2):437-46.
2. Wong R, Thomas G, Cummings B, Froud P, Shelley W, Withers RH, Williams J. The role of radiotherapy in the management of pelvic recurrence of rectal cancer. Can J Oncol 1996;(6 Suppl 1):39-47.
3. Wilson JW, Morales A, Bruce AW, Froud P. Interstitial radiotherapy for localized carcinoma of the prostate. Can J Surg 1983;26(4):363-5.

Fryer, Christopher J.

1. Pickles T, Goodman GB, Fryer CJ, Bowen J, Coldman AJ, Duncan GG, Graham P, McKenzie M, Morris WJ, Rheaume DE, Syndikus I. Pion conformal radiation of prostate cancer: results of a randomized study. Int J Radiat Oncol Biol Phys 1999;43(1):47-55.
2. Hutchinson RJ, Fryer CJ, Davis PC, Nachman J, Krailo MD, O'Brien RT, Collins RD, Whalen T, Reardon D, Trigg ME, Gilchrist GS. MOPP or radiation in addition to ABVD in the treatment of pathologically staged advanced Hodgkin's disease in children: results of the Children's Cancer Group Phase III Trial. J Clin Oncol 1998;16(3):897-906.
3. Lawlor ER, Murphy JI, Sorensen PH, Fryer CJ. Metastatic primitive neuroectodermal tumour of the ovary: successful treatment with mega-dose chemotherapy followed by peripheral blood progenitor cell rescue. Med Pediatr Oncol 1997;29(4):308-12.
4. Lawlor ER, Anderson RA, Davis JH, Fryer CJ, Pritchard SL, Rogers PC, Wu JK, Schultz KR. Immunosuppressive therapy: a potential alternative to bone marrow transplantation as initial therapy for acquired severe aplastic anemia in childhood? J Pediatr Hematol Oncol 1997;19(2): 115-23.
5. Pickles T, Goodman GB, Rheaume DE, Duncan GG, Fryer CJ, Bhimji S, Ludgate C, Syndikus I, Graham P, Dimitrov M, Bowen J. Pion radiation for high-grade astrocytoma: results of a randomized study. Int J Radiat Oncol Biol Phys 1997;37(3):491-7.
6. Inomata T, Goodman GB, Fryer CJ, Chaplin DJ, Palcic B, Lam GK, Nishioka A, Ogawa Y. Immune reaction induced by X-rays and pions and its stimulation by schizophyllan (SPG). Br J Cancer 1996;27(Suppl):S122-5.
7. Fryer CJ. Pelvic rhabdomyosarcoma: paying the price of bladder preservation. Lancet 1995;345(8943):141-2.
8. Agranovich AL, Ang LC, Fryer CJ. Central neurocytoma: report of 2 cases and literature review. J Neurooncol 1993;16(1):47-53.
9. Hays DM, Fryer CJ, Pringle KC, Collins RD, Hutchinson RJ, O'Neill JA, Constine LS, et al. An evaluation of abdominal staging procedures performed in pediatric patients with advanced Hodgkin's disease: a report from the Childrens Cancer Study Group. J Pediatr Surg 1992;27(9):1175-80.
10. Fryer CJ. Paediatric oncology: the optimal model for evaluating radiation-chemotherapy interactions. Front Radiat Ther Oncol 1992;26:162-71.
11. Chan KW, Rogers PC, Fryer CJ. Breast metastases after bone marrow transplantation for rhabdomyosarcoma. Bone Marrow Transplant 1991;7(2):171-2.
12. Chan KW, Fryer CJ, Steinbok P. Modification of the 8 drugs in 1 day regimen: feasibility of substitution of other agents. J Neurooncol 1990;9(2):153-7.

13. Fryer CJ, Hutchinson RJ, Krailo M, Collins RD, Constine LS, Hays DM, Heller RM et al. Efficacy and toxicity of 12 courses of ABVD chemotherapy followed by low-dose regional radiation in advanced Hodgkin's disease in children: a report from the Children's Cancer Study Group. J Clin Oncol 1990;8(12):1971-80.
14. Makley JT, Krailo M, Ertel IJ, Fryer CJ, Baum ES, Weetman RM, Yunis EJ et al. The relationship of various aspects of surgical management to outcome in childhood nonmetastatic osteosarcoma: a report from the Childrens Cancer Study Group. J Pediatr Surg 1988;23(2):146-51.
15. Chan KW, Fryer CJ, Denegri JF, Buskard NA, Phillips GL. Allogeneic bone marrow transplantation using partially-matched related donors. Bone Marrow Transplant 1987;2(1):27-32.
16. Krailo M, Ertel I, Makley J, Fryer CJ, Baum E, Weetman R, Yunis E, et al. A randomized study comparing high-dose methotrexate with moderate-dose methotrexate as components of adjuvant chemotherapy in childhood nonmetastatic osteosarcoma: a report from the Childrens Cancer Study Group. Med Pediatr Oncol 1987;15(2):69-77.
17. Strife CF, Quinlan M, Waldo FB, Fryer CJ, Jackson EC, Welch TR, McEnery PT, et al. Minoxidil for control of acute blood pressure elevation in chronically hypertensive children. Pediatr 1986;78(5):861-5.
18. Steinbok P, Flodmark O, Norman MG, Chan KW, Fryer CJ. Primary Ewing's sarcoma of the base of the skull. Neurosurg 1986;19(1):104-7.
19. Fryer CJ. Advances in pediatric radiotherapy in the last ten years and future proposals. Cancer 1986;58(2 Suppl): 554-60.
20. Reece DE, Buskard NA, Hill RS, Fryer CJ, Naiman SC, Phillips GL. Allogeneic bone marrow transplantation for Philadelphia-chromosome positive acute lymphoblastic leukemia. Leuk Res 1986;10(4):457-9.
21. Chan KW, Fryer CJ, Fraser GC, Dimmick JE. Sudden cerebral death in malignant presacral teratoma. Med Pediatr Oncol;1985;13(6):395-7.
22. Rogers PC, Fryer CJ, Hussein S. Radiation dose to the thyroid in the treatment of acute lymphoblastic leukemia (ALL). Med Pediatr Oncol 1982;10(4):385-8.
23. Van Dyk J, Keane TJ, Kan S, Rider WD, Fryer CJ. Radiation pneumonitis following large single dose irradiation: a re-evaluation based on absolute dose to lung. Int J Radiat Oncol Biol Phys 1981;7(4):461-7.
24. Coldman AJ, Fryer CJ, Elwood JM, Sonley MJ. Neuroblastoma: influence of age at diagnosis, stage, tumor site, and sex on prognosis. Cancer 1980;46(8):1896-1901.
25. Fryer CJ. Therapeutic ratio and radiosensitizers [letter]. Br J Radiol 1979;52(618):507-8.
26. Fryer CJ. The bone marrow organ: the critical structure in radiation-drug interaction [letter]. Int J Radiat Oncol Biol Phys 1979;5(4):583.
27. Fryer CJ, Fitzpatrick PJ, Rider WD, Poon P. Radiation pneumonitis: experience following a large single dose of radiation. Int J Radiat Oncol Biol Phys 1978;4(11-12): 931-6.

Gibson, John M.

1. Gibson JM, Prinn MG. Hodgkin's disease involving the thyroid gland. Br J Surgery 1968;55(3):236-8.

Goddard, Karen J.

1. Westeel V, Murray N, Gelmon K, Shah A, Sheehan F, McKenzie M, Wong F, Morris J, Grafton C, Tsang V, Goddard K, Murphy K, Parsons C, Amy R, Page R. New combination of the old drugs for elderly patients with small-cell lung cancer: a phase II study of the PAVE regimen. J Clin Oncol 1998;16(5):1940-7.
2. Munk PL, Lee MJ, Poon PY, Goddard KJ, Knowling MA, Hassell PR. Computed tomography of retroperitoneal and mesenteric sarcomas: a pictorial essay. J Can Assoc Radiol 1996;47(5):335-41.
3. Neumann E, Kalousek DK, Norman MG, Steinbok P, Cochrane DD, Goddard K. Cytogenetic analysis of 109 pediatric central nervous system tumors. Cancer Genet Cytogenet 1993;71(1):40-9.
4. Murray N, Shah A, Osoba D, Page R, Karsai H, Grafton C, Goddard K, Fairey R, Voss N. Intensive weekly chemotherapy for the treatment of extensive-stage small-cell lung cancer. J Clin Oncol 1991;9(9):1632-8.
5. Jenkin D, Goddard K, Armstrong D, Becker L, Berry M, Chan H, Doherty M, et al. Posterior fossa medulloblastoma in childhood: treatment results and a proposal for a new staging system. Int J Radiat Oncol Biol Phys 1990;19(2):265-74.

Goodman, George B.

1. Pickles T, Goodman GB, Fryer CJ, Bowen J, Coldman AJ, Duncan GG, Graham P, McKenzie M, Morris WJ, Rheaume DE, Syndikus I. Pion conformal radiation of prostate cancer: results of a randomized study. Int J Radiat Oncol Biol Phys 1999;43(1):47-55.
2. Pickles T, Goodman GB, Rheaume DE, Duncan GG, Fryer CJ, Bhimji S, Ludgate C, Syndikus I, Graham P, Dimitrov M, Bowen J. Pion radiation for high grade astrocytoma: results of a randomized study. Int J Radiat Oncol Biol Phys 1997;37(3):491-7.

3. Inomata T, Goodman GB, Fryer CJ, Chaplin DJ, Palcic B, Lam GK, Nishioka A, Ogawa Y. Immune reaction induced by X-rays and pions and its stimulation by schizophyllan (SPG). Br J Cancer 1996; 27(Suppl):S122-5.
4. Pickles T. Lam G. Goodman GB. Late results in patients treated with pi-mesons for bladder cancer. Cancer 1993;72(7):2286.
5. Takai Y, Goodman GB, Chaplin DJ, Grulkey W, Lam GK. The response of murine B-16 melanoma to fractionated doses of pions. Int J Radiat Oncol Biol Phys 1992;23(3):573-8,.
6. Duncan GG, Goodman GB, Ludgate CM, Rheaume DE. The treatment of adult supratentorial high grade astrocytomas. J Neurooncol 1992;13(1):63-72.
7. Goodman GB, Kaplan PD, Stachura I, Castranova V, Pailes WH, Lapp NL. Acute silicosis responding to corticosteroid therapy. Chest. 1992;101(2):366-70.
8. Pickles T, Bowen J, Dixon P, Gaffney C, Pomeroy M, Rheaume D, Vernimmen F, Goodman GB. Pions — the potential for therapeutic gain in locally advanced prostate cancer: dose escalation and toxicity studies. Int J Radiat Oncol Biol Phys 1991;21(4):1005-11.
9. Ogawa Y, Goodman GB, Chaplin DJ, Grulkey W, Lam GK. The response of mouse tumours to fractionated doses of pions: determination of therapeutic gain factor. Oncology 1991;48(1):81-7.
10. Ogawa Y, Goodman GB, Chaplin DJ, Grulkey W, Lam GK. Combination therapy of pions and SPG (Sonifilan, Schizophyllan), a biological response modifier for mouse tumor systems. Int J Radiat Oncol Biol Phys 1990;18(6):1415-20.
11. Goodman GB, Skarsgard LD, Thompson GB, Harrison R, Lam GK, Ludgate C. Pion therapy at TRIUMF. Treatment results for astrocytoma grades 3 and 4: a pilot study. Radiother Oncol 1990;17(1):21-8.
12. Shirato H, Harrison R, Kornelsen RO, Lam GK, Gaffney CC, Goodman GB, Grochowski E, Pate B. Detection of pion-induced radioactivity by autoradiography and positron emission tomography. Med Phys 1989;16(3):338-45.
13. Shirato H, Gaffney CC, Goodman GB. Autoradiographic imaging of pion stopping distribution utilizing scanning laser stimulated luminescence. Br J Radiol 1989;62(735): 285-7.
14. Ludgate CM, Douglas BG, Dixon PF, Steinbok P, Jackson SM, Goodman GB. Superfractionated radiotherapy in grade III, IV intracranial gliomas. Int J Radiat Oncol Biol Phys 1988;15(5):1091-5.
15. Goodman GB. Skarsgaard LD. La Brooy M. Triumf Pion Therapy. Br Columbia Med J 1987;29(7) 394-397.
16. Goodman GB, Lam GK, Harrison RW, Bergstrom M, Martin WR, Pate BD. The use of positron emission tomography in pion radiotherapy. Int J Radiat Oncol Biol Phys 1986;12(10):1867-71.
17. Goodman GB, Dixon P, Lam GK, Harrison R, Kornelsen RO, Ludgate CM, Flores AD. Preparatory clinical studies of Pi-mesons at TRIUMF. Rad Res 1985;8(Suppl):S279-84.
18. Goodman GB, Douglas BG, Jackson SM, Kornelsen RO, Lam GK, Ludgate CM, Skarsgard LD. Pions, Vancouver. Int J Radiat Oncol Biol Phys 1982;8(12):2187-90.
19. Goodman GB, Hislop TG, Elwood JM, Balfour J. Conservation of bladder function in patients with invasive bladder cancer treated by definitive irradiation and selective cystectomy. Int J Radiat Oncol Biol Phys 1981;7(5):569-73.
20. Goodman GB, Price JD, Batho HF. An assessment of the effect on renal function of irradiation for testicular tumours. Clin Radiol 1972;23(2):235-45.
21. Goodman GB, Balfour JB. Radical Cobalt 60 in bladder cancer. J Urol 1964;92(1):30-36.
22. Goodman GB, Balfour JB. Local Recurrence of bladderc-Cancer after supervoltage irradiation. J Can Assoc Radiol 1964;XV:92-98,1964.

Grafton, Clive A.

1. Murray N, Livingston RB, Shepherd FA, James K, Zee B, Langleben A, Kraut M, Bearden J, Goodwin JW, Grafton C, et al. Randomized study of CODE versus alternating CAV/EP for extensive-stage small-cell lung cancer: an Intergroup Study of the National Cancer Institute of Canada Clinical Trials Group and the Southwest Oncology Group. J Clin Oncol 1999;17(8):2300-8.
2. Murray N, Grafton C, Shah A, Gelmon K, Kostashuk E, Brown E, Coppin C, et al. Abbreviated treatment for elderly, infirm, or noncompliant patients with limited-stage small-cell lung cancer. J Clin Oncol 1998;16(10):3323-8.
3. Westeel V, Murray N, Gelmon K, Shah A, Sheehan F, McKenzie M, Wong F, Morris J, Grafton C, Tsang V, Goddard K, Murphy K, Parsons C, Amy R, Page R. New combination of the old drugs for elderly patients with small-cell lung cancer: a phase II study of the PAVE regimen. J Clin Oncol 1988;16(5):1940-7.
4. Murray N, Shah A, Osoba D, Page R, Karsai H, Grafton C, Goddard K, Fairey R, Voss N. Intensive weekly chemotherapy for the treatment of extensive-stage small-cell lung cancer. J Clin Oncol 1991;9(9):1632-8.
5. Quirt I, Eisenhauer E, Bramwell V, Knowling M, Grafton C, Hirte W, Cripps M, Maksymiuk A. Phase II study of
6. mitoxantrone in untreated and previously minimally treated patients with metastatic soft tissue sarcomas. Cancer Treat Rep 1987;71(11):1109-10.

7. Worth AJ, Basco VE, Grafton CA, Jackson SM, Baird RM, Brown DA, Clay MG, et al. Conservative breast surgery. Br Columbia Med J 1986;28(1):27-29.
8. Holmvang AM, Grafton C, Sandy JT. Review of conservative surgery in early breast cancer: British Columbia experience. Am J Surg 1985;149(5):599-601.

Hadzic, Eyub

1. Murray N, Shah A, Wilson K, Goldie J, Voss N, Fryer C, Klimo P, Coy P, Hadzic E, et al. Cyclic alternating chemotherapy for small cell carcinoma of the lung. Cancer Treat Rep 1985;69(11):1241-2.

Hay, John H.

1. Jackson SM, Hay JH, Flores AD, Weir L, Wong FL, Schwindt C, Baerg B. Cancer of the tonsil: the results of ipsilateral radiation treatment. Radiother Oncol 1999;51(2):123-8.
2. Taylor RH, Hay JH, Larsson SN. Transanal local excision of selected low rectal cancers. Am J Surg 1998;175(5):360-3.
3. Jackson SM, Weir LM, Hay JH, Tsang VH, Durham JS. A randomised trial of accelerated versus conventional radiotherapy in head and neck cancer. Radiother Oncol 1997;43(1):39-46.
4. Lau HY, Hay JH, Flores AD, Threlfall WJ. Seven fractions of twice daily high dose-rate brachytherapy for node-negative carcinoma of the mobile tongue results in loss of therapeutic ratio. Radiother Oncol 1996;39(1):15-8.
5. Ma R, Epstein JB, Emerton S, Hay JH. A preliminary investigation of an association between dental restorations and carcinoma of the tongue. Eur J Cancer. Part B, Oral Oncol 1995;31B(4):232-4.
6. McGregor GI, Davis NL, Hay JH. Impact of cervical lymph node metastases from squamous cell cancer of the lip. Am J Surg 1992;163(5):469-71.
7. Osoba D, Flores AD, Hay JH, Wong F, Maher M. Phase I study of concurrent carboplatin and radiotherapy in previously untreated patients with stage III and IV head and neck cancer. Head Neck 1991;13(3):217-22;discussion 222-3.
8. Hay JH, Flores AD. Intraluminal irradiation in oesophageal tumors using the high-dose-rate Microselectron . Br J Radiol 1990;63(751):583-4,1990.
9. Flores AD, Nelems B, Evans K, Hay JH, Stoller J, Jackson SM. Impact of new radiotherapy modalities on the surgical management of cancer of the esophagus and cardia. Int J Radiat Oncol Biol Phys 1989;17(5):937-44.
10. Hay JH, Busuttil A. Steel CM. Duncan W. The growth and histological characteristics of a series of human bladder cancer xenografts. Radiother Oncol 1986;7(4):331-40.
11. Canney PA, Larsson SN, Hay JH, Yussuf MA. Case report: Salmonella pneumonia associated with chemotherapy for non-Hodgkin's lymphoma. Clin Radiol 1985;36(5):459-60.
12. Hay JH, Morten JE, Clarke B, Swinton J. The suitability of immunosuppressed mice kept in a standard animal unit as recipients of human tumour xenografts. Lab Anim 1985;19(2):119-22.
13. Morten JE, Hay JH, Steel CM, Foster ME, De Angelis CL, Busuttil A. Tumorigenicity of human lymphoblastoid cell lines, acquired during in vitro culture and associated with chromosome gains. Int J Cancer 1984;34(4):463-70.
14. Hay JH, Duncan W, Kerr GR. Subsequent malignancies in patients irradiated for testicular tumours. Br J Radiol 1984;57(679):597-602.
15. Hay JH, Duncan W, Kerr GR. Radiotherapy of testicular tumours: an analysis of patients treated in Scotland between 1950 and 1969. Clin Radiol 1984;35(1):13-6.
16. Hay JH, Busuttil A. Oat-cell carcinoma of the larynx. J Laryngol Otol 1981;95(10):1081-8.

Haylock, Brian J.

1. Haylock BJ, Coppin CM, Jackson J, Basco VE, Wilson KS. Locoregional first recurrence after mastectomy: prospective cohort studies with and without immediate chemotherapy. Int J Radiat Oncol Biol Phys 2000;46(2): 355-62.
2. Haylock BJ, Coppin CML, Basco VE, Olivotto IA. A prospective study of the effect of combination chemotherapy in isolated locoregional recurrence (stage IV NED) after mastectomy. Clin Invest Med 1996;39:591.
3. Haylock BJ, Murrell DS, Bourne H, Acworth P. Stage I endometrial carcinoma: the role of neoadjuvant progesterone therapy. Clin Oncol 1993;5(2):102-6.
4. Haylock BJ, Deutsch GP. Radiotherapy treatment for subglottic carcinoma. Clini Oncol 1993;5:143-146.
5. Haylock BJ, Deutsch GP. Radiotherapy for subglottic carcinoma (15 year review). Br J Radiol 1991;64(Congress Suppl): 124.
6. Haylock BJ, John DG, Paterson CM. The treatment of paranasal sinus malignancy. A review of 72 cases. Clin Oncol 1991;3:(1);17.
7. Maughan TS, Haylock BJ, Mayward M, Facey P, Evans WD, Shelley MD, Fish RG, Adams M. Immunoscintigraphy inovarian carinoma. A comparison with alternative methods of assessment. Clin Oncol 1990;2(4):199.
8. Trafford JAP, Freedman A, Bennet-Jones D, Haylock BJ. A double blind comparison of Inderal L.A. (160mg/day) with conventional Inderal (80 mg twice daily) in the management of hypertension. Br J Clin Pract Suppl 1982.

Hoegler, David B.

1. Hoegler DB, Davey P. A prospective study of short course radiotherapy in elderly patients with malignant glioma. J Neurooncol 1997;33(3):201-4.
2. Hoegler D. Radiotherapy for palliation of symptoms in incurable cancer. Curr Probl Cancer 1997;21(3):129-83.
3. Hoegler DB, Sole MJ, Liew CC. Rat brain regional preproenkephalin A messenger RNA levels are altered in genetic hypertension. Am J Hypertens 1989;2(7):542-8.

Jackson, Stewart M.

1. Froud PJ, Mates D, Jackson JS, Phillips N, Andersen S, Jackson SM, Bryce CJ, Olivotto IA. Effect of time interval between breast-conserving surgery and radiation therapy on ipsilateral breast recurrence. Int J Radiat Oncol Biol Phys 2000;46(2):363-72.
2. Olive PL, Durand RE, Jackson SM, Le Riche JC, Luo C, Ma R, McLaren DB, Aquino-Parsons C, Thomson TA, Trotter T. The comet assay in clinical practice. Acta Oncol 1999;38(7):839-44.
3. Jackson SM, Baerg B. Compliance with radiation treatment guidelines in a provincial setting. Cancer Prevent Contr 1999;3(3):196-201.
4. Jackson SM, Hay JH, Flores AD, Weir L, Wong FL, Schwindt C, Baerg B. Cancer of the tonsil: the results of ipsilateral radiation treatment. Radiother Oncol 1999;51(2):123-8.
5. Zhang Y, LeRiche JC, Jackson SM, Garner D, Palcic B. An automated image cytometry system for monitoring DNA ploidy and other cell features of radiotherapy and chemotherapy patients. Radiat Med 1999;17(1):47-57.
6. Ragaz J, Jackson SM, Le N, Plenderleith IH, Spinelli JJ, Basco VE, Wilson KS, Knowling MA, Coppin CM, Paradis M, Coldman AJ, Olivotto IA. Adjuvant radiotherapy and chemotherapy in node-positive premenopausal women with breast cancer. N Engl J Med 1997;337(14):956-62.
7. Jackson SM, Weir LM, Hay JH, Tsang VH, Durham JS. A randomised trial of accelerated versus conventional radiotherapy in head and neck cancer. Radiother Oncol 1997;43(1):39-46.
8. Kwa W. Tsang V, Fairey RN, Jackson SM, El-Khatib E, Harrison RW, Kristensen S. Clinical use of asymmetric collimators. Int J Radiat Oncol Biol Phys 1997;37(3):705-10.
9. Olive PL, Trotter T, Banath JP, Jackson SM, Le Riche J. Heterogeneity in human tumour hypoxic fraction using the comet assay. Br J Cancer 1996;27(Suppl):S191-5.
10. Olivotto IA, Kim-Sing C, Bajdik CD, Trevisan CH, Ludgate CM, Weir LM, Jackson SM, Basco VE. Effect of acetylsalicylic acid on radiation and cosmetic results after conservative surgery for early breast cancer: a randomized trial. Radiother Oncol 1996;41(1):1-6.
11. Olivotto IA, Weir LM, Kim-Sing C, Bajdik CD, Trevisan CH, Doll CM, Lam WY, Basco VE, Jackson SM. Late cosmetic results of short fractionation for breast conservation. Radiother Oncol 1996;41(1):7-13.
12. Olivotto IA, Bajdik CD, Plenderleith IH, Coppin CM, Gelmon KA, Jackson SM, et al. Adjuvant systemic therapy and survival after breast cancer. N Engl J Med 1994;330(12):805-10.
13. Olive PL, Durand RE, Le Riche J, Olivotto IA, Jackson SM. Gel electrophoresis of individual cells to quantify hypoxic fraction in human breast cancers. Cancer Res 1993;53(4): 733-6.
14. Weir LM, Jackson SM. Repopulation and the rationale for using accelerated fractionation radiation for locally advanced cancers of the head and neck. Can J Oncol 1993;3:161-165.
15. Olive PL, LeRiche JC, Jackson SM. Growth function of human tumors: assay and complications. Sem Radiat Oncol 1993;3:90-95.
16. Zbieranowski I, Le Riche JC, Jackson SM, Olivotto I. The use of sequential fine-needle aspiration biopsy with flow cytometry to monitor radiation induced changes in breast carcinoma. Anal Cell Pathol 1992;4(1): 13-24.
17. Flores AD, Nelems B, Evans K, Hay JH, Stoller J, Jackson SM. Impact of new radiotherapy modalities on the surgical management of cancer of the esophagus and cardia. Int J Radiat Oncol Biol Phys 1989;17(5):937-44.
18. Jackson SM, Fairey RN. Kornelsen RO. Young ME. Wong FL. Clinical results in carcinoma of the cervix: radium compared to caesium using remote afterloading. Clin Radiol 40(3):302-6,1989.
19. Ludgate CM. Douglas BG. Dixon PF. Steinbok P. Jackson SM. Goodman GB. Superfractionated radiotherapy in grade III, IV intracranial gliomas. Int J Radiat Oncol Biol Phys. 15(5):1091-5,1988.
20. Connors JM, Klimo P, Fairey RN, Voss NJS, Jackson SM. Testicular lymphoma: improved outcome with early brief chemotherapy. J Clin Oncol 1988;6:776-781.
21. Worth AJ, Basco VE, Grafton CA, Jackson SM, Baird RM, Brown DA, Clay MG, et al. Conservative breast surgery. Br Columbia Med J 1986;28(1):27-29.
22. McGregor GI, Luoma A, Jackson SM. Lymph node metastases from well-differentiated thyroid cancer: a clinical review. Am J Surg 1985;149(5):610-2.
23. Lee YM, Jackson SM. Primary seminoma of the mediastinum. Cancer Control Agency of British Columbia experience. Cancer 1985;55(2):450-2.

24. Flores AD, Anderson DW, Doyle PJ, Jackson SM, Morrison MD. Paranasal sinus malignancy — a retrospective analysis of treatment methods. J Otolaryngol 1984;13(3):141-6.
25. Elwood JM, Pearson JC, Skippen DH, Jackson SM. Alcohol, smoking, social and occupational factors in the aetiology of cancer of the oral cavity, pharynx and larynx. Int J Cancer 1984;34(5):603-12.
26. Goodman GB, Douglas BG, Jackson SM, Kornelsen RO, Lam GK, Ludgate CM, Skarsgard LD. Pions, Vancouver. Int J Radiat Oncol Biol Phys 1982;8(12):2187-90.
27. Jackson SM, Olivotto I, McLoughlin MG, Coy P. Radiation therapy for seminoma of the testis: results in British Columbia. Can Med Assoc J 1980;123(6):507-12.
28. Jackson SM, Montessori GA. Malignant lymphoma of the testis: review of 17 cases in British Columbia with survival related to pathological subclassification. J Urol 1980;123(6):881-3.
29. Williams PC, Hunter RD, Jackson SM. Whole body electron therapy in mycosis fungoides — a successful translational technique achieved by modification of an established linear accelerator. Br J Radiol 1979;52(616):302-7.
30. Wong FL, Jackson SM. Five year survey of lip cancer seen at BCCI 1960-1965. Br Columbia Med J 1978;20(7):214-216.
31. Jackson SM, Taylor G. Proceedings: Is immunotherapy a practical adjunct to the conventional treatment of breast cancer? Br J Radiol 1975;48(569):415.
32. Jackson SM, Gibb R. Electron beam therapy of the post-mastectomy chest wall. Br J Radiol 1972;45(538):745-7.
33. Duncan W, Jackson SM. The treatment of early cancer of the penis with megavoltage x-rays. Clin Radiol 1972;23(2):246-8.
34. Alderson MR, Jackson SM. Long term follow-up of patients with menorrhagia treated by irradiation. Br J Radiol 1971;44(520):295-8.
35. Jackson SM, Naylor GP, Kerby IJ. Ultrasonic measurement of post-mastectomy chest wall thickness. Br J Radiol 1970;43(511):458-61.
36. Jackson SM. The clinical application of electron beam therapy with energies up to 10 MeV. Br J Radiol 1970;43(511):431-40.
37. Jackson SM, Garrett JV, Craig AW. Lymphocyte transformation changes during the clinical course of Hodgkin's disease. Cancer 1970;25(4):843-50.
38. Craig AW, Garrett JV, Jackson SM. Quantitation of lymphocyte transformation using radioactive iododeoxyuridine. J Clin Pathol 1969;22(5):558-9.
39. Jackson SM. Ovarian dysgerminoma in three generations? J Med Genet 1967;4(2):112-3.
40. Jackson SM. Ovarian dysgerminoma. Br J Radiol. 40(474): 459-62,1967.
41. Jackson SM. Carcinoma of the breast — the significance of supraclavicular lymph node metastases. Clin Radiol 1966;17(2):107-14.
42. Jackson SM. The treatment of carcinoma of the penis. Br J Surg 1966;53(1):33-5.

Kader, Hosam A.

1. Kader HA, Khanna S, Hutchinson RM, Aukett RJ, Archer J. Pulmonary complications of bone marrow transplantation: the impact of variations in total body irradiation parameters. Clin Oncol 1994;6(2):96-101.
2. Kader HA, Rostom AY. Follicle stimulating hormone levels as a predictor of recovery of spermatogenesis following cancer therapy. Clin Oncol 1991;3(1):37-40.
3. Kader HA, Bolger JJ, Goepel JR. Bilateral pneumothorax secondary to metastatic angiosarcoma of the breast. Clin Radiol 1987;38(2):201-2.
4. Bolger JJ, Whipp MJ, Kader HA, Goepel JR, Powell C. Haematuria due to urinary bladder metastases from small cell carcinoma of the bronchus [letter]. J R Soc Med 1986;79(4):250.

Keane, Thomas J.

1. Fyles AW, Milosevic M, Wong R, Kavanagh MC, Pintilie M, Sun A, Chapman W, Levin W, Manchul L, Keane TJ, Hill RP. Oxygenation predicts radiation response and survival in patients with cervix cancer [published erratum appears in Radiother Oncol 1999 Mar;50(3):371]. Radiother Oncol. 1988;48(2):149-56.
2. Milosevic MF, Fyles AW, Wong R, Pintilie M, Kavanagh MC, Levin W, Manchul LA, Keane TJ, Hill RP. Interstitial fluid pressure in cervical carcinoma: within tumor heterogeneity, and relation to oxygen tension. Cancer 1998;82(12): 2418-26.
3. Warde P, O'Sullivan B, Bristow RG, Panzarella T, Keane TJ, Gullane PJ, Witterick IP, et al. T1/T2 glottic cancer managed by external beam radiotherapy: the influence of pretreatment hemoglobin on local control. Int J Radiat Oncol Biol Phys 1998;41(2):347-53.
4. Robertson C, Robertson AG, Hendry JH, Roberts SA, Slevin NJ, Duncan WB, MacDougall RH, Kerr GR, O'Sullivan B, Keane TJ. Similar decreases in local tumor control are calculated for treatment protraction and for interruptions in the radiotherapy of carcinoma of the larynx in four centers. Int J Radiat Oncol Biol Phys 1998;40(2):319-29.
5. Chow E, Payne D, Keane T, Panzarella T, Izard MA. Enhanced control by radiotherapy of cervical lymph

node metastases arising from nasopharyngeal carcinoma compared with nodal metastases from other head and neck squamous cell carcinomas. Int J Radiat Oncol Biol Phys 1997;39(1):149-54.
6. Davidson J, Keane T, Brown D, Freeman J, Gullane P, Irish J, Rotstein L, et al. Surgical salvage after radiotherapy for advanced laryngopharyngeal carcinoma. Arch Otolaryngol Head Neck Surg 1997;123(4):420-4.
7. Hodson DI, Bruera E, Eapen L, Groome P, Keane T, Larsson S, Pearcey R. The role of palliative radiotherapy in advanced head and neck cancer. Can J Oncol 1996;6 Suppl 1:54-60.
8. Brierley JD, Keane TJ, Cummings B, Hao Y. The absence of an adverse effect of prolongation of radiation treatment of primary rectal adenocarcinoma. Clin Oncol 1996;8(2): 97-101.
9. Weir L. Keane T. Cummings B. Goodman P. O'Sullivan B. Payne D. Warde P. Radiation treatment of cervical lymph node metastases from an unknown primary: an analysis of outcome by treatment volume and other prognostic factors. Radiother Oncol 1995;35(3):206-11.
10. Withers HR, Peters LJ, Taylor JM, Owen JB, Morrison WH, Schultheiss TE, Keane T, et al. Local control of carcinoma of the tonsil by radiation therapy: an analysis of patterns of fractionation in nine institutions [see comments]. Int J Radiat Oncol Biol Phys 1995;33(3):549-62.
11. Withers HR, Peters LJ, Taylor JM, Owen JB, Morrison WH, Schultheiss TE, Keane T, et al. Late normal tissue sequelae from radiation therapy for carcinoma of the tonsil: patterns of fractionation study of radiobiology [see comments]. Int J Radiat Oncol Biol Phys 1995;33(3):563-8.
12. Rowley H, Viani L, Leen E, Keane T. Chondrosarcoma of the paranasal sinuses presenting with eye symptoms. Ir J Med Sci 1995;164(3):205-6.
13. O'Sullivan B, Warde P, Keane T, Irish J, Cummings B, Payne D. Outcome following radiotherapy in verrucous carcinoma of the larynx. Int J Radiat Oncol Biol Phys 1995;32(3):611-7.
14. Brierley JD, Cummings BJ, Wong CS, Keane TJ, O'Sullivan B, Catton CN, Goodman P. Adenocarcinoma of the rectum treated by radical external radiation therapy. Int J Radiat Oncol Biol Phys 1995;31(2):255-9.
15. Rowley H, Viani L, Leen E, Broe P, Keane T. Leiomyosarcoma of the upper oesophagus — a difficult pre-operative diagnosis. Ir J Med Sci 1994;163(11):501-2.
16. Hao Y, Keane T. A procedure for estimating the dose modifying effect of chemotherapy on radiation response. Int J Radiat Biol Phys 1994;65(6):699-704.
17. Hendry JH, Roberts SA, Slevin NJ, Keane TJ, Barton MB, Agren-Cronqvist A. Influence of radiotherapy treatment time on control of laryngeal cancer: comparisons between centres in Manchester, UK and Toronto, Canada. Radiother Oncol 1994;31(1):14-22.
18. Keane TJ. Limits to the analysis and interpretation of non-experimental clinical data. Radiother Oncol 1994;30(2): 95-6.
19. Mah K, Keane TJ, Van Dyk J, Braban LE, Poon PY, Hao Y. Quantitative effect of combined chemotherapy and fractionated radiotherapy on the incidence of radiation-induced lung damage: a prospective clinical study. Int J Radiat Oncol Biol Physics 1994;28(3):563-74.
20. Davidson J, Briant D, Gullane P, Keane T, Rawlinson E. The role of surgery following radiotherapy failure for advanced laryngopharyngeal cancer. A prospective study. Arch Otolaryngol Head Neck Surg 1994;120(3):269-76.
21. Cummings BJ, Keane TJ, O'Sullivan B, Wong CS, Catton CN. Mitomycin in anal canal carcinoma. Oncology 1993;50(Suppl)1:63-9.
22. Keane TJ, Cummings BJ, O'Sullivan B, Payne D, Rawlinson E, MacKenzie R, Danjoux C, Hodson I. A randomized trial of radiation therapy compared to split course radiation therapy combined with mitomycin C and 5 fluorouracil as initial treatment for advanced laryngeal and hypopharyngeal squamous carcinoma [see comments]. Int J Radiat Oncol Biol Phys 1993;25(4):613-8.
23. Liu FF, Keane TJ, Davidson J. Primary carcinoma involving the petrous temporal bone. Head Neck 1993;15(1):39-43.
24. Fyles A, Keane TJ, Barton M, Simm J. The effect of treatment duration in the local control of cervix cancer [see comments]. Radiother Oncol 1992;25(4):273-9.
25. Barton MB, Keane TJ, Gadalla T, Maki E. The effect of treatment time and treatment interruption on tumour control following radical radiotherapy of laryngeal cancer [see comments]. Radiother Oncol 1992;23(3):137-43.
26. Wong CS, Cummings BJ, Keane TJ, O'Sullivan B, Catton CN. Results of external beam irradiation for rectal carcinomas locally recurrent after local excision or electrocoagulation. Radiother Oncol 1991;22(2):145-8.
27. Wong CS, Cummings BJ, Keane TJ, Dobrowsky W, O'Sullivan B, Catton CN. Combined radiation therapy, mitomycin C, and 5-fluorouracil for locally recurrent rectal carcinoma: results of a pilot study [see comments]. Int J Radiat Oncol Biol Phys 1991;21(5):1291-6.
28. Cummings BJ, Keane TJ, O'Sullivan B, Wong CS, Catton CN. Epidermoid anal cancer: treatment by radiation alone or by radiation and 5-fluorouracil with and without mitomycin C [see comments]. Int J Radiat Oncol Biol Phys 1991;21(5):1115-25.

29. Jawad J, Lang J, Leader M, Keane T. Extraskeletal myxoid chondrosarcoma of the maxillary sinus. J Laryngol Otol 1991;105(8):676-7.
30. Van Dyk J, Newcomb CH, Mah K, Keane TJ. Further comments on dose-time-fractionation considerations for lung damage. Radiother Oncol 1990;18(2):183-4.
31. Van Dyk J, Keane TJ. Determination of parameters for the linear-quadratic model for radiation-induced lung damage [letter]. Int J Radiat Oncol Biol Phys 1989;17(3): 695.
32. Keane TJ, Van Dyk J. TBI schedules prior to bone marrow transplantation: requirements for comparison [letter; comment]. Radiother Oncol 1989;15(2):207-12.
33. Van Dyk J, Mah K, Keane TJ. Is there an influence of overall treatment time in the response of lung to fractionated radiotherapy? [letter]. Radiother Oncol 1989;14(2):169-73.
34. Van Dyk J, Mah K, Keane TJ. Radiation-induced lung damage: dose-time-fractionation considerations [see comments]. Radiother Oncol 1989;14(1):55-69.
35. Gilbert RW, Lundgren JA, van Nostrand AW, Keane TJ. T3N0M0 glottic carcinoma — a pathologic analysis of 41 patients treated surgically following radiotherapy. Clin Otolaryngol 1988;13(6):467-79.
36. Lundgren J, Gilbert RW, van Nostrand AW, Harwood AR, Keane TJ, Briant TD. T3N0M0 glottic carcinoma — a failure analysis. Clin Otolaryngol 1988;13(6):455-65.
37. Feigen M, Cummings B, Hawkins N, Keane T, O'Sullivan B, Wong S. Low dose postoperative adjuvant radiation therapy for rectal cancer is ineffective. Radiother Oncol 1988;13(3):181-6.
38. Warde P, Harwood A, Keane T. Carcinoma of the subglottis. Results of initial radical radiation. Arch Otolaryngol Head Neck Surg 1987;113(11):1228-9.
39. Barton DJ, Walsh TN, Keane T, Duignan JP. Malignant duodenocolic fistula. Report of a case and review of the literature. Dis Colon Rectum 1987;30(8):636-7.
40. Heaney JA, Allen MA, Keane T, Duffy MJ. Prostate-specific antigen. Superior serum marker for prostatic carcinoma. Ir J Med Sci 1987;156(5):138-41.
41. Mah K, Van Dyk J, Keane T, Poon PY. Acute radiation-induced pulmonary damage: a clinical study on the response to fractionated radiation therapy. Int J Radiat Oncol Biol Phys 1987;13(2):179-88.
42. Guarischi A, Keane TJ, Elhakim T. Metastatic inguinal nodes from an unknown primary neoplasm. A review of 56 cases. Cancer 1987;59(3):572-7.
43. Keane T. Reply to: Oesophageal carcinoma: the problems of historical controls [letter]. Radiother Oncol 1986;6(4): 329.
44. Keane TJ, Harwood AR, Beale FA, Cummings BJ, Payne DG, Elhakim T, Rawlinson E. A pilot study of mitomycin-C/5-fluorouracil infusion combined with split course radiation therapy for carcinomas of the larynx and hypopharynx. J Otolaryngol 1986;15(5):286-8.
45. Mah K, Poon PY, Van Dyk J, Keane T, Majesky IF, Rideout DF. Assessment of acute radiation-induced pulmonary changes using computed tomography. J Comput Assist Tomogr 1986;10(5):736-43.
46. Keane TJ, Harwood AR, Elhakim T, Rider WD, Cummings BJ, Ginsberg RJ, Cooper JC. Radical radiation therapy with 5-fluorouracil infusion and mitomycin C for oesophageal squamous carcinoma. Radiother Oncol 1985;4(3):205-10.
47. Wong CS, Harwood AR, Cummings BJ, Keane TJ, Thomas GM, Rider WD. Postoperative local abdominal irradiation for cancer of the colon above the peritoneal reflection. Int J Radiat Oncol Biol Phys 1985;11(12):2067-71.
48. Garrett PG, Beale FA, Cummings BJ, Harwood AR, Keane TJ, Payne DG, Rider WD. Carcinoma of the tonsil: the effect of dose-time-volume factors on local control. Int J Radiat Oncol Biol Phys 1985;11(4):703-6.
49. Sutherland HJ, Llewellyn-Thomas H, Hogg SA, Keane TJ, Harwood AR, Till JE, Boyd NF. Do patients and physicians agree on the assessment of voice quality in laryngeal cancer? J Otolaryngol 1984;13(5):325-30.
50. Wong CS, Harwood AR, Cummings BJ, Keane TJ, Thomas GM, Rider WD. Total abdominal irradiation for cancer of the colon. Radiother Oncol 1984;2(3):209-14.
51. Llewellyn-Thomas HA, Sutherland HJ, Hogg SA, Ciampi A, Harwood AR, Keane TJ, Till JE, Boyd NF. Linear analogue self-assessment of voice quality in laryngeal cancer. J Chronic Dis 1984;37(12):917-24.
52. Cummings BJ, Blend R, Keane T, Fitzpatrick P, Beale F, Clark R, Garrett P, et al. Primary radiation therapy for juvenile nasopharyngeal angiofibroma. Laryngoscope 1984;94(12 Pt 1):1599-605.
53. Cummings B, Keane T, Thomas G, Harwood A, Rider W. Results and toxicity of the treatment of anal canal carcinoma by radiation therapy or radiation therapy and chemotherapy. Cancer 1984;54(10):2062-8.
54. Cummings BJ, Beale FA, Garrett PG, Harwood AR, Keane TJ, Payne DG, Rider WD. The treatment of glomus tumors in the temporal bone by megavoltage radiation. Cancer 1984;53(12):2635-40.
55. Garrett PG, Beale FA, Cummings BJ, Harwood AR, Keane TJ, Payne DG, Rider WD. Cancer of the tonsil: results of radical radiation therapy with surgery in reserve. Am J Surg 1983;146(4):432-5.

56. Harwood AR, Beale FA, Cummings BJ, Keane TJ, Payne DG, Rider WD. Management of early supraglottic laryngeal carcinoma by irradiation with surgery in reserve. Arch Otolaryngol 1983;109(9):583-5,1983.
57. Keane TJ, Hawkins NV, Beale FA, Cummings BJ, Harwood AR, Payne DG, Rider WD. Carcinoma of the hypopharynx results of primary radical radiation therapy. Int J Radiat Oncol Biol Phys 1983;9(5):659-64.
58. Harwood AR, Beale FA, Cummings BJ, Keane TJ, Payne DG, Rider WD, Rawlinson E. Elhakim T. Supraglottic laryngeal carcinoma: an analysis of dose-time-volume factors in 410 patients. Int J Radiat Oncol Biol Phys 1983;9(3):311-9,1983
59. Cummings BJ, Rider WD, Harwood AR, Keane TJ, Thomas GM. Radical external beam radiation therapy for adenocarcinoma of the rectum. Dis Colon Rectum 1983;26(1): 30-6.
60. Johnston CA, Keane TJ, Prudo SM. Weight loss in patients receiving radical radiation therapy for head and neck cancer:a prospective study. J Parenter Enteral Nutr 1982;6(5):399-402.
61. Cummings BJ, Thomas GM, Keane TJ, Harwood AR, Rider WD. Primary radiation therapy in the treatment of anal canal carcinoma. Dis Colon Rectum 1982;25(8):778-82.
62. Van Dyk J, Keane TJ, Rider WD. Lung density as measured by computerized tomography: implications for radiotherapy. Int J Radiat Oncol Biol Phys 1982;8(8):1363-72.
63. Keane TJ. Carcinoma of the hypopharynx. J Otolaryngol 1982;11(4):227-312.
64. Keane TJ, van Dyk J, Rider WD. Interstitial pneumonitis after bone-marrow transplantation [letter]. Lancet 1982;1(8278):967.
65. Harwood AR, Keane TJ. General principles of irradiation therapy as applied to head and neck cancer. J Otolaryngol 1982;11(2):69-76.
66. Cummings BJ, Rider WD, Harwood AR, Keane TJ, Thomas GM, Erlichman C, Fine S. Combined radical radiation therapy and chemotherapy for primary squamous cell carcinoma of the anal canal. Cancer Treat Rep 1982;66(3): 489-92.
67. Harwood AR, Beale FA, Cummings BJ, Keane TJ, Payne D, Rider WD. T4NOMO glottic cancer: an analysis of dose-time volume factors. Int J Radiat Oncol Biol Phys 1981;7(11):1507-12.
68. Harwood AR, Beale FA, Cummings BJ, Keane TJ, Rider WD. T2 glottic cancer: an analysis of dose-time-volume factors. Int J Radiat Oncol Biol Phys 1981;7(11):1501-5.
69. Keane TJ, Rider WD, Harwood AR, Thomas GM, Cummings BJ. Whole abdominal radiation in the management of metastatic gastrointestinal carcinoid tumor. Int J Radiat Oncol Biol Phys 1981;7(11):1519-21.
70. Keane TJ, Van Dyk J, Rider WD. Idiopathic interstitial pneumonia following bone marrow transplantation: the relationship with total body irradiation. Int J Radiat Oncol Biol Phys 1981;7(10):1365-70.
71. Van Dyk J, Keane TJ, Kan S, Rider WD, Fryer CJ. Radiation pneumonitis following large single dose irradiation: a re-evaluation based on absolute dose to lung. Int J Radiat Oncol Biol Phys 1981;7(4):461-7.
72. Harwood AR, Beale FA, Cummings BJ, Hawkins NV, Keane TJ, Rider WD. T3 glottic cancer: an analysis of dose time-volume factors. Int J Radiat Oncol Biol Phys 1980;6(6): 675-80.
73. Cummings BJ, Harwood AR, Keane TJ, Thomas GM, Rider WD. Combined treatment of squamous cell carcinoma of the anal canal: radical radiation therapy with 5-fluorouracil and mitomycin-C, a preliminary report. Dis Colon Rectum 1980;23(6):389-91.
74. Wagenfeld DJ, Keane T, van Nostrand AW, Bryce DP. Primary carcinoma involving the temporal bone: analysis of twenty-five cases. Laryngoscope 1980;90(6 Pt 1):912-9.
75. Harwood AR, Hawkins NV, Keane T, Cummings B, Beale FA, Rider WD, Bryce DP. Radiotherapy of early glottic cancer. Laryngoscope 1980;90(3):465-70.
76. Keane TJ, Gorman AM, O'Connell LG, Fennelly JJ. Epsilon-amino-caproic acid in the management of acute promyelocytic leukaemia. Acta Haematol 1976;56(4):202-4.
77. O'Connell LG, Gorman A, Keane TJ. Fennelly JJ. Cellular dysmaturity as a prognostic index in acute myeloid leukaemia. Ir J Med Sci 1976;145(2):35-43.
78. Fennelly JJ, O'Connell LG, Cahalane SF, Keane T, Gorman A, McBride A. Management of acute non-lymphocytic leukaemia. Ir J Med Sci 1974;143(3):129-36.

Kim-Sing, Charmaine

1. Pickles T, Duncan GG, Kim-sing C, McKenzie MR, Morris WJ. PSA relapse definitions — the Vancouver Rules show superior predictive power. Int J Radiat Oncol Biol Phys 1999;43(3):699-700.
2. Voss N, Kim-Sing C. Radiotherapy in the treatment of dermatologic malignancies. Dermatol Clin 1998;16(2): 313-20.
3. Kim-Sing C, Basco VE. Postmastectomy lymphedema treated with the Wright linear pump. Can J Surg 1997;30(5):368-70.
4. Olivotto IA, Kim-Sing C, Bajdik CD, Trevisan CH, Ludgate CM, Weir LM, Jackson SM, Basco VE. Effect of acetylsalicylic acid on radiation and cosmetic results after conser-

vative surgery for early breast cancer: a randomized trial. Radiother Oncol 1996;41(1):1-6.
5. Olivotto IA, Weir LM, Kim-Sing C, Bajdik CD, Trevisan CH, Doll CM, Lam WY, Basco VE, Jackson SM. Late cosmetic results of short fractionation for breast conservation. Radiother Oncol 1996;41(1):7-13.
6. Olivotto IA, Weir L, Kim-Sing C. In response to Rescigno et al [letter; comment]. Int J Radiat Oncol Biol Phys 1995;31(1):203.

Kostashuk, Edmond C.

1. McKenzie M, MacLennan I, Kostashuk E. Bainbridge T. Postirradiation sarcoma after external beam radiation therapy for localized adenocarcinoma of the prostate: report of three cases. Urology (Online) 1999;53(6):12281
2. Murray N, Grafton C, Shah A, Gelmon K, Kostashuk E, Brown E, Coppin C, Coldman A, Page R. Abbreviated treatment for elderly, infirm, or noncompliant patients with limited-stage small-cell lung cancer. J Clin Oncol 1998;16(10):3323-8.
3. Wong K, Poon P, Berry K, Coppin C, Kostashuk E. Paraneoplastic demyelinating disorder in the brain of a patient with seminoma. J Comput Assist Tomogr 1998;22(1):136-8.
4. Syndikus I, Pickles T, Kostashuk E, Sullivan LD. Postoperative radiotherapy for stage pT3 carcinoma of the prostate: improved local control [see comments]. J Urol 1996;155(6):1983-6.
5. Coy P, Hodson DI, Murray N, Pater JL, Payne DG, Arnold A, Kostashuk E et al. Patterns of failure following locoregional radiotherapy in the treatment of limited stage small cell lung cancer [see comments]. Int J Radiat Oncol Biol Phys 1994;28(2):355-62.
6. Murray N, Coy P, Pater JL, Hodson I, Arnold A, Zee BC, Payne D, Kostashuk EC, et al. Importance of timing for thoracic irradiation in the combined modality treatment of limited-stage small-cell lung cancer. The National Cancer Institute of Canada Clinical Trials Group. J Clin Oncol 1993;11(2):336-44.
7. Lam S, Kostashuk EC, Coy EP, Laukkanen E, LeRiche JC, Mueller HA, Szasz IJ. A randomized comparative study of the safety and efficacy of photodynamic therapy using Photofrin II combined with palliative radiotherapy versus palliative radiotherapy alone in patients with inoperable obstructive non-small cell bronchogenic carcinoma. Photochem Photobiol 1987;46(5):893-7.
8. Kostashuk E, Laukkanen E, Coy P. Radiation Therapy in Lung Cancer. Br Columbia Med J 1987;29(1):603-604.
9. Lam S, Muller NL, Miller RR, Kostashuk EC, Laukkanen E, Evans K, Szasz IJ, LeRiche JC, Champion P. Laser treatment of obstructive endobronchial tumors: factors which determine response. Lasers Surg Med 1987;7(1):29-35.
10. Prior JC, Cox TA, Fairholm D, Kostashuk E, Nugent R. Testosterone-related exacerbation of a prolactin-producing macroadenoma: possible role for estrogen. J Clin Endocrinol Metabol 1987;64(2):391-4.
11. Murray N, Shah A, Brown E, Kostashuk E, Laukkanen E, Goldie J, Band P, et al. Alternating chemotherapy and thoracic radiotherapy with concurrent cisplatin-etoposide for limited-stage small-cell carcinoma of the lung. Sem Oncol 1986;13(3 Suppl 3):24-30.
12. Lam S, Muller NL, Miller RR, Kostashuk EC, Szasz IJ, LeRiche JC, Lee-Chuy E. Predicting the response of obstructive endobronchial tumors to photodynamic therapy. Cancer 1986;58(10):2298-306.

Kwan, Winkle B.

1. Kwan WB, Liu FF, Banerjee D, Rotstein LE, Tsang RW. Concurrent papillary and squamous carcinoma in a thyroglossal duct cyst: a case report [see comments]. Can J Surg 1996;39(4):328-32.
2. Kwan W, Bjarnason GA. Hamilton P. Adjuvant therapy with fluorouracil and levamisole and liver ultrasound mimicking liver metastases [letter; comment]. J Clin Oncol 1994;12(6):1335-6.
3. Siu TO, Kwan WB. Hormones in chemotherapy for pancreatic cancer, chemoagents or carriers. In Vivo 1989;3(4): 255-8.

Larsson, Stephan N.

1. Taylor RH, Hay JH, Larsson SN. Transanal local excision of selected low rectal cancers. Am J Surg 1998;175(5):360-3.
2. Barnett JB, Fedoruk M, Gaucher MP, Larsson SN. A home page on the Internet for the Vancouver Island Cancer Centre, British Columbia Cancer Agency. Clin Oncol 1996;8(6):390-2.
3. Larsson SN. Radiotherapy patient scheduling using a desktop personal computer [see comments]. Clin Oncol 1993;5(2):98-101.
4. Larsson SN. Dose specification in radiotherapy [letter]. Clin Oncol 1992;4(6):401.
5. Canney PA, Larsson SN, Hay JH, Yussuf MA. Case report: Salmonella pneumonia associated with chemotherapy for non-Hodgkin's lymphoma. Clin Radiol 1985;36(5):459-60.

Lau, Harold Y.

1. Lau HY, Chua ET, Yang TL, Chua EJ. Orbital lymphoma: results of radiation therapy. Ann Acad Med Singapore 1998;27(4):474-7.

2. Lau HY, Kagawa K, Lee WR, Hunt MA, Shaer AH, Hanks GE. Short communication: CT-MRI image fusion for 3D conformal prostate radiotherapy: use in patients with altered pelvic anatomy. Br J Radiol 1996;69(828):1165-70.
3. Lau HY, Hay JH, Flores AD, Threlfall WJ. Seven fractions of twice daily high dose-rate brachytherapy for node-negative carcinoma of the mobile tongue results in loss of therapeutic ratio. Radiother Oncol 1986;39(1):15-8.

Laukkanen, Ethan

1. Laukkanen E, Maier M. Design and implementation of an electronic point-of-contact oncology clinical record. Medinfo 1995;8(1):317-8.
2. Laukkanen E, Klonoff H, Allan B, Graeb D, Murray N. The role of prophylactic brain irradiation in limited stage small cell lung cancer: clinical, neuropsychologic, and CT sequelae. Int J Radiat Oncol Biol Phys 1988;14(6):1109-17.
3. Laukkanen E, Olivotto I, Jackson S. Management of seminoma with bulky abdominal disease. Int J Radiat Oncol Biol Phys 1998;14(2):227-33.
4. Lam S, Kostashuk EC, Coy EP, Laukkanen E, LeRiche JC, Mueller HA, Szasz IJ. A randomized comparative study of the safety and efficacy of photodynamic therapy using Photofrin II combined with palliative radiotherapy versus palliative radiotherapy alone in patients with inoperable obstructive non-small cell bronchogenic carcinoma. Photochem Photobiol 1987;46(5):893-7.
5. Kostashuk E, Laukkanen E, Coy P. Radiation therapy in lungcCancer. Br Columbia Med J 1987;29(1)603-604.
6. Jones GW, Laukkanen E, Miller RR. Well-differentiated squamous cell carcinoma of the thymus. Can Med Assoc J 1987;137(1):43-4.
7. Lam S, Muller NL, Miller RR, Kostashuk EC, Laukkanen E, Evans K, Szasz IJ et al. Laser treatment of obstructive endobronchial tumors: factors which determine response. Lasers Surg Med 1987;7(1):29-35.
8. Jones G, Laukkanen E. Tolerance revisited [letter]. Int J Radiat Oncol Biol Phys 1987;13(2):290-1.
9. Murray N, Shah A, Brown E, Kostashuk E, Laukkanen E, Goldie J, Band P et al. Alternating chemotherapy and thoracic radiotherapy with concurrent cisplatin-etoposide for limited-stage small-cell carcinoma of the lung. Sem Oncol 1986;13(3 Suppl 3):24-30.

Leong, Carson

1. Leong C, McKenzie MR, Coupland DB, Gascoyne RD. Disseminated intravascular coagulation in a patient with metastatic prostate cancer: fatal outcome following strontium-89 therapy [see comments]. J Nucl Med 1994;35(10):1662-4.

Ludgate, Charles M.

1. Pickles T, Goodman GB, Rheaume DE, Duncan GG, Fryer CJ, Bhimji S, Ludgate C, Syndikus I, Graham P, Dimitrov M, Bowen J. Pion radiation for high grade astrocytoma: results of a randomized study. Int J Radiat Oncol Biol Phys 1997;37(3):491-7.
2. Olivotto IA, Kim-Sing C, Bajdik CD, Trevisan CH, Ludgate CM, Weir LM, Jackson SM, Basco VE. Effect of acetylsalicylic acid on radiation and cosmetic results after conservative surgery for early breast cancer: a randomized trial. Radiother Oncol 1996;41(1):1-6.
3. Duncan GG. Goodman GB. Ludgate CM. Rheaume DE. The treatment of adult supratentorial high grade astrocytomas. J Neurooncol 1992;13(1):63-72.
4. Roberts FJ, Murphy J, Ludgate C. The value and significance of routine urine cultures in patients referred for radiation therapy of prostatic malignancy. Clin Oncol 1990;2(1):18-21.
5. Mildenberger M, Beach TG, McGeer EG, Ludgate CM. An animal model of prophylactic cranial irradiation: histologic effects at acute, early and delayed stages. Int J Radiat Oncol Biol Phys 1990;18(5):1051-60.
6. Ludgate CM. Three dimensional radiation therapy planning using light projection of CT scans. Clin Radiol 1989;40(4):426.
7. Ludgate CM, Douglas BG, Dixon PF, Steinbok P, Jackson SM, Goodman GB. Superfractionated radiotherapy in grade III, IV intracranial gliomas. Int J Radiat Oncol Biol Phys 1988;15(5):091-5.
8. Ludgate CM. Pathogenesis of the late-side effects of radiotherapy [letter]. Clin Radiol 1987;38(1):105-6.
9. Goodman GB, Dixon P, Lam GK, Harrison R, Kornelsen RO, Ludgate CM, Flores AD. Preparatory clinical studies of Pi-mesons at TRIUMF. Rad Res 1985;8(Suppl):S279-84.
10. Olivotto IA, Ludgate CM, Allen LH, Rootman J. Supervoltage radiotherapy for Graves' ophthalmopathy: CCABC technique and results. Int J Radiat Oncol Biol Phys 1985;11(12):2085-90.
11. Ludgate CM. Preliminary report: acetylsalicylic acid therapy in the treatment of complications following abdominal radiation. J Can Assoc Radiol 1985;36(2): 138-40.
12. Goodman GB, Douglas BG, Jackson SM, Kornelsen RO, Lam GK, Ludgate CM, Skarsgard LD. Pions, Vancouver. Int J Radiat Oncol Biol Phys 1982;8(12):2187-90.
13. Jacob J, Hindmarsh JR, Ludgate CM, Chisholm GD. Observations on the ultrastructure of human urothelium: the response of normal bladder of elderly subjects to hyperthermia. Urol Res 1982;10(5):227-37.

14. Ludgate CM, McLean N, Tulloch WS. Hyperthermic irrigation of bladder in treatment of transitional cell carcinoma: its effectiveness in controlling persistent haematuria. J R Soc Med 1979;72(5):336-40.
15. Jacob J, Ludgate CM, Forde J, Tulloch WS. Recent observations on the ultrastructure of human urothelium. 1. Normal bladder of elderly subjects. Cell Tissue Res 1978;193(3):543-60.
16. Ludgate CM, Anderson TJ, Langlands AO. Sarcoma of the female breast — report of a series of 30 cases. Clin Oncol 1997;3(1):97-105.
17. Ludgate CM, Webber RG, Pettigrew RT, Smith AN. Coagulation defects following whole body hyperthermia in the treatment of disseminated cancer: a limiting factor in treatment. Clin Oncol 1976;2(3):219-25.
18. Ludgate CM, Watson GS. Unilateral renal hypertension following major trauma. Br J Urol 1976;48(5):362.
19. Ludgate CM, McLean N, Carswell GF, Newsam JE, Pettigrew RT, Tulloch WS. Hyperthermic perfusion of the distended urinary bladder in the management of recurrent transitional cell carcinoma. Br J Urol 1975;47(7): 841-8.
20. Ludgate CM, Galt JM, Pettigrew RT, Smith AN. The clinical effects of whole body hyperthermia in advanced malignant disease. Langenbecks Arch Chir 1975;Suppl:225-6.
21. Pettigrew RT, Galt JM, Ludgate CM, Smith AN. Clinical effects of whole-body hyperthermia in advanced malignancy. Br Med J 1974;4(5946):679-82.
22. Pettigrew RT, Ludgate CM, Smith AN. Proceedings: The effect of whole body hyperthermia in advanced cancer. Br J Cancer 1974;30(2):179.
23. Pettigrew RT, Galt JM, Ludgate CM, Horn DB, Smith AN. Circulatory and biochemical effects of whole body hyperthermia. Br J Surg 1974;61(9):727-30.
24. Galt JM, Ludgate CM, Pettigrew RT, Scratcherd T, Smith AN. Proceedings: Circulatory and electrolyte changes during hyperthermia to 42 degrees C. J Physiol 1974;238(1):30P-31P.
25. Ludgate CM, Pettigrew RT, Galt JM, Horn DB, Smith AN. Proceedings: effects of hyperthermia in advanced malignancy. Br J Surg 1973;60(11):905-6.
26. Ruckley CV, Maclean M, Ludgate CM, Espley AJ. Major outpatient surgery. Lancet 1973;2(7839):1193-6.
27. Ruckley CV. Espley AJ. Ludgate CM. Surgery on day patients [letter]. Br Med J 1973;4(885):165,1973.

Ma, Roy

1. Crawford RI, Tron VA, Ma R, Rivers JK. Sinonasal malignant melanoma - a clinicopathologic analysis of 18 cases. Melanoma Res 1995;5:261-265.
2. Ma R, Epstein JB, Emerton S, Hay J, A preliminary investigation of an association between dental restorations and carcinoma of the tongue. Eur J Cancer. Part B, Oral Oncol 1995;31B(4):232-234.

Manji, Mohamed M.

1. Hoskins PJ, Wong F, Swenerton KD, Pike JA, Manji M, McMurtrie E, Acker B, Le Riche J. Small cell carcinoma of the cervix treated with concurrent radiotherapy, cisplatin, and etoposide. Gynecol Oncol 1995;56(2):218-25.
2. Manji M, Hay J, Flores AD. The management of carcinoma of the anal canal by external beam radiotherapy, experience in Vancouver 1971-1988. Radiother Oncol 1992;25(3):196-202.
3. Agranovich AL, Anderson GH, Manji M, Acker BD, Macdonald WC, Threlfall WJ. Carcinoid tumour of the gastrointestinal tract: prognostic factors and disease outcome. J Surg Oncol 1991;47(1):45-52.
4. Ragaz J, Buskard N, Manji M. Thrombocytopenia after combination therapy with aminoglutethimide and tamoxifen: which drug is to blame? Cancer Treat Rep 1984;68(7-8):1015-6.

McKenzie, Michael R.

1. Clark BG, McKenzie MR. Radiation techniques for the 21st century. Can Med Assoc J 1999;161(10):1292.
2. Pickles T, Duncan GG, Kim-sing C, McKenzie MR, Morris WJ. PSA relapse definitions — the Vancouver Rules show superior predictive power [letter; comment]. Int J Radiat Oncol Biol Phys 1999;43(3):699-700.
3. McKenzie MR. Surgery in stereo [letter; comment]. Can Med Assoc J 1998;159(3):219-20.
4. McKenzie MR. Oncology and palliative care: bringing together the two solitudes. Can Med Assoc J 1998;158(13):1702-4.
5. McKenzie MR. Androgen deprivation and radiation therapy [letter; comment]. Urology 1996;47(2):286.
6. McKenzie MR. Re: The value of serial prostate specific antigen determinations 5 years after radiotherapy: steeply increasing values characterize 80% of patients [letter; comment]. J Urol 1995;153(6):1953-4.
7. McKenzie M, Duncan G, Nixon L, MacKenzie G. The British Columbia Cancer Agency: joining the palliative care team. Br Columbia Med J 1995;37(8):538-543.
8. McKenzie MR. BC network to improve palliative care [letter; comment]. Can Med Assoc J 1995;152(9):1378.
9. Leong C, McKenzie MR, Coupland DB, Gascoyne RD. Disseminated intravascular coagulation in a patient

with metastatic prostate cancer: fatal outcome following strontium-89 therapy [see comments]. J Nucl Med 1994;35(10):1662-4.
10. McKenzie MR, Souhami L, Caron JL, Olivier A, Villemure JG, Podgorsak EB. Early and late complications following dynamic stereotactic radiosurgery and fractionated stereotactic radiotherapy. Can J Neurol Sci 1993;20(4): 279-85.
11. McKenzie MR, Wong FL, Epstein JB, Lepawsky M. Hyperbaric oxygen and postradiation osteonecrosis of the mandible. Eur J Cancer. Part B, Oral Oncol 1993;29B(3):201-7.
12. McKenzie MR. Freeman CR. Pla M. Guerra J. Souhami L. Pla C. Podgorsak EB. Clinical experience with electron pseudoarc therapy. Br J Radiol. 1993;66(783):234-40.
13. McKenzie MR. Souhami L. Podgorsak EB. Olivier A. Caron JL. Villemure JG. Photon radiosurgery: a clinical review. Can J Neurol Sci 1992;19(2):212-21.

Mildenberger, Marianne

1. Aquino-Parsons C, Lim P, Wong F, Mildenberger M. Papillary serous and clear cell carcinoma limited to endometrial curettings in FIGO stage 1a and 1b endometrial adenocarcinoma: treatment implications. Gynecol Oncol 1998;71(1):83-68.
2. Emami B, Myerson RJ, Cardenes H, Paris KG, Perez CA, Straube W, Leybovich L, Mildenberger M, et al. Combined hyperthermia and irradiation in the treatment of superficial tumors: results of a prospective randomized trial of hyperthermia fractionation (1/wk vs 2/wk). Int J Radiat Oncol Biol Phys 1992;24(1):145-52.
3. Mildenberger M, Beach TG, McGeer EG, Ludgate CM. An animal model of prophylactic cranial irradiation: histologic effects at acute, early and delayed stages. Int J Radiat Oncol Biol Phys 1990;18(5):1051-60.

Morris, W. James

1. Pickles T, Duncan GG, Kim-Sing C, McKenzie MR, Morris WJ. PSA relapse definitions — the Vancouver Rules show superior predictive power [letter; comment]. Int J Radiat Oncol Biol Phys 1999;43(3):699-700.
2. Pickles T, Goodman GB, Fryer CJ, Bowen J, Coldman AJ, Duncan GG, Graham P, McKenzie M, Morris WJ, Rheaume DE, Syndikus I. Pion conformal radiation of prostate cancer: results of a randomized study. Int Radiat Oncol Biol Phys 1999;43(1) 47-55.
3. Graham PH, Morris WJ, Pickles TP. Four-week arc radiotherapy for B2-C prostate cancer: the need for prospective evaluation of short fractionation schemes. Australas Radiol 1997;41(3):266-9.
4. Johns H, Morris WJ, Joiner MC. Radiation response of murine eccrine sweat glands. Radiother Oncol 1995;36(1): 56-64.
5. Judas L, Bentzen SM, Johns H, Joiner MC, Morris WJ. Time evolution of the number of functional murine eccrine sweat glands after irradiation: a quantitative analysis of experimental data using a model of proliferative and functional organization. Int J Radiat Oncol Biol Phys 1995;67(5):565-75.
6. Morris WJ, Dische S, Mott G. A pilot study of a method of estimating the number of functional eccrine sweat glands in irradiated human skin. Radiother Oncol 1992;25(1):49-55.

Olivotto, Ivo A.

1. Kan L, Olivotto IA, Warren Burhenne LJ, Sickles EA, Coldman AJ. Standardized abnormal interpretation and cancer detection ratios to assess reading volume and reader performance in a breast screening program. Radiology 2000;215(2):563-7.
2. Jackson JS, Olivotto IA, Wai MDE, Grau C, Mates D, Ragaz J. A decision analysis of the effect of avoiding axillary lymph node dissection in low risk women with invasive breast carcinoma. Cancer 2000;88(8):1852-62.
3. Schwartz GF, Solin LJ, Olivotto IA, Ernster VL, Pressman PI. The consensus conference on the treatment of in situ ductal carcinoma of the breast, April 22-25, 1999. Hum Pathol 2000;31(2):131-9.
4. Schwartz GF, Solin LJ, Olivotto IA, Ernster VL, Pressman PI. Consensus conference on the treatment of in situ ductal carcinoma of the breast, April 22-25, 1999. Cancer 2000;88(4):946-54.
5. Froud PJ, Mates D, Jackson JS, Phillips N, Andersen S, Jackson SM, Bryce CJ, Olivotto IA. Effect of time interval between breast-conserving surgery and radiation therapy on ipsilateral breast recurrence. Int J Radiat Oncol Biol Phys 2000;46(2):363-72.
6. Lingawi SS, Bilbey JH, Munk PL, Poon PY, Allan BM, Olivotto IA, Marchinkow LO. MR imaging of brachial plexopathy in breast cancer patients without palpable recurrence. Skeletal Radiol 1999;28(6):318-23.
7. Doll C, Durand R, Grulkey W, Sayer S, Olivotto I. Functional assessment of cutaneous microvasculature after radiation. Radiother Oncol 1999;51(1):67-70.
8. Olivotto IA, Kan L. Screening mammograms: who and how often? Br Columbia Med J 1999;4(10):498-500.
9. Olivotto IA, Mates D, Kan L, Fung J, Samant R, Burhenne LJ. Prognosis, treatment, and recurrence of breast cancer for women attending or not attending the Screening

Mammography Program of British Columbia. Breast Cancer Res Treat 1999;54(1):73-81.
10. Olivotto IA, Kan L, Mates D, King S. Screening Mammography Program of British Columbia: pattern of use and health care system costs [see comments]. Can Med Assoc J 1999;160(3):337-41.
11. Recht A, Bartelink H, Fourquet A, Fowble B, Haffty BG, Harris JR, Kurtz J, McCormick B, Olivotto IA, et al. Postmastectomy radiotherapy: questions for the twenty-first century [see comments; published erratum appears in J Clin Oncol 1998 Sep;16(9):3211]. J Clin Oncol 1998;16(8): 2886-9.
12. Olivotto IA, Jackson JS, Mates D, Andersen S, Davidson W, Bryce CJ, Ragaz J. Prediction of axillary lymph node involvement of women with invasive breast carcinoma: a multivariate analysis [see comments]. Cancer 1998;83(5): 948-55.
13. Olivotto IA, Kan L, Coldman AJ. False positive rate of screening mammography [letter; comment]. N Engl J Med 1998;339(8):560;discussion 563.
14. Sawka C, Olivotto I, Coldman A, Goel V, Holowaty E, Hislop TG. The association between population-based treatment guidelines and adjuvant therapy for node-negative breast cancer. British Columbia/Ontario Working Group. Br J Cancer 1997;75(10):1534-42.
15. Hislop TG, Coldman AJ, Warren-Burhenne LJ, Smart MJ, Olivotto IA. Mammographic density and risk of breast cancer within the screening mammography program of British Columbia. Br Columbia Med J 1997;39(9)496-500.
16. Goel V, Olivotto I, Hislop TG, Sawka C, Coldman A, Holowaty EJ. Patterns of initial management of node-negative breast cancer in two Canadian provinces. British Columbia/Ontario Working Group [see comments]. Can Med Assoc J 1997;156(1):25-35.
17. Ragaz J, Jackson SM, Le N, Plenderleith IH, Spinelli JJ, Basco VE, Wilson KS, Knowling MA, Coppin CM, Paradis M, Coldman AJ, Olivotto IA. Adjuvant radiotherapy and chemotherapy in node-positive premenopausal women with breast cancer [see comments]. N Engl J Med 1997;337(14):956-62.
18. Olivotto IA, Kim-Sing C, Bajdik CD, Trevisan CH, Ludgate CM, Weir LM, Jackson SM, Basco VE. Effect of acetylsalicylic acid on radiation and cosmetic results after conservative surgery for early breast cancer: a randomized trial. Radiother Oncol 1996;41(1):1-6.
19. Bradbury J, Bryant H, Casebolt T, Latreille J, Pawelek J, Olivotto I. A Canadian experiment with breast cancer information exchange pilot projects. Patient Educ Couns 1996;28(2):169-74.
20. Olivotto IA, Weir LM, Kim-Sing C, Bajdik CD, Trevisan CH, Doll CM, Lam WY, Basco VE, Jackson SM. Late cosmetic results of short fractionation for breast conservation. Radiother Oncol 1996;41(1):7-13.
21. Hislop TG, Olivotto IA, Coldman AJ, Trevisan CH, Kula J, McGregor GI, Phillips N. Variations in breast conservation surgery for women with axillary lymph node negative breast cancer in British Columbia. Can J Public Health. Revue Canadienne Sante Publique 1996;87(6):390-4.
22. Olivotto IA, Weir L, Kim-Sing C. In response to Rescigno et al [letter; comment]. Int J Radiat Oncol Biol Phys 1995;31(1):203.
23. Olivotto IA, Hislop TG, Kan L, Poon P, Warren-Burhenne LJ. Who benefits from screening mammography. Br Columbia Med J 1995;37(7):468-472.
24. Clay MG, Hislop TG, Kan L, Olivotto IA, Burhenne LJ. Screening mammography in British Columbia: 1988-1993. Am J Surg 1994;167(5):490-2.
25. Olivotto IA, Bajdik CD, Plenderleith IH, Coppin CM, Gelmon KA, Jackson SM, Ragaz J et al. Adjuvant systemic therapy and survival after breast cancer [see comments]. N Engl J Med 1994;330(12):805-10.
26. Olive PL, Durand RE, Le Riche J, Olivotto IA, Jackson SM. Gel electrophoresis of individual cells to quantify hypoxic fraction in human breast cancers. Cancer Res 1993;53(4): 733-6.
27. Palcic B, Susnik B, Garner D, Olivotto I. Quantitative evaluation of malignant potential of early breast cancer using high resolution image cytometry. J Cell Biochem Suppl 1993;17G:107-13.
28. Bryce CJ, Kuusk U, Olivotto IA. Tamoxifen: new indications for an old drug. Br Columbia Med J 1993;35(1):26-28.
29. Zbieranowski I, Le Riche JC, Jackson SM, Olivotto I. The use of sequential fine-needle aspiration biopsy with flow cytometry to monitor radiation induced changes in breast carcinoma. Anal Cell Pathol 1992;4(1):13-24.
30. Olivotto IA. Breast cancer: recent progress. Can Oper Room Nurs J 1992;10(3):22-6.
31. Olivotto IA. Early breast cancer- into the 1990s. Br Columbia Med J 1991;33(8):436.
32. Olivotto IA, Baird RM, Harrison DA, Worth AJ. Management of in-situ breast carcinoma. Br Columbia Med J 1991;33(8) 444.
33. Olivotto IA, Kuusk U, Basco VE. Breast conservation. Br Columbia Med J 1991;33(9):488.
34. Hassell PR, Olivotto IA, Mueller HA, Kingston GW, Basco VE. Early breast cancer: detection of recurrence after conservative surgery and radiation therapy. Radiology 1990;176(3):731-5.

35. Olivotto IA, Rose MA, Osteen RT, Love S, Cady B, Silver B, Recht A. Harris JR. Late cosmetic outcome after conservative surgery and radiotherapy: analysis of causes of cosmetic failure. Int J Radiat Oncol Biol Phys 1989;17(4): 747-53.
36. Olivotto IA, Fairey RN, Gillies JH, Stein H. Fatal outcome of pelvic radiotherapy for carcinoma of the cervix in a patient with systemic lupus erythematosis. Clin Radiol 1989;40(1):83-4.
37. Rose MA, Olivotto I, Cady B, Koufman C, Osteen R, Silver B, et al. Conservative surgery and radiation therapy for early breast cancer: long-term cosmetic results. Arch Surg 1989;124(2):153-7.
38. Olivotto IA, Ludgate CM, Allen LH, Rootman J. Supervoltage radiotherapy for Graves' ophthalmopathy: CCABC technique and results. Int J Radiat Oncol Biol Phys 1985;11(12):2085-90.
39. Laukkanen E, Olivotto I, Jackson S. Management of seminoma with bulky abdominal disease. Int J Radiat Oncol Biol Phys 1988;14(2):227-33.
40. Jackson SM, Olivotto I, McLoughlin MG, Coy P. Radiation therapy for seminoma of the testis: results in British Columbia. Can Med Assoc J 1980;123(6):507-12.

Parsons, Christina

1. Partridge SE, Aquino-Parsons C., Luo C, Green A, Olive PL. A pilot study comparing intratumoural oxygenation using the comet assay following 2.5% and 5% carbogen and 100% oxygen. Int J Radiat Oncol Biol Phys 2001;49: 575-580.
2. Aquino-Parsons C, Luo C, Vikse CM, Olive PL. Comparison between the comet assay and the oxygen microelectrode for measurement of tumour hypoxia. Radiother Oncol 1999;51:179-185.
3. Olive PL, Durand RE, Jackson SM, Le Riche JC, Luo C, Ma R, McLaren DB, Aquino-Parsons C, Thomson TA, Trotter T. The comet assay in clinical practice. Acta Oncologica 1999;38:839-844.
4. Westeel V, Murray N, Gelmon K, Shah A, Sheehan F, McKenzie M, Wong F, Morris J, Grafton C, Tsang V, Goddard K, Murphy K, Aquino-Parsons C, Amy R, Page R. New combination of the old drugs for elderly patients with small-cell lung cancer: A phase II study of the PAVE regimen. J Clin Oncol 1998;16(5):1940-47.
5. El-Khatib E, Hussein S, Nikolic M, Voss NJS, Aquino-Parsons C. Variation of electron beam uniformity with beam angulation and scatterer position for total skin irradiation with the Stanford technique. Int J Radiat Oncol Biol Phys 1995;33(2):469-7.

Pickles, Thomas A.

1. Duncan GG, Philips N, Pickles T. Report on the quality of life analysis from the phase III trial of pion versus photon radiotherapy in locally advanced prostate cancer. Eur J Cancer 2000;36(6):759-65, 2000.
2. Lohrisch C, Murray N, Pickles T, Sullivan L. Small cell carcinoma of the bladder: long term outcome with integrated chemoradiation. Cancer 1999;86(11):2346-52.
3. Pickles T, Duncan GG, Kim-Sing C, McKenzie MR, Morris WJ. PSA relapse definitions — the Vancouver Rules show superior predictive power [letter; comment]. Int J Radiat Oncol Biol Phys 1999;43(3):699-700.
4. McLaren DB, McKenzie M, Duncan G, Pickles T. Watchful waiting or watchful progression? Prostate specific antigen doubling times and clinical behavior in patients with early untreated prostate carcinoma. Cancer 1998;82(2):342-8.
5. McLaren DB, Pickles T, Thomson T, Olive PL. Impact of nicotinamide on human tumour hypoxic fraction measured using the comet assay. Radiother Oncol 1997;45(2): 175-82.
6. Ohizumi Y, Lam GK, Pickles T, Chaplin DJ. Early skin response to fractionated doses of pions for determining therapeutic gain factors. Tokai J Exper Clin Med 1996;21(2):69-75.
7. Syndikus I, Pickles T, Kostashuk E, Sullivan LD. Postoperative radiotherapy for stage pT3 carcinoma of the prostate: improved local control [see comments]. J Urol 1996;155(6):1983-6.
8. Ohizumi Y, Lam GK, Pickles T, Fryer C, Chaplin DJ. Radiosensitizing effect of nicotinamide and carbogen combined in fractionated pions or x-rays in SCCVII tumors. Radiat Med 1995;13(6):291-5.
9. Ohizumi Y, Lam GK, Pickles T, Chaplin DJ. Biological effectiveness of fractionated dose of pions in microscopic SCCVII tumors: comparison between tumor control dose and tumor growth time assays. Jpn J Cancer Res 1995;86(6):600-6.
10. Pickles T, Lam G, Goodman GB. Late results in patients treated with pi-mesons for bladder cancer [letter; comment]. Cancer 1993;72(7):2286.
11. Pickles T, Bowen J, Dixon P, Gaffney C, Pomeroy M, Rheaume D, Vernimmen F, Goodman GB. Pions — the potential for therapeutic gain in locally advanced prostate cancer: dose escalation and toxicity studies. Int J Radiat Oncol Biol Phys 1991;21(4):1005-11.
12. Pickles T. Lower hemibody irradiation [letter]. Clin Oncol 1990;(3):182-3.
13. Pickles T, Perry L, Murray P, Plowman P. 4-hydroxyandrostenedione — further clinical and extended endocrine

observations. Br J Cancer 1990;62(2):309-13.
14. Pickles T. Non-melanoma skin cancer [letter]. Br Med J 1989;299(6713):1464.

Probert, John C.

1. Probert JC, Saben HS, Gregory CJ. Use of the pig for assessing damage in the locally treated pelvis and abdomen. Int J Radiat Oncol Biol Phys 1977;2(5-6):491-503.
2. Probert JC, Parker BR. The effects of radiation therapy on bone growth. Radiology 1975;114(1):155-62.
3. Probert JC. Animal experiments in radiotherapy II: large animals. J Can Assoc Radiol 1975;26(1):25-34.
4. Brown JM, Probert JC. Early and late radiation changes following a second course of irradiation. Radiology 1975;115(3):711-6.
5. Rosenthal AR, Egbert PR, Wilbur JR, Probert JC. Leukemic involvement of the optic nerve. Trans Pacific Coast Oto-Ophthalmological Soc 1974;55:137-58.
6. Probert JC. Brown JM. A comparison of three and five times weekly fractionation on the response of normal and malignant tissues of the C3H mouse. Br J Radiol 1974;47(563):775-80.
7. Horn NL, Thompson M, Howes AE, Brown JM, Kallman RF, Probert JC. Acute and chronic effects of x irradiation on blood flow in the mouse limb. Radiology 1974;113(3): 713-22.
8. Probert JC, Thompson RW, Bagshaw MA. Patterns of spread of distant metastases in head and neck cancer. Cancer 1974;33(1):127-33.
9. Marsa GW, Probert JC, Rubinstein LJ, Bagshaw MA. Radiation therapy in the treatment of childhood astrocytic gliomas. Cancer 1973;32(3):646-55.
10. Probert JC, Parker BR, Kaplan HS. Growth retardation in children after megavoltage irradiation of the spine. Cancer 1973;32(3):634-9.
11. Brown JM, Probert JC. Long-term recovery of connective tissue after irradiation. Radiology 1973;108(1):205-7.
12. Probert JC, Lederman M, Bagshaw MA. Medulloblastoma — treatment and prognosis. A study of seventeen cases in ten years. Calif Med 1973;118(1):14-7.
13. Probert JC. Doubts about the nominal standard dose. Br J Radiol 1971;44(524):648.
14. Probert JC. Secondary carcinoma in cervical lymph nodes with an occult primary tumour. A review of 61 patients including their response to radiotherapy. Clin Radiol 1970;21(2):211-8.
15. Probert JC, Jelliffe AM, Lund WS, Birt BD. Continuous intraarterial infusion of tumours with vinblastine followed by radiotherapy. Clin Radiol 1969;20(1):83-9.

Rheaume, Dorianne E.

1. Pickles T, Goodman GB, Fryer CJ, Bowen J, Coldman AJ, Duncan GG, Graham P, McKenzie M, Morris WJ, Rheaume DE, Syndikus I. Pion conformal radiation of prostate cancer: results of a randomized study. Int J Radiat Oncol Biol Phys 1999;43(1):47-55.
2. Pickles T, Goodman GB, Rheaume DE, Duncan GG, Fryer CJ, Bhimji S, Ludgate C, et al. Pion radiation for high grade astrocytoma: results of a randomized study. Int J Radiat Oncol Biol Phys 1997;37(3):491-7.
3. Pickles T, Graham P, Syndikus I, Rheaume DE, Duncan GG, Green A, Marlow C. Tolerance of nicotinamide and carbogen with radiation therapy for glioblastoma [see comments]. Radiother Oncol 1996;40(3):245-7,1996.
4. Duncan GG, Rheaume DE. Management of extradural spinal cord compression in malignancy. Br Columbia Med J 1995;37(2):99-101.
5. Rheaume DE. Neuro oncology. Br Columbia Med J 1995;37(2):79, 37(3):166.
6. Duncan GG, Goodman GB, Ludgate CM, Rheaume DE. The treatment of adult supratentorial high grade astrocytomas. J Neurooncol 1992;13(1):63-72.
7. Pickles T, Bowen J, Dixon P, Gaffney C, Pomeroy M, Rheaume D, Vernimmen F, Goodman GB. Pions — the potential for therapeutic gain in locally advanced prostate cancer: dose escalation and toxicity studies. Int J Radiat Oncol Biol Phys 1991;21(4):1005-11.

Sheehan, Finbarr G.

1. Westeel V, Murray N, Gelmon K, Shah A, Sheehan F, McKenzie M, Wong F, Morris J, Grafton C, Tsang V, Goddard K, Murphy K, Parsons C, Amy R, Page R. New combination of the old drugs for elderly patients with small-cell lung cancer: a phase II study of the PAVE regimen. J Clin Oncol 1998;16(5):1940-1947.
2. Tyldesley S, Sheehan F, Munk P, Tsang V, Skarsgard D, Bowman CA, Hobenshield SE. The use of radiologically placed gastrostomy tubes in head and neck cancer patients receiving radiotherapy. Int J Radiat Oncol Biol Phys 1996;36(5):1205-1209.
3. Nelson KA, Walsh TD, Sheehan FG: The cancer anorexia-cachexia syndrome. J Clin Oncol 1994;12:213-225.
4. Nelson KA, Walsh TD, Sheehan FG: A Phase II study of delta - 9 - tetrahydrocannabinol bon appetite stimulation in cancer associated anorexia. J Palliat Care 1994;10: 14-18.
5. Nelson KA, Walsh TD, Sheehan FG, Donovan PO, Falk GW: Assessment of upper gastrointestinal motility in the cancer-associated dyspepsis syndrome. J Palliat Care

1993;9:27-31.
6. Sheehan FG, Connolly CE, MacCarthy CF: Hepatoma in haemochromatosis in the absence of cirrhosis. Gut 1989;30:889.
7. Sheehan FG, Egan E: Autologous blood transfusion: a safer surgical blood transfusion practice. Ir Med J 1987;80(12):385-6.

Trapp, Ethlyn
1. Trapp E, Hardie MFB, Stadler O. The role of irradiation in the treatment of carcinoma of the corpus uteri. Can Med Assoc J 1956;75:898-904.

Truong, Pauline
1. Chan RH Dar AR, Yu E, Stitt LW, Whiston F, Truong P, Vincent MD, Kocha WI. Superior vena cava obstruction in small-cell lung cancer. Int J Radiat Oncol Biol Phys 1997;38(3):513-20,1997.

Tsang, Victor H.
1. Westeel V, Murray N, Gelmon K, Shah A, Sheehan F, McKenzie M, Wong F, Morris J, Grafton C, Tsang V, Goddard K, Murphy K, Parsons C, Amy R, Page R. New combination of the old drugs for elderly patients with small-cell lung cancer: a phase II study of the PAVE regimen. J Clin Oncol 1998;16(5):1940-7.
2. Munk PL, Lee MJ, Poon PY, Rankin RN, Sheehan B, Tsang V, Bromley P, Tyldesley S. Percutaneous gastrostomy in radiologic practice. Australas Radiol 1997;41(4):342-50.
3. Jackson SM, Weir LM, Hay JH, Tsang VH, Durham JS. A randomised trial of accelerated versus conventional radiotherapy in head and neck cancer. Radiother Oncol 1997;43(1):39-46.
4. Kwa W, Tsang V, Fairey RN, Jackson SM, El-Khatib E, Harrison RW, Kristensen S. Clinical use of asymmetric collimators. Int J Radiat Oncol Biol Phys 1997;37(3):705-10.
5. Munk PL, Morgan-Parkes J, Lee MJ, Janzen DL, Poon PY, Logan PM, Connell DG, Epstein J, Tsang V. Introduction to panoramic dental radiography in oncologic practice. Am J Roentgenol 1997;168(4):939-43.
6. Tyldesley S, Sheehan F, Munk P, Tsang V, Skarsgard D, Bowman CA, Hobenshield SE. The use of radiologically placed gastrostomy tubes in head and neck cancer patients receiving radiotherapy. Int J Radiat Oncol Biol Phys 1996;36(5):1205-9.
7. Teo P, Tsao SY, Shiu W, Leung WT, Tsang V, Yu P, Lui C. A clinical study of 407 cases of nasopharyngeal carcinoma in Hong Kong. Int J Radiat Oncol Biol Phys 1989;17(3): 515-30.

Tyldesley, Scott
1. Tyldesley S, Zhang-Salomons J, Groome P, Zhou S, Schulze K, Paszat L, Mackillop WJ. The association between age and the utilization of radiotherapy in Ontario. Int J Radiat Oncol Biol Phys 2000;47(2):469-480.
2. Tyldesley S, Sheehan F, Munk P, Tsang V, Skarsgard D, Bowman A, Hobenshield S. The use of radiologically placed gastrostomy tubes in head and neck cancer patients receiving radiotherapy. Int J Radiat Oncol Biol Phys 1997;36:1205-1209.
3. Munk P, Lee M, Poon P, Rankin R, Sheehan B, Tsang V, Bromley P, Tyldesley S. Percutaneous gastrostomy in radiologic practice. Australas Radiol 1997;41(4):342-250.

Voss, Nicholas J.
1. Voss N , Kim-Sing C. Radiotherapy in the treatment of dermatologic malignancies. Dermatol Clin 1998;16(2): 313-20.
2. Murray N, Shah A, Osoba D, Page R, Karsai H, Grafton C, Goddard K, Fairey R, Voss N . Intensive weekly chemotherapy for the treatment of extensive-stage small-cell lung cancer. J Clin Oncol 1991;9(9):1632-8.
3. Lohri A, Barnett M, Fairey RN, O'Reilly SE, Phillips GL, Reece D, Voss N,. Connors JM. Outcome of treatment of first relapse of Hodgkin's disease after primary chemotherapy: identification of risk factors from the British Columbia experience 1970 to 1988. Blood 1991;77(10): 2292-8.
4. Connors JM, Klimo P, Voss N,. Fairey RN, Jackson S. Testicular lymphoma: improved outcome with early brief chemotherapy. J Clin Oncol 1988;6(5):776-81.
5. Connors JM, Klimo P, Fairey RN, Voss N . Brief chemotherapy and involved field radiation therapy for limited-stage, histologically aggressive lymphoma. Ann Intern Med 1987;107(1):25-30.
6. Murray N, Shah A, Wilson K, Goldie J, Voss N,. Fryer C, Klimo P, Coy P, Hadzic E, et al. Cyclic alternating chemotherapy for small cell carcinoma of the lung. Cancer Treat Rep 1985;69(11):1241-2

Weir, Lorna M.
1. Jackson SM, Hay JH, Flores AD, Weir L, Wong FL, Schwindt C, Baerg B. Cancer of the tonsil: the results of ipsilateral radiation treatment. Radiother Oncol 1999;51(2):123-8.
2. Jackson SM, Weir LM, Hay JH, Tsang VH, Durham JS. A randomised trial of accelerated versus conventional radiotherapy in head and neck cancer. Radiother Oncol 1997;43(1):39-46.

3. Hayes MM, Matisic JP, Weir L . Apocrine carcinoma of the lip: a case report including immunohistochemical and ultrastructural study, discussion of differential diagnosis, and review of the literature. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1996;82(2):193-9.
4. Olivotto IA, Kim-Sing C, Bajdik CD, Trevisan CH, Ludgate CM, Weir LM, Jackson SM, Basco VE. Effect of acetylsalicylic acid on radiation and cosmetic results after conservative surgery for early breast cancer: a randomized trial. Radiother Oncol 1996;41(1):1-6.
5. Olivotto IA, Weir LM, Kim-Sing C, Bajdik CD, Trevisan CH, Doll CM, Lam WY, Basco VE, Jackson SM. Late cosmetic results of short fractionation for breast conservation. Radiother Oncol 1996;41(1):7-13.
6. Weir L , Keane T, Cummings B, Goodman G, O'Sullivan B, Payne D, Warde P. Radiation treatment of cervical lymph node metastases from an unknown primary: an analysis of outcome by treatment volume and other prognostic factors. Radiother Oncol 1995;35(3):206-11.
7. Olivotto IA. Weir L . Kim-Sing C. In response to Rescigno et al [letter; comment]. Int J Radiat Oncol Biol Phys 1995;31(1):203.

Wong, Frances L.

1. Jackson SM, Hay JH, Flores AD, Weir L, Wong FL, Schwindt C, Baerg B. Cancer of the tonsil: the results of ipsilateral radiation treatment. Radiother Oncol 1999;51(2):123-8.
2. Epstein JB, Emerton S, Lunn R, Le N, Wong FL. Pretreatment assessment and dental management of patients with nasopharyngeal carcinoma. Oral Oncol 1999;35(1): 33-9.
3. Grogan M, Thomas GM, Melamed I, Wong FL, Pearcey RG, Joseph PK, Portelance L et al. The importance of hemoglobin levels during radiotherapy for carcinoma of the cervix. Cancer 1999;86(8):1528-36.
4. Epstein JB, Gorsky M, Wong FL, Millner A. Topical bleomycin for the treatment of dysplastic oral leukoplakia Cancer 1998;83(4):629-34.
5. Epstein JB, Wong FL, Millner A, Le ND. Topical bleomycin treatment of oral leukoplakia: a randomized double-blind clinical trial. Head Neck 1994;16(6):539-44.
6. Cooper JK, Wong FL, Swenerton KD. Endometrial adenocarcinoma presenting as an isolated calcaneal metastasis. A rare entity with good prognosis. Cancer 1994;73(11): 2779-81.
7. Epstein JB, Wong FL. The efficacy of sucralfate suspension in the prevention of oral mucositis due to radiation therapy. Int J Radiat Oncol Biol Phys 1994;28(3):693-8.
8. McKenzie MR, Wong FL, Epstein JB, Lepawsky M. Hyperbaric oxygen and postradiation osteonecrosis of the mandible. Eur J Cancer. Part B, Oral Oncol 1993;29B(3):201-7.
9. Archibald CP, Coldman AJ, Wong FL, Band PR, Gallagher RP. The incidence of cervical cancer among Chinese and Caucasians in British Columbia. Can J Public Health. Revue Canadienne Sante Publique 1993;84(4):283-5.
10. Epstein JB, Wong FL, Dickens A, Szasz I, Lepawsky M. Bone and gallium scans in postradiotherapy osteonecrosis of the jaw. Head Neck 1992;14(4):288-92.
11. Jackson SM, Fairey RN, Kornelsen RO, Young ME, Wong FL. Clinical results in carcinoma of the cervix: radium compared to caesium using remote afterloading. Clin Radiol 1989;40(3):302-6.
12. Epstein JB, Rea G, Wong FL, Spinelli J, Stevenson-Moore P. Osteonecrosis: study of the relationship of dental extractions in patients receiving radiotherapy. Head Neck Surg 1987;10(1):48-54.
13. Epstein JB, Wong FL, Stevenson-Moore P. Osteoradionecrosis: clinical experience and a proposal for classification. J Oral Maxillofac Surg 1987;45(2):104-10.
14. Wong FL, Jackson SM. Five year survey of lip cancer seen at BCCI 1960-1965. Br Columbia Med J 1978;20(7)214-216.

Wu, Jonn S.

1. Roa WH, Miller GG, McEwan AJ, McQuarrie SA, Tse J, Wu J, Wiebe LI. Targeted radiotherapy of multicell neuroblastoma spheroids with high specific activity [125I]meta-iodobenzylguanidine. Int J Radiat Oncol BiolPhys 1998;41(2):425-32.

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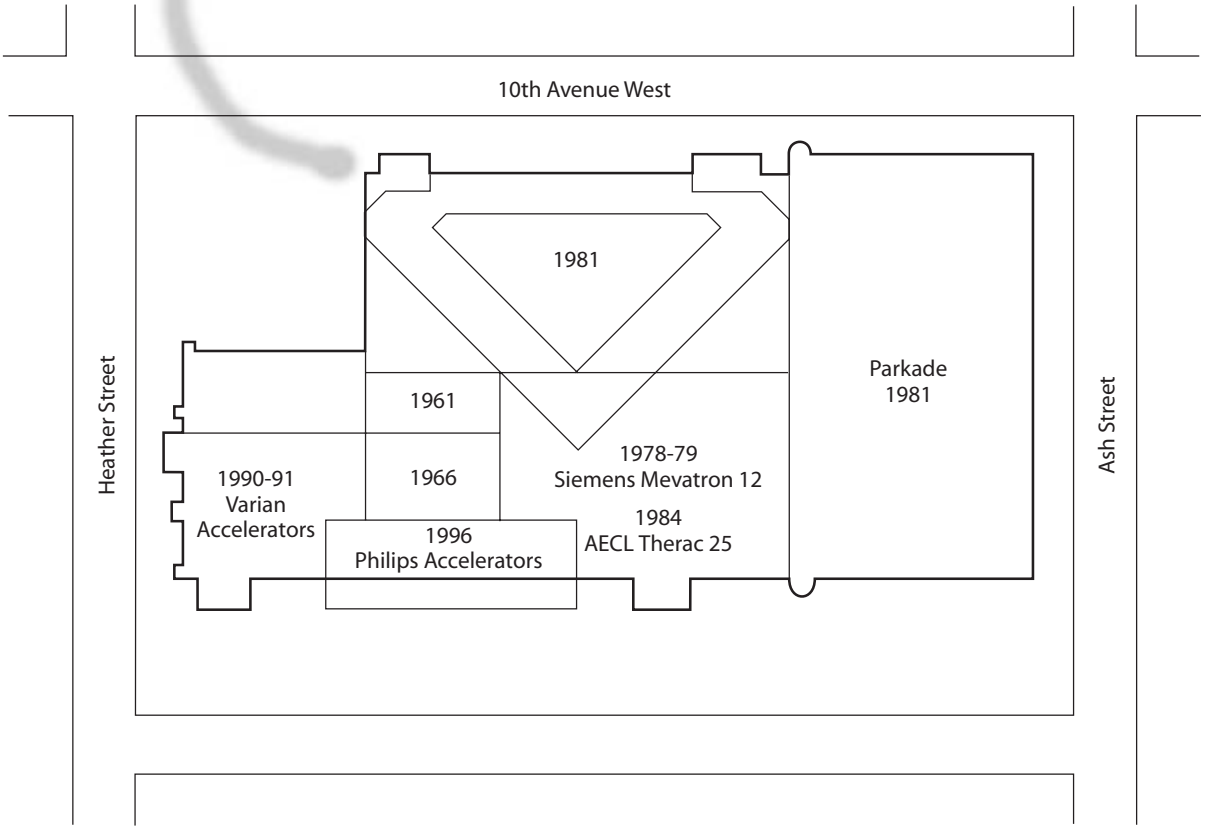

Expansion fills the city block.