The development of

MEDICAL PHYSICS

and

BIOMEDICAL ENGINEERING

in

NEW ZEALAND HOSPITALS

1945-1995

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Some personal overviews by

Hugh Jamieson
Bruce White
Ray Trott
Jack Tait
Gordon Monks

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PREFACE

It is appropriate, and essential, to first pay a tribute to the many hospital physicists, biomedical engineers, and physics technical officers, in all our New Zealand centres, who have worked together hard and effectively over these many years, in the interests of patients, hospital services, and medical physics/biomedical engineering. Isolation has always been a problem with the separation of our centres, but this has been overcome through the years with occasional correspondence, meetings, and our friendships. We have always agreed and supported each other in any matters of moment, and we have been able to disagree amicably on some details at times.

We should also like to record here the names of those physicists who worked with us in earlier years, but are now deceased - they are well-remembered: Campbell Begg (first physicist at Palmerston North Hospital); Howard Tripp (who began in Dunedin, and was briefly the first physicist at Waikato Hospital); and Maurice Looser (who worked for two periods in Dunedin).

It is difficult today to predict the future in the health services, and in our major hospital centres, but our retired group of hospital physicists will continue to follow with great interest the ongoing developments in both hospital physics and in biomedical engineering. We all wish our successors well in the next fifty years of their endeavours!

Hugh Jamieson	and	Owen Hames
Bruce White		Tom Rogers
Ray Trott		Wallace Armstrong
Jack Tait		Bob Borthwick
Gordon Monks		Ross Garrett

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PREFACE TO SECOND EDITION, May 1996

The quality of reproduced photographs has been greatly improved for this edition, due to willing and skilled assistance offered by David Goode and Richard Fright at Christchurch Hospital. We appreciate their considerable help.

There have been minor changes and additions to the text, with some corrections. A few photographs have been added, and some changes made to suit the revised format.

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"THE DEVELOPMENT OF HOSPITAL PHYSICS, and BIOMEDICAL ENGINEERING, in NEW ZEALAND HOSPITALS"

"Some personal overviews for the period 1945-1995"

INTRODUCTION:

The first fulltime hospital physicist in NZ was appointed in Dunedin in November 1945. Other centres followed suit until by 1965, all six main centres employed hospital physicists.

Coincidentally, the Roentgen Centennial Year 1995 also marks fifty years since the appointment of the first hospital physicist. As a number of the early hospital physicists are now retired, it is an appropriate time to have them record their personal overviews of developments in their particular centres. Not all retired people wished to be included.

This booklet contains these writings. They are not strictly histories as such, but much accurate historical matter is included, along with the individual 'flavour' which each person brings with his unique knowledge of people and events of the times.

The names of the contributors are noted here, together with the centre with which they were so closely associated, and the years in which they worked there. They are given in the order in which the first appointment was made in each centre.

Hugh Jamieson	Dunedin	1947-1984	(First appt 1945)
.. .. ..	Wellington		(" 1950)
Bruce White	Auckland	1961-1993	(" 1952)
Ray Trott	Palmerston North	1962-1986	(" 1952)
Jack Tait	Christchurch	1956-1988	(" 1954)
Gordon Monks	Hamilton	1965-1985	(" 1965)

Only a small amount of editing has been done, to minimise repetition, and to give a reasonably uniform format. I appreciate that those contributing asked me to act as editor.

Hugh Jamieson
November 1995

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EARLY HOSPITAL PHYSICS IN NZ: SOME MEMORY FRAGMENTS (1945-95)

THE BACKGROUND SCENE:
It's more than fifty years, depending on criteria! Through John Strong Lectures, we know of the early radon plant set up by Noel Hill (then a part-time physics student) at Wellington Hospital in 1925, but in Dunedin I found a 1921 letter about "one package of radium bromide" sent to "Professor R Jack, Otago Hospital & Charitable Aid Board, Dunedin". Bobby Jack was then Professor of Physics; he also set up the first radio station in NZ; in 1945 he was a player in having Warren Sinclair appointed as the first full-time hospital physicist in NZ.

X-rays were demonstrated in Dunedin on August 26, 1896, to the Otago Branch, NZ Medical Association; 8 months after Roentgen's discoveries (A C Begg, NZ med J, 1975, 82 1-5). Diagnostic radiology soon spread - I still have an original print of a hand radiograph taken in 1899 in Dunedin; many centres started X-ray work by 1910. There were many sad stories: "...Dr Ewart of Wellington Hospital worked his machine in the cellar stripped to his singlet because of the heat. With the soft X-rays his chest showed a curious mottling which gave him warning of danger. He suffered burns in the hands...." (C C Anderson, Histoire Generale de la Radiologie, no's 57-59,Sept-Nov 1956).

And radiotherapy also started early - "...Dr Hosking of Masterton set up a private plant with electrical treatment apparatus and a supply of Radium. Being a pioneer, his work was ridiculed, but before 1910 he showed a case of proved epithelioma of the lip. The lip was diagnosed microscopically, cured with Radium..." (C C Anderson, 1956). There is a lot of early documentation from around the country, much of it written up by Dr Colin Anderson, Radiologist, of Invercargill, and by Dr Cameron and others active in the early days.

More into the hospital physics scene, I came across mention of "radiation dose" in roentgens in a Dunedin patient's notes dated 1932, which was not long after the original definition of the roentgen in 1928 (and extended in 1937). In the UK, professional hospital physicists were appointed from 1914 onwards, with early names such as Russ, Hopwood, and Mayneord.

THE FIRST NZ HOSPITAL PHYSICIST:
Our first full-time NZ hospital physicist, Warren Sinclair, started work at Dunedin Hospital on November 29 1945, just after completing an Otago M Sc (Hons) degree. The conditions of appointment are interesting, and a model of brevity since lost when one looks at present-day "job specifications":

" DUTIES OF RADIOLOGICAL PHYSICIST

1 Two hours per week for lectures in Physics to students of Diagnostic Radiology
2 Six hours per week as Assistant in Physics Department under the direction of the Professor of Physics

3 Practical instruction of Diagnostic Radiologists at Physics Department and Hospital
4 Duties as Physicist to Hospital Board and Cancer Research Committee.

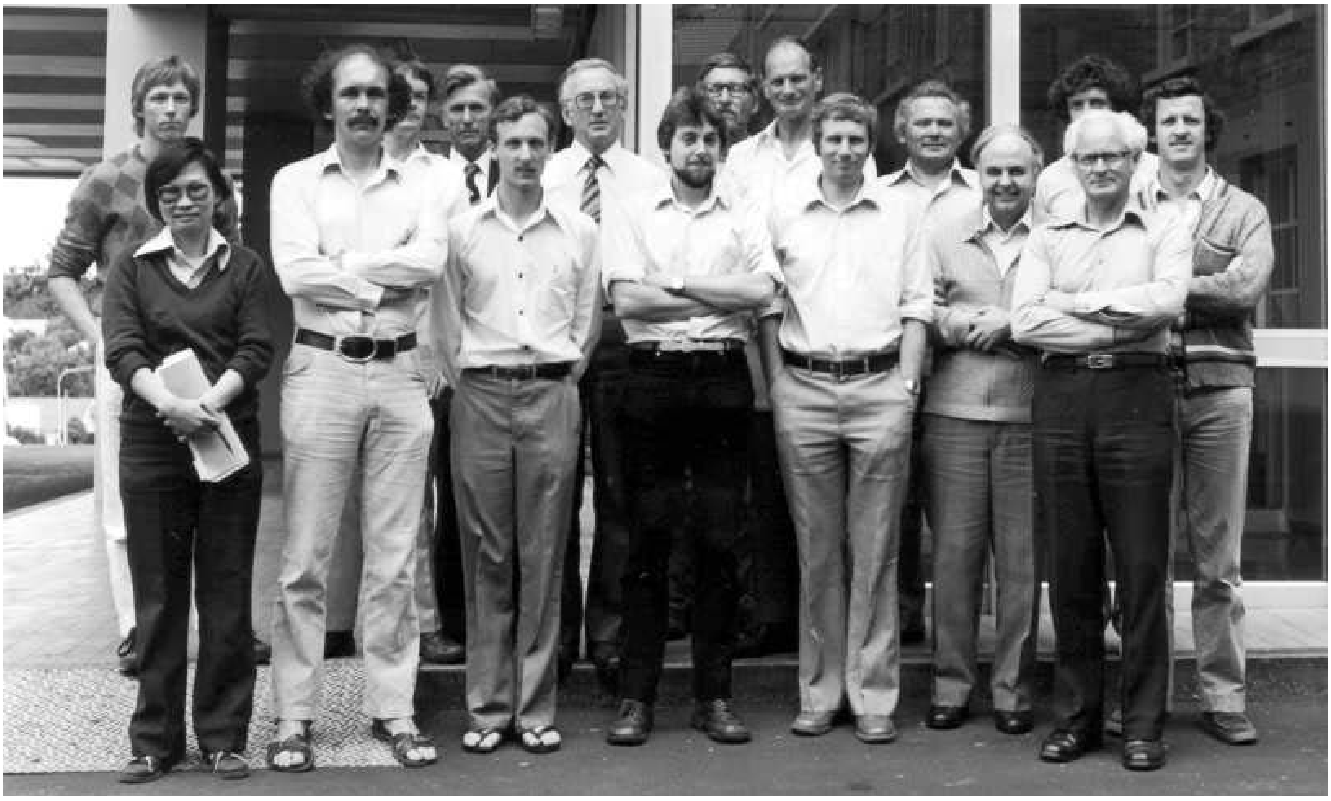
The person appointed will be under the direction of the Professor of Physics. "

This set up a clear connection with the Otago University Physics Department which was invaluable; indicated the new Otago DDR; gave a connection with the Cancer Society (then BECC); and a broad-based appointment (not just radiotherapy). When I began in December 1947, the same conditions applied, and it was useful to dust them off from time to time to establish status. The starting salary was fixed at 500 pounds per annum ($1000 pa), which then was about 50% above the starting salary for a secondary teacher. It included $100 from the University of Otago and $100 from the BECC.

The original physics equipment included a Victoreen R-meter (purchased by the hospital in 1938), a 0-2 mR/min Victoreen ratemeter, and very little else. Warren obtained a set of "isodose curves" in July 1946 from the Royal Marsden Hospital, London, a slide rule, a basement office (of course! Where else would you expect to find a physicist?) and began treatment planning with no other help except a 2-week visit to the National Radiation Lab in Christchurch, where he met George Roth and Bert Yeabsley. By late 1946, Warren was corresponding with John Read in London about the British HPA Diagrams & Data Scheme (included isodose curves, physics data, etc) which John Read was instrumental in setting-up.

Radiotherapy equipment in Dunedin was good! It included a new Westinghouse 200 kVp Quadrocondex as the main X-ray unit, with an older 200 kVp GE Maximar, a 60-140 kVp Dermadex for superficial therapy, and a Philips 50 kVp contact therapy X- ray unit lurking unused in the shadows. And of course, a good supply of radium tubes, needles, plaques and seeds. There was a newly appointed UK-trained radiotherapist, Dr Peter Jerram, recently discharged from the NZRAF/RAF where he served during the war as a radiologist. He was very concerned at some legal cases due to overdosage in other NZ centres. Dr Bill Sowerby, Radiologist, also helped in obtaining establishment for a physicist. A radiography course (radiology and radiotherapy included) was also set up in Dunedin in 1945, by collaboration between Radiology and Radiotherapy.

So the stage was set - but no Physics workshop facilities, no supervoltage radiotherapy (except an overseas handful of 1MV machines, one at St Bart's London; a few in USA), no artificial radioactive materials, no calculators (except log tables and slide rules!), no computers, and no other hospital physicists in NZ; only NRL in Christchurch with 2 physicists busy with radiation protection and dose output checks around NZ centres.



(Left to right) People at NZMPBEA Conference, Hamilton 1981 (Courtesy NRL)

(Back) Peter Metcalfe, Fergus Thomson, Gordon Monks, Hugh Jamieson, Bill Artner, Ray Trott, Tom Rogers, Lee Dakers, David Armstrong
(Hamilton) (Auckland) (Hamilton) (Dunedin) (PalmerstonNorth) (Christchurch) (Auckland) (Christchurch)
(Front) Miss Y C Chan, Malcolm McQueen, John Poletti, John Le Heron, Martin Pracy, Bruce White, Jack Tait
(Hamilton) (Dunedin) (NRL) (NRL) (Hamilton) (Auckland) Christchurch)

Mr R L Luke and HDJ with the original radiograph of Mr Luke's hand taken in 1899, in Dunedin. On this occasion, Mr Luke was back for a '75-year follow-up' radiograph - a unique record.

AROUND THE CENTRES:

The need for hospital physicists in the main centres from 1950 was becoming recognised, although there are serious recorded discussions about whether there was enough work for a full-time physicist in any centre! Early names in the various centres are given below, to indicate our beginnings:

DUNEDIN HOSPITAL: As noted, Warren Sinclair began here on November 29 1945. Within a year, he realised the need for overseas experience, and was able to obtain a position under Prof Mayneord at the Royal Marsden Hospital, London. He left Dunedin Hospital in August 1947, intending to return after 3 years' leave, and asked me to fill in for him for that period. In the event, he never returned (another story there!). I completed my M Sc (Hons) course at Otago University (including a thesis using primitive X-ray crystallography equipment, unused but bought the year I was born!) and began at Dunedin Hospital on December 16 1947, with no intention of being there for 37 years!

WELLINGTON HOSPITAL: Bob Borthwick began here in June 1950, but soon became disillusioned at lack of the progress he thought necessary in radiotherapy - perhaps it is significant that he was appointed to the "Radium Department". He resigned in December 1951, and took up a position at NRL in diagnostic X-ray protection. He was followed at Wellington Hospital by Ross Garrett (1952-1956, when he moved to Auckland University), and Wallace Armstrong (1956-1980) who then gave up medical physics and moved into meteorology. Wallace was our 1994 Strong Memorial Lecturer.

AUCKLAND HOSPITAL: Owen Hames began in January 1952, and continued on until his retirement in 1988. John Wright began in 1955 after the introduction of supervoltage radiotherapy but left in 1960 (returned to the UK). Bruce White began in the Auckland Hospital path lab (biochemistry) in Feb 1961, moved into nuclear medicine in Feb 1963; became head of the new medical physics and biomedical engineering department in Jan 1979; he moved into asset management in Dec 1992; and retired in November 1994. We all know of the ongoing substantial developments in Auckland from early on.

PALMERSTON NORTH HOSPITAL: Dr Don Urquhart was a driving force here, firstly as radiologist (including private practice); he then developed radiotherapy; later still, nuclear medicine. When the embryonic Radiotherapy Department began, Campbell Begg was appointed in April 1952 as physicist/radiographer. He worked very hard, qualified as a therapy radiographer as he worked, and finally left to take up a hospital physics appointment in the UK in January 1961. His health was not good, and he died in 1963. Ray Trott then took over, but as radiographer/physicist until he became fully qualified in physics, when he took up the post as physicist until his retirement in July 1986.

CHRISTCHURCH HOSPITAL: Initial developments were slower at Christchurch Hospital. Bob Borthwick moved again, in June 1954 (this time from NRL), to start up hospital physics. Jack Tait joined him in 1956, and continued on over many developments until he retired in 1989. Bob Borthwick went overseas on a UN assignment to Pakistan, and never returned but moved on to a variety of UN posts, initially in IAEA and later in UNDP. Christchurch grew and flourished with Jack's hard work and cheerful leadership.

WAIKATO HOSPITAL: By the late 1950's, there was provision for 2-3 physicists at each of the main centres, but there was a shortage of applicants which was serious. Hamilton was the last major centre to appoint a hospital physicist, in their new Radiotherapy/Nuclear Medicine Dept. Howard Tripp, who had been assistant physicist in Dunedin from 1955-1965 took up the Hamilton post in June 1965, but tragically died a week later after a traffic accident in the grounds of Waikato Hospital. Gordon Monks then came out from the UK to take up the post in October 1965, returned to the UK for a time in 1967/68, came back to Hamilton in 1968 and worked there until his retirement in May 1985.

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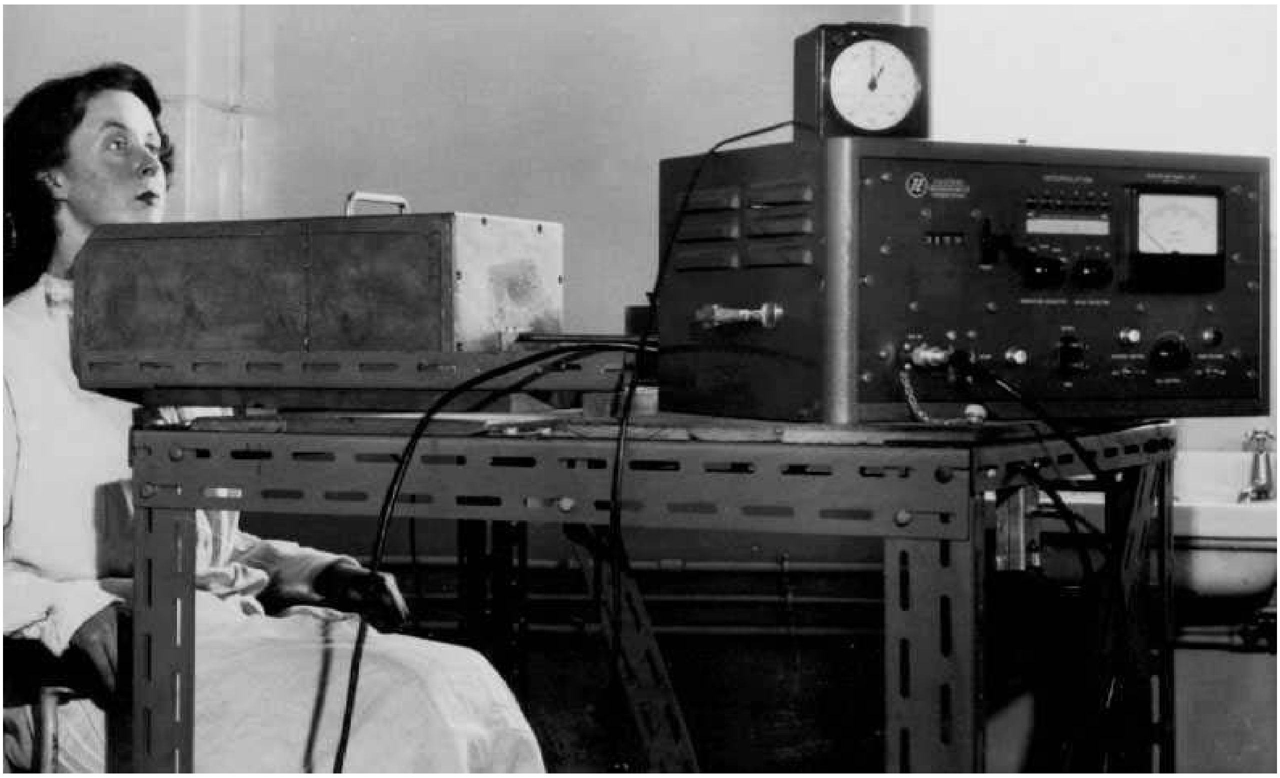
SUPERVOLTAGE RADIOTHERAPY:

It was obvious by 1949 to those working in the field - radiotherapists and physicists alike - that supervoltage X-ray therapy was essential for adequate radiotherapy of deep-seated conditions. Technical developments specifically for radiotherapy equipment had been slowed greatly by WW2, but betatrons had been developed for industrial radiography from 1942. Direct high voltage equipment, with 1-2 MV resonant transformers and 2 MV Van de Graaff generators, were also now available in the USA.

With radar microwave developments in wartime, and of course the availability of artificial radionuclides from nuclear reactors, the post-WW2 possibilities of new equipment had arrived. USA suppliers offered the Allis-Chalmers 24 MeV betatron or the 2MV Van de Graaff; Canada with high-flux nuclear reactors was busily producing Co-60, and the AECL (Atomic Energy of Canada Ltd) set up production of the Theratron series (Type A - traditional X-ray look alike, in appearance a 44 gallon drum on pivots, and with a mercury shutter(!); Type B - isocentric rotation units with 75 cm source-axis distance (SAD) initially, later increased to 80 cm.

First supervoltage radiotherapy unit in NZ: AECL Theratron-B Co-60 isocentric unit, 75 cm SAD; installed at Christchurch Hospital in 1956.



I-131 thyroid uptake equipment, 1952, as developed by Thyroid Research Unit, Otago Medical School. Two G26.Pb geiger tubes; 25 mm lead-walled 'castle'; perspex neckbar; good geometry, with 20 inches (50 cm) distance from geiger tube to neckbar; Note binary '64 Scaler' with separate timer. 'Patient' seated in dental chair for easy positioning. 15 uCi (550 kBq) given.

The UK MRC drew up specifications in 1950 for medical linear accelerators, with isocentric design, high dose-rates, precise adjustable diaphragms and localisation accessories, and 5 MeV operation. Philips/Mullard and Metropolitan-Vickers entered the field with competitive designs, which in the event operated at 4 MeV. This MRC isocentric design has basically continued on to the present machines, except that now bending magnets allow horizontal waveguides.

Christchurch led the New Zealand charge into supervoltage radiotherapy, with a Theratron B gifted by Sir Arthur Sims on Sept 9 1954. High-cost technology had arrived although the phrase arrived much later! The official view by all "authorities" was that "Two supervoltage units would serve the country for many years to come" (documentary evidence on hand). But no money of course! Auckland and Otago/Southland ran public appeals in 1955, and money poured in! Both centres raised over 100,000 pounds ($200,000, which with inflation since, would be about $2-3M today). Auckland chose a 4 MeV Metrovick linac; Dunedin chose the Allis-Chalmers 24 MeV betatron, both installed in 1958. Not to be outdone, Don Urquhart organised a public appeal in Palmerston North in 1957 to provide a Co-60 unit there; a Barazzetti small isocentric unit (55 cm SAD) was installed in 1958 also. In 1962, the first Government-purchased unit, a TEM (British) isocentric Mobaltron Co-60 (75 cm SAD) unit was installed at Wellington Hospital. Finally, in 1965 Waikato Hospital set up a completely new Department, including a Theratron-80 Co-60 unit, and, uniquely, a Continental Cs-137 unit. So much for the 1955 "official" view, that 2 units were enough! (Note that this official view recurred regularly with new developments, ie that 2 of anything would "Serve NZ for many years to come." See later!)

It is interesting now to look back at what happened to the original machines. Christchurch "made-over" their Theratron-B as the basic gantry for their 'home-built' X-ray CT scanner. The Dunedin betatron (condemned by various visiting "experts" usually with no personal experience of supervoltage radiotherapy) continued in full operation for 32 years; introduced electron beam therapy into NZ. Its energy range for photons and electrons is now the recognised desirable high-energy range. The Barazzetti Co-60 unit was later moved to New Plymouth, where it bravely survived against all odds for many (too many really) years. The Dunedin small Theratron C-II Co-60 unit (55 cm SAD; installed 1961; removed 1971) was offered to NRL to give them a Co-60 calibration source. Other units have come and gone up and down the country....

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NUCLEAR MEDICINE:

The post-WW2 era also ushered in vast new possibilities with the availability of artificial radionuclides, subject of course to their provision and practicable delivery to remote areas like NZ. However, for interest it could be noted that apart from the recognised uses of radium and radon from early days, there were earlier medical uses of radioactive materials! I was intrigued by obviously old small packs of "radioactive selenide", found during a cleanout at Dunedin Hospital pharmacy, which had been used around 1935 as a colloidal solution given intravenously in conjunction with X- ray therapy. The descriptive pamphlet said "...Results obtained are stated to be good, (and in italics) 'all things considered'...."

Then there was the NZ use of "radon ointment", provided (presumably with reluctance!) by NRL, as a preparation of radon in vaseline ("0.76 mCi/12.6 gm ointment"), to treat small skin areas with necrosis after radiotherapy. The idea was that alpha rays accelerated healing (refer "Treatment of radiation necrosis with radon ointment", C C Anderson (Invercargill), Australasian Radiology, vol 4, p 104, 1961.) This article was followed interestingly enough by "Clinical RBE of 24 MV X-rays cf 200 kVp", CWS Jerram (Dunedin), vol 4, p 106, 1961.

So making a quantum leap into modern nuclear medicine, what do we find? Dr Jim Campbell, late Radiotherapist at Christchurch Hospital, prescribed the first doses of I-131 for medical use in NZ in 1948, the same year that artificial radionuclides first became available in the UK. In Christchurch, three shipments of I-131 were imported directly from Oak Ridge, and were dispensed by George Roth and Bert Yeabsley of NRL, as there was then no Christchurch hospital physicist. The "official" view on this new field was that all 'nuclear medicine' work should be centred in Christchurch. Bob Borthwick was busy from his appointment there in June 1954, setting up a "hot" lab (basement/s of course!) and developing other nuclear medicine activities.

However, of course other centres were soon involved. In Dunedin, the highly-regarded Medical School Thyroid Research Unit (Drs Purves and Adams; note in passing that Purves and Hercus introduced iodised salt into the NZ diet to prevent goitre) was carrying out I-131 thyroid uptake tests by 1950, with equipment they designed themselves - I became involved in this, and by 1955 all these tests were carried out at Dunedin Hospital. The first Dunedin Hospital use of I-131 was on August 13 1950, using 400 uCi I-131 to test possible uptake in a large skull secondary (hemisphere 10 cm dia), with positive results. After thyroidectomy, the patient was then treated with 62 mCi I-131. A further secondary was found in the spine before any radiological evidence, which gave our radiologists food for thought. The patient did well but refused to attend further follow-ups! P-32 was first used in June 1954; other radionuclides came slowly into use.

All centres rapidly got into usage of radionuclides. The first recorded NZ use of intravenous P-32 for polycythaemia was in July 1952 in Palmerston North (Don Urquhart again, with Athol Rafter from Nuclear Sciences, DSIR). The use of I-131 followed in that year (1952). In Auckland, the Dept of Endocrinology under Prof Kaye Ibbertson was using radionuclides for diagnosis and treatment from 1954. In Wellington, Eugene Lynch (radio-therapist) started up thyroid tests in January 1952. The use of P-32 for polycythaemia began there on April 28 1953 under Verney Cable (physician). There is a semi-whimsical comment added about this in Allan McArthur's paper "The Evolution of Nuclear Medicine in NZ", 1989, which is still thought-provoking from a protection aspect: "...Many prominent personalities gathered in a lean- to room adjacent to the old Radiotherapy Dept to witness this procedure. Besides Verney Cable there were George Roth, Athol Rafter, Bill McCabe, Eugene Lynch and John Logan. On this day George Roth discovered a small amount of unsealed radium overlooked during the shift of the radon plant to Christchurch. The source was sealed and quietly transported to Christchurch for safe disposal. 36 years later there is still detectable activity in this area, but as it is not occupied, there is no staff hazard...."

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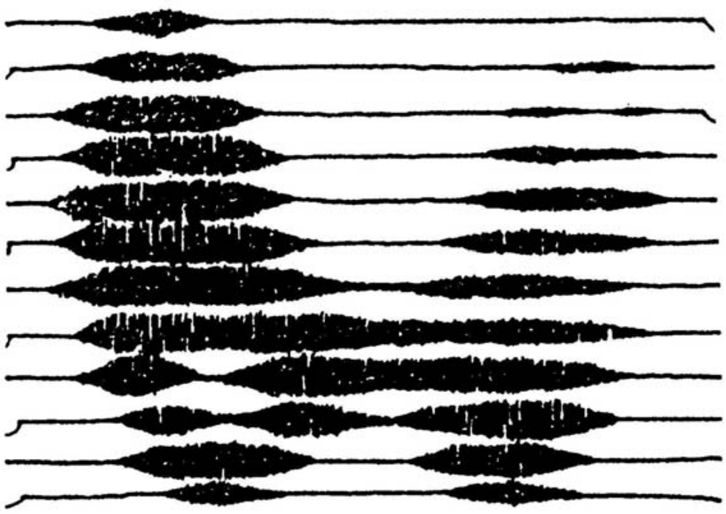

Typical thyroid scan, using phantom, taken on the Christchurch Hospital original rectilinear scanner (see later)

NUCLEAR MEDICINE IMAGING:

(Some detail below comes from Allan McArthur's paper on NZ nuclear medicine developments. His paper makes interesting reading on other aspects). Imaging was a natural extension of the use of radionuclides in medicine. In Auckland, "thyroid scanning" began with a hand-held counter with a pinhole collimator over the patient's neck, after I-131 administration, with the physicist reciting and recording the ratemeter counts. An IDL dual probe colour scanner came into use in 1965, with Bruce White in the action. In Christchurch, Jack Tait, Tom Rogers, and George Gates designed and built a rectilinear scanner for whole-body imaging 1963-66. Dunedin purchased the first commercial scanner, a Picker Cliniscanner (crystal 50 mm dia x 25 mm), with vibrating stylus and teledeltos paper (grey-scale image), and had it in use in January 1962. As clinical interest grew, Fergus Thomson and Colin Medcalf designed and built a colour-scanning head, and had it in use by Feb 1966. Different models of Picker Magnascanners appeared soon after in most centres - Palmerston North 1965; Wellington ?1965; Hamilton 1966; Auckland 1968; Dunedin (Invercargill unit on loan) 1968; then Radiax scanner 1970; Invercargill (unit retrieved from Dunedin) 1972; Napier ??

Gamma cameras were now under active development - I saw British prototypes in 1963, but Anger was well ahead in the USA. There was a period around 1965 when rapid developments in gamma cameras raised the question of whether to buy now, or wait for the next advance. But with the advent of Tc-99m generators, first in use in Auckland in 1967, the scene was set for a very rapid transformation into modern imaging with gamma cameras in most centres by 1969-72. The new field of production of radiopharmaceuticals locally had also arrived and had to be solved, usually with the addition of a radiopharmacist. The overall expansion led to setting-up of Nuclear Medicine Depts in several centres, with hospital physicists closely involved, except in Palmerston North. To some extent, hospital physicists had initiated the developments, often with considerable scientific and technical achievements in equipment, and then saw the fruits of their labours seized gratefully by interested clinicians! As we all know, there has been no pattern, with ongoing fragmentation, sometimes with Radiology, Haematology, or Laboratory Services claiming relevant areas.

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BIOMEDICAL ENGINEERING:

Hospital physics was always associated with developmental electronics work, initially with radiation dosimetry, then in nuclear medicine, but later extending beyond that in all centres. Before long, there was obviously a 'conflict of interest' between this type of development, and the traditional electronic servicing which had existed earlier under hospital boards' electrical engineers. However, hospital physicists have always operated completely in the clinical environment, whereas hospital electrical engineers and their staff came under local chief engineers, and were primarily involved in 'hospital plant' maintenance. And so when tentative steps were made by hospital physicists into the clinical scene outside 'traditional' areas, they found that medical staff were already familiar with asking electronics servicemen to help them with their ideas.

Once clinicians became aware of the existence of hospital physicists, there were increasing requests for help in a wide range of work. All six centres developed quite differently in this respect, for an interesting variety of reasons. The rapid growth of nuclear medicine, in which major input from hospital physicists was an integral part, helped to develop the 'hospital physics presence'. In most centres, this growth began within the local radiotherapy department. Nuclear medicine must have been the most rapidly growing new medical speciality in the 1955-75 era. As it outgrew its place within a particular radiotherapy department, it was 'disestablished', and an independent Department of Nuclear Medicine was established, under the control of a 'nuclear physician', which was a specialist classification that caused some controversy in medical circles, as to where it properly belonged. It also required licensing from NRL.

In Christchurch, when Nuclear Medicine became a separate department in 1972/73, Medical Physics was also able to 'escape' from Radiotherapy under Jack Tait's leadership, and to become autonomous; they actually moved physically as well, into a house at 20 Cashel Street; changed their name to that of Medical Physics & Bioengineering Department, and developed an important link with the University of Canterbury Electrical Engineering Dept, and in particular, with Prof Richard Bates. A substantial development in biomedical engineering was then begun.

Auckland took a different road - when the (then new) huge Auckland Hospital Block was being commissioned, Bruce White and Murray John (who at that time were in the already independent Nuclear Medicine Dept) were given the task by hospital management of assessing capital requests for equipment from all departments, with a view to rationalising these requests and to make economies. They did this very successfully indeed! They were recognised for their efforts, and were then on the road in 1979, with good administrative support, to form their new independent Department of Medical Physics and Clinical Engineering. This drew together other physicists and electronic technicians in a number of hospital departments, to form a substantial integrated Department.

In Hamilton, when Nuclear Medicine separated from Radiotherapy in 1981, it suffered a further fission, with imaging going to Radiology, and radioimmunoassay being taken over by Pathology. At that point, the Medical Physics folk, who had been within the combined Radiotherapy & Nuclear Medicine Department from their beginnings in 1965, needed a new home as well. With the support of their hospital administration, they set up as the Division of Scientific Services in 1981, to provide a wide range of services wherever required. Again, they drew other isolated groups of technicians into the larger whole.

In Christchurch and Hamilton, an essential 'ingredient' was that there was a registered engineer already lurking within a physicist (Jack Tait and Gordon Monks respectively); this made it possible to comply with the relevant Act in regard to electronic/electrical maintenance. In Auckland, Jon Henderson, who was already a registered engineer and had been drawn into their new enlarged Department,was able to meet this requirement.

At Wellington Hospital, Ian Ross, who had been primarily involved in Nuclear Medicine, became involved in matters such as technician training at CIT. When there were discussions on setting up biomedical engineering at Wellington Hospital, Ian had a difficult time when the Wellington Clinical School wanted to set up a Biomedical Engineering Unit, to include hospital people. That did not proceed, but a Department of Biomedical Engineering was established in the 1980's, which again drew together isolated groups of technicians, along the lines of other centres.

In Dunedin, for historical reasons, the hospital electrical engineer had always controlled the area of electronic maintenance around the hospital. Furthermore, there were several independent electronics workshops in the Medical School (physically just across King Street from Dunedin Hospital; each workshop the 'property' of the particular medical specialist heading 'his' department). These workshops supplied the needs of medical staff who wore two 'hats', with joint appointments in hospital and medical school. Apart from all that, there were running battles over the years about servicing X-ray units in radiotherapy and radiology; these were absurd but also potentially hazardous (similar stories were told in the UK). Efforts made from 1978 to expand Medical Physics to include biomedical engineering were frustrated by the (then) Chief Executive, who was able to turn down any initiative from the Medical Supt-in-Chief and to support the claims made by the Electrical Engineer.

In Palmerston North, when Nuclear Medicine separated from Radiotherapy, the nuclear physician took complete control, and did not call on any physics services, which was unfortunate. The hospital administration also declined to ever establish an independent Medical Physics Department, for their own imponderable reasons.

Genuine moves by the Health Department from 1977/78 to promote the establishment of comprehensive medical physics and biomedical engineering departments in the six centres had to be abandoned because of the hostile reception by hospital engineers and some Board executives. The 1977 visit by Dr Dennis Hill, Regional Scientific Officer, NE Thames Regional Health Authority, to promote biomedical engineering in NZ, with a Report issued in 1978, generated more heat than light. He raised the question of registration, which was met in some centres here (as noted above) with physicists who also had obtained registration as engineers during their careers.

A copy of

A REPORT ON THE ROLE OF BIOMEDICAL ENGINEERING AND MEDICAL PHYSICS IN NEW ZEALAND

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Auckland, August 1978

SUMMARY

Arising from a visit to six major hospital centres in NZ, it is recommended that the existing hospital medical physics activities should be expanded, where necessary, to make provision for medical electronics and biomedical engineering work and that the division of equipment maintenance services should be decided on a more formal basis, which will vary from hospital to hospital. The bulk of this routine service work falls more naturally under the hospital engineering organisation, but specialised apparatus should continue to be the concern of hospital physics departments. Wherever possible all the hospital's equipment should be serviced under the control of a unified maintenance system.

Much mutual benefit is being derived from an active co-operation between the science and engineering departments of NZ universities and the hospitals, and this should be encouraged.

A distinct need was evident for the Department of Health to employ a hospital scientist and engineer on its staff and to establish a Standing Advisory Committee for Hospital Technical and Scientific Services. At the level of the larger Hospital Boards a similar committee would provide an effective representation for the views of hospital scientists and engineers in the allocation of equipment and resources and the planning of services.

COMPUTING IN HOSPITALS:

I was first introduced to the possibilities of computing in 1956 by a very senior forward-looking accountant in Dunedin. His interest was of course in commercial possibilities, but together we started in on an American correspondence course in programming. Another friend, who later became a University lecturer in accounting, dismissed the whole idea of the widespread use of computers as preposterous. He thought that in time, there could be commercial use for one computer in the North Island, and one in the South. Last week a local kindy here was talking of computers for their pre-schoolers.

In 1963 while on study leave in the UK, I attended a computer workshop at Elliott Computing Services ("803 Computer hire at 4 pounds per hour"). (Earlier, they charged for their courses; now they were free to encourage users who could then hire (or buy!) an 803. Their Computing Centre opened in 1953; by 1963, "...Over 100 National-Elliott 803 Computers have been delivered to customers throughout the world..."). But I digress.

The Health Dept by 1975 saw computing as another high-cost-nightmare ahead so, as it were, they seized the bull by the horns, and decreed it would set up a stand-alone Health Computer Unit. This was obviously going to be a total disaster, in itself and also in the inhibiting of progress in hospitals. The budget was $28M to be spent over 5 years; there would be initially three "core" national systems, payroll, unique patient identification, and a laboratory system. Centres were established in Auckland and Christchurch (to the familiar tune: "Two units will serve the country.."); staff employed, including people who flew madly up and down the country to talk to everyone, at great expense; work began on the "core" systems. No purchases of computers were allowed in hospitals. In all centres, hospital physicists began lengthy and frustrating report-writing on a variety of computing proposals. Somehow Christchurch Hospital beat the system and obtained a PDP-11 which they used enthusiastically. A ponderous payroll system was set up; timesheets appeared, causing great fury; the 'national patient identification system' ground along (does it exist yet?); the laboratory system was overtaken by technology as computerised auto-analysers appeared in hospital laboratories. The $28M disappeared; more money was poured in...

Along that weary road, the question of radiotherapy treatment planning arose. National meetings were held with hospital physicists; the Health Computer Unit produced an instant 'expert' who asked endless questions and proceeded to write a programme....It has of course all come to nothing, with sophisticated RTP systems in use in all centres.

Efforts were actually made, by hospital physicists and others over a number of years, to show up the gross inefficiences of the whole Health Department Computer system, but admissions from the Health Dept of total failure were never made.

Rumours of large rooms full of unused PDP 11/34's (soon to be obsolete) circulated; they were true, as Wallace Armstrong told us in his 1994 Strong Memorial Lecture, with the Met Service being given a cobweb-covered unit which came from this store. The whole Sad Saga was on a monumental scale of waste of money, waste of time and effort by many people who just wanted to make progress in their part of the hospital scene; total waste.

To end on a cheerful note, and to demonstrate that scientific progress cannot really be constrained by administrative means, all centres soon found alternative access to computer facilities. This varied from purchases with outside funding, (eg through a local Cancer Society); use of a computer bureau; use of a University Computer Centre; or by access to computers already in use by other hospital departments.

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Computing, 1963-style:

In the UK, Elliott Brothers opened a Computing Centre in 1953, which was the first in Europe. They developed their #803 Computer as "...a small, medium-speed, digital computer, flexible in operation and economical to run. The central processor, power unit, paper tape station and keyboard forming the minimal installation require only 400 sq ft altogether (approx 40 sq metres), and power consumption is about 3.5 kilowatts....The basic #803 uses 5-track paper tape input and output, and has a main storage (magnetic core) capacity of 4096 words, extendable to 8192 words maximum. Punched card input and output are available as optional extras....The automatic floating-point arithmetic unit is an optional extra...."

"Speeds:	Tape input	500 char/sec	Card input	340 cards/min
	Tape output	100 char/sec	Card output	100 cards/min
	Direct output	10 char/sec	Film transfer	4350 char/sec in block;... 5 blocks/sec"

"The #803 computer is the most successful British computer ever. Over one hundred have been delivered to customers throughout the world. It is reliable, easy to program, easy to operate...."

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THE ONGOING DEVELOPMENTS:

Into the 1980's, there were major technological advances which were rapidly reflected in NZ hospitals - X-ray CT scanners (often purchased after regional appeals); major sophisticated radiological systems were purchased; ultrasound scanning spread rapidly; in-house computers became common. Then into the 1990's magnetic resonance imaging systems were introduced. It was a new era.

Earlier stages of equipment development up to about 1975 in radiotherapy, radiology, nuclear medicine, imaging, radiotherapy treatment planning, dosimetry, and biomedical equipment were usually brought about by in-house design-and-build efforts by hospital physicists and technical staff. It was possible to purchase components, and with the help of our skilled technical officers, to set up quite major systems in many of these areas. By the 1980's, this had changed, with the availability - at a price, usually in the range $0.5M to 2.5M of sophisticated commercially produced systems.

CONCLUSION:

The people involved in those earlier days, hospital physicists and technical officers appointed in the 1947-1965 period, began retiring from 1984 onwards, so that along with the major change in equipment systems, there has been a major change in personnel. It is unfortunate that coincident with these changes, there have been great changes in our national fortunes, which have caused the often-quoted 'winds of change' to blow right through the health system, with some degree of destruction of what has been built up since 1945.

We would hope that as the next 'wave' of medical physicists and biomedical engineers continue on towards 2000 AD and a new century, they may be able to rebuild, and build anew, as they pursue their own new initiatives.

Hugh Jamieson
November 1995

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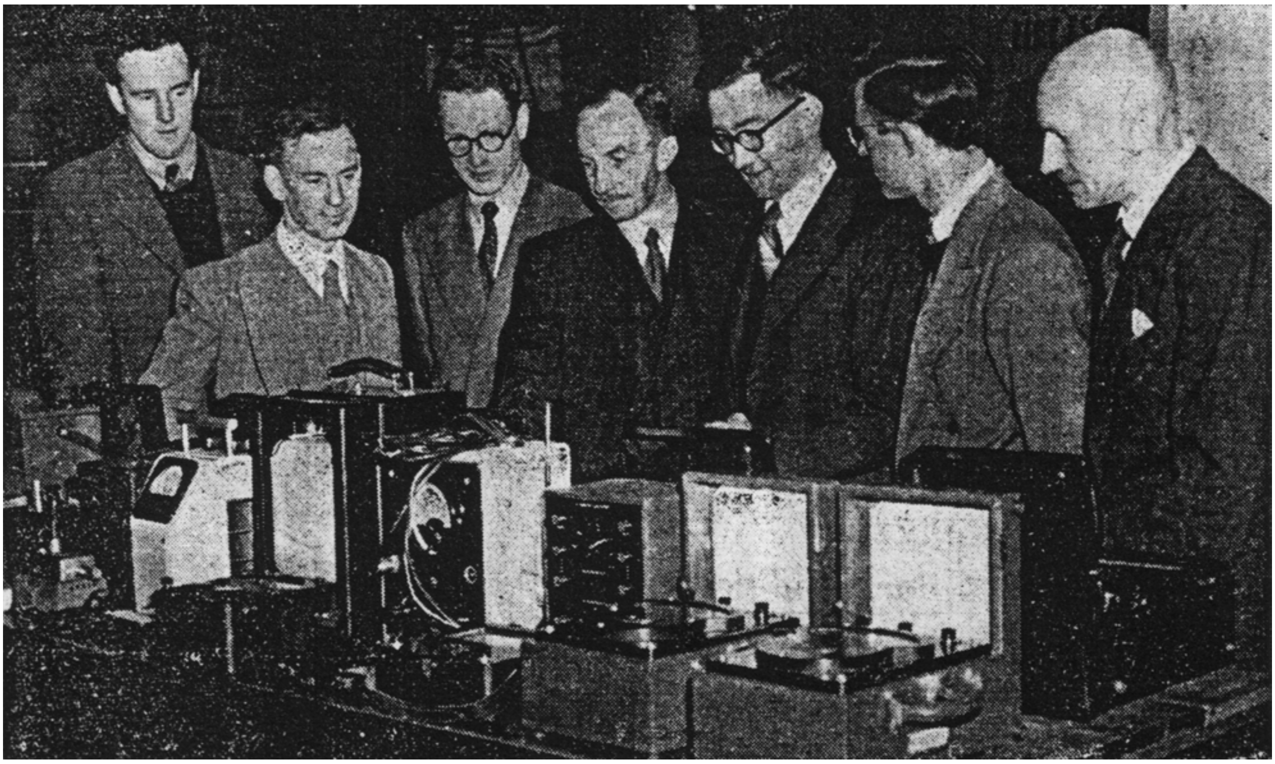
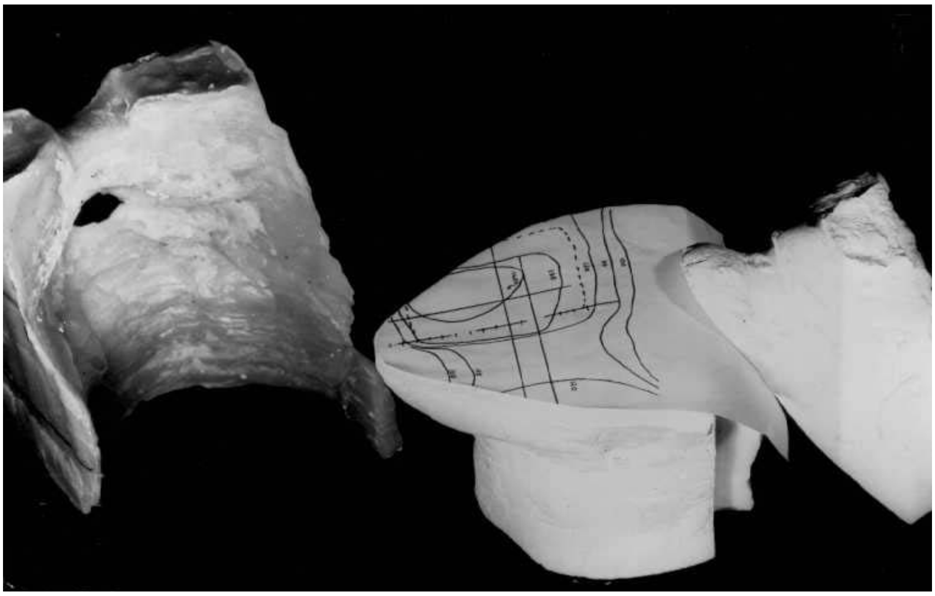


"Examining some of the equipment at the Dominion X-ray & Radium Laboratory are seven of the delegates to a meeting of hospital physicists from all over New Zealand now being held in the city. Left to right: Mr R A Borthwick (Christchurch Hospital); Dr John Read (Head of Cancer Research (Physical), Dunedin); Dr H C Sutton (Head of Cancer Research (Chemical), Dunedin); Mr H R Atkinson (Physicist in charge of the therapy section at the DXRL, and convenor of the meeting); Messrs Hugh Jamieson (Dunedin Hospital); Ross Garrett (Wellington Hospital); and Campbell Begg (Palmerston North Hospital)" (Photo Christchurch Press, Sept 7 1954)

Dunedin radiotherapy techniques, circa 1951:



Treatment of ca tongue, right side; 200 kVp X-rays; HVL 2.0 mm Cu; two fields; wax build-up/positioning block; isodose curves shown on plaster cast made from patient.

Various radium moulds - top left: Christie Hospital design for treatment of ca lip (front + back 'planes'); top centre: mould for inside of cheek; top right: plaster cast of hard palate, and (bottom right) treatment mould with slots for Ra tubes; bottom centre: Ra mould for cavity in ethmoid (surgical access through hard palate); bottom left: denture with Ra tubes used to treat lesion on lower gum.

HOSPITAL/MEDICAL PHYSICS IN DUNEDIN - 1945 to 1985

A personal overview of events and people - Hugh Jamieson

The background scene:

In Dunedin, there has always been a close association between the Dunedin hospitals and the University of Otago, especially with the Medical and Dental Schools, but also with other University Departments. Many medical staff in earlier times held joint Hospital and Med School appointments. This gave rise to various arguments on the desirability of such joint appointments; what it has meant in a positive sense is a strong University linkage with the hospital scene, and this has also applied in hospital physics.

There is very early documentary evidence of the use of X-rays in Dunedin. Dr de Lautour procured an X-ray unit in January 1899; he wrote the first radiological paper in NZ - "The localisation of foreign bodies by X-rays" in the NZ Medical Journal, 1900. I have an original radiograph taken by Dr de Lautour dating back to 1899, given to me in 1955 by the patient, who was a lad of 12 in 1899, and had shotgun pellets in his hand from an innocent rabbit-shooting expedition. The University link was apparent in a 1921 letter about "one package of radium bromide" sent to "Professor R Jack, Otago Hospital & Charitable Aid Board, Dunedin." Bobby Jack was Professor of Physics until 1948, and both Warren Sinclair and I were graduates under his reign.

In 1945, just post-WW2, there were effective moves by the newly appointed radiotherapist, Dr CWS (Peter) Jerram, (Jan 1 1945), who was a NZer with a British qualification from St Thomas's Hospital, and the incumbent head radiologist, Dr W (Bill) Sowerby, to set up an Otago University Diploma of Diagnostic Radiology (DDR), establish a School of Radiography; and with Professor Jack's help, to appoint the first hospital physicist in NZ, who was to provide physics teaching in these areas, and to develop the British 'style' of hospital physics on the radiotherapy scene.

The first NZ hospital physicist:

Warren Sinclair had just completed his MSc (Hons, Physics) at Otago, with a thesis on the measurement of radon from the radium content in NZ rocks. Under Professor Jack's benevolent eye, he was appointed as 'Radiological Physicist' and began work on November 29 1945. There was vacant space in the basement of the (then) new 'X-ray Block' in Hanover St; Warren drew up plans for an office, workshop, storeroom, and a lecture room for radiography lectures. It was typical for a physicist to start work in a basement area! He began with a Victoreen R-meter (bought in 1938), slide rule, flexible curve, a half dozen assorted handtools; acquired a light-top printing table for plotting isodose curves, dental films for protection checks.

Through John Read and the UK HPA Diagrams & Data Scheme, he purchased a selection of radiotherapy isodose curves produced by the Royal Marsden Hospital. He was in business! He first checked with film badges to see if there was any significant X-ray penetration of the ceiling over his desk, which happened to be directly under the radiotherapy Maximar 200 kVp unit - 'nothing found'. He spent 2 weeks at NRL in Christchurch with George Roth and Bert Yeabsley; ordered further ionisation chambers for the Victoreen R-meter; started up lectures with radiography students (foundation class of 4 students), with practical work at the University Physics Dept; read journals, and joined the British HPA in 1948.

Within the first year, Warren felt the need for some overseas experience, and obtained an appointment under Prof Mayneord at the Royal Marsden Hospital, London. The Otago Board agreed to pay him half-salary while he was away for 3 years; this was never done for dubious reasons; Warren finally resigned while in London and never returned, but as we know, then had a most successful career, firstly at the Marsden, and then in the USA.

While working at Dunedin Hospital, Warren kept in touch with the University Physics Department; that was where I first met him. In 1947, I was completing my MSc (Hons) degree, with a thesis on X-ray crystallography, using a gas X-ray tube and a primitive X-ray spectrometer. These had been bought the year I was born (!) and had lurked in a Physics Department cupboard awaiting my arrival in Dunedin, to be dusted off and given to me with a vague suggestion that I get them to work, and use them. I had an unheated basement room (of course!) to work in; Jim McCahon (later at NRL) had an adjoining room. Warren rode up on his bike one day while I was having lunch outside the Clock Tower, and asked if I would like to fill in for him while he was away for his 3 years. In those days, a physicist could join the DSIR, teach, or if fortunate, become a University junior lecturer. I thought the hospital job an interesting alternative and agreed; Warren gave me a quick run around the hospital scene for a couple of hours and then vanished! I completed my MSc, had a brief holiday, and started in as a locum on December 16 1947.

The 1947 radiotherapy scene:

After using a home-made X-ray plant, hospital equipment was marvellous! The aged Maximar 200 (200 kVp; 8 mA), bought in 1938, had such a stable dose-rate (as given in the GE printed brochure!) that any measured deviation required a close look first at the Victoreen R-meter itself, and then contemplation of the X-ray unit (It was possible for the X- ray dose-rate with a failing tube to drop off without any electrical indication to the operator). The 'modern' (ie post-WW2) equipment (possibly supplied under the US Lend- Lease deal?) was Westinghouse; a 200 kVp 16 mA Quadrocondex machine (voltage-doubling, very reliable circuit) and a Dermadex 60-140 kVp machine, run only at 100 kVp 10 mA, for superficial therapy. Lurking in the background, and unused, was a Philips 50 kVp 2 mA 'Contact Therapy' unit. Down in the basement was a 'Radium Strongroom', which any bank would have been pleased to have, containing only a small lead- shielded safe storing about 800 mgm radium in tubes, needles, 'seeds', and two dubious 'radium plaques' with very thin front 'windows' so that the emitted radiation was a mixture of beta and gamma rays.

Where to start working?

I was an avid reader of in-house and Medical Library radiological literature, and went back to the earliest available journals - BJR (back to 1937), also the AJR and Acta Radiologica. Even to a brand-new and totally inexperienced hospital physicist in 1948, it was immediately obvious that the first requirement in radiotherapy was for proper beam direction techniques (as developed already in the UK and described in the BJR); it was also soon obvious that 'deep therapy' at 200 kVp (HVL 2.0 mm Cu) was grossly inadequate for most cancer sites. We tried very hard with what we had, developing 'back pointers', accurate angle indicators (gimbal mounted), a better range of treatment field sizes (our own design, much later applied usefully for nuclear medicine collimators); and patient treatment 'shells' with wax build-up.

Nobody knew what a hospital physicist was, except the few immediate colleagues - radiotherapist, radiologist, radiographer - and unfortunate radiography students! I have always been most grateful for the 'open house' morning and afternoon tea sessions with Drs Sowerby, Jerram, and Begg, to which I was made welcome from the start, and where I enjoyed good conversation, learnt much about hospital life and practice, and met many medical specialists, who dropped in for tea, or to discuss cases of interest in radiology or radiotherapy. These 'sessions' were initially in Dr Sowerby's office, and later moved across the corridor to Peter Jerram's office. I was also made welcome in the University Department of Physics, where there was a new head in 1948, Prof Nimmo. I took practical demonstrations and experiments there, for radiology and radiography students, using regular Stage 1 experiments and the like. My name appeared in the OU Calendar as 'Lecturer in Radiological Physics', from 1948.

'High-tech' medicine had arrived in Dunedin in 1945, with a Neurosurgery Unit, and a 'sophisticated' diagnostic X-ray Schonander skull unit, with 'C'-arm mounting. Allegedly, this was provided at short notice when the (then) Minister of Health needed skull radiography, and the shortcomings of older equipment was made clear to him! In those early days (around 1948), radiotherapy was required for a number of brain tumours, usually after neurosurgery. I had a special caliper built to enable accurate head measurements, and we used the X-ray therapy beam with lead-screens in cassettes to check beam direction in the treatment set-ups.

The need for supervoltage:

In mid-1948, Peter Jerram took up a Fellowship at Memorial Hospital, New York. With his British training in radiotherapy, and his very witty conversational skills, he made a big impression, and stayed on for a further 6-months, with his family joining him there. Memorial at that time had two one-million-volt GE units, which reinforced the clinical advantages of supervoltage radiotherapy. The British experience with 'radium beam' units from 1926 (one had as much as 10 grams of radium!!), together with the unique St Bart's one-million-volt machine (1939) had already shown the advantages of megavoltage radiation, but technology had not then caught up with 'demand'. Peter Jerram's comment on his return in mid-1949, when he first saw me - "We must have a supervoltage machine"; from what I had already realised, I strongly agreed with him, and over the next few years, it was a recurring topic of conversation.

Early beam direction attempts:

We continued to attempt improvements with what was on hand. There was no physics workshop, but various mystified fitters, plumbers, and carpenters, willingly and skillfully made up strange things for the young physicist. I also made use of the University Physics Department workshops, but Prof Nimmo thought that the Hospital Board should make some notional payment for their work. The first thing they made was a special 'pin-and-arc' caliper for application to the patient in marking up treatment fields; Prof Nimmo thought a charge of 5 pounds ($10) was a modest charge. The repercussions! I was summoned to the Medical Superintendent's office, where Dr James Thompson, who ran the hospital extremely well with benevolent supervision, was in brisk conversation with the Hospital Board Secretary. The latter suggested strongly that if Jamieson wanted gadgets, let him pay for them! Jamieson got a little excited at this, but James Thompson waved him down, told the Secretary to pay up, while he gazed with sorrowful mystification at the offending object, pondering as a Scotsman how such an odd-looking thing could possibly cost so much!

It was hardly the start of 'high-cost technology' in hospitals, but it reminds me strongly of the time 20 years later when we included on our Capital Estimates for 1969, among various modest items, '1 Gamma Camera - $83,000'. That also required a visit to see the Medical Superintendent, now Dr John Cleminson (a strong-minded Yorkshireman, who said proudly the first time I met him "I know nothing about physics", which ended our conversation), who wanted to know what this was all about; he solved the problem by referring it to an appropriate Committee. Nuclear medicine comes up later in this story, but I still link these visits I had to make to successive Medical Superintendents-in-Chief.

Radiation protection:

From when I began in 1947, annual series of physics lectures to radiography students continued, with practical sessions at Otago University Physics Department. Radiation protection measurements were undertaken for radiotherapy and radiology staff, Chest Clinics (more later), and at the University Physics Department. There, it had been their practice to run an unshielded gas X-ray tube with a 250 kVp induction coil - when I checked this out, standing at the top rear of the large lecture room, my only protection ionisation chamber meter went rapidly off-scale, signalling the end of that pastime. Internationally, in 1948 there were serious discussions as to whether the current 'tolerance dose' limit of 1 roentgen/week should be reduced by a factor of 10, to meet concerns of geneticists. From 1950, in most years, there was at least one X-ray registrar taking the Otago DDR course, for which of course physics was a prime requirement; I enjoyed these sessions.

TB Chest Clinics presented particular protection problems. Fixed vertical fluoroscopes were in use, with a short target-tabletop distance, no image intensifiers of course, operated with good intent by chest physicians. These conditions required dark adaptation (long since forgotten!) by the operator, preferably for 40 mins, with use of red goggles to allow other work to be done in normal lighting. One never-forgotten moment was when on a bright sunny Dunedin day, the physician arrived, put on goggles, called for the first patient, turned off the lights, took off goggles, wound up kVp and mA controls until to my astonished gaze the unit was running at 18 mA! I measured the exposure-rate at the patient's skin as 100 roentgens/minute, which was an excellent radiotherapy exposure-rate! To make matters worse, these were patients with active-TB (and before the days of effective drug therapy) for whom the regular treatment then was to collapse the lung for 'rest', by injecting air into the pleural cavity; fluoroscopy was used to check whether the lung had expanded as this air was resorbed, so that these patients had repeated fluoroscopy sessions, at about 2-weekly intervals.

A number of hospital X-ray practices were changed; in radiology, I had protective cubicles for X-ray control panels built; we ran our own basic film badge service before the days when this was available through NRL; for radiotherapy, new X-ray treatment applicators were designed and constructed by an obliging local firm to give better collimation of beams and a wider range of treatment fields.

With an enthusiastic radiotherapy registrar, Dr Frank Ramsay (started in Jan 1950), we embarked on the construction of plaster casts of patients under treatment, so that we could make up wax 'build-up' blocks for more accurate radiotherapy, with beam direction. We had no experience of the use of plaster; an early memorable occasion was when we just poured surplus mixed 'runny' plaster down the Physics Workshop sink. I shortly afterwards had a visit at afternoon tea by the head plumber (who always wore a hat), who very politely asked me to accompany him downstairs to this sink, where the whole outlet pipe was solid with plaster. He never did say to me what he had obviously said to his staff... In short order, we had a bright new plaster trap supplied to facilitate this new work.

I was also asked to make protection checks around Dunedin, especially at shoe-shops using fixed vertical fluoroscopes to enable customers to check how well shoes fitted feet. This called immediately for added aluminium filters (except for one shop where the union rep had already insisted that something be done). These units were of course later banned.

New York 'experience', 1953:

In 1952, I was offered a Fellowship as a trainee physicist at Memorial Hospital, New York, for 18 months. This obviously came about from Peter Jerram's earlier associations there. I was able to obtain a Fulbright Travel Award, and I left NZ on December 31 1952, with Marjorie and our family to follow. The trip was by sea (ss Rangitane) to Panama, and by air (DC- 6) to New York via Miami. Post WW2, US dollars were still very hard to come by in 1952; my bank manager was quite excited to get me US$80!! I took US$40 with me; he earnestly sent the other US$40 to the Chase Manhattan Bank in New York to establish my 'creditworthiness'. For a locum physicist at Dunedin Hospital in my absence, I was fortunate to find Owen Smith, a young graduate physicist who was a secondary teacher - in those days, physics graduates were few and very far between, and I would not have been able to go to New York without finding someone in my place.

Memorial Hospital, on East 68th St, was a prestigious centre, with John Laughlin just appointed as Head of Physics. There was excellent equipment, with a GE 1 MV resonant transformer; a recently installed Allis-Chalmers 24 MeV betatron (with its own team of physicists and technicians!) and a row of about ten 250 kVp GE machines. Clinical physics was just developing, and I found that I was well up with their stage, from my Dunedin reading and work. I was given the assignment of commissioning a rotation-therapy 250 kVp Westinghouse machine, with a rotating (upright) chair, primarily for neck and chest cases. A lot of physics development was needed; I had an enthusiastic young radiotherapist to work with. One evening a week, and Saturday morning, was allocated to physics measurements on various radiotherapy plant including their betatron. A group of young physicists worked there; we got on well together. I enjoyed New York, and was able to meet a number of major 'players', including Edith Quimby and Carl Braestrup.

Unfortunately, my enthusiastic radiation protection forays around Chest Clinics in Dunedin caught up with me, and I developed early pulmonary TB. I found out what Memorial Hospital beds were like, for 3 weeks in the sweltering summer, and was then shipped up-State to Ray Brook Hospital in the Adirondacks for 6 months. I got busy there working in their laboratories, doing routine blood counts, which was useful experience; I also saw some of the country with other staff/patients who had cars, and enjoyed the beautiful autumn, which turned to snow. Daytime temperatures were down to about -20 C; lovely crisp days! In January 1954, I returned to NZ, again by air to Panama, and ship to NZ (Shaw Savill 'Akaroa').

Back in Dunedin, Owen Smith continued on at the Hospital until June 1954, so that I had time to read and reflect, and to discuss with Peter Jerram on and off how we could move into the 'supervoltage era'. This was also the time when Hugh Atkinson at NRL took the initiative, with discussions all round, on setting up the NZ Medical Physicists' Association, which had its very successful inaugural meeting at NRL in Christchurch, on 9 Sept 1954.

The 1955 'Supervoltage Appeal':

Peter Jerram was well known in Dunedin circles, so that on Feb 10 1955, a small group of us met in the Municipal Chambers, chaired by the Mayor, Len Wright, to discuss setting up an Appeal Committee to raise funds for a supervoltage unit. It was soon agreed to call together a larger group to establish an Otago & Southland Appeal Committee. The Chairman was Sir Gordon Bell, Emeritus Professor of Surgery and also Chairman of the BECC in Dunedin, so that the BECC was involved in the project although it did not initiate it. The full Committee met, decided to proceed forthwith, and all eyes fell on me, as the youngest present, to be secretary.

The Appeal Committee included business men, an advertising agency head, and a newspaper columnist; it was a most effective single-minded organisation. It took unto itself the resounding title "The Otago & Southland Super Deep Ray Cancer Unit Appeal", was extremely well organised, drew support from the whole Otago/Southland area in all kinds of community and business groups, and although the target was set at 45,000 pounds ($90,000), money poured in to the final initial total of 108,000 pounds ($216,000 - and remember that was the 1955 $). The Health Dept and Government tried in various ways to prevent the Appeal getting off the ground - I still have some letters about this - it was claimed officially that "...two supervoltage units would serve the country for many years to come.." This opposition had caused some Appeal Committee folk to feel that the Appeal target should be reduced before it was launched, but the newspaper columnist, Tom Anderson, (who obviously had the best feeling for the public 'pulse') said we should double it instead! He was obviously correct.

In 1955, the choice of supervoltage unit was limited. The GE 1 MV and 2 MV units were available, and proven, but the 2 MV unit was enormous and needed a 3-storey building to house it; the 1 MV unit was of too low an energy. Co-60 units had been introduced (and Christchurch had one, a Theratron 'B') but Co-60 was in short supply, especially for high specific activity and small diameter sources. There was a 2 MV Van de Graaff generator (in a pressurised tank), in use at Sheffield and elsewhere, which had proven to be reasonably reliable and of modest cost. The Allis-Chalmers 24 MeV betatron had a proven track record since 1942 in industrial work ("..a radiographic unit used in filming protective plates for the AEC during the development of the atomic bomb..") but there were only a few medical versions (Wisconsin, Memorial and Toronto); they only operating with photons, but had the possibility ahead of electron beams.

The Swiss Brown-Boveri betatron was large, with an isocentric mounting, but a very low photon dose-rate, and so not a real option; the Siemens betatron of that time had a trivial photon dose-rate. The real potential leader was the British-design of medical linear accelerator - Metropolitan-Vickers and Philips/Mullard built these to meet the excellent British MRC/Radiotherapeutic Research Unit 1950 design ("Functional specification: 4 MeV Linear Accelerator for X-ray Therapy"). The original design was for 5 MeV photon energy (but this proved in fact to be 4 MeV), high dose-rate, adjustable diaphragms, isocentric mounting - the fore-runner of several generations of linear accelerators which are now in routine use. Bending magnets had not been introduced then, so the "Series 1" machines were quite high, with a straight 1-metre waveguide/target assembly. They were just coming into routine production, and we did not favour a prototype machine.

For the Otago/Southland Appeal, our choice initially was the 2 MV Van de Graaff, at a cost of $56,000 (about comparable to Co-60, but with a higher constant dose-rate). In the event, with $216,000, we had to think again! The Health Dept and Minister could no longer try to sweep all this under the rug, but were anxious that we should get a machine different to others in NZ; Co-60 already in Christchurch, and a Metropolitan-Vickers 4 MeV linac shortly to be purchased for Auckland following their own successful public appeal. Peter Jerram went walkabout overseas to gaze upon available machines; he conferred widely, including with Warren Sinclair. I discussed the options with John Laughlin at Memorial Hospital, and made a detailed comparison of all available machines. The choice without question fell on the Allis-Chalmers betatron; Peter Jerram (at Warren Sinclair's suggestion, I think) also recommended a 'small' Co-60 rotation therapy unit, with a similar one to be offered to Invercargill; (The machine of choice here was finally the Theratron C-II (55 cm SAD) in 1961)

I well remember the Appeal Committee meeting where Peter Jerram's recommendations were tabled. His third recommendation was for a microscope. With the first two main recommendations for substantial sums, it was quite understandable that Sir Gordon Bell, as Chairman, cleared his throat and asked: "Dr Jerram, do you mean an electron microscope?" He was relieved to hear that a normal optical microscope would suffice for the purpose intended.

Planning for Wakari:

Once the 'supervoltage era' was forced upon the Health Dept, the Otago Hospital Board (OHB) called for plans to be drawn for suitable buildings (the 'supervoltage' portion to be paid for by the Appeal). The Radiotherapy Dept at that time was on the 'ground floor' (strictly the first floor) of the 'X-ray Block' fronting onto Hanover Street at Dunedin Hospital. Niel Wales, son of the senior partner in Mason & Wales, Architects, was given the job of drawing up plans. I was heavily involved in this; we got on just fine. Niel drew initial draft plans for the Dunedin Hospital site adjacent to the existing building (and not far from where the present Radiotherapy/Oncology building is), but when the Chief Engineer vetoed the proposal, on the grounds that it would interfere with the 'sacred' ring steam mains for the whole site (long since gone, both Engineer and steam mains!), successive waves of administrative hands wafted the to-be-built Department to the Wakari Hospital site. In our ongoing collaboration, Niel Wales and I drew up what I still consider were then very acceptable plans for radiotherapy, medical physics, the embryonic nuclear medicine work, and importantly, adequate research rooms for John Read (radiation biology) and Harry Sutton (radiation chemistry).

All this activity went on in 1956-57, with the new building completed in 1958. The betatron was ordered and arrived late in 1957. Installation was carried out in January to March 1958. With all the public interest and pressure, we had to begin our physics work in the incomplete building, with workmen all around, no heating or fixed lighting (but betatron power available!), mud and duckboards outside.

Our Physics 'team':

On June 28 1955, with goodwill on the part of the new Chief Engineer (a Welshman, Jones by name) I was able to have Colin Medcalf start working with me as our physics technician; this was a very amicable and fruitful long-term association. Colin rapidly became a highly skilled Technical Officer who contributed greatly to all our endeavours over the next 30 years. All our NZ centres have been most fortunate in having equivalent technical people working alongside local hospital physicists; I know how much we have all appreciated and valued their contributions. Then in late-1957, with some misgivings the Hospital Board approved the establishment for a second physicist! Radical thinking! In those days, there were very few physicists about; our advert only attracted one applicant, Howard Tripp, who was duly appointed in January 1958. We then had a team of three, together with an X-ray serviceman, Ted Dickey, who was notionally under the Electrical Engineer, but worked hard and well with us until his sudden death with a heart attack at work, one lunch-time. We missed his cheerful personality.

The Betatron:

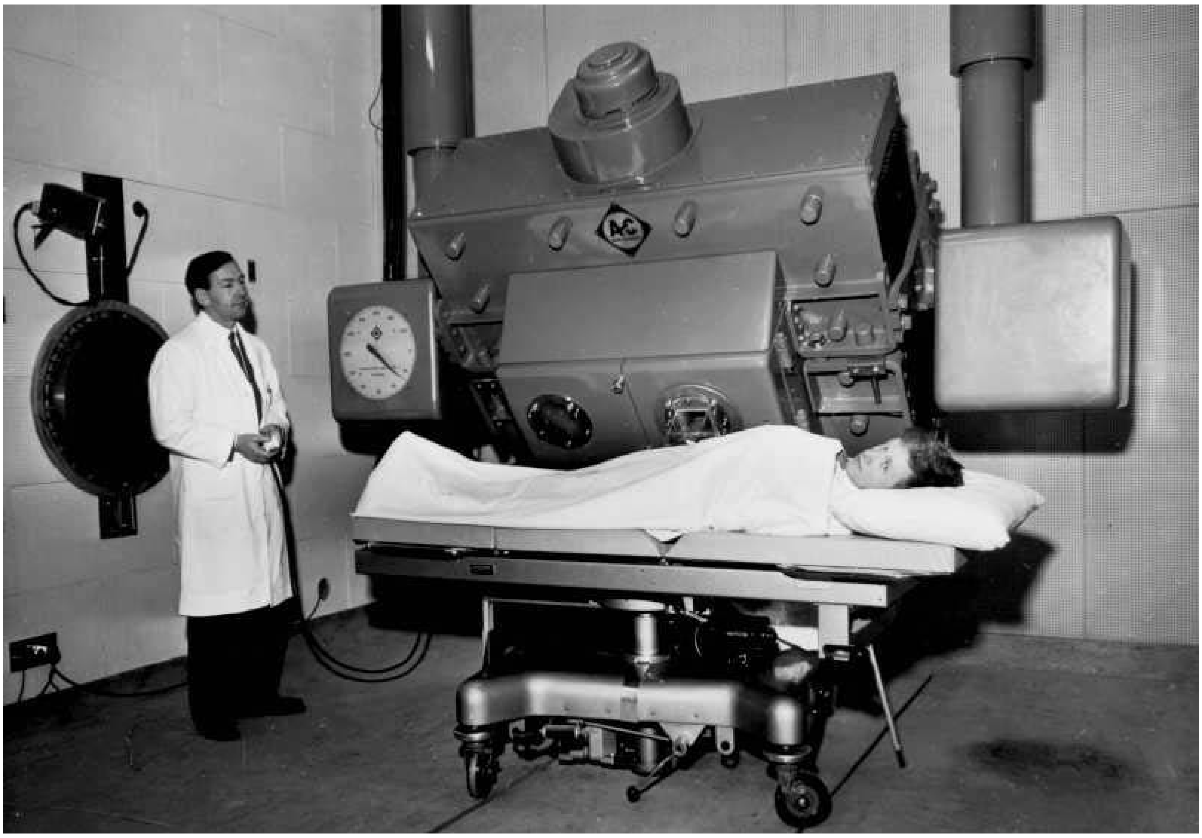
The choice of the A-C betatron, with 40 years hindsight, was still an excellent one. The betatron was more-or-less 'condemned' by several visiting committees over the years, as being noisy (correct), non-isocentric (correct), limited in field sizes available (correct) - but then most members of these supposedly investigative committees had no personal experience of clinical supervoltage radiotherapy; none had any experience of electron beam therapy. On the positive side, the photon beam had an adequate if not high dose-rate; % depth dose was ideal; the electron beam energies which became available after our local developmental work (6-20 MeV) came to be regarded everywhere as those essential for a modern unit; the reliability of the betatron over its active working life of 32 years (!) greatly exceeded that of any competitive machine. Its original cost was about that of linacs then available. The photon energy (24 MeV) has also come to be the high energy required of modern replacements, 30 years on.

The problems with the betatron were largely physics matters - dosimetry in 1958 (when this machine was commissioned) for high energy photons had all sorts of question-marks; there was little clinical physics data available (although we obtained some isodose curves from Memorial Hospital, they differed from our machine); X-ray collimators had to be designed and built; beam flattening was unique to each machine, as was beam monitoring; we had to develop our electron beam operation completely, starting with only a dual beam donut (photon / electron) and an Allis-Chalmers' transmission monitor. This work included beam scattering foils; collimators; added protection; totally reliable beam energy/scattering foil selection. We ran daily dose calibration checks throughout the working life of the betatron, and never ever had any clinical problems due to machine malfunction. This was, and is, a great tribute to our small medical physics team of physicists and physics technicians, and X-ray servicemen, who worked together over all that time. The only problems came when the engineers (Chief Engineer and Electrical Engineer) tried to, or did, interfere, claiming that they were the proper people to 'look after' the betatron. They caused some unpleasant problems. A saga familiar to all centres in NZ, and many in the UK!

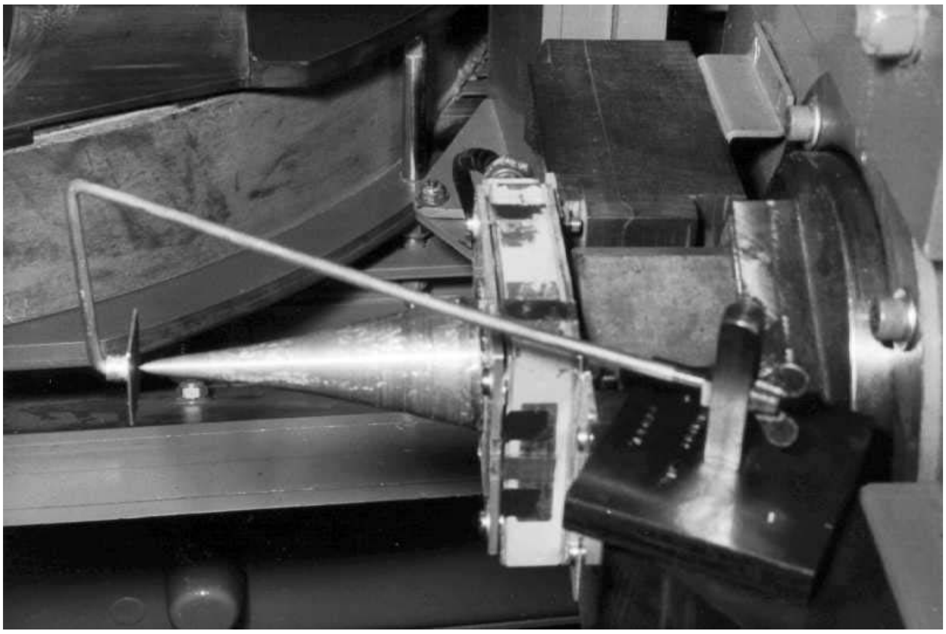
The beginnings of nuclear medicine:

Nuclear medicine (surely a misnomer, I always thought?) in NZ hospitals has been noted as beginning in 1948, with some I- 131 studies being carried out at Christchurch Hospital, with physics assistance by George Roth and Bert Yeabsley from DXRL (now NRL). Perhaps that isn't the full story, because when the Dunedin Hospital dispensary was cleaning out old stock, they unearthed some 'radioactive selenide'. The use of this had been developed at the Bristol Royal Infirmary for the treatment of cancer, and so was

Wakari Hospital: Ground floor - Radiotherapy Department
(1957/8 extensions) First floor - Medical Physics, and
Radiobiology Research



Allis-Chalmers 24 MeV Betatron, Wakari Hospital, March 1958
(Dr Frank Ramsay holding pendant controls; Howard Tripp as
simulated patient. Note 60 cm dia water window; TV camera.



Betatron: Inside magnet doors, showing aluminium conical compensator, with our alignment jig in place. Also visible, magnet field coils, transmission monitor. 1958.

21 MeV 'natural' electron beam at open aperture in door, showing asymmetry caused by fringing magnet field; the problem was to achieve a uniform 'scattered' beam for use. 1961 developmental work; Kodak 'Translite' pearl-based film.

not a diagnostic test. An article by a Dr A T Todd in the British Journal of Surgery vol 21 no 84 1934 described the use of two types of colloids, including this radioactive selenide, given intravenously in conjunction with X-ray therapy. A pamphlet with the ampoules made interesting reading; the results obtained were stated to be good, 'all things considered...'

I-131 therapy started up in Dunedin in 1950, with two spectacular cases to begin with. The first was a lady, who as the story goes, was visiting her GP, who noticed that her hat was on at a jaunty angle; on enquiry he found she had a 'bit of a lump', a hemispherical shape 100 mm diameter, in her skull. On Aug 15 1950, using 400 uCi (15 MBq) I-131 as a tracer dose, this was found to be an active thyroid secondary; after thyroidectomy, she was treated successfully with 62 mCi I-131. Another feature of the case was that we picked up another secondary in the spine before there was any clinical evidence or radiological detection of it. The patient was still alive and well in 1955, and steadfastly refused to come back for a check-up. The second patient had a toxic goitre, and several thyroidectomies, which had affected his vocal cords - I-131 therapy for the residual nodules was highly successful.

In 1955, at Dunedin Hospital again, the origins of nuclear medicine were developing. The Otago Medical School across the road provided many useful contacts, including the Thyroid Research Unit, with Dr Purves and Duncan Adams setting up I-131 thyroid uptake tests. Dick Purves designed an excellent detector 'head', using a pair of G26Pb geiger tubes (26 cm long, lead-impregnated copper cathodes) and massive lead slab shielding, trolley mounted. This gave reasonable detection efficiency (for those days) and good geometry, so that 15 uCi (0.55 MBq) I-131 gave reasonable results, with counting at 8, 24, and 48 hours. They had a '128' (binary) scaler; people today would find it hard to believe that binary scalers, with much arithmetic, were in common use, and all calculations were done by slide rules. I agreed to continue this work at Dunedin Hospital rather than in the Medical School, from September 1955, and set up a basic radioisotope lab in a small storeroom adjacent to my own office - in the basement of course!

P-32 was first used therapeutically in June 1954, a case memorable in that the patient was incontinent, and had broken skin on his hands as a result of gout. The resulting contamination always made me thoughtful about therapeutic applications of radionuclides. (Then there was the later case, of a patient taking a drink through a straw of an I-131 solution for a thyroid uptake - when he sneezed!.... Not to mention a certain senior surgeon, with great confidence injecting Au-198 into a patient for some purpose I have forgotten, when, as he claimed, "the syringe exploded!". He was the first staff member we introduced to the shower I had insisted on including with the building plans, in case decontamination was required...) Other radionuclides came slowly into use in Dunedin - Au-198 was first used in treatment in June 1957.

Physics in radiology:

We were also regularly involved in radiology; teaching physics for the Otago DDR to X-ray registrars was an ongoing, and pleasurable, activity from 1950. Efforts to improve radiation protection continued, with the addition of control booths; graded filters for radiography in pregnancy, shoulders, skulls; and so on. Colin Medcalf and I produced an effective manual cassette changer for Charles Begg's highly-regarded neuroradiology work, in the days when these were not available commercially.

Physics workshop; Colin Medcalf:

By 1957, we had been able to purchase and instal workshop equipment (lathe, drillpress, bandsaw) in the so-called laboratory adjacent to my office (basement still); this was viewed with great suspicion by the Chief Engineer and with disbelief by the Electrical Engineer. Colin had begun on his career of producing precision accessories of all kinds dreamed up by the physicists. At all times, he worked alongside physicists when making measurements in radiotherapy, radiology, nuclear medicine, and so on. This meant that he knew requirements, and could modify our designs with insight, and to our advantage. The great advantages of this were obvious to anyone who had visited major overseas centres, where workshop staff were remote from the measurement scene, and had to work only from drawings provided by physicists or others.

Early computing:

In 1956, when early computers were on the distant horizon, I was approached by a good friend, Mr R C Burgess, senior partner in the major accountancy firm of Barr Burgess & Stewart. His thinking was far ahead of his times, so he was aware of the coming possibilities; he asked me to help him and his associate, Miss Homan, in working through a California-based business computer programming course "Programming for Business Computers" (Business Electronics Inc, 420 Market Street, San Francisco). This was a very interesting association for me over the next 2 years; I have sometimes contemplated the outcome if I had continued on with them. However, by that time the betatron was on order, and I was committed there.

Computer input at that stage was by punched cards or paper tape; programming was a most laborious individual process. Bob Burgess was curious about electronic hardware, so I was able to show him our 1956-purchased 'advanced' radioisotope counting equipment comprising a 'decade' scaler (dekatrons with circular display on illuminated pins) and a scintillation head with a 'big' 0.75 inch (19 mm) diameter crystal, which impressed him greatly!

As a side comment, I also knew a senior partner in another major accountancy firm; he gave me his considered opinion, probably in 1958, that "...in time, there will probably need to be two business computers in NZ, one in the North Island, and one in the South

Island..." There has been this curious NZ administration attitude about new major developments - I first met it in 1955 over supervoltage radiotherapy - that "Two units will serve the country for many years to come - one in the North and one in the South.." There was an early suggestion that Christchurch should be THE nuclear medicine centre for the country. Here it is again in 1958 over computers, followed later, around 1975, by the Health Dept monumental foolishness over computers; it reappeared around 1980 when X-ray CT scanners became available. I suppose the originator of these policies was King Canute with his celebrated directive to the sea.

Life at Wakari Hospital:

And so in 1958 we moved to Wakari Hospital, with the Medical Physics Department, and John Read's Department, on the first floor, above the Radiotherapy Department. When plans were being drawn up, there actually was a suggestion that the physics services could be housed in an adjacent basement. I told Niel Wales that the basement in the new building should not be habitable for humans, but satisfactory for storage only. He agreed. When the ground floor area spread out too far for the Medical Supt-in-Chief's liking, with a wave of the hand he consigned physics etc to the first floor, which made a marvellous setting, with - for the first time, both for hospital physics and for John Read - adequate space and facilities, coupled with a wonderful view out northwards to Mt Cargill. From the workshop windows, you could see the sea! Visitors, both local administrators, and all others, admired the views; the former wondering how it had happened.

Betatron commissioning:

The betatron absorbed our energies early and late from March 1958; we had to develop our own dosimetry techniques, beam alignment techniques, isodose-plotting, beam direction, and so on. Film dosimetry (using fine grain industrial film) proved successful for our early isodose plotting; our Baldwin 'Ionex' dosemeter arrived right on cue, and was indispensible for many purposes - output measurements; depth dose; cross- field plots. I still remember the first time I pressed the control button to raise the betatron 5-tonne head on its supporting columns, just as a workman happened to fire a ramset gun into the wall behind me; I can still feel the shock! We worked late every night, and found our precarious way in the dark along duckboards on the mud, often to all climb into Howard's ancient-but-elegant Vauxhall, to career homewards.

Especially with the major successful public Appeal for funds, there was pressure from all sides for an early start-up of patient treatments. We had to continue our physics work during building completion, subject to interruptions by contractors and visiting 'firemen'; and late working up to 10 pm was routine. Our families hardly saw us for 3 months. Treatments (24 MV X-rays) began on July 9 1958, with Wednesday afternoons kept free for ongoing physics purposes.

Other facilities:

For radiotherapy treatment simulation, we designed a swivelling gantry with X-ray tube at one end and an image intensifier at the other. We had looked at the possibility of xeroradiography which was becoming available, but it was not proven in routine use. There was also a small theatre for biopsies and radium insertions, as had been the case at Dunedin Hospital. And a 'Radioisotope Clinic' and 'hot lab'.

The betatron was air-cooled, and with 19 kW power dissipation, an air-conditioning plant was obviously essential; this was much appreciated by staff and patients. Even with some attempted noise-reduction by suitable room lining, the sound level was 90 dB in the treatment room, but it was a pure sine waveform at 150 Hz! We had thought of providing an out-of-phase sound signal at the patient's head position, but there was never time to pursue this.

Early Wakari years 1958-62:

The years 1958-1961 passed very rapidly. By 1961, we had begun physics work on the betatron electron beam. The small Theratron C-II arrived in July 1961 for installation in the large room we had provided for the second machine, without knowing what it would finally be. For Christmas, 1961, we took delivery of a Picker 'Cliniscanner' for organ imaging in nuclear medicine. This had only a 50 mm dia crystal, and a vibrating stylus printing out in shades of grey on teledeltos paper. With the eye of faith, a senior surgeon claimed that he had seen an hydatid cyst (proven at subsequent surgery) so that the stocks of nuclear medicine rose sharply. They were busy days!

RBE - Betatron 24 MV X-rays cf 200 kVp X-rays:

In 1960/61, with John Read as the senior partner, and using his famous broad bean roots as test material, we evaluated the RBE of the betatron X-ray beam. This was interesting and useful work; our published results with a mean RBE of 0.85 agreed closely with overseas work surveyed by Warren Sinclair. The discovery from 1954 of errors in the early determination of the 'roengten' (unit of radiation exposure) was still in the air; the 'new small' roentgen had replaced the 'old big' roentgen; the 'rad' had been introduced; some radiotherapists overseas were disgruntled about the whole dosimetry business.

During 1962, we were able to bring our electron beam work forward to the point where by the beginning of 1963, treatment with electrons, initially at 20 MeV, was possible, but clinical enthusiasm was slow in developing.

Overseas leave 1963:

In 1963, I had the opportunity to take 6 months study leave on an IAEA Fellowship to the UK, so with the whole family, we set sail in March on the 'Northern Star'. The 5-weeks trip gave us a good break from the pressures of the last few years. I greatly enjoyed and appreciated the round of visits set up by the British Council, visiting many centres in England and Scotland. I made many useful contacts with medical physics staff at all levels, which were invaluable over the next 20 years. I was interested to see the whole-body counting work at Leeds and elsewhere; this was the stage where solid state electronics had just replaced thermionic valves, so that complex counting equipment became compact and heat dissipation from large racks was no longer a problem. I also saw the British embryonic gamma cameras. In the UK, linear acelerators reigned supreme; at Christie Hospital, Manchester, some senior physicists considered clinical use of electron beams was almost unethical (!), so that our Dunedin work was not viewed with favour there.

I should perhaps note here that in Dunedin, we had the 20 MeV electron beam ready for clinical use in March 1963, although the first patient was not treated until later in the year, when we were in the UK. In a 1973 US review article by J C Katterjohn, on the use of betatron photon and electron beams, he states "...On May 1 1963, electron beam therapy was started in the Dept of Radiotherapy at the MD Anderson Hospital in Houston..." (where Warren Sinclair then was). It was pleasing to see that Dunedin could also offer the same facility by that time.

The Christie did have the unique Metropolitan-Vickers 20 MeV betatron, based on the original GE design (which was turned over in WW2 to Allis-Chalmers to develop), but it operated with the photon beam only. This centre was also the proving ground for the new Metrovick 4 MeV linac, but I was interested to note that large patients were selectively treated on the betatron, which of course gave much better % depth dose.

About people:

An account of this kind cannot proceed linearly with the passing years, because the fields of hospital physics endeavour multiplied, and the number of people involved increased greatly! So some comments on people involved in earlier days:

Howard Tripp joined me on Jan 6 1958, by which time the betatron was being installed, to join Colin Medcalf and myself as our miniscule 'Physics Team' voyaging on into unknown territory. It is extraordinary (?appalling) to look back at what was expected of us, in commissioning a new supervoltage machine about 6000 miles from the makers, with negligible machine or physics data, and earnest expectations of clinicians and public for its early use with patients.

The same conditions applied in Auckland, with their new 4 MeV Metropolitan-Vickers linac; the Theratron-B in Christchurch was a much more straightforward proposition, but still required a lot of physics input. The betatron began routine clinical treatments on July 9 1958, after 3 months physics work (during which the building was also being completed).

After this initiation and much hard work, Howard felt the need to go overseas himself, to see something of hospital physics in the UK. And so in 1961, with Margaret and their 2 children, and no financial support from the Otago Hospital Board (OHB), (but unpaid leave 'granted'!) they set sail for London, where Howard worked at St Thomas' Hospital, just over the Thames. There he became quite fascinated with the developing work in nuclear medicine; they returned to Dunedin late in 1962 after 14 months away. We were then developing the betatron electron beam; the Picker Cliniscanner was in use; I was preparing to go overseas in March 1963; they were busy days indeed!

By the end of 1963, we were becoming overwhelmed with work on all fronts. Fortunately, I was able to get approval to employ a senior physics student for each University long vacation. This extra help, with a succession of good young graduates, was quite important to us especially in the 1960's. Neil Sullivan was the first of these, as a new BSc (Hons) graduate, who worked for 11 weeks from Nov 18 1963. Then in December 1964, I was pleased that we were able to appoint one Fergus Thomson, who also had just completed his BSc(Hons), for the long vacation initially, and then as a permanent staff member. I gave Fergus a minor job of work to do when he first started; he rapidly reappeared with it done. This went on for a while, with rapid completion of all jobs. I took a deep breath, and said to Fergus that we needed a colour printout head on the Cliniscanner, as the teledeltos gray scale was obviously outmoded. He gulped; went away; reappeared before long with circuit drawings of what was needed. In those days, we had reasonable freedom to develop projects on our own initiative, with a modest allocation of capital estimates money. Fergus and Colin Medcalf went into partnership, and during 1965, while keeping up with other work, they developed between them an extremely effective and reliable printing head, with 6-colour ribbons we obtained from the UK. The provision of colour scanning put organ imaging on a major growth curve in 1966, with clinical oversight provided by Dr Allan McArthur, who was working as a radiotherapy registrar (but also a qualified radiologist). As this work expanded, it began to encroach on Radiotherapy Department space, which caused some friction - but that comes later in this account. Fergus also took over our electronic design work of all kinds, notably dosemeters for the betatron, to replace the ageing original dose monitors. We all enjoyed working together - and hard work continuously it was.

At the end of May 1965, Howard left us to go off with high hopes to become the first hospital physicist at Waikato Hospital, Hamilton, where Dr Alan Lomas was setting up the new Radiotherapy Department. Howard started there on June 14; tragically, he died on June 19, the day after an accident outside Waikato Hospital - he was hit by a taxi when he must have been walking along deep in thought about his work. It was a tragedy for Margaret and their 2 girls, with their son born later.

Our Medical Physics Department:

Returning from people to events of those times: From 1963, our miniscule Medical Physics Department became involved in a wide variety of endeavours. In the first place, because of my brief (8 lines) original conditions of appointment, which did not firmly place me in any particular clinical Department, I claimed allegiance to the Medical Superintendent-in-Chief, which became a cause of frustration especially to radiotherapists! This gave us some freedom to tackle useful projects in any clinical Department. (And the Annual Reports required for the Med Supt-in-Chief have preserved excellent summaries of what we were up to in the 1960's).

1963 activities:

In 1963, we reassessed our supervoltage dosimetry, ie for betatron 24 MV X-rays; the 20 MeV electron beam (available for clinical use in March 1963); and our small Theratron C-II Co-60 unit (installed July 1961; began routine treatments on 11 August 1961). We had little physics time for setting up the Co-60 unit, but after the betatron developments, it 'came easy'. The bulk of nuclear medicine work as such was mainly I-131 uptakes still; we were pleased to find that year, by comparing our thyroid detector collimating system with that brought around by Dr Gomez-Crespo for the IAEA, that our system was better than his requirements. This related to our past experience in designing X-ray collimators to give minimum penumbra; the two reciprocal situations (treatment, and detection) were closely similar in requirements.

Betatron electron beam:

In 1964, we set up our supervoltage dosimetry in line with the British HPA/NPL Code of Practice 1963 - while I was in the UK in 1963, I was fortunate in being able to attend the NPL conference when this was set up, so that I was able to appreciate what was involved. We were also busy setting up the betatron electron beam for operation at 10 MeV as well as at 20 MeV. This required a completely fail-safe system of scattering foil selection. I thought out a system using a betatron 'leg turn' voltage signal, which was quite energy- specific; Fergus quickly built the necessary electronic circuit; Colin Medcalf built and installed the scattering foil motorised system. It operated completely successfully throughout the life of the betatron up to its decommissioning in December 1990.

Diversity of work in 1964:

One 'extramural' activity Howard and I indulged in during 1964, with Frank Sanderson from OU Mineral Technology, was a survey around Dunedin and Otago of background terrestrial radiation, arising from some published comment by Sir Ernest Marsden (DSIR) on high background radiation from Otago road metal. The major quarry owner asked if he should shift his quarry! This involved us in measurements at quarries, in houses around Dunedin (wood, brick; iron/tile roofs), at different altitudes (sealevel to about 1100 ft (330 metres) at Halfway Bush), and over different subsoils. The best location to live, if low background was the criterion, would be on a wooden houseboat on a major lake. I found all this interesting because of work I had seen in Leeds in 1963, where they were into background radiation measurements, and whole-body radioactivity assessment. We found no significant overall increase in radiation dose to humans due to this quarry gravel. I have since wondered what radon levels were in various situations, but this particular quarry gravel was a hard phonolite, and I think radon leaching would be minimal...

We also set up a method of sterilising small quantities of soil samples for Microbiology, using Co-60 radiation from the Theratron C-II (later, using the Theratron-80); the minimum dose we used was 2.5 megarad, with overnight and weekend irradiation - it was really just making use of 'wasted' out-of-hours radiation time. We also set up a method of seed irradiation for Maurice Jenner, of Dunedin Teachers' College. He was busy establishing the extremely useful set of 'science kits', using surplus University equipment, which were made available to all secondary schools. We settled on irradiation of peas, providing him with 'packs' given a range of 3 dose levels (10, 30, 60 Krad), which could then be grown under controlled conditions by students. They could then measure the growth reduction with increased dose.

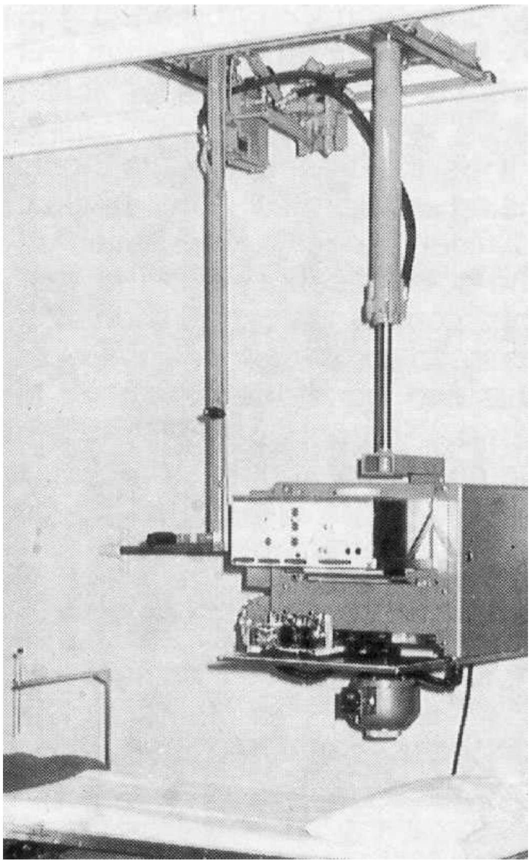
Another interesting 1964 effort was to copy watermarks in paper. Our University Library wanted to check the authenticity of part of an 18th century book by comparing watermarks in different sections of the book. Watermarks cannot be photographed; a method had been developed overseas using rather expensive beta-emitting radionuclides, but we needed to do it at little cost. In fact, I used secondary electrons emitted in the backwards direction from a lead sheet irradiated with 200 kVp X-rays. This was really quite simple for us to do, as we had done extensive film dosimetry with the betatron, and had suitable fine grain film.

At the other extreme of thickness, we were asked to use the betatron for industrial radiography (its first use), by some Dunedin steel foundries. We were able to take good quality radiographs of up to 6 inch (150 mm) steel castings. Some of these 'jobs' were extremely heavy, which required those asking for this radiography to provide large mobile jigs to bring their 'exhibits' in, and facilitate beam alignment.

Uncommon radiography:

Watermark imaging 1964. Set-up with 200 kVp X-rays, HVL 2.0 mmCu, 50 cm FSD; single emulsion Ilford N560 film; 1 min exp. Beam aimed at 'sandwich' of film, sample, and sheet lead. Secondary electrons from lead gave excellent results. This historical photo with an NZ 10/- ($1) note shows good detail

Research problem with NZ skinks, 1992: to count tail segments. Used superficial X-ray therapy unit; 20 kVp; HVL 0.1 mm Al; 10 mA; 60 cm FFD; 15 sec; Kodak Industrex-M film.



Picker 'Cliniscanner', 1961:
Demonstration of original use,
With teledeltos paper + vibrating
stylus

Modified Cliniscanner, with added
colour printout; now ceiling-mounted
over (former) X-ray table; 1967

1965 - continuing developments:

In 1965, the betatron was still operating well; it had run up 4000 hours by the end of 1965 (7+ years); there were some minor fatigue fractures in non-vital sheet steel components; we were working on 6 MeV electron beam operation; we continued to do some industrial radiography (up to 15 cm steel) for local foundries. We used Co-60 for 'thinner' objects. Howard left for Hamilton; Fergus and Colin were busy building the colour scanning output system for the Cliniscanner; we had made provision on our Capital Estimates for twin scintillation counter units for radionuclide renography, with the heads mounted below an old X-ray table we 'borrowed' from Allan McArthur. The Royal Marsden (Warren Sinclair design) Au-198 gold grain 'gun' was now in use; we made up more specially shaped filters for use in radiology.

The NZMPA met in Dunedin Nov 17-19 1965, with only 6 able to attend. The newspaper photo about the Conference showed the OHB Chairman addressing the front row of the Conference - it did not indicate there was only one row!

21 years on:

1966 was noteworthy in several regards - it was 21 years since Warren Sinclair first set foot in Dunedin Hospital; the Dept of Health approved bursaries for the training of physicists; we forwarded our Dunedin % depth dose data (24 MV X-rays; Co-60 gamma rays; 20 MeV and 10 MeV electron beams) to the British HPA for inclusion in the new BJR Supplement on Depth Dose Data being prepared. We set up a motorised traversing couch for use under the betatron for whole body- surface irradiations of patients unfortunate enough to have mycosis fungoides.

Colour scanning - Dunedin-style:

The major work in 1966 was the introduction for clinical use of the Thomson/Medcalf colour-scanning system on the Cliniscanner! At the same time, we were able to begin using Mo-99/Tc-99m generators (the first generators were rather primitive); Fergus developed and tested Tc-99m labelled sulphur colloid for liver scanning. We could now provide scanning for liver (Tc-99m), kidney (Hg-197), brain (Hg-197), thyroid I-131). The point was made that we still had to carry out this work at Wakari Hospital, while the main patient beds were at Dunedin Hospital. In this regard, as one radiologist said to me, "Wakari Hospital is about as close to Dunedin Hospital as is Mars!"

As an historical footnote, I came across the text of a paper I gave at the NZMPA 1966 meeting, entitled "21 years of hospital physics in NZ". One comment reads "...The use of modern equipment and the more recently developed radionuclides...has brought about big changes...About 10 years ago (1956), I suggested to the head radiologist that radionuclide diagnostic tests really belonged in the same field as X-ray diagnosis. The suggestion was rejected, but now that scintillation scanning has really arrived (!) a quite different view is being taken..."

Nuclear medicine expansion, 1967:

1967 brought a change of emphasis in our hospital physics work. In radiotherapy, a Vickers barotherapy unit was commissioned, for use with the betatron. This required the construction of a twin light beam system to indicate the treatment distance for the patient in the tank. However, the main work was in nuclear medicine, with the great increase during the year of requests for organ imaging with the new colour printout in use on the Cliniscanner. This was ceiling mounted on rails over the modified X-ray table, which had the twin renography units mounted below. Fergus went onto half-time work so that he could complete an MSc at OU; even with the extra help of a most competent qualified nurse (Mrs Murray) in nuclear medicine, we were over-burdened with work. The term 'radiopharmaceutical' entered the nuclear medicine field; we built a perspex sterile cabinet for making up Tc-99m compounds; renography with Hg-197 was routine; a range of other radionuclides were in use for an increasing variety of tests. The expanding work needed more space, and the adjacent physicist's office was invaded. We produced a graph showing a near-exponential increase in scans required towards the end of the year.

Because of the encroachment of nuclear medicine work into Radiotherapy Department space, and the widening clinical use of radionuclides, a 'Radioisotope Committee' was formed with Peter Jerram as chairman. It first met on July 5, and again on July 26 1967; it recommended that a Department of Nuclear Medicine should be instituted, with a suitably qualified medical officer in charge, and located at Dunedin Hospital (not at Wakari).

Talking computers...:

The term 'hospital computer' appeared in our 1967 annual report, noting that some medical research work was being done on the OU computer, and making the point that interested hospital staff should meet to consider their requirements. Little did we then know the 'shape' of computing in the national health services in years ahead!

Changes in 1968:

In 1968, there were major changes in several areas. Fergus resumed full-time work, having successfully completed his MSc. He took over as sole physicist for 6 months from August 1968 while I was away on an IAEA assignment in Singapore, at the Outram Road General Hospital. They had a new building under construction, with two Theratron-80's being installed. I helped with radiation protection surveys, development of hospital physics facilities and dosimetry, and gave lectures. It was a useful assignment, and one I enjoyed.

In Dunedin, although the work-load in nuclear medicine scanning increased steadily, the workload in radiotherapy physics declined after Peter Jerram resigned on Jan 31 1968, and moved to Wanaka. There were reduced radiotherapy services, which depended on visiting radiotherapists from other centres, until Frank Ramsay came back again as locum radiotherapist on Dec 5. (Duncan Shine, then at Waikato Hospital, was interested in the position here, but was still 'tied' to Hamilton) During the interim period, we developed the electron beam for use at 15 MeV at Dr Tony Goldstein's request. Frank brought the barotherapy unit into regular use, using his experience of the Melbourne developmental work in that area.

The Theratron C-II now had a low dose-rate (still the original source), and did not have enough clearance for the barotherapy unit to be used. However, since it had been provided by the Appeal Committee, there had been negligible OHB costs for seven years from its installation in 1961. It was suggested the time was coming for it to be replaced with a major unit.

There was again a student physicist in the long vacation, continuing on with this regular annual temporary addition; Mrs Murray continued on as Staff Nurse and Dr Allan McArthur continued to provide clinical oversight in nuclear medicine. Diane Jackson was appointed as 'radioisotope technician'; with a BSc (Chemistry), she proved invaluable in taking over production of radiopharmaceuticals.

In nuclear medicine, the workload on the Cliniscanner had levelled off at the maximum possible throughput. There was further encroachment on Radiotherapy space, which caused some problems. The Advisory Committee on Radioisotope Developments met several times during the year (Alan Clarke, Prof of Surgery now chairman); recommended the purchase of a gamma camera (which we included on our Capital Estimates); and proposed that the Radioisotope Unit should transfer to Dunedin Hospital to occupy the space originally held by the Radiotherapy Department in pre-supervoltage days. These proposals were accepted by the OHB. It was like going back home, to re-occupy familiar space, although it was pointed out from the beginning that the space was inadequate for the present range of work.

Fergus drew up a 'Forward Planning Report' in October 1968, raising the issues of (1) radioisotope diagnostic services (dealt with above); (2) the need for a co-ordinated development of computer services in hospitals; and (3) the need for rational development of medical electronics, preferably with a suitably qualified physicist in charge. This is interesting to view from a 1995 perspective!

From my time in Singapore, I was sharply aware of their lack of technical equipment and staff, which was an ongoing problem in developing countries for a number of years. This made me appreciate all the more our own advantages in having Colin Medcalf and a range of good workshop machines. However, by now we also needed to add a Technical Officer in electronics to deal with our requirements.

Nuclear medicine changes, 1969:

1969 brought major changes in nuclear medicine, with all parties agreed that a Department of Nuclear Medicine should be set up, at Dunedin Hospital. In March, we recommended (using Ken Clarke's Melbourne model) that we needed 4500 sq ft for this Department; In February, Frank Ramsay had already strongly supported our proposal. Dr Cleminson, as Med Supt-in-Chief, said we could have the old Radiotherapy Dept space off Hanover St, or nothing! Frank had also said that ultimately, Nuclear Medicine should be in the DPH New Ward Block now in the planning stage; this may have helped the later transfer there to more adequate space from the approx 2000 sq ft we now had to use. It was interesting to 'make over' the space I first worked in at Dunedin Hospital, which included mostly 12 inch (300 mm) concrete walls. The old Maximar room became the 'hot lab' and radioisotope dispensary; the old Quadrocondex room became (later) the gamma camera room, the old Dermadex room became the radioimmunoassay lab, with a small room off it housing automatic counting equipment; the former secretary's office became a Physics office; the old bed-waiting space housed the rectilinear scanner and the thyroid uptake unit; a miniscule darkroom was squeezed in. Peter Jerram's original office became the nuclear physician's office; the old small theatre became an endocrinology lab. Briefly, it was workable, but only with mutual tolerance among staff in cramped conditions. The old 'radium strongroom' in the basement reverted to a storage area for used radionuclide generators and the like. There was just no waiting space for patients; bed patients had to wait in the corridor. All of which meant much drawing of plans; meetings; etc etc; right through 1969. Therapeutic use of radionuclides was to continue in the Radiotherapy Dept at Wakari Hospital.

The hard-worked Cliniscanner reached the end of its useful life after making its invaluable contribution since 1961. The Supervoltage Appeal Committee (which became the Supervoltage Appeal Trust, with Mayor, Town Clerk, Radiotherapist, and Physicist) still had a role to play. Although Southland had been offered a Theratron C-II for radiotherapy in Invercargill, they were never in a position to take up that proposal. Instead, at their request, Kew Hospital was offered nuclear medicine facilities, with a rectilinear scanner (Picker Magnascanner, with 5 inch crystal), thyroid uptake equipment, and accessory facilities. This equipment had been purchased, but staff were not yet trained to take over. On request, Kew Hospital agreed to loan us their Magnascanner for the interim period until they had staff available to use it there. The Magnascanner, which was the universal 'work horse' in nuclear medicine, was set up at Wakari Hospital, where it served us very well for some time.

Late in 1969, David Stewart (a NZer working in Sydney) was appointed as Associate Prof of Medicine, with Nuclear Medicine & Endocrinology under his control. This necessitated some modifications of plans, and much correspondence as he was still in Sydney. Progress was made in the choice of equipment for the new Department.

And radiotherapy changes:

On the radiotherapy front, Duncan Shine was appointed as Director of Radiotherapy at Wakari, but he was still working in Hamilton. By Sept 1969, the inevitable Radiotherapy Subcommittee had given approval to replacement of the Theratron C-II by a Theratron-80 (its counterweight modified to allow more 'reach' over the hyperbaric chamber; a major treatment simulator; a full mould room with vacuum moulder. This led on to more building plans, with additions to the Radiotherapy building needed to house the new simulator, mould room, and a new physicist's office. 1969 was a very busy 'paper-pushing' year!

1970 saw continuation of much of this activity, with ongoing planning for Nuclear Medicine at DPH, but the work still being done at Wakari Hospital. Redevelopment planning for the Radiotherapy Dept also continued. Since the Theratron C-II was to be replaced, I suggested it should be offered to NRL, so that they would have a 'megavoltage-equivalent' photon source for dosemeter calibration. Until then, they only had up to a 250 kVp X-ray source. NRL readily accepted the offer - the unit moved out on July 22 1971.

Duncan Shine moved to Wakari Hospital to take up his new appointment. This brought up some friction with Medical Physics - Peter Jerram, and to some extent Frank Ramsay, had preferred to have treatment planning done by radiographers directly under their supervision; Duncan Shine was keen to have a physicist involved, but with only two physicists fully committed in other ways, this was not then practicable. This difficult state of affairs continued on through the year, the whole being complicated by the ongoing reconstruction for radiotherapy at Wakari, and for nuclear medicine at DPH.

More about people:

Fergus Thomson left us in April 1970, to commence his PhD studies at Auckland University, and thereafter to join Medical Physics at Auckland Hospital. Ian Ross joined us in July 1970, from his previous work in the NZ Patents Office, and was immediately 'thrown' into coping with the busy and cramped nuclear medicine work. Conditions were far from ideal. Allan McArthur was still involved jointly (and uncertainly) as radiotherapy registrar and handling the clinical side of nuclear medicine, which was difficult for him.

OU medical physics lectures:

The OU Physics Department, which had little contact with us in recent years, except for providing an excellent series of senior students/new graduates for long vacation work, now approached John Read and myself in 1970, asking if we would accept Honorary Lectureships in Medical Physics (unpaid of course!), in order to provide an optional Stage-3 part-paper for senior students. We accepted. Actually, I had always had a position at OU as 'Lecturer in Radiological Physics' from when I began. John Read and I gave some lectures in 1971 to a few students, with some staff sitting in. Later, in 1978, we had an MSc student (Colin White) doing a thesis on quality assurance in radiology (long before it became a fashionable subject). This was an early forerunner of much later developments with the setting-up of the OU MSc (Medical Phyics) course in 1983.

Major reconstruction, 1971:

By 1971, actual construction work was under way both at Wakari (Radiotherapy additions, and new Theratron-80 etc), and at DPH (completion of Nuclear Medicine area in the old Radiotherapy Dept).

Welcome additions to staff, 1971:

Our few Physics staff had to continue to cope under many difficulties. This was greatly helped when we were able to attract Peggy Robinson (now Edmonds!) to join us in February 1971 - Peggy had trained under Johns & Cunningham in Toronto, and was having a look around NZ. She said that I wrote her the 'best letter' when she had written around NZ medical physics centres asking about possible jobs! For us, it was most opportune to have Peggy start with us, as a physicist trained in radiotherapy physics - the first in NZ to have had such formal training - to take over completely the requirements for the 'renovated' Radiotherapy Dept under Duncan Shine. It was again not an easy time, as her new office was not completed, although it was a magnificent office when the additions were finished.

We were fortunate also in recruiting Roy Saunders from the UK in October 1971 as a Technical Officer experienced in medical electronics. This helped our physics work greatly; Roy and Colin worked well together over many years on all aspects of our increasing hospital activities.

Nuclear Med at DPH:

The new Nuclear Medicine Dept at DPH finally opened on November 10 1971, with the new Pho Gamma III gamma camera installed, and the Radiax rectilinear scanner moved down from Wakari Hospital (where it had taken over from the Invercargill Magnascanner). Lynne Forster had taken over as radiochemist in May 1971, working initially in John Read's former lab at Wakari Hospital, and then transferring her work to the new site. There was also new automatic counting equipment in use at DPH. Nuclear Medicine had finally arrived in Dunedin in a complete comprehensive unit.

The widening scene in 1972/1973:

After all the planning, building, and re-equipping of 1969-1971, 1972 settled down into a busy year of consolidation. Hospital physics had broadened its base to include Dunedin Hospital with Wakari Hospital, and this did complicate ongoing work and communication between our few people. At the same time, there was increased interaction with staff in radiotherapy and nuclear medicine, and in engineering services!

Duncan Shine as radiotherapist would have much preferred to 'have his own physicist', and said so to me more than once. Peggy coped well in what was at times a difficult situation. Much physics activity was required to provide clinical physics data for the new Theratron-80, with a wide range of wedge filters and the like.

In nuclear medicine, after physicists had done all the early developmental work, control was taken over by the 'nuclear physicians'; the increasing complexity of scanning compounds required a radiopharmacist; radioimmunoassay needed a biochemist; and the physicist had a different role. The gamma camera itself was satisfactory, but accessory data-processing equipment was still in the developmental phase, and far from satisfactory. The videotape unit gave problems, and the so-called 'clinical data system'(CDS-4096) was a name indelibly imprinted on the brain! This was never satisfactory; the supplier finally had to take it back and refund its cost. That money should have been applied to purchase a small computer, but by that stage (see later), the Health Dept had intervened, and the money was lost into the OHB's coffers. Ian set up the new major automatic counting equipment, one unit for gamma rays; another for beta-counting. The new DPH accomodation was cramped; overall, the conditions were far from ideal, but were workable.

By this year, 1972, Kew Hospital, Invercargill, was ready to start up their nuclear medicine work. Our Physics folk went down on occasion to help them get established, with their Magnascanner, thyroid uptake system (IDL equipment; trolley mounted), and an NE manual well counter with an IDL electronics unit identical with equipment we had in Dunedin. We also calibrated their superficial X-ray therapy equipment on request; normally this would have been done by NRL.

In February 1972, on request from the Professor of Physics, I agreed to take on N V Tuan, a Vietnamese BSc student, for a year. However, he never really settled into hospital physics; he preferred computer-type work and left to join the OU Computer Centre in Feb 1973. Ian Ross decided by May that he needed a change of scene, and moved to Wellington Hospital. We were fortunate that a peripatetic Canadian, Peter George, happened to be in Dunedin at the time; he readily agreed to join us for a year or so, from April 1972. Peter worked in Nuclear Medicine until Jan 1974, when he returned to Canada.

I was asked to take up another IAEA assignment, this time in Malaysia; I agreed to go for 10 months, and left for Kuala Lumpur in May 1972, to help develop their nuclear medicine and hospital physics facilities. It came to involve other work as well, including an IAEA roving mission for 3 weeks.

Things settled down to a more stable pattern in 1973, with plenty of ongoing physics work all around. When Peter George left us in Jan 1974, overseas advertising brought us Peter Richold from the UK, who started in Feb 1974. Peter had been out to NZ earlier on, to look at the possibility of coming to NZ with his wife. After two years here, they decided they preferred their English life-style, and returned to the UK in June 1976. Peter Richold had worked in UK hospitals, and had experience in $FeSO_4$ chemical dosimetry, which I was keen to introduce for use with our electron beams as a quite independent dose assessment technique. In 1974, we put in a lot of work on re-assessing electron beam dosimetry, using ionisation chamber methods, and wanted confirmation through chemical dosimetry methods. Peter got this going, and we tried to set up $FeSO_4$ dosimetry for possible use by other centres as well. Some assessments were done, but this work did not really proceed effectively, due mainly to Peter's ongoing physics commitments in nuclear medicine. Down at Nuclear Medicine, Jeanette Wood (BPharm) took over in March 1974 from Lynne Forster as radiopharmacist, and produced an excellent range of Tc-99m compounds for bone, kidney, and liver imaging, with freeze dried cold kits.

Problems over computer acquisition, 1974 onwards:

This led into the confused era from 1974 onwards with much energy spent in trying to obtain and use small computers to process nuclear medicine data (especially after the failure of the CDS-4096 referred to above); radioimmunoassay results; radiotherapy treatment planning; and radiotherapy dose assessment. We were too slow off the mark to beat the Health Dept 1975 deadline after which local purchases of small computers were postponed indefinitely. More needs to be said about the Health Dept approach, as it led to great wastage of staff time and energy, and a gross delay for years of useful applications of computers.

The Health Dept set up a National EDP Committee (Health) in 1969, "..to coordinate and promote the use of electronic data processing (EDP) in the health services..". It was claimed that its "..endeavours were tried for 5 years without conspicuous success.." And so on October 8 1974, Touche Ross & Co were appointed to produce overall recommendations. They called for submissions, went up and down NZ meeting interested groups in hospitals etc, produced a draft Report in Feb 1975, which "...was accepted by the Government in May 1975 as a final report..." Touche Ross were then appointed to implement their proposals. (I noted that among 65 named submissions to Touche Ross were the Medical Physics Dept, Christchurch Hospital; HDJ, Dunedin; Tony Johnson and Wallace Armstrong, Wellington; Jon Henderson, Auckland; Bruce White, Auckland; Ray Trott and Phil Morris, Palmerston North. We tried, chaps! But why was the NZMPA or the NZHPA(Inc) not on the list?)

The proposals were to spend $28 million over 5 years; to set up 3 'core' systems in the first instance (national payroll; national patient ID; a national hospital laboratories system). Touche Ross set up (surprise! surprise!) two major computers, one in the North Island (Auckland); one in the South Island (Christchurch), and proceeded unsteadily from there....
A "Report to the Minister of Health by the Special Advisory Committee on Computer Re-organisation in Hospital and Health Services" was issued on Jul 8 1976; what it said overall was 'Keep it going as recommended...' And the years rolled on... and on....and on....with many reports of frustration from all directions, not least among hospital physicists, up to 1982 at least.

In the event, this was all overtaken, once again, by rapid technological advances, eg in the first X-ray CT scanner (EMI; 1972); microprocessor-controlled equipment; equipment with microprocessor data processing; interactive radiotherapy treatment planning systems, and the like. The wastage of the Touche Ross approach in money, and in staff time, was enormous. The original $28 million, if allocated around hospital boards with strict guidelines, would have been vastly more cost-effective.

Next stage of nuclear medicine planning:

From 1975 onwards, Nuclear Medicine ran routinely in its cramped accommodation, with planning by then under way for better facilities in the New Ward Block, a 9-storey building on the Frederick St side of the hospital complex. Nuclear Medicine was allocated a good area on the first floor, which was adjacent to the Radiology Dept in the Clinical Services Block (on Cumberland St). We were able to claim some space in this area for Medical Physics, comprising 2 offices, an electronics/workshop lab, and later an unallocated room for equipment and a notional office. There were some radiation protection problems to consider throughout the Ward Block, as all partitions were light-weight and notionally removable. We had to return to the days of sheet-lead protection in Nuclear Medicine 'radiation areas', especially the 'hot lab', imaging rooms, and counting rooms. For patients having treatment with I-131, or those with Cs-137 insertions for radiotherapy, Colin built heavy mobile lead shields; patient rooms also had to be selected to include inverse-square-law reduction of dose-rate for other patients and staff. This led to some problems, especially when there were a number of such patients. We also had to look at the degree of protection in the light-weight concrete floors/ceilings. With the opening of the Ward Block in 1981, it was time for Nuclear Medicine to move again, from the Hanover St building which had enabled a good development of procedures in imaging, radiopharmaceutical production, and radioimmunoassay, although in cramped conditions, to its final home, with space and good facilities. A new major Technicare gamma camera with a data processing system was included in the commissioning grant; the 'old' Pho-Gamma camera was also moved; both were housed in a large 'L'-shaped room. The Radiax scanner moved; as did the thyroid counting unit, and the auto-gamma unit and the auto-beta unit.

Meanwhile, work at Wakari Hospital continued on as usual. With increasing technical requirements, I was able to take on a 'physics trainee', Evan Thompson, in 1975, who was to take his NZCS (NZCE as it turned out), while working with Roy and Colin. Evan came to know our ways, and added to our technical capability, until he moved out some years later, in Aug 1985, to take up a position with Philips (NZ). After John Read finally retired, we were able to take over his laboratory space in 1978, for an extra office, some storage, and also to provide for our increasing need for lead work, eg making up the shields spoken of earlier. The supply of lead in radionuclide shielding for Mo-99/Tc-99m and other 'generators' was just about enough to keep up with our requirements.

After Peter Richold left us, we appointed Maurice Looser in June 1976. Maurice took over the nuclear medicine work (still in the cramped space off Hanover Street); he also had a deep interest and knowledge in electronics. At this time, mini-computers/microprocessors were in the stage of rapid development as integrated circuit technology became more available. With the ban on hospital computer-purchase, Maurice set about building his own mini-computer, making up the necessary etched boards, with Roy Saunders' help. He also built us a prototype electronic timer, which we had hoped to use with the Theratron-80. However, in that case, AECL (Canada) had available a well-proven timer, which was finally chosen and installed on the Theratron-80.

X-ray CT scanners:

By 1975, people were talking seriously about X-ray CT scanners, and although the Health Dept yet again tried to make like King Canute, by 1980 several centres including Dunedin were fund-raising locally to purchase X-ray CT units. A Technicare 2020 X-ray CT unit was installed at DPH in 1981, but we were not directly involved. Initially, these scanners were still to some extent 'state-of-the-art', with maintenance problems in the X-ray circuitry due to high tube-loadings; a substantial computer data-processing facility; and software-upgrades included. Each X-ray CT scanner sold had with it a 'maintenance engineer', who needed to be a composite person. This appealed to Maurice, who left us in April 1981 to join Technicare (our X-ray CT supplier), and re-appeared later as their on-site engineer at DPH.

Radiation units:

As an exercise in genuine hospital physics, SI units were introduced in 1976. This was discussed specifically at the NZMPA meeting in Auckland in Feb 1976; the final outcome was that the cGy simply and numerically replaced the rad, but there was the more complicated (for non-physicists) change in nuclear medicine etc from the curie (mCi, uCi, nCi...) to the becquerel and multiples thereof. (Which reminds me that once-upon-a-time (1946) there was a serious suggestion from the US National Bureau of Standards that there should be a unit of general applicability to radioactive sources, called the 'rutherford', where 1 Rd = 1 million dps!)

The biomedical engineering debate:

Partly because of the universal computer problems post-Touche Ross, there was much more correspondence between centres from about 1975. There was also the ongoing argument as to who should handle medical electronics in hospitals, particularly for the 'patient appliance' area. The Health Dept "McLennan Report, 1976" favoured this field being handled within an expanded "Department of Medical Physics & Bioengineering" in each centre. This was hotly disputed by Chief Engineers and Electrical Engineers. In 1977, there was a visit by Dr Dennis Hill, Chief Scientific Officer of the South-East Thames Region in the UK. He visited all centres; talked to everyone; and issued a report which generated more heat than light all round. In the event, on May 23 1977, the Health Dept called a meeting with reps of the NZHPA(Inc) and the NZ Hospital Engineers Assn, to discuss the matter. The meeting was inconclusive; the Health Dept did try later in 1977 to see if hospital boards would go along with the idea, but later dropped the proposal, as being too difficult to resolve. So the status quo remained, certainly at an unsatisfactory level in Dunedin, if not elsewhere.

There was always the difficulty in Dunedin, that Medical Physics came under the Medical Supt-in-Chief, while the Chief Engineer and Electrical Engineer came under the Chief Executive. This meant that these engineers were present at eg OHB Works Committee meetings, which gave them a considerable advantage in presenting their viewpoints; furthermore, Board members thought they could understand engineering to some extent, but their minds 'glazed over' when 'physics' was mentioned. The problem was very real, and was never resolved in forty years!

More about computing:

Computing for radiotherapy physics and treatment planning was always a problem post-Touche Ross. Peggy joined us in 1971 from Toronto, with experience and details of their computerised treatment planning programmes; it was always a frustration that she was not able to introduce this early on.

The OHB set up an EDP Committee at some stage, on which Physics was not represented, but it was apparently only concerned about administrative usage. The OHB did establish an EDP Unit, which made use of the OU Computer Centre equipment. In 1974, Peggy was able to negotiate with Paul Fluitsma of the EDP Unit to set up a radiotherapy treatment planning programme (RTPP) to run on the OU system, but it was very frustrating to have to explain to non-physicists what the programme was all about. Furthermore (and this may seem unbelievable today) the process involved data sheets filled out at Wakari Hospital; transported by hospital taxi to the OHB Offices in Hanover St, where typists converted the data onto punched cards. These then went by human feet to the OU Computer Centre, where they were run. The resulting printout sheets found their way back to Dunedin Hospital, and by taxi back to Wakari Hospital. But it was a system that worked! (A recent note from Peggy says "On reflection, find this quite amazing! Data left Wakari Hospital at 11.45 am by taxi; plans came back at 4.45 pm by hospital taxi!").

When the Touche Ross Disaster struck in 1975, the agreement was that all hospital programmes in use would be transferred to the Health Dept Computer. In due course, this happened to our RTPP in 1977. It was again necessary for Peggy to explain to a non-physicist what a RTPP was all about. One Gordon McLister rushed in and out with masses of paper, carrying out the so-called conversion; there was much letter-writing in 1977-79 to Alan Dougall, Manager of the Chch Regional Data Centre, trying unsuccessfully to get corrections made to the converted RTPP.

We were writing letters to the OHB in October 1978 "..Re Wakari Hospital Terminal to Chch Computer Centre..". Then on March 9 1979, there was a Health Dept "Circular Letter No Hosp 1979/40, on "Lifting the Embargo on Local Computer Projects" (but note that by then several other centres had their own mini-computers, purchased by local Cancer Societies etc, and were doing their own RTPP!) On March 30 1979, there was a letter from the Auckland (!) Regional Computer Centre, admitting problems over the RTPP conversion, and offering an 'interim solution'(!), with Christchurch Hospital programmes, and the Palmerston North input/output system! Other centres were not interested in any 'interim solutions'; we had no choice at that time. On June 20 1979, we had a visit from Alan Dougall, with the offer to instal a computer terminal at Wakari Hospital. They admitted that a dedicated local interactive treatment planning system was desirable! Then in August 1979, a computer terminal and printer were installed in the Admissions Office at Wakari Hospital, and the 'interim solution' RTPP could be run from there. However, there were still various technical problems and interruptions. And finally, in January 1982, after ten wasted years, a PDP 11/34 was actually provided and installed in the room adjacent to my office at Wakari Hospital, for use in RTPP. We added an input unit, and a Hewlett-Packard 4-colour X-Y plotter for output plotting. Peggy finally had an in-house usable radiotherapy treatment planning system!

Well...almost. Everything took time. Only those working in the hospital physics scene, with conditions of minimum staff and maximum demands, can really understand! To complete this 'Computer Extravaganza' before moving onto other activities, more needs to be told. Another young physicist, Chris Golding, joined us in Dec 1981 (for reasons discussed later), with a good knowledge of electronics and some computing experience. He arrived just in time to see this gear arrive, and was soon involved in its commissioning.

Peggy took overseas leave for 4 months, March-June 1982, so Chris was heavily committed to radiotherapy physics from his arrival. Peggy has outlined below how we made progress. Chris did all of the computer setting-up, including peripherals and programmes. All the NZ-centres had worked very well together in developing RTP programmes in our difficult NZ environment. The RTP programmes we used were from Hamilton; (the original of these was developed by Christchurch - who then went onto another system they developed). Because our peripherals were slightly different from Hamilton, we also got some programmes from Auckland (who also had the Chch programmes). Peggy set up all the data for our machines (betatron 24 MV X-rays, and Theratron-80 Co-60), and did the testing and verification of our data and the programmes, for our Dunedin scene.

This was all done along with rigorous supervision of routine radiotherapy treatment planning, and other normal work. It took the latter half of 1982 and all of 1983. By March 1984, it was introduced into regular use, and a long frustrating saga extending over more than ten years was ended.

It is probably useful for posterity to have this on record; it may well be the last major development that had to be undertaken in-house by hospital physicists, using developing technology, before the 'modern' era where major commercial systems of all kinds can be purchased - at a price! - with all developmental work done by the manufacturers.

The 1980's scene:

Generally speaking, from 1980's onwards, events involving hospital physics seemed to spread out like a river delta, with a wider range of activities and events, most carrying a lot of 'silt' (eg the proliferation of photo-copied reports). We were involved at both Wakari and Dunedin Hospitals; I spent about half my time at each. Giles Wynn-Williams joined us in 1981, with commitments in Ophthalmology (where he had been previously working under Prof John Parr) and in Radiology. Malcolm McQueen also joined us, later in 1981, taking over in Nuclear Medicine after Maurice Looser had left, and also with interests in computing.

The Radiology Department was expanding, with the X-ray CT scanner commissioned in 1981. It was located physically between Nuclear Medicine and Radiology. Other major systems (cardiac radiology; ultrasound) were also now in use, which required more physics instrumentation and measurements.

Long service leave 1980:

I took long service leave, plus some study leave, from May-August 1980. We had brief stopovers at centres in USA and Canada, but mainly visited familiar UK medical physics centres. On the way home, we relaxed at familiar places in Malaysia and Singapore.

Local events in 1981/83:

'Quality assurance', which is a commonly used and accepted term today, was always of concern to hospital physicists in radiation dosimetry standardisation, and in radiotherapy physics. In 1981, we became more involved in oversight of treatment planning, which required the appointment of an extra physicist. This led to Chris Golding being appointed in December 1981, with a primary commitment in radiotherapy physics, under Peggy's supervision. With Peggy's overseas leave due in 1982, this was of course most helpful to us.

Nuclear Medicine continued on; the time was coming when there were others looking at taking over the facilities, such as Radiology wanting to take over imaging; Laboratory Services indicating that radioimmunoassay was properly in their territory.

NACCTS 1981-87:

The National Advisory Committee on Cancer Treatment Services (NACCTS) was set up in 1981, representing all disciplines involved in hospitals, and with Health Dept representation. I was asked to be involved, as rep of the NZHPA(Inc). The Committee met fairly often; it set up a group to visit all centres to look primarily at re-equipment with linacs. The brief broadened to include a wide range of concerns, including adequate buildings, accommodation and facilities; bed allocation; nursing needs; chemotherapy safety; and so on. I was in this group, which worked fairly effectively. A major Report was finally produced in 1985; although it had some defects, it did give a good working basis for upgrading all cancer treatment facilities.

On matters affecting physics, it recommended the provision of new linacs in all centres; provision of modern interactive treatment planning systems; provision of modern isodose plotting systems; looked at the recruitment and retention of technicians; and looked at the need for training/recruitment of hospital physicists especially with a number of senior people due to retire before long.

The Report did have useful flow-on effects in some regards; it did get overtaken by events in some areas, and affected by other subterranean forces acting within the health system. However, redevelopment of all radiotherapy/oncology services followed on from the Report. I remained on NACCTS 1981-87; Alun Beddoe then took over the NZHPA(Inc) representative's role.

Training schemes for hospital physicists:

On the question of training/recruitment of hospital physicists, this was a matter of general concern in the UK as well as here. The UK HPA in 1981 set up a training scheme; this was used to promote the idea with NACCTS. On the local Dunedin scene, the OU Physics Department became interested, and in 1983, an MSc (Medical Physics) course was set up, admittedly in part because it would give them extra full-time student-equivalents. Some papers were hospital-based (lectures by hospital physicists); others were based on existing Physics Dept papers. A thesis/project was included; this was useful for our hospital work, as it was an extension of our earlier practice of long-vacation employment of a senior physics student, to work on some project useful in the hospital setting. This Otago MSc (Medical Physics) course became an important and useful source of good-quality Physics graduates to fill vacancies in a number of NZ hospitals. Waikato University also set up a useful scheme.

Retirement:

I retired in December 1984, just 37 years after I began at Dunedin Hospital, although I continued on as NZHPA(Inc) representative on NACCTS, and continued to take an interest in the NZ Branch, ACPSEM. Alun Beddoe was then appointed in September 1985 after the inevitable delays, as Chief Physicist to the Otago Hospital Board.

Cogitation:

The detail of the ongoing changes from 1985 are outside the scope of this personal record, which covers nearly 40 years from Warren Sinclair's beginning in November 1945, until a year after my retirement in December 1984.

However, some comment on the period 1985-1995 in Dunedin needs to be added. Alun Beddoe worked away to develop the wider aspects of medical physics, but met considerable frustration in all aspects of administration, from inadequate secretarial help, to failure to achieve a 'meeting of the minds' with the new Chief Engineer, to lack of support from the new Chief Executive of the Hospital Board. The Otago MSc (Medical Physics) did become well established, and has produced some excellent young hospital physicists who became active in other centres. However, Alun gave up the struggle after two years, in December 1987, and moved to a position in Adelaide.

Malcolm McQueen was then appointed as Chief Physicist, in 1988. Largely because of new hospital management structures, and not helped by the continuing division of physics staff between the Wakari Hospital and Dunedin Hospital sites, there followed a period of disintegration. Radiotherapy (now designated Oncology) moved to the Dunedin Hospital site, to accomodate the new linac (replacing the faithful 32-year old betatron); Medical Physics staff moved as well. However, by July 1991, physics staff were being divided between Oncology and Radiology. Malcolm finally resigned in December 1993. Problems in management foreseen back in 1983 finally caught up with medical physics in Dunedin. Since then, other centres have come under pressure from layers of hospital lay management anxious to demolish Medical Physics/Bioengineering Departments - Wellington has suffered similarly; Palmerston North, as Ray has said, was never able to establish an independent Medical Physics Department; chill winds have been blowing in Christchurch. There will be an ongoing story to be told some day.

Quite apart from changes in hospital administration in the last ten years, there have been major changes in the demands on hospital physicists over the last fifty years, in their areas of involvement. These have changed at roughly decade intervals - the initial decade 1945-55 involved work in improving accuracy in radiotherapy, and in radiation protection; then approx a decade 1955-65 in establishing supervoltage radiotherapy; followed by the rapid rise in the importance of nuclear medicine including imaging, 1965-75; the introduction of other imaging modalities and computerised systems 1975-85.

The present decade 1985-95 has brought in the era of major expensive commercially-developed sophisticated systems, where there is no longer the scope for in-house development as went on earlier, with unlikely components being picked up cheap at army-surplus stores and the like! The modern hospital physicist, and his biomedical engineering colleague, have come a long way from their earlier 'prototypes'.

Conclusion:

Happily, whatever changes have come over the years in systems and technology, human values remain much the same. It is a pleasure to look back at colleagues locally and nationally (and overseas come to that!), who have become friends through these years of endeavour, and among various trials and tribulations, in applying minds and hands to develop hospital facilities in the interests of patients.

Hugh Jamieson
Dannevirke
August 1995

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DUNEDIN STAFF LIST: PHYSICISTS and TECHNICAL OFFICERS

Physicists:

W K Sinclair (Warren) Nov 1945 - Aug 1947 (went overseas to Royal Marsden Hospital, London; cont'd career overseas)
H D Jamieson (Hugh) Dec 1947 - Dec 1984 (retired)

O D Smith (Owen) Dec 1952 - Jun 1954 (locum while HDJ in New York); came from/returned to, sec'y teaching)
C G H Tripp (Howard) Jan 1958 - May 1965 (to Waikato Hospital; deceased June 19 1965)
F J Thomson (Fergus) Dec 1964 - Apr 1970 (to Auckland University; then to Auckland Hospital)
I T H Ross (Ian) Jul 1970 - May 1972 (to Wellington Hospital)
P B Edmonds(Peggy) (Robinson) Feb 1971 - present (1995) (from Toronto, Canada)
N V Tuan Feb 1972 - Feb 1973 (only temporary attachment)
P George (Peter) Apr 1972 - Jan 1974 (from Canada; returned there)
P C H Richold (Peter) Feb 1974 - Jun 1976 (from UK; returned there)
M A Looser (Maurice) Jun 1976 - Apr 1981 (to Technicare) and Dec 1986 - May 1987 (to Sydney; deceased June 3 1990)
C C Golding (Chris) Dec 1981 - Apr 1986 (to Australia)

G Wynn-Williams (Giles) ... 1981 - present (1995)

M P C McQueen (Malcolm) ... 1981 - Dec 1993 (resigned)

A H Beddoe (Alun) Sep 1985 - Dec 1987 (from Auckland; to Adelaide)
L Dakers (Lee) Jul 1986 - Jan 1994 (from Auckland Hospital; returned there)
J Nicholls (Jeremy) Apr 1990 - present* (from UK; to OU as Lecturer for MSc (Med Px)
*(part-time from 1992)
M I Paris (Matthew) Mar 1990 - present (1995)

B L Waller (Brett) May 1995 - Jul 1995

P Cardno (Paul) Aug 1995 - present (1995) (Otago MSc MedPhysics)

Technical Officers:

C C Medcalf (Colin) Jun 1955 - Dec 1985 (retired)
H R Saunders (Roy) Oct 1971 - Feb 1991 (retired)
E R Thompson (Evan) ... 1975 - Aug 1985 (to Philips (NZ) as Service Manager)
N Robinson (Norman) ... 1985 - present (1995)
B Baxter (Barry) Dec 1985 - Oct 1995
R Otway (Roy) Feb 1995 - present (1995)

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WELLINGTON HOSPITAL: MEDICAL PHYSICS & BIOMEDICAL ENGINEERING
A brief summary of developments from 1925

There is a fascinating variety in the origins and development of hospital physics and related activities in each of our NZ centres - this is particularly evident when looking at events at Wellington Hospital.

Early days from 1925:

History of the early days is extremely well recorded in the John Strong Lecture of 1964, by Dr Roger Marshall, Director of Radiology at Auckland Hospital. He describes the work done initially by Noel Hill from 1925, and then by himself, when they were physics students at VUC (Victoria University College, then part of the University of NZ), in setting up the first radon plant in NZ, at Wellington Hospital. Believe me, that Lecture is well worth re-reading!

Overseas interest:

I was surprised and interested a while ago to have a letter from Prof Harold Miller, who built up the excellent Sheffield Department of Medical Physics, and was one of Rutherford's students at Cambridge. (He is in that well-known photograph of Rutherford at the centre of a big group of students). Another of those students was Ernest Marsden, who came to VUC as Professor of Physics, and later moved to DSIR. All Rutherford's students had to develop glass-blowing skills as part of their 'apprenticeship' under him. Marsden in fact worked with Geiger in the development of the ubiquitous GM counter, that object of mingled love and hate to many thousands of aspiring and perspiring physicists over the decades since.

Harold Miller knew that Marsden had something to do with Wellington Hospital - in fact, it was only that Marsden gave Noel Hill some initial advice on glass-blowing when he was building the radon plant. I phoned Dr Hill (who gave up physics and turned to radiology), who confirmed this; he said that Ernie Marsden's help was only for a brief period. Fascinating how in 1995, there are still folk around who were original players in the development of physics from the Rutherford era!

Enter John Strong, 1932:

Then after a succession of physics students (Hill, Marshall, McNickle), John Strong took over in 1932. That radon plant later moved to Christchurch, where it came under the care of NRL, and was re-built by Harry Sutton as an MSc project in 1947 - Harry then went into radiation chemistry with John Read, and later was well-known at the Institute of Nuclear Sciences.

Advertising for a hospital physicist, 1949:

In 1949, Wellington Hospital advertised for a hospital physicist, to work under Dr E G Lynch, in radiotherapy physics. At the time, I was the locum in Dunedin for Warren Sinclair, and was of course interested. I applied for the position, explaining that my application was conditional on whether Warren was returning or not. I was offered the post provisionally, and tried to find out Warren's intentions. He in turn had to find out if the Otago Hospital Board was indeed going to pay the agreed half-salary during his 3-year leave; and you can imagine how fast that all was! There were some undercurrents 'here and there' around the country opposing support for Warren; in the event the Board did not pay; Warren did not return; I stayed in the Dunedin job and wrote Dr Lynch on Oct 31 1949, declining the Wellington post and apologising for the delay I had caused. This over-long account indicates that there have always been problems in the hospital physics scene, often not perceived by earnest young physicists who can be innocently unaware of what lurks in the thickets nearby!

Job re-advertised, 1950:

It is also worth noting that physics graduates were thin on the ground - this was the case for the next twenty years at least. The position was re-advertised in 1950; Bob Borthwick applied and was appointed in June 1950. I knew Bob from VUC days; he was at the time working with Jim McCahon (later at NRL) in the DSIR under (now) Sir Ernest Marsden.

At Wellington Hospital,the radiotherapy department was known as the "Radium Department"; space for the physicist was found, not quite in a basement, but near enough and quaint. Bob did not find the work there satisfying; he left again in December 1951 to move to NRL, where he took up diagnostic X- ray protection work. He also found the pay was better! Salary scales were already a topic of conversation by 1950.

And again, 1952:

Ross Garrett then took up the position at Wellington Hospital in 1952; he was one of the names at the NZMPA 1954 inaugural meeting, where he gave a paper on "Conditions for saturation in cylindrical ionisation chambers", a topic of moment for many years before and since! After a few years, he felt the need for wider experience and looked overseas. Since my time in 1953 at Memorial Hospital, New York, I had occasional requests from John Laughlin for me to return there, or to suggest other names to him. And so Ross, now married to Jennifer Thompson from NRL, moved to New York in 1956; when they returned to NZ later, Ross took up a position at Auckland University Physics Dept, from where he retired recently.

And again, 1956:

Come August 1956, enter Wallace Armstrong! Wallace worked away to develop hospital physics in a not-very-easy environment. Supervoltage radiotherapy was slower in coming to Wellington - it was not until 1962 that a (British) Co-60 Mobaltron (75 cm SAD) was installed, the first unit in NZ actually purchased by the Health Dept! (Waikato came later, but their Dept did not exist until 1965). Nuclear medicine activities began in 1952 with I-131 thyroid uptakes; P-32 came into use in April 1953. Wallace developed other work in nuclear medicine (refer Allan McArthur's paper on NZ nuclear medicine developments). Imaging began around 1965, with the purchase of a Picker Magnascanner. Wallace was early on the trail of computer-use in hospitals; he fought many battles along the way with the Health Dept Computer Centre philosophy with little benefit to his ideas, or to his blood pressure! (Look up his 1994 John Strong Lecture for some comments).

Various other physicists joined Wallace, and moved on again. One was Richard Milne (1969-72), who then moved sideways to take a Pharmacy degree at Otago University (and helped me by giving some DDR physics lectures, and setting the examination while I was on my IAEA assignment in Malaysia).

For years, Wellington suffered from limited space for building development. When the Mobaltron badly needed replacement, a Varian Clinac-4 was installed, partly because of its modest space requirements. Major hospital building redevelopment has since occurred, with the present substantial facilities. The establishment of the Wellington Clinical School added to both buildings and complications.

Ian Ross, 1972, and others:

Ian Ross moved from Dunedin to Wellington in July 1972, and as we all know, worked very hard to develop nuclear medicine in the first place, and then to establish a Department of Biomedical Engineering. Tony Johnson joined in 1975, and Blair Steer in 1978. Wallace finally decided to get away from it all, and resigned in 1980 to move over to the NZ Meteorological Service. Alex Mitchell began in 1981, to work in radiology with their X-ray CT scanner; Lynne Greig arrived in Feb 1991, after a time at Palmerston North Hospital, to work in radiotherapy physics. As a variation, Tony Johnson left in Nov 1989 to take up fruit farming in Hawkes Bay, but he has been known to reappear from time to time in his old hospital haunts. When you look back over this account, and see the number of people who have gone from Wellington Hospital to other work or places, there have been an interesting variety of possibilities!

The dismantling of Biomedical Engineering, 1994:

After all the hard and effective work put in, especially by Ian Ross, to develop the wider aspects of biomedical engineering with a good group of professional and technical staff, it is most

TEM Mobaltron, Co-60 unit, 75 cm SAD; similar to unit installed at Wellington Hospital, 1962

At 1957 NZMPA meeting in Palmerston North - a young trio of Dr Don Urquhart (radiotherapist, Palmerston North); Wallace Armstrong (Wellington Hospital); Jack Tait (Christchurch) regrettable that for administrative reasons not apparent to the onlooker, and in the new climate of lay managerial responsibility in CHE's, their Department was dismantled and divided between Oncology/Radiotherapy and Radiology. Technical staff were transferred to the 'Facilities' Group.

Conclusion:

This is a brief account of the Wellington scene from an interested observer, but it is written with knowledge especially of earlier times and players. It is to be hoped that the present staff can continue to apply their considerable range of professional expertise over the still expanding fields of physics and bioengineering in the hospital setting. It is too early to try to anticipate what the future of medical physics and biomedical engineering will be in the next period in our NZ hospitals.

HDJ

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WELLINGTON STAFF LIST:
Physicists:

R A Borthwick (Bob)	Jun 1950 - Dec 1951	(to NRL; later to Chch Hospital; then to IAEA; UNDP)
R Garrett (Ross)	... 1952 - ... 1956	(to Auckland Univ Physics Dept)
W E Armstrong (Wallace)	Aug 1956 - ... 1980	(to NZ Met Service; now retired)
R Roberts (Rosemary)	... 19.. - ... 1973?	(.....?
C Currant (Christine)	... 19.. - ... 19..?	(.....?
R J Milne (Richard)	Apr 1969 - ... 1972	(to OU, Pharmacy degree course)
R Thomas (Roger)	... 1977 - ... 1979	(from Wales; returned o'seas)
I T H Ross (Ian)	Jul 1972 - present (1995)	
A D Johnson (Tony)	... 1975 - Nov 1989	(to fruit farming; occasional work back at Wgton Hosp)
A W Mitchell (Alex)	Jan 1981 - present (1995)	
B Steer (Blair)	Jul 1978 - present (1995)	
L Greig (Lynne)	Feb 1991 - present (1995)	(from Palmerston North Hospital)
S Billing (Shelly)	Mar 1995 - present (1995)	

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HOSPITAL PHYSICS BEGINNINGS AT AUCKLAND HOSPITAL, 1952
A brief view of the early days

The background scene:

Auckland was the third NZ centre to advertise for a hospital physicist. When the ad appeared in late 1951, there were physicists only at Dunedin (Hugh Jamieson) and Wellington (Bob Borthwick, who was shortly to move to NRL). A better salary was on offer, actually with an increasing scale! In those days, the only way to get a salary increase was to ask the local Board to match the opening 'bid' by another centre!

Owen Hames was appointed there in January 1952; the few hospital physicists were soon in communication by letter - it helped a great deal in reducing the sense of isolation to have other people working in hospitals, even at considerable distances. Of course, Auckland was then, and still is, much the largest centre in NZ. This meant there has always been considerable pressure on radiotherapy facilities to cope with the patient load.

The head radiotherapist was Dr Nolan, a very hardworking and approachable person, who had trained at the well-known Christie Hospital, Manchester, where radium techniques had been developed in a very comprehensive manner to produce the 'Paterson-Parker System' (a formidable radiotherapist-physicist combination). This System had been written up about 1945 into the essential text for every radiotherapist and hospital physicist by J W (Jack) Meredith, head of Medical Physics at the Christie for many years, and a major important but benevolent figure in hospital physics over a great many years. In those days, radiotherapists doing extensive radium therapy in busy centres were very much at risk from radiation exposure.

Supervoltage, 1955:

Auckland and Dunedin both felt the need to move into supervoltage radiotherapy by 1955; both ran most successful public appeals each totalling over 100,000 pounds ($200,000), but Auckland had the advantage of being 'Government-approved' and it was easier to proceed. The decision was taken to buy the Metropolitan-Vickers 4 MV linear accelerator; there is no doubt that was the correct decision for the workload demand.

Accommodation on the Auckland Hospital site was a problem - it was not possible to build on to the main Hospital, and a separate 'stand-alone' building was erected. This meant problems throughout the lifetime of the building for inpatient access.

Unfortunately, this particular linac was the first one from the factory 'run'; all earlier ones were produced in the Metrovick research workshops. There was a fault in assembly, giving rise to a vacuum leak which was most difficult to detect. Owen was joined in 1955 by John Wright; the linac took up a great deal of their time and energy. The problems with the linac probably contributed to the untimely death of Dr Nolan some years later.

Once the nature of the linac problem was finally found and corrected, the linac gave good service over many years. John Wright left in 1960 to return overseas; Owen continued on, and deserves much credit for keeping that early linac and other radiotherapy physics going. There were always good technical supporting staff.

LATER RADIOTHERAPY REDEVELOPMENT

With the major Auckland patient load, it became necessary to add further treatment units, and in time the present major Oncology Department was built, with modern accelerators, and good physics facilities. Years of work went into the planning, and then the commissioning of the new building, with its new equipment. The old linac continued on for some time in the original building. After Dr Nolan's death, Dr Ross Burton took over as Director for some years, and later still, Professor John Probert became Director. Owen worked on throughout these changes.

Physics staffing:

The staff list at Auckland Hospital indicates that there was some turnover of other physicists working with Owen Hames in radiotherapy physics, until Isla Nixon and Lee Dakers joined the staff. With major re-equipment for the new Oncology Department, and with extra Physics appointments and good facilities, it was possible to run the busy physics services (which were by now part of the Medical Physics & Clinical Engineering Dept) in a more co-ordinated manner. Lee moved to Dunedin in 1986, but Allun Stewart's appointment in 1987 supported the service during the commissioning, and subsequently. Owen retired in 1988; Isla was appointed as Principal Physicist, Oncology, and was rejoined by Lee who returned to Auckland in 1994.

Through the years, the physicists have been ably supported by conscientious physics technicians, especially Melanie Harris, Physics Technical Officer, who commenced work in 1978. Technical support was provided originally by Terry McQuillan who started in 1956; Gerhard Denissen in 1969; and Ian Sharp in 1987. This type of support is now provided by the mechanical and electronic staff of the Medical Physics & Clinical Engineering Dept.

THE FORMATION OF THE MEDICAL PHYSICS & CLINICAL ENGINEERING DEPARTMENT

As described later, Bruce White began work in the Hospital Laboratory in 1961, and moved into Nuclear Medicine in 1963. He was joined by Murray John in 1969. In 1974, Jon Henderson (an electronics engineer) was appointed to establish an Electronics Department. In 1979, a co-ordinated Department was established, bringing together Radiotherapy Physics, Nuclear Medicine Physics, Electronics, Computers, Anaesthetic Servicing, X-ray Servicing, and Mechanical Servicing, under the chairmanship of Bruce White. Fergus Thomson was appointed as CT/Ultrasound Physicist in 1979. In 1982, Murray John took over from Bruce as Manager, Medical Physics & Clinical Engineering. The formation of this Department is described in detail later.

HDJ and BW

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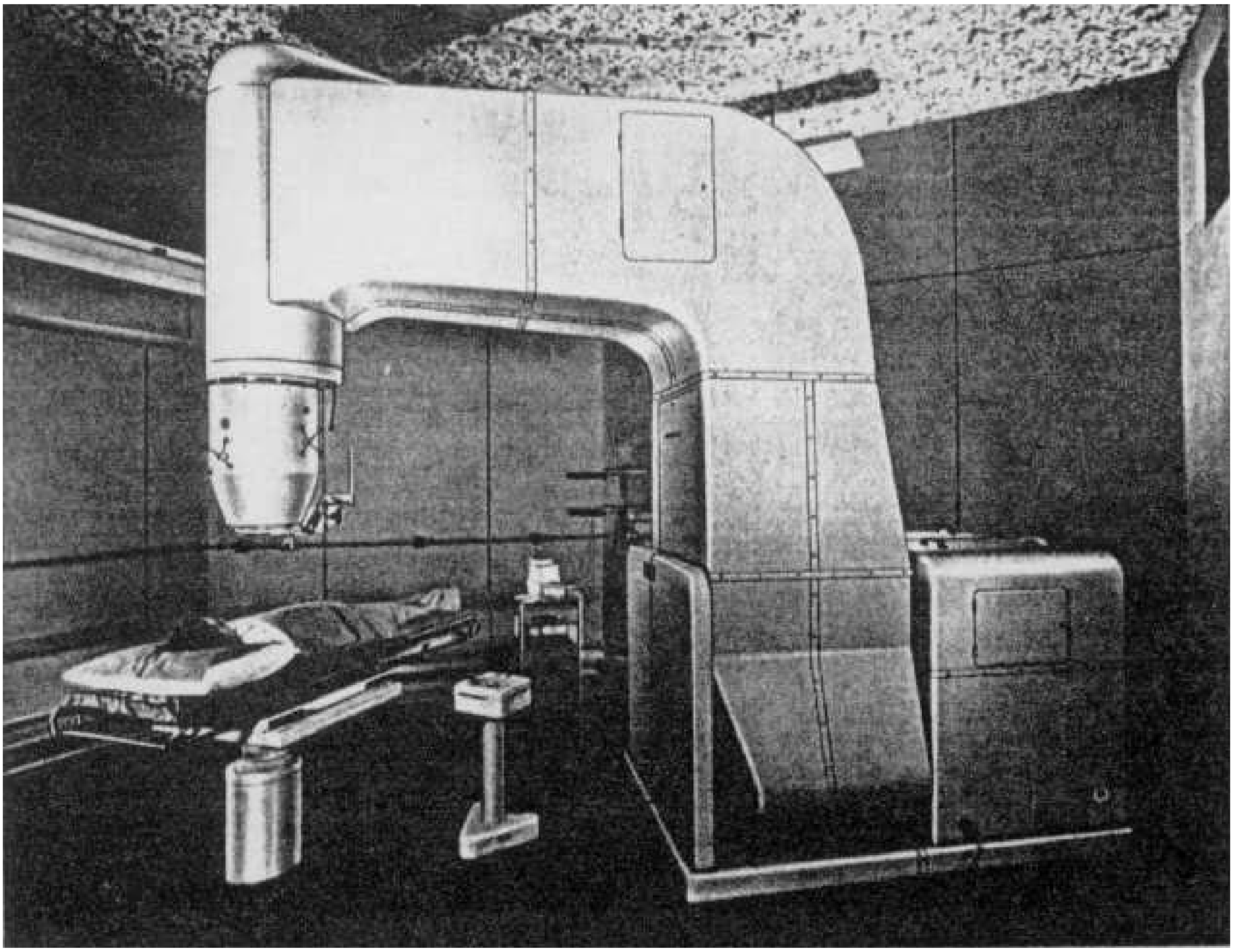

Metropolitan-Vickers 4MV Series-1 Linear accelerator, with 1 metre waveguide: identical to the Auckland Hospital unit, installed 1958

THE HISTORY OF NUCLEAR MEDICINE IN AUCKLAND 1961 - 1986

A personal overview by Bruce White

The early years:

I started at Auckland Hospital in February 1961, and was employed in the Biochemistry Section of the Pathology Laboratory, to perform blood volumes, red cell survivals, and Schilling tests.

Equipment consisted of an annular scintillation counter, and an Ekco scaler/timer with a single discriminator. The vitamin B12 for the Schilling tests came in ampoules for performing 5 tests; the powder was dissolved in distilled water, made into a drink, and given to the patient. Three days later, the test was repeated after stirring hog intrinsic factor (dessicated hog stomach) into the drink. I was performing these tests at the same time as "Dr Findlay's Case Book" was shown on TV, where the discovery had just been made that the cure for pernicious anaemia was eating raw liver sandwiches. When performing these tests, which involved a B12 injection, I would think how far medicine had progressed since those days. I also wondered why patients could not be given the bottle of hog intrinsic factor to sprinkle on their steak instead of receiving continuing vitamin B12 injections.

Working with Dr Royce Farrelly, we progressed to measuring fat absorption, and then to performing serum iron studies, iron turnover, and utilisation rates. Performing these studies gave the physicist a challenge in adding the dimension of time to laboratory studies. I would delight in working out micrograms per hour per kilogram of iron in the serum being utilised for haemoglobin synthesis, but I was not keen on homogenising faecal collects for counting. The apparatus used was a vitamizer plate fitted to the lid of the collecting tin, and the effect of some of the explosions was horrendous. It was a major break-through when a large sample counter consisting of 5 x 1 foot Geiger-Mueller tubes was discovered in the Radiotherapy Department. The statistics of counting was appalling, but I would ensure that I counted long enough to prevent the alternative of homogenisation. Red cell volumes and plasma volumes were also performed.

We also possessed a lead castle with a Geiger-Mueller tube for measuring beta emissions from solid precipitates, and this was used to measure sulphate space.

It was about this time that I observed Owen Hames (in Radiotherapy) throwing out a large Geiger-Mueller tube assembly of horseshoe shape, which was used to count the patient's neck during thyroid uptakes. A scintillation probe had been purchased, and this was connected to an old mechanical Ekco scaler. I used to think that performing a thyroid uptake using a Geiger-Mueller detector required a virtual therapy dose of I-131. The advent of scintillation counters with their much higher efficiency allowed the test to be performed with what could be regarded as a true tracer level of activity.

Red cell survivals:

Red cell survivals continued to be performed on a regular basis under the auspices of Dr Jock Staveley (now Sir Jack) and Dr Cyril Levine. Dr Staveley was head of the Blood Transfusion Service, and Cyril Levine was a haematologist who subsequently went to Israel.

The mathematics of calculating red cell survival using Cr-51 remains quite complex, and the particular equations used are dependent on the assumed age distribution of the labelled red cells. I was also dubious about the chromium elution factor, preferring a theory that older cells labelled preferentially. Some very interesting discussions and decisions were made as to whether the patient's own cells should be labelled, whether the blood should be taken before or after transfusion, or whether the red cells from the transfused blood should be labelled. Spleen counting at this time was performed in the Radiotherapy Department, using the hospital's only portable scintillation counter.

About licensees and colleagues:

I remember a rather traumatic experience one week after starting work, when Dr Ross Burton, radiotherapist and the sole licensee at Auckland Hospital, expressed his concern that I was doing all this work without his knowledge! This was quickly rectified by Dr Farrelly having a heated (?) discussion with Dr Burton, and subsequently obtaining his own licence.

Being among the first graduates employed in a Pathology Laboratory, I used to receive quite a hard time from my laboratory technologist colleagues, who enjoyed my ignorance of laboratory technology, and not a week would pass without them advising me of some terrible disease I must have contracted, as determined from blood samples I had generously given for normal controls. They also went to ingenious lengths to plant small standard radioactive sources in strategic places, and using a Geiger-Mueller monitor to confirm that I was doomed to a life of sterility. I formed long-lasting friendships with many of these technologists, who I now regard as some of my best friends.

Move to the Dept of Medicine:

After one year in the Laboratory, I transferred with Dr Farrelly when he joined the Department of Medicine, and was shortly involved with John Scott (now Sir John) in his beta-lipoprotein research work. This was absolutely fascinating. It would involve separating beta-lipoprotein from plasma, using the brand-new ultra-centrifuge, labelling with I-131 (later I-125), and measuring the rate of metabolism. People of my age never forget what they were doing when the news of President Kennedy's assassination came through. Well, that's where I was, lowering yet another sample of radioactive pig's aorta into the counter.

An Ekco dual channel scaler, with a well crystal, had been purchased on a research grant for this purpose. The improvement in counting efficiency with the well crystal as compared to the annular crystal was quite dramatic, and to have a dual-channel scaler - I thought I was at the leading edge of nuclear medicine technology!

Towards the end of 1962, Dr Peter Hurley, a medical registrar in the Dept of Medicine, also became involved in the beta-lipoprotein work with John Scott, and this could have initiated his interest in radioisotopes.

Work in other Auckland hospitals:

About this time, National Women's Hospital started I-131 Hippuran renal studies, using a dual probe system with dual Ekco ratemeters and chart recorders. They also purchased a Volumetron counter for measuring blood volumes directly. I was involved in keeping this equipment calibrated. I did some work with the National Women's people to determine how much I-131 crossed the placenta during blood volume studies on pregnant women.

I was also involved at Green Lane Hospital during isolated perfusion operations, where a limb (usually the leg) would be infused with a cancer treatment agent. Cr-51 labelled cells would be injected into the isolated circulation, and during the operation I was expected to comment on how much was leaking through into the main circulation. This was my first experience of an operating theatre, and I carried out these tests with some trepidation as I tried to manipulate my radiation counting equipment amongst surgeons' scalpels, blood pumps, etc.

Radio-isotope Unit, 1963:

Late in 1962, Dr Ibbertson returned from England to establish the Radioisotope Unit; I transferred from the Department of Medicine to this new unit in February 1963. I did so with some trepidation, as it was a complete change from a laboratory environment to a predominantly clinical environment However, the Diagnostic Laboratory's radionuclide tests were also transferred to the new Radioisotope Unit. In October 1963 I was appointed to the position of Physicist, Radioisotope Work.

Dr Ibbertson's speciality in endocrinology meant that the diagnosis and research into thyroid conditions became a major emphasis. Thyroid uptakes were transferred from Radiotherapy to the Radioisotope Unit. Our interests in in-vitro radioisotope tests started at this point with the development of an 'in-house' T3 resin uptake test, so that a correction could be applied to the protein-bound iodine; a test which had recently become available from the main Pathology Laboratory. Two full-time laboratory assistants were appointed to assist me, Miss Jackie Mortimer and Miss Shirley Frith. They subsequently became the first qualified Technical Assistants in Radioisotope Techniques in the country.

My employment in the Radioisotope Unit meant that bloods could be taken from patients for estimation of PBI-131. This measurement is an indication of the utilisation of iodine for the production of thyroxine. The I-131 procedures performed at this time were the 4- and 48-hour uptake, PBI-131, and thyroid scan. Before my arrival, Kaye Ibbertson's secretary, a warm-hearted but fiery Scottish lady used to dispense the thyroid I-131 doses from a milk jug. She must have been very accurate, as the 100% uptake level in patients was very consistent. One of my first innovations was to set up a repeating automatic dose dispenser, but she was never convinced of the need for such a scientific approach.

The thyroid scan was performed by Dr Ibbertson, when he returned from his Friday ward round, by holding a scintillation counter fitted with a pinhole collimator over the patient's neck, while I would call out the reading from the ratemeter dial.

Introduction of radioimmunoassay:

In August 1964, Mrs Susan Cameron, a laboratory technologist, was appointed to prepare for the return of Dr David Scott from America. Dr Scott was bringing back with him the new technique of radioimmunoassay (RIA), and Susan was purchasing chemicals, etc, so that work could commence immediately on his return. With some 'gentle persuasion' by Dr Ibbertson, supported by Owen Hames, Dr Burton agreed that a room on the top floor of the Supervoltage Unit (over the road from the Radioisotope Unit) could be converted to a Radioassay Laboratory.

On his return to NZ from England (after having spent some time with Drs Yallow and Berson in the USA, where the RIA technique was invented), Dr Scott established the first RIA at Auckland Hospital. The test performed was for growth hormone. This was late 1964 / early 1965. The separation technique was chromato-electrophoresis, where strips of buffer-impregnated paper were inserted into an electro-phoresis system which sat in a large refrigerated stainless steel tank. The antibody-antigen complex was applied at the origin, and after electrophoresis, the strips were dried, joined together with sellotape, ironed with a domestic iron (Mrs Cameron used the same technique as used on her husband's collars), and then passed through an automated Packard strip beta-counter fitted with a chart recorder and integrator. The ratio of the areas under the bound/free peaks were then converted to growth hormone levels. It was mysterious and magic, with the quality of the standard curve for each assay, whether it was 'flat' or 'hooked', depending perhaps on what one had had for breakfast! We used to talk about 'specific activities', 'antibody avidities', 'equilibrium constants', 'incubation times', but wishing all the time that we knew the real secret to success. As recently reminded by Janet Stacey, we finally decided that success was linked to phases of the moon.

Gradually Science began to come into radioassay, with an increasing knowledge of these factors such as 'specific activities', 'antibody avidity', etc. The next radioassay to be developed was a cortisol method using powdered Fullers Earth as the separating agent, and cortisol binding globulin as the binding agent. This solid phase separating agent was a major breakthrough; when applied to the growth hormone assay using powdered talc, it allowed the work and effort to be reduced significantly, with a great increase in precision. The strip counter and domestic iron became things of the past; the iron was returned to the owner with thanks!

The next method for development was the thyroxine assay. In 1969, Miss Margaret Evans joined the Department from the Steroid Laboratory, Green Lane Hospital; with her considerable assistance and attention to proper scientific methods, the growth hormone, cortisol, and thyroxine assays soon became routine procedures. There is a background story here - back in 1961, I met Margaret at Green Lane Hospital, where she was performing steroid measurements for Frank Sims, the pathologist. I was impressed by her then, and thought she was now the person we needed for radioassay developments. After discussing it with Kaye Ibbertson, I infiltrated Dr Sim's lab to inveigle Margaret to come and join us. After three visits, by which time Dr Sim's suspicions were very much aroused, Margaret decided in 1969 to take the plunge into the great unknown at Auckland Hospital. It only took me about two years to have the courage to face Dr Sim again!

The next two radioassays to be developed were the insulin method (assistance provided by Dr Stuart Ross), and in 1970, an ACTH method (undertaken under Margaret's supervision by Dr Ian Holdaway).

The 'Himalayan interlude':

In the period 1966-70, Dr Ibbertson was heavily involved in thyroid research involving the Sherpas in Nepal. After his first visit there, accompanied by Sir Edmund Hillary and Jack Tait, he brought back samples of blood and urine from the Sherpas, also buckwheat, goat's urine, etc, which involved many of us, especially Tom Lim, research scientist, in many hours of chromatography work, estimating MIT, DIT's, etc. Jack Tait, Kaye Ibbertson, and a train of Sherpas, also lugged a whole neck uptake counting system up the Himalayas. This consisted of many Ekco modules which were donated by WHO (or IAEA?). I recall being at Auckland Airport one time when the 'expedition' returned with hundreds of samples, and observing an irate official shaking his clipboard at Kaye and yelling "Someone's head is going to roll over this little lot!".

Continuing developments:

In 1969, Murray John joined me as the second physicist in radioisotope work, and it is because of his continuing great support that I have been able to survive. (Later, he moved with me as my first assistant to the newly established Medical Physics & Bioengineering Department.) Kaye quickly recognised Murray's ability with statistics. Neither Murray nor I had ever encountered some of Kaye's techniques for making results meaningful. Some of the correlation graphs showed wide standard deviations, but Kaye found a wonderful method to reduce this scatter....I still wonder about the legitimacy of all this; however we trust Kaye enough to add up the cricket score at departmental matches.

Also at this time, a major research interest was in the measurement of early thyroid clearances and uptakes, using Tc-99m (trapping) and I-131 (binding). The IDL scanner, and sections of the Autogamma counter were utilised, the clinic held, and then the Autogamma counter quickly reassembled to count the blood samples. All manner of clearances, uptakes, ratios of clearance/uptakes were initially calculated manually using a 2-memory Canon calculator - not an easy task. (People today who routinely expect computers to do such work are certainly well off!).

During 1971, the Radioisotope Unit was split into an Endocrine Section of the Department of Medicine, and the Auckland Hospital's Nuclear Medicine Department. The Endocrine Department was headed by Dr Ibbertson (now Professor), and Nuclear Medicine was to be headed by Dr Peter Hurley, on his return in December 1971 from Johns Hopkins Hospital in the USA.

Rectilinear scanning (early days):

In 1964, I visited the Medical Physics Dept at Christchurch Hospital, and was extremely impressed with the radioisotope scanner that had been designed and developed by Jack Tait. The amusing point about the machine was that the mechanism for moving the scintillation probe was driven by an egg beater motor, and the correct settings for performing scans was either 'mashed potatoes' or 'scrambled egg'. Nevertheless, it was far superior to our 'hand-held' scanning method in Auckland.

In 1965, the Postgraduate Medical Committee of the University of Auckland conducted a 5-day course in radioisotopes, mainly organised by Dr Ibbertson and me; this was attended by people throughout the country who were involved in radionuclide work. It was regarded by those attending as a great success. The guest speakers were Professor James McRae, from Sydney University / Nuclear Medicine Dept, Royal Prince Alfred Hospital (ie, RPAH); Dr H Kronenberg, Haematologist, RPAH; and Dr C Nordin, Mineral Metabolism Research Unit, Leeds. My long-continued friendship with the McRae family started at this time.

The IDL scanner and its use:

This course coincided with a major step for nuclear medicine scanning in Auckland, with the arrival of an IDL dual probe isotope scanner. This had a moving patient bed (the probes remaining stationary), with servo-motors coupled to a colour ribbon printout - the colour of the ribbon was related to the count-rate. This system had been developed by Prof John Mallard in England. Thyroid counting now became a pleasure to perform.

The next scans to be introduced were liver scans, using colloidal Au-198. With the given dose restricted to 200 uCi, the statistics were poor, and many patients were diagnosed as having cirrhosis when the results obtained were probably due to statistical 'flutter'. In fact, I remember on one occasion scanning a liver-shaped tank of water containing 200 uCi Au-198, and the physician reading the scan thought the 'patient' probably had cirrhosis!

The next scans introduced were bone scans using Sr-85, but once again statistics proved a problem, and quite often it was difficult to determine where the spine was, let alone any tumour within the spine. This improved markedly with the introduction of Sr-87m.

The order in which scans were introduced was very dependent on physician interest. Naturally, thyroid was the first, and then it was Dr Gordon Nicholson who was keen to perform liver scans, and Dr Noel Dowsett (radiotherapist) provided the incentive to press ahead with bone scanning.

Australian visit, 1966:

In 1966, I attended a course for graduates at the Australian School of Nuclear Technology. After that course, I visited Jim McRae and John Morris at the RPAH, and was impressed with their dual positron detection isotope scanner for performing radioactive arsenic brain scans. I spent several nights and weekends at RPAH, going through old scans, and producing polaroid pictures of them along with copying the reports which accompanied each scan. This was all subsequently mounted in a ring binder of scans, which I still have, and which became a reference at that time for various physicians when reporting scans.

I also spent several days with Dr Kronenberg, Haematologist at RPAH. He was extremely kind and helpful, and I picked up many valuable clues about the radioassay of vitamin B12. His wife was a GP, and I spent a fascinating Saturday morning with her while she did her rounds in the poorer suburbs of Sydney. She was also the editor for a regular poetry publication in Australia, and I became intrigued with her ability in writing poems. The Kronenbergs hosted me for one weekend at their fabulous beach home on the shores of Bulgola Beach, north of Sydney.

Another valuable contact I made then was with John Morris; both John and his wife were very hospitable and kind. He was particularly helpful in arranging for me to meet one of his 'contacts', which I recall was in the wharf area of Sydney. The purpose of this mission was to obtain cheap 'Koala' bears, which was obviously successful as I arrived home from Sydney with a large suitcase full of these stuffed toys for dispensing to various nephews and nieces. This 1966 visit to Australia was extremely successful, and the friendliness and help accorded to me at that time is appreciated to this day.

Major advances in 1967:

In 1967, there were two major advances in radioisotope methodology within our Department:
(a) I-125, with its longer half-life, became available (in 1966) for radioassay work;
(b) Tc-99m became available (in 1967) for scanning.

The first Tc-99m brain scan was performed in the presence of Jim McRae from Sydney, who was visiting Auckland at the time. We were astounded at the increase in count-rate over previous agents; the ratemeter banging to full scale, and therefore could be 'turned up' two notches. The other marked difference was that the time constant could be reduced from 5 secs to 0.2 sec, and the scalloping effect at the edge of scans obviated. I was hesitant about turning the time constant so low, as the ribbon servomotor drive mechanism for the printout ribbon went crazy, but Jim McRae was reassuring and he was proved correct in that the machine held together for several years. My feelings at this time were that the advent of Tc-99m had turned 'unclear' medicine into 'nuclear' medicine.

If I remember correctly, the first supplier of our technetium 'generators' was Amersham, UK; then we switched to Lucas Heights, and then Duphar. The original Mo-99/Tc-99m generators were 'glorified' test-tubes; a far cry from the sophisticated units of today.

Brain scanning 'took off' with the advent of Tc-99m, and we consequently advertised for a senior technician "with radiography experience" to perform scans. In 1968, a second scanner was purchased, a Picker Magnascanner, with a photo-dot output, which for the first time presented scans in a format familiar to radiologists and radiographers. Its other major advantage was the ability to set a contrast level, so that the film density range could be optimised across the radioisotope count range. This improved both brain and bone scanning. The radiologist, who for some time had been interpreting brain scans presented in colour printout on paper, on being handed his first photo-dot image exclaimed "Thank God! I haven't told you before this, but I'm actually colour blind!" as he slipped it into the viewing box.

The above separate developments in the laboratory and scanning areas would indicate that Auckland, from the very inception of nuclear medicine, was regarding it as two separate specialties. Today, the Scanning Section is part of the Organ Imaging Services, and the

Radioisotope Laboratory is part of Pathology Services. I remember a visit from Dr Les Dugdale (1968?), a radiologist from Melbourne, who had come over to discuss with Dr Ibbertson whether Nuclear Medicine was better allied to the College of Physicians or the College of Radiologists. This was of no direct concern to me, but 20 years later (1988), I'm still not sure if this issue has been resolved satisfactorily!

George Roth (Director, NRL):

I regarded George with some awe. He always seemed to me to take a great interest in one personally, and the work one was doing. During an NZMPA conference in Christchurch (1962 or '63?) I remember a very hospitable evening at his home in the Cashmere Hills, with a view overlooking the city's sparkling lights. I recall his fantastic slide collection, all in cassettes, neatly catalogued, and on shelves on one side of his library. They were predominantly of photographs taken on the Continent. I wonder where they are now.

My other main contact with him was during the visit of Dr Gomez-Crespo, a member of an IAEA specialist thyroid committee. Dr Gomez-Crespo was travelling the world with a suitcase containing a mannequin with a removable thyroid. Hot and cold nodules, as well as diffusely radioactive glands, could be fitted, and he would pronounce how well a department met the world thyroid uptake standard. George accompanied him through NZ.

George Roth through his involvement with WHO, also arranged for a Thai nuclear medicine student to visit Christchurch and Auckland during 1966 and '67. I still correspond regularly with Somlak Kositthan 21 years later. Her visit was so successful it was followed by another in 1970. This was by Dr Wanida Guratava and Miss Malulee Premyodin. Exposure to a little of the Thai way of doing things was quite educational for me. Their education while in Auckland was enhanced by regular visits to the movies. Wanida and Malulee so enjoyed the film "Paint your Wagon" that they went 16 times! When asked what fascinated them so much, after a lot of mirth they admitted it was Lee Marvin's deep voice singing "I was born under a wandering star". I think George Roth's initiative in arranging such visits from Thai students, and Jack Tait and family's later sojourn in Bangkok, was to be admired.

Other highlights and features of my early career:

A major one was the design and implementation (along with Maurice Young, radioassay senior technician, and Wayne Deeming, the Board's computer programmer) of a comprehensive computer system for handlng the radioassay workload. This system registered all patients, produced results, performed the curve fitting (using Rodbards 4-parameter equation) and listed errors - tests not performed, wrong test performed, etc. It was introduced in 1974 and proved a great success. Much of the work done then still forms the basis of the existing programme.

Dr Peter Hurley's arrival and subsequent installation as head of Nuclear Medicine in 1972 was important. I remember too the events leading up to his tragic death in 1983.

I much enjoyed my 1972 visit to the USA, where I spent a month working with Jim McRae and Hal Anger at the Donner Laboratory, University of California, Berkeley. This was predominantly on Hal Anger's tomographic scanning device. I was honoured with a key to the laboratory and would snoop around out-of-hours, like a spy, investigating all the interesting equipment in various stages of development. Some of the plans for phantoms were sent home, and Murray John had them made up. They were in use in Auckland even before appearing on the American market!

I was amazed when visiting the Nuclear Chicago factory while in the US to see a production line of gamma cameras, one even destined for Auckland. (The first gamma camera arrived in Auckland in 1972). This was the third in the country, following Christchurch and Dunedin.

I visited Subramanian (radiochemist) and McAfee (senior radiologist) in Syracuse during my 1972 visit, and ended up in Intensive Care for one week, following a bleed from a stomach ulcer. A more intimate experience of American hospitals than I desired! Subramanian was working at the time on diphosphonate bone scanning agents, another major nuclear medicine breakthrough.

After recovering from my illness I went to Boston for several weeks and attended, and passed, a course in Nuclear Medicine conducted by the Massachusetts Institute of Technology (MIT).

In 1971, Murray John and I were asked by the Medical Superintendent to conduct a review of all clinical equipment requested for commissioning the new main Auckland Hospital Block. This review involved us in some painstaking and demanding work, taking long hours. However, it resulted in savings of over $1M, and was the start of a new career in equipment management. From 1979, I became the head of the new Medical Physics & Bioengineering Department of 45 staff, but nevertheless maintained an interest and a responsibility in the Nuclear Medicine Department.

The Nuclear Medicine Dept currently (1988) performs 500 scans per month, and the Radioassay Lab produces 4,800 patient results per month.

Bruce White

Auckland staff photo - Nuclear Medicine Department, 1972
Dr Peter Hurley (centre), to his left Bruce White, Murray John.

Auckland staff photo - Department of Medical Physics & Clinical Engineering.

AUCKLAND HOSPITAL: THE ESTABLISHMENT AND OPERATION OF AN AUTONOMOUS DEPARTMENT OF MEDICAL PHYSICS & CLINICAL ENGINEERING 1979-88

A personal overview by Bruce White

This write-up details the effort required over a period of twenty years in establishing and sustaining an integrated Department, which initially included 43 people (25% physics or engineering graduates; 70% technical staff), each with their own aims and aspirations. Those whose hospital careers have been of a predominantly scientific nature may regard administration as boring. I have found management to be interesting and productive. Nevertheless, I will always regard the early years of my career in establishing Nuclear Medicine (ably assisted by Murray John) and the Diagnostic Radioassay Service as the most exciting and satisfying.

The impetus for the establishment of a combined Medical Physics & Bioengineering Dept was the increasing scientific and technical requirements associated with the commissioning of the new Auckland Hospital Block in 1972. At the time, this new Hospital Block had the largest floor area of any building in NZ, and its commissioning was to be a colossal task. A multitude of requests for monitoring, measurement, and treatment equipment had been received by the administration, as well as requests for maintenance facilities. As was usual, budgets had been well exceeded.

Auckland Hospital benefitted from a far-sighted Medical Superintendent (Dr Alec Warren), who realised he needed independent input on the value of requests for medical equipment. Looking around his resources at the time, he decided that physicists had a background and knowledge that could assist in decisions about advanced technology equipment. Murray John and I were given the 'onerous task' of reviewing all the equipment requirements with an associated brief to try and reduce the total cost.

This was a learning experience for two physicists who had to rapidly become familiar with many aspects of the clinical services, how various parts inter-related, and the function of equipment. It also helped to establish strong liaisons with the medical staff, which proved invaluable later in gaining support for the establishment of our new Department.

This review was duly completed, resulting in savings of about $1M, mainly through reducing duplication, rationalisation of computer requests, and proposing centralisation of equipment servicing and developments.

The Medical Supt next established a Joint Technical Development & Services Committee, consisting of key medical people, and key scientific and technical people, chaired by the Superintendent. I have copies of several submissions (dated 1972 and 1973) written to this Committee by senior medical staff, proposing the establishment of an autonomous Medical Physics & Bioengineering Department.

The Committee eventually recommended that such an autonomous Department be established, and in response to the submissions, that it be under the Medical Supt (through the Committee) rather than under the Hospital Engineers. It also recommended that an Electronics Engineer should be appointed to head the Electronics Section. This led to the appointment of Dr Jon Henderson in 1975, who with his special abilities in the bioengineering field quickly contributed to the strengthening of the service. As a registered professional engineer, Jon's appointment overcame many of the perceived problems that the Hospital Engineers had with the proposed Department with physicists as the only professional staff.

Like many hospitals at that time, several Auckland Hospital clinical departments had their own physics and/or technical sections. These units functioned independently, and it was obvious that there was

1 Duplication of effort and equipment;
2 Poor utilisation of staff expertise;
3 Lack of uniformity in practice and standards;
4 Lack of continuity caused by staff resignations;
5 Unsatisfactory career structures.

Although the Medical Electronics Unit had been established with Jon Henderson and two technicians to provide a totally integrated service as a first step, it was soon obvious that these independent units in clinical departments needed to agree to transfer the aspect of their work involving electronics into the new Medical Electronics Unit. Equipment maintenance staff at the time were employed in Radiotherapy; Nuclear Medicine; Radiology (under the hospital engineers); Neurophysiology; Critical Care; and Renal Dialysis. There was also a large Anaesthetic equipment servicing workshop.

The question of integrating the physicists into the expanded new Department also had to be considered. Since 1972, the autonomous Nuclear Medicine Department had been functioning independently of its historical connection with the Endocrine Dept. The latter was headed by Prof Kaye Ibbertson, who was a key physician in hospital decision making at that time. He proposed the appointment of a Nuclear Medicine Physician, and that post was eventually taken up by Dr Peter Hurley, who returned from Johns Hopkins Hospital in Baltimore. After Peter's unfortunate and premature death just a few years later, this post was taken up by Dr Michael Rutland from England.

The appointment of nuclear medicine physicians (who were expert in that technology, use of computers, etc) significantly reduced the input required from physicists, to one predominantly of quality control and radiation safety. This important aspect was provided by Murray John. The physics requirements in Radiotherapy continued and became greater with the advent of simulators, planning computers, and more powerful and versatile treatment machines. Constant electronics and physics technical input were also required to keep the linear accelerators operational. This team continued to be headed by Owen Hames. The Radioassay Service was expanded rapidly beyond the various thyroid blood tests into other hormone and vitamin tests; with my Path Lab background, I gave emphasis to this aspect. Staff expanded rapidly in the radioassay section as in-house immunology procedures and computer technology advanced.

Ongoing Nuclear Medicine battles:

Two ongoing battles characterised nuclear medicine at the time -
1 Should Nuclear Medicine (Scanning; Radiodiagnostic Haematology; Radioassay) be regarded as a speciality on its own, or should it be broken up into Radiology (Scanning) and Pathology (Radioassay)? Advocates of the former idea were Nuclear Medicine Physicians and the Society of Nuclear Medicine; the Society strongly promoting the now defunct course at the CIT for Nuclear Medicine technicians.

2 Should radiologists or physicians interpret scans (the radiologists identified strongly with the X-ray film 'PhoDot' images now being produced by radioisotope scanners)? And should pathologists be interpreting the biochemical levels produced by radioassay technology?

To some extent, these battles continue to a greater or lesser degree in a number of NZ hospitals, and working solutions differ in various parts of the country.

As Senior Physicist in Nuclear Medicine, I thought the future at Auckland Hospital was one of specialisation, and developed the scanning and radioassay aspects separately, employing radiographers to perform the scanning, and laboratory technologists and technicians to perform radioassays. This approach was not followed at all NZ hospitals, but at Auckland it has meant that radioassay is now part of the Laboratory Service, and 'scintigraphy' is part of Radiology.

As specialist staff were trained, the need for physicists in nuclear medicine became less, and this allowed me, as secretary of the Joint Technical Development & Services Committee (JTDSC), to devote more time to developing the combined Medical Physics & Bioengineering Dept. Murray John maintained the in-vivo radioisotope requirements and safety aspects of radionuclide usage in the hospitals and Medical School, whereas I acted in a consulting capacity on radioassay techniques, and was a full member of the Committee of Pathologists. Dr Hurley went along with this split role for his senior physicist.

Working towards the Medical Physics & Bioengineering Dept:

So that this integrated Department could be established, it was necessary to give considerable reassurance to clinical staff, that where their physicist/s and technician/s were to be administratively (and sometimes physically) removed from them, the service they would receive from a new combined Department would at least continue at the same level, and hopefully would be better. It was a big 'ask' of them, because the staff would no longer be 'theirs' to control. This integration could have been achieved by a Medical Superintendent decree, but we preferred to do it by negotiation and persuasion with the prospect of longer-term stability. It was achieved in the Oncology/Radiotherapy area by my establishing a contract between the Professor of Oncology and our new combined Department, covering the services to be provided. Contracts between departments are now fairly commonplace, but this one was a trail blazer.

The new combined Department established!:

In 1978, the Medical Superintendent advised all medical staff that after receiving support from the Hospital Medical Committee, and discussing the concept with "two recent distinguished visitors to New Zealand" (Dr D W Hill from London, and Prof Harold Johns from Toronto - both these visits under the auspices of the ACPSEM), he would formally constitute the Department of Medical Physics & Bioengineering on Jan 1 1979. In mid-1979, the Hospital Board gave formal advice of its approval of the concept, and of the transfer of physics and technical staff from about seven clinical departments to the new Department. What a major achievement! There could be no backward slippage from this point.

I remain appreciative to this day of the 100% support from Jon Henderson, Owen Hames, and Murray John, during this long gestation period. The ongoing support provided to the concept by Medical Superintendents was essential. The Hospital Commissioning Officer at that time also supported the concept, and this was useful in making sure that Board Administration were also 'on side'.

Administration of the new Department:

The new department was administered by a 'Coordinating Committee' - Bruce White, Owen Hames, Jon Henderson, and Terry McQuillan. (Terry was the Senior Technical Officer in the anaesthetic servicing area, and ex-physics technician for Owen Hames.) The Committee was later joined by Murray John. The Department had several sections at that time - Electronics; Oncology Physics; Special Mechanical Services; Organ Imaging/Nuclear Medicine; Dedicated Computers. There were 20 technical staff; 8 graduate staff; and one secretary. Bruce White as Chairman was responsible to the Medical Superintendent. I was elected to this post 'for the first term', which subsequently lasted twelve years.

With the advent of Area Health Boards later, I became the Manager of the Service. For a short time, this became Area Manager, Clinical Engineering, a post that disappeared with the still later establishment of CHE's.

Unfortunately, it never proved possible to physically bring the whole Department together into one location. The Electronics Section was initially housed in the basement of the (then) Medical Centre, which would flood during heavy rain (photographic evidence was obtained to convince management of this unsatisfactory state of affairs). Both the Mechanical Workshop and Administration were located in the large basement area under the X-ray Department in juxtaposition with other interesting sections such as the Pathology Museum (for a bit of light relief during breaks).

The old Nurses' Home became vacant when a new multi-storey one went up, and the Electronics, Computer, Physics QA, and Administration were moved to one wing of this building. This allowed Murray John to move from Nuclear Medicine to become my able assistant. Murray retained his involvement and influence in Radioisotope Safety in the Hospitals and Medical School.

The Special Mechanical Services expanded into the old Mortuary building after a suitable service by the Hospital Chaplains and Hospital Maori Whanau. The Order of Service instructs: "..The chaplain removes his black scarf, symbolising the removal from this building of its old association with death, and puts on a white stole symbolising the building's resurrection to the new purpose of healing and life."

Although work was centralised as much as possible into the two workshops, it still made sense to have dedicated areas in Clinical Departments (as satellite workshops and offices) where the workload warranted. This philosophy continues today with separate workshops in Critical Care, Medicine, Renal Dialysis, and a Physics suite in the new Oncology Block.

Medical Physicists v Hospital Engineers:

One of the early battles (1977) that had to be fought and resolved was the role that Hospital Engineers were to play in the clinical technology area. This important question was not unique to Auckland. It seemed to exist in any hospital where there were medical physicists. There was also the vexed question of union membership (eg Electrical Workers' Union). This conflict between Hospital Engineers and Medical Physicists reached Health Dept level, and resulted in several excellent reports on the role of Medical Physics Departments in NZ, prepared by the Senior Physicists from all centres at the time. (Note: In the event, the Health Dept finally declined adopting a policy on the matter, after consulting Hospital Boards affected).

As mentioned previously, at Auckland this conflict was largely dissipated by the appointment of Jon Henderson, a registered engineer and PhD. However, the area of X-ray servicing remained a festering sore. Although the Chief Engineer had no daily input into X-ray servicing, he still insisted that it remain under his control, whereas the Professor of Radiology supported the proposal that it should become a part of Medical Electronics within the

Medical Physics & Biomedical Engineering Dept. The X-ray servicing staff themselves also wished to make this change. The Board set up a working party consisting of the Medical Supt-in-Chief, Deputy Chief Executive, and Dr Toby Whitlock (of Green Lane Hospital) to resolve this issue. In July 1980, this working party produced a report which is as relevant today as it was then. It resulted in the transfer of the X-ray servicing staff to Medical Electronics; it commented on the support this change would give from people with "different but complementary skills", assist the X-ray servicing staff in developing their professional skills, and keep up with changing technology, and assist in the introduction of a surveillance/monitoring service of X-ray equipment by physicists, an "overdue necessity". This report strengthened the role of the new Department considerably.

Although the physicists and physics technicians had been providing a Quality Control service to Radiotherapy and Nuclear Medicine (counters and gamma cameras), and monitoring areas using radioisotopes for some time, the above report opened the way for regular monitoring of X-ray and ultrasound equipment. This service was established, test equipment developed or purchased, and the task given to Stephen Strother (later followed by Chris Newcombe) to implement it, with the assistance of two physics technicians. Our Department was ultimately monitoring X-ray equipment at all the Board's hospitals on a regular basis, and was providing useful feedback to Radiology Departments. It also provided predictive information to the X-ray Servicing Section. The results were always shown to NRL physicists during their visits, and interesting comparisons were made with their own measurements. However, some opposition to our regular monitoring began to surface, particularly from a few of the senior radiographers, who seemed to regard our involvement as an intrusion into their area, or profession. I eventually decided to cease our regular monitoring. These radiographers preferred a situation where they would call on our Physics Section for measurements to be made when they suspected that something was wrong, rather than accepting regular monitoring by an external department. And so a proactive approach once again became reactive, which I still regret. It did have positive spin-offs however. A monthly meeting was regularly held to discuss X-ray technical matters between me (as Chairman of our Dept), relevant Physics staff, Clinical Engineer, X-ray Servicing staff, and the Board's Charge Radiographer. Senior Radiologists would also occasionally attend.

This exercise also gave an excellent grounding in imaging physics to the two previously mentioned physicists (their talents were subsequently lost to the country). Stephen Strother became a world expert in PET scanning, and is now located in Wisconsin; Chris Newcombe is now a Senior Physicist, and Professor, at the Ontario Cancer Institute).

Grading - 'Scientific Work' v 'Research':

One conflict that had to be addressed was that of the effort and time that could be devoted to 'research' versus 'servicing'. The national grading position of Hospital Physicists (later redesignated Hospital Scientific Officers, to include all professional scientists eg biochemists) was determined significantly by their research ability, and yet the Staffing Dept of the Hospital Board was insistent that scientists existed in the hospital service to enhance techniques that could be of direct benefit to the patient. Research aimed solely at enhancing the reputation, aspirations, or educational qualifications of the individual was discouraged by the Board. Scientists with these leanings "should either join the DSIR or University", I was often told. This was a matter of continual disagreement between the Board Staffing and our own Department's administration.

A similar but less acute situation existed for technical staff. Their merit grading was determined by their performance and 'potential' in the job they were performing. However, internal friction could develop if an individual technician was tasked with a development project, whereas a colleague was directed solely at maintenance, and was liable for 'on-call' duties etc. Developmental work was always regarded as more interesting.

Resolution of the problem:

After consultation with several Government Departments, I decided that a figure of 30% of the average work effort for our Department as a whole could be spent on research / development. This was agreed to by the Medical Supt, and reluctantly accepted by Board officers as a compromise between some, and none. These projects could be initiated by the staff themselves, or by requests from clinical departments. Requests would be approved by the Co-ordinating Committee, and progress reports monitored. This also overcame the problem of direct requests from doctors to technicians for involvement in long projects, which committed the Department's resources on an unfair basis.

Over 200 varied projects were undertaken using this approval procedure. Examples of some were: automated electrical safety testers were developed (and later marketed); digital computer link between hospitals for medical record transmission; paediatric respiratory tract monitor; handicapped communication aid; gait rehabilitation efficacy device; eyelid movement detector; CT image transfer between hospitals; X-ray trigger for infant breathing abnormalities; X-ray tube heating simulator; defibrillator tester; dialysis reverse osmosis monitor; beam flatness tester; urodynamics flow monitor, computer, and display; carpark computer for security; etc etc.

Monthly staff meetings:

Owen Hames instituted and chaired monthly meetings of all Departmental staff, where our own staff would talk about their particular interests and progress on a topic. At these meetings, we would sometimes be addressed by clinicians, Board administrators, or outside experts in some specialist field. In addition, scientists in the Department would also meet separately once a month; after administrative matters had been coped with, each took a turn to make a scientific presentation on their work. Jon Henderson also convened monthly meetings of the (by now) large Electronics Section for lectures on equipment function and safety.

Technical staff retention:

In 1984, a problem which had been developing for some time became very evident. Our Department was unable to retain its trained engineering technicians who, after qualifying, were leaving in droves to take up employment in the expanding private medical equipment industry. This constant 'creaming off' of trained technicians was threatening the viability of the service we provided. Many agencies of overseas suppliers were being established, usually with headquarters in Auckland. Our Department was losing up to 10% of its staff per annum. Most staff on leaving us would have a salary improvement of up to $8000 pa, with a company car provided. These ex-Department technicians, when visiting their previous colleagues, would cause considerable strife when enticing them with the better conditions in the outside sector.

We seemed to be hamstrung in improving hospital conditions because of the strange effects of the nationwide merit system in deciding salaries. In theory, the system seemed fair, especially for the older long-term staff, but in practice, with the operation of the percentage constraints within grades, many of the younger promising technical staff were not adequately rewarded. It became obvious to me that hospital technicians were even more compromised than similar technical staff in the rest of the public service. This was confirmed when I visited Wallace Armstrong (formerly Senior Physicist at Wellington Hospital) and met senior technical staff in the NZ Meteorological Service. After a long battle (3 years!) the Public Service scale PS225 was introduced into the hospital service. These moves were largely opposed by the Technicians Union, mainly on the grounds that engineering technicians would get a better deal than physiology technicians, although this opposition turned to support when the marked improvements across the board became obvious.

Health Service Personnel Commission (HSPC):

In 1986, the cold winds of change were stirring! Great changes in the State Sector Act were initiated, and subsequently a Health Service Personnel Commission (HSPC) came into being. It was no longer adequate to present cases based on the self-promotion of one's services, or oneself, and expect them to be accepted by these 'higher authorities' even when such cases were supported by Medical

Superintendents, Chief Executives, etc. There were hints of the 'commercial model and new management structures' being introduced into the Health Service.

Use of outside consultants, 1986:

I thought it was time to 'fight fire with fire', and requested the Chief Executive that we be funded to employ outside consultants (who were then the 'in thing') to do a review of the whole Medical Physics & Clinical Engineering Department (updated name); its structure, service provided, costs and salaries, etc. This was a considerable gamble, and many staff had reservations about the wisdom of such action. However, I was supported by Owen Hames, Jon Henderson, and Murray John in this action. The review took several months, and was carried out by PA Management Consultants; their report was presented to the Hospital Board in November 1986.

The conclusion of the consultants provided further guidelines for the development of our Department in pushing ahead with information systems; service agreements with our users; responsibility for all medical maintenance within the Board whether performed by our Department or by outside contractors; a greater involvement of the Department in the purchase of new medical equipment. Looking back now, many of their recommendations have been implemented.

I chose these particular consultants because of their accepted role in the private sector for wage fixing. On this matter, they concluded "..The Department has lost electronics staff to the private sector for increased remuneration packages, and has been unable to attract qualified and experienced staff because the salary offered is too low." They recommended that the national merit list be discontinued, and that engineering technicians' individual grading be established by comparison with the rest of the public service. They also drew up an organisational chart for our Department, with salaries prescribed to the different organisational and responsibility levels that were based on private sector remunerations. This information prepared by unbiassed independent consultants was to prove extremely useful in the future. Interestingly, they also stated that the work of the Department was extremely valuable in that the competition we provided kept the private sector "honest".

The successful outcome for technicians:

After many meetings between Jon Henderson and myself, and representatives of the HSPC, making very slow progress at improving the situation for technicians' salaries, I eventually exceeded the tolerance level of our Area Health Board's Personnel Manager. She telephoned to advise me that I was to get ready to meet the State Services Commission, as next day we would be flying to Wellington. On the plane trip down, I kept her baby under control while she read the files; at the meeting with the State Services representatives, to my surprise, all our proposals were accepted! This meeting led to a new scale for Engineering Technicians (HS58) being introduced into the Health Service, and subsequently substantial pay increases for our technicians, based on the organisational chart prepared earlier by the consultants. The stress of the consultants' review and all the background work had paid off at long last! This improvement was quickly activated throughout the country, and at Auckland produced a stable staffing situation for many years.

There is now far greater freedom in wage fixing. Salaries are now based on performance and productivity - it could be difficult for individual General Managers to directly assess this in the scientific and technical areas, when their past experience has been restricted to administration. I know that departmental managers will do their best for their staff, but the financial squeeze and debt burdens some CHE's carry cannot help but influence General Managers' decisions about pay increases to occupational groups who perform duties of which they have no direct knowledge. Administrative managerial staff will probably find it easier to obtain acceptance for increases based on their own productivity.

'Computerised management systems' - ERIS:

By the late 1980's, hospital managers were starting to question how work effort was being spent. In addition, for service departments such as our own, there was increasing emphasis on the 'on-charging' of services. Considerable full-time effort was therefore devoted to developing a computer system, which would, in addition to keeping records of equipment, keep details of work performed by staff. There was initial resistance by some staff who could not accept the need to document their work effort. However, without such accountability, management could not be expected to provide funds for our Department's operation. The computer system ERIS (Equipment Registration & Information System) that was eventually developed, along with the implementation of coded work sheets; recording of quality assurance tests performed; lectures given; etc, resulted in the Dept being ahead of its time in producing pro-forma invoices that could be sent to our 'customers'. The Asset Register module of ERIS subsequently became the Asset Register for the CHE, and now has financial information added. Additional maintenance information is also supplied by outside contractors for inputting. It is said that " information is power ", and from small beginnings, ERIS has become a powerful information tool in providing replacement programmes for capital purchases; costs of maintenance on all equipment; producing monthly invoices; etc. Although it is now networked throughout the CHE, its control remains with the Medical Physics & Clinical Engineering Department.

AUCKLAND HOSPITAL STAFF LIST:

Physicists and Engineers:

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O S Hames  (Owen)    Jan 1952 - Jun 1988 (retired)
J Wright   (John)    ... 1955 - ... 1960 (from UK; to UK)
B McL White (Bruce)  Feb 1961 - Dec 1992
                         (to Asset Management; retired Nov 1994)
J Hawk     (John)    ... 1963 - ... 1965 (now leading UK
                                              dermatologist)
Fong Chen Khen       Feb 1965 - Jan 1968 (to Auck Tech Inst)
M Kennedy  (Malcolm) Apr 1966 - Feb 1970
R Burgess  (Richard) ... 1968 - ... 1970 (to Neurophysiology)
V Marsden  (Vera)    Feb 1968 - ... 1968 (to Waikato Hosp)
M B John   (Murray)  Mar 1969 - present  (1995)(now Manager,
                                Med Physics & Clin Eng Dept)
R Roberts (Rosemary) ... 1972 - ... 1973
J D Henderson (Jon)  Sep 1974 - Dec 1990 (graduate engineer;
                         to Physics Dept, Waikato University)
A H Beddoe (Alun)    ... 1976 - Jan 1981 (from Chch; to Auck
              Med School in vivo neutron activn; to DPH 1985)
N Livick   (Noel)    ... 1978 - Jan 1981 (to Pte Software Co)
I M Nixon  (Isla)    Jun 1978 - Nov 1980 (then overseas)
                 and Jun 1985 - present  (1995)
F J Thomson (Fergus) May 1979 - present  (1995)(from Dunedin,
                     and Auckland Univ School of Engineering)
S Strother (Stephen) ... 1979 - ... 1982 (to Montreal; now
                                 Wisconsin; PET world expert)
P Litchfield (Paul)  ... 1979 - Mar 1985 (to NZ Steel
                                            Computer Section)
D Williams (David)   ... 1980 - ... 1983 (from/to England)
L Dakers   (Lee)     ... 1981 - Jul 1986 (moved to Dunedin)
                    and Jan 1994 - present  (1995)
C Eccles   (Craig)   ... 1981 - ... 1982 (returned to Massey)
C Newcombe (Chris)   Feb 1983 - Jul 1985 (to Princess
                                  Margaret Hospital, Toronto)
D Blomfield (Douglas)May 1983 - present  (1995)(graduate
                                        engineer, electronics)
M Driesbock (Mary)   May 1986 - May 1987 (from USA; retired
                                                 to Kerikeri)
J Turner   (John)    Feb 1987 - Mar 1989 (from UK; to Chch)
S Duck     (Stephen) Sep 1987 - Apr 1989 (to Royal Marsden;
                        then to Clatterbridge Hosp, Liverpool)
B Lunt     (Brian)   Oct 1987 - present (1995)(Otago MSc
                                            (Medical Physics)
A Stewart  (Allan)   Oct 1987 - present (1995)(from Zimbabwe/
                                                Saudi Arabia)
J Hayward  (John)    ... 1989 - ... 1990 (to Christchurch)
C Lewis    (Craig)   ... 1991 - ... 1994 (from/to Canada)
P Greer    (Peter)   ... 1993 - present (1995)(Otago MSc
                                            (Medical Physics)
J Fisher   (Julie)   ... 1994 - present (1995)(UK MSc
                                            (Medical Physics)
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Equipment selection and testing:

Many problems experienced by our staff with medical equipment located in Auckland Hospital (eg incompatibility; lack of spares and service manuals) were due to inappropriate decision-making at the time of purchase, with sub-optimal acceptance testing before payment was made. It was therefore essential for our Department to be accepted as the authority in these areas, and for medical staff not to rely solely on information provided by agents (or on what they saw overseas). After many years of gaining confidence with medical staff,(greatly assisted initially by Jon Henderson's ability and standing; subsequently continued by other scientists and senior technical staff) and my efforts with the Supply Department, and Finance Department, procedures have reached the stage where our Department (MP&CED) is now in a position of maximum leverage in the purchase of, and payment for, equipment. Agents do not get paid unless complete deliveries are made, and equipment passes acceptance tests. Our Department makes these decisions. These actions are supported by CHE-wide policies. Purchases are controlled by specifications which have been prepared by our Department.

I suppose it was the volume of equipment at Auckland Hospital, and the size of the operation, plus the rapidly growing influence of private agents on medical staff that made me realise the need for an independent department of the Board to provide unbiassed scientific and technical input into the whole field of equipment management. Twenty years later, I can say that this has been achieved. I grabbed every opportunity to enhance the aims of our Department, and as frequently mentioned, I have relied heavily on the support from, and tolerance of, Jon Henderson, Owen Hames, and Murray John.

Problems along the way:

On the way, some people were unsettled as I encroached into what had become their comfortable routines. I supported freedom of action, but demanded accountability of staff for time spent. I constantly liaised with management (frustratingly resetting to zero during frequent management changes); I became a member of decision-making committees at Board and Hospital level whenever I could, instead of just criticising their actions from outside. I fought hard for the conditions of employment of staff, and a fair remuneration for the important work they performed. I attended many management meetings; capital expenditure meetings; computer meetings; allied professional staff meetings; etc....! I prepared a multitude of budgets and 'Strategic Plans', and generally kept my ear close to the ground to try and keep one step ahead of management. I knew that one could no longer rely on the assumption that management should be unquestioning and accepting of how one's individual or departmental work effort was being expended. Hence my constant drive to improve our staff and equipment information systems. When dealing with management, one computer printout detailing work performed was worth 1000 spoken words! Even better if the printout was churned out while the manager waited and watched!

"What DO you do?"

My observation has been that the work performed by our technical staff could always be comprehended and appreciated by managers, whereas they were never quite so clear about scientists; and yet it was this latter group that, although contributing greatly, were the most reluctant to document their work effort for a better understanding by management. I am strongly convinced that it was the existence of a combined Department of both graduate scientists and engineers, coupled with good engineering technicians, where all these disciplines enjoyed an unencumbered exchange of ideas and worked together as a combined team, which has resulted in a greatly enhanced and recognised service.

Contemplation in retrospect:

Although of necessity my own time was taken up with much administration, my main enjoyment came from presentations of work performed by scientists and technicians. The monthly printout from ERIS was always of satisfaction to me, because one could see what had been achieved at the 'workface', and that is what all the effort was aimed at.

This report does not cover my involvement (sometimes minimal) in the scientific and technical work of the Department. Thousands of items made up of electronic, anaesthetic, laboratory, nuclear measuring, X-ray, radiotherapy, and computer equipment, were maintained and their performance checked. There were activities like treatment planning, radiation surveys, scientific project work; lectures were given; technology was constantly changing. Nevertheless, I attempted to remain informed on all these diverse activities, as questions could suddenly arise from medical or management staff, and as Head of the Service, an unfavourable impression is created if you don't seem to have your finger on the pulse! I regarded my main objective as ensuring all this work could carry on unimpeded, coupled with a high degree of staff satisfaction.

Conclusion:

One of the greatest pleasures has been the long-term friendships which have developed with staff colleagues, in spite of some stressful times. And I must express my deep appreciation to all my senior colleagues - without their continuing support, our Department would not have come about.

On my retirement in 1993, the baton has been handed to Murray John, who has all the abilities and experience required to continue the race, striving confidently towards the constantly shifting finishing line.

Bruce White
Maraetai
May 16 1995

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PALMERSTON NORTH HOSPITAL STAFF LIST:

Physicists:

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C G Begg  (Campbell) Apr 1952 - Jan 1961 (to Rochester
                             Hospital, UK;   deceased late 1963)
B Gillion (Bruce)    ... 1961 - ... 1962 (joined IBM)

R A Trott (Ray)      ... 1962 - Jul 1986 (retired)

P Morris  (Phil)     ... 1974 - ... 1978 (from UK, and sec'y
           teaching at PNBHS; to Cancer Inst, Regina, Canada)
WG Artner (Bill)     ... 1979 - ...?1989 (from USA; teaching
                    at PNBHS; to Wisconsin hospital post)
K Croft   (Keith)    Jan 1986 - present (1995) (took OU MSc
                                       (Med Physics) course)
L Greig   (Lynne)    Feb 1987 - Jan 1991 (from work overseas
                         as geophysicist; moved to Wgton Hospital)
T O'Brien  (Tim)     ... 1990 - present (1995)

A Brindhaban         ... 1993 - ... 1995 (to Manawatu
           (Ajit)                            Polytechnic)
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HOSPITAL/MEDICAL PHYSICS AT PALMERSTON NORTH HOSPITAL

A personal overview 1952 - 1986: Ray Trott

Background days:

The histories of the Manawatu and Taranaki centres are as closely bound as those of medical physics and radiotherapy.

New Plymouth embarked on radiotherapy first, when Dr Cooper had a Siemens 200 kVp machine installed in 1939. This was a Villard unit with two enormous air-insulated rectifying valves and an air-insulated X-ray tube. A 60 kVp Chaoul tube was also included. The installing engineer from Siemens was a dedicated Nazi, but as the installation took longer than anticipated, he spent the war years in an internment camp.

Dr Peter Allen took up residence in New Plymouth in 1942, and treated many Manawatu patients during the next decade.

Palmerston North saw the first signs of radiotherapy when Dr Gillies installed a 140 kVp machine in the mid-40's. This first machine was a Westinghouse unit which, along with a couple of diagnostic machines, were surplus from the American armed forces.

She was later followed by Dr Don Urquhart when he returned from WW2 war service, and later from his postgraduate studies in 1948. The first supply of radium was purchased in this year at a cost of 900 pounds ($1800).

The first hospital physicist:

In the early 1950's, Dr Urquhart saw the future of Palmerston North as a regional centre for radiotherapy. To this end, he started a campaign to get a higher-powered machine, and also to establish a patient base. He set up clinics in Wanganui, Masterton, Dannevirke, and the Hawkes Bay. At the same time, he recognised that specialist physics support was also vital; so in 1952 a Marconi 250 kVp machine was installed, and the first physicist, Campbell Begg, was appointed. Slide rules were the tools of the trade in those days, but for big jobs Campbell had a manual adding machine.

Campbell was a very interesting chap, having spent the war working on radar research in the UK, and then tried his hand (successfully) as a commercial photographer in Dunedin. But physics was his main love, and he threw himself into the work of the Department with gusto. He felt that in order to understand the day to day application of X-rays, he should qualify as a radiographer, which he did, completing the MSR examinations. Wonder what his physics marks were?

An accomplished pianist, Campbell dabbled in many unusual pursuits including graphology and spiritualism. He would form an opinion of a radiography applicant from their handwriting and seal it in an envelope. At interview, Don Urquhart would also make his assessment, and after the person left they would compare notes. Unfortunately we have no record of their findings.

On one occasion, a radium tube was misplaced and went through the hospital furnace, the clinker then being spread on the paths of the hospital farm. Having no survey meter, the story goes that Campbell made a classic electrometer from pithballs and thread. Those who knew him consider that the story is more likely to be true than not. It is on record that over 90% of the activity was recovered, which was no mean feat.

In 1955, the old Siemens unit in New Plymouth had come to the end of its time. The rectifiers had failed, and were replaced with the only ones still surviving in NZ, hidden away in Otago University. It was decided to replace this unit with a Marconi 250 kVp machine identical with that in Palmerston North. In 1951, I had moved up there, having qualified as a radiographer in Wellington in 1949, and also with half a BSc. I had become interested in the physics of radiotherapy and had been doing such planning as was necessary in those days. While this new machine was being installed, which required a rebuilding of the Department, all the patients plus the staff were transferred to Palmerston North.

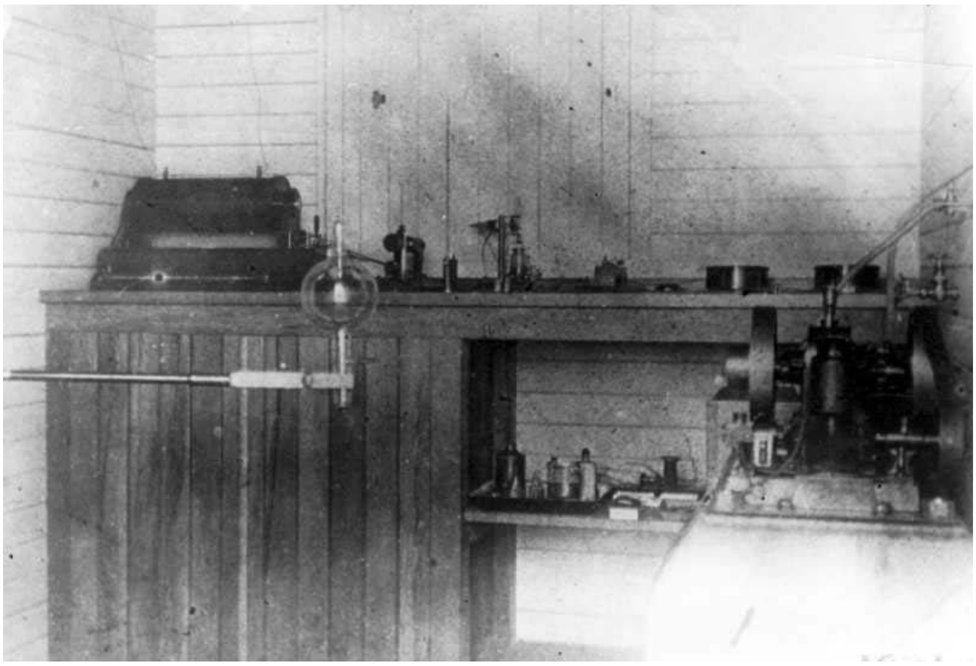
In 1957, Don Urquhart bought the old Siemens unit, and installed it in his private rooms, but with a modern rectifying system built by the local AWA serviceman, Keith Sigley. This set-up was used for several years, but was eventually withdrawn and presumably scrapped.

The move into supervoltage therapy:

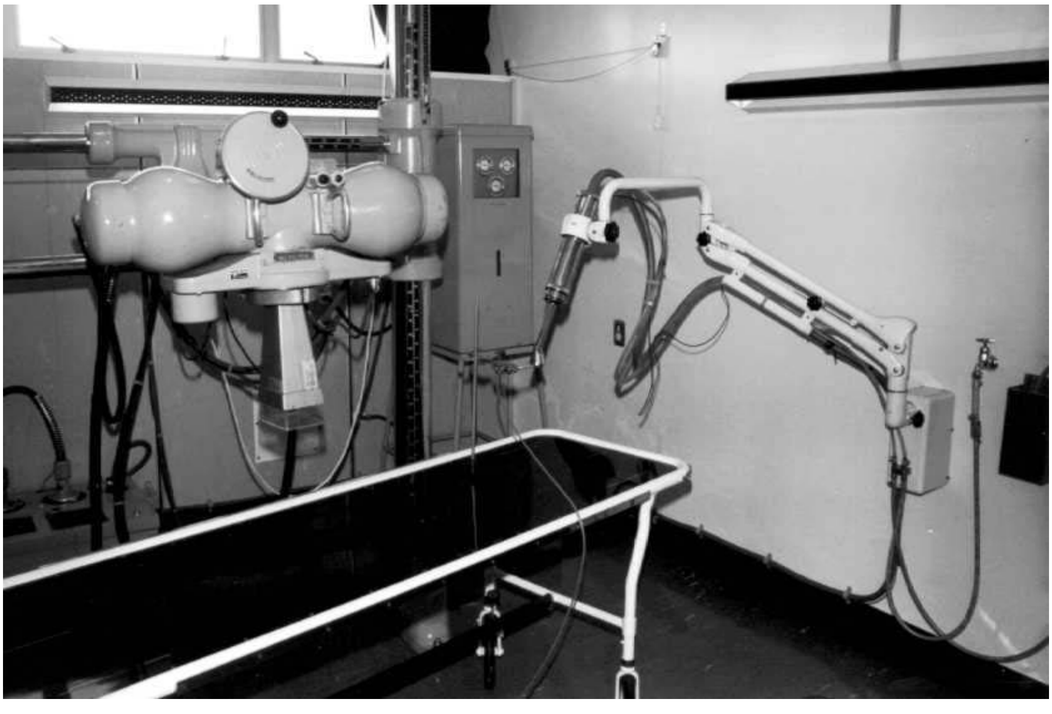
Just after this, the advantages of supervoltage radiotherapy were recognised, and Don Urquhart started a campaign to raise funds to purchase such a unit. The Health Dept at that stage had refused to supply any funds. The Cancer Societies from the Manawatu, Wairarapa, Hawkes Bay, Wanganui, and Taranaki all pitched in, and over 10,000 pounds ($20,000) was raised. When the goal had been reached, the Health Dept then decided to subsidise the purchase on a pound-for-pound basis. Campbell Begg went off overseas to see what was offering, and the Italian Barazzetti Jupiter Junior was chosen.

Enrico Barazzetti was a former employee of Picker, so it was not surprising that his machine looked like a Picker, and it was also finished in an olive green paint job. This unit had some deficiencies, notably a 55 cm SAD which caused some problems, but on the whole it was a remarkably efficient machine. Patients not only from Taranaki but also from Wellington started to be referred here.

The unit was housed in the Physiotherapy gymnasium. As the Outpatients Dept was directly overhead, a large concrete ceiling beam had to be installed for protection. This meant that the floor had to be lowered, so although the unit didn't actually go into the usual basement situation, it came close!



Palmerston North Hospital, 1904: First X-ray plant. Note induction coil (at left on bench) as 'HT supply'; and absence of any radiation shielding.



Marconi X-ray therapy equipment, with 250 kVp X-ray head. Using a switching arrangement (see on rear wall), it was possible to switch to a Chaoul 'contact therapy' X-ray tube, operating at 60 kVp, HVL 3.3 mm Al (unfiltered).

Palmerston North Hospital first supervoltage unit: Barazzetti Co-60, 55 cm SAD unit, installed 1958.

'Twin tower' entrance to Palmerston North Hospital. The two 'towers' were for supervoltage therapy units, a Theratron-80 Co-60 unit, and the Siemens betatron (in use 1974). These are at first-floor level; also, a corridor can be seen off to the right, leading to the later addition of a Varian 21C linac in a matching 'tower' building

The first source change caused some problems, as there was no suitable transfer container available; the whole head, minus the collimator, was sent over to Lucas Heights, Sydney. On its return, there was a disagreement about the activity being charged, as the local figures were lower than the Australian ones. This was eventually resolved by Hugh Atkinson of NRL flying up from the Deep South, as at that time there was no official physicist on the staff. The Australian values were, of course, made without the collimator, and the AAEC deferred to the local figures.

The next source change saw the AAEC modify a Philips transfer container so that the source could be exchanged on site, and this worked very well on several later occasions.

Staff changes:

In 1960, Campbell Begg decided to return to his much loved England. While waiting for a replacement, I came down for 3 days about once a month or when required, to keep the wheels rolling. Bruce Gillion was eventually appointed in 1961. Unfortunately he only stayed a year, and then joined IBM, where he still is.

After many months of trying to fill the position, I was appointed as a physics radiographer in 1962. This served both parties, as it gave the Department some physics cover, and also enabled me to successfully complete my degree.

Redevelopment:

After about ten years, the deficiencies of the Barazzetti became pressing, and plans were developed to replace it with a newer machine. And so in 1968 the present Theratron-80 was installed. The Barazzetti unit was eventually sold to New Plymouth, where it continued to give good service for many years with their relatively small patient load.

Plans for the new Clinical Services Block (CSB) started in 1968. The original intention was to add a second Co-60 unit to the existing one. But in 1972, Dr Urquhart met Dr John Ho from Hong Kong and discussed the revival of interest in electron beam therapy. He and I looked at the various possibilities, and were fortunate to have, at that time, Dr Dick Walton, radiotherapist at the Winnipeg General Hospital, visiting this country as the manager of the Canadian swimming team, to prepare for the 1974 Commonwealth Games. His recommendation that "If you haven't got 15 MeV, don't bother about electron beams" ruled out all the existing linear accelerators. Although several companies had high energy machines on the drawing boards, they would not be in clinical use for many years. The only machine that fulfilled the hospital's requirements, and also remained within the Health Dept's guidelines "not to be markedly different in price to a Co-60 unit", was the Siemens Betatron 200A, with 18 MV X-rays and 20 MeV electrons.

New building design:

The design of the supervoltage suite caused some problems, as the Board policy was to have Radiotherapy as part of the new CSB; in fact, on the first floor. This was opposed by Radiotherapy, as the existing Department was already on two levels, with horrific frustrations as the treatment units were two floors away from everything else. Also, they did not want to be buried underground as so often happened overseas. A suggestion from a draughtsman, that some sort of wheat silo built adjacent to the main building might solve the problem, fired my imagination. With the assistance of Hugh Atkinson at NRL, it was shown to be a feasible solution. The architects then proceeded to make the two towers a feature of the main extrance to the Hospital, complete with an artificial lake and bridge. A suggestion that the addition of a portcullis would complete a good defensive position was not appreciated by them.

It was calculated that this novel twin tower design required considerably less concrete than if the same structure had been built at ground level. This was due to the fact that most of the protection was by the inverse square law, which happens to be rather cheap. However, the Siemens engineers in Erlangen did not grasp the concept until they were shown photographs of the partially completed towers on a visit to the factory.

Permission to purchase was eventually obtained, and the installation started in April 1974. The first patient was treated in December 1974, but the new Department was not available until May 1976. As the contractors would not allow general access to the partially completed main building, a special stairway was installed to get patients to the betatron. The first criterion for treatment at that time was the ability of a patient to climb those stairs.

Staff; computers; planning:

In 1974, Dr Phil Morris was appointed as assistant physicist. He immediately became interested in computer applications, and in 1976 devised a programme for treatment planning which ran on the Pathology Dept's PDP 11/40 computer. This was a much simpler and more restricted version of the Christchurch programme.

In 1975, Terry Devere, who had trained at St Luke's Hospital, Guildford, was appointed as physics technician - he was instrumental in setting up the Physics workshop, and the mould room.

In 1978, Phil Morris left to go to Canada; he was replaced by Bill Artner in 1979. Terry Devere also left at about this time, and eventually completed a BE at Auckland University. May 1979 saw the installation of a PDP 11/34 computer for radiotherapy treatment planning. This ended about 15 years of frustration trying to get Health Dept approval for such a machine.

Changes in the 1980's:

1985 saw the installation of an X-ray CT scanner in the Hospital, and the appointment of Keith Croft (a graduate of the Otago University new MSc (Medical Physics) degree course) who was intended to be associated with the scanner. However, this did not eventuate, and Keith has been full-time in the Radiotherapy Department.

July 1986 saw my retirement after 40 years of service (24 of them at Palmerston North), and the appointment of Bill Artner to the senior position, with Lynne Greig coming in as his assistant.

A major enlargement of the Department was started in 1987, with the eventual installation of a Varian 21C linear accelerator. The additional building housed an oncology day ward unit, and on the ground floor a separate Physics suite.

The betatron was by now showing its age, and was replaced in 1993 with a Varian 6 MV linear accelerator.

It is perhaps sad to recall that after 30 years of frustrating struggle to have an autonomous Medical Physics Department established, no such institution exists today. It has been a continuous saga of evasions from various administrators over the years.

Research:

From the time I arrived at Palmerston North, the Medical Superintendent, Dr Ken Archer, always encouraged the use of hospital facilities for research projects other than internal medical ones, with the obvious proviso that they did not cost too much, and that they did not interfere with patients' treatments. Also, they had to be done in my own time.

Several research projects were run in conjunction with the Veterinary School at Massey University; the most notable was an investigation into the recalcification of bone at a fracture site. Dr Urquhart felt that the radiological appearances of healed fractures, particularly pathological fractures, did not tell the whole story, and so the help of Bob Wyburn, veterinary radiologist, was sought. A dog that had been sent in for euthanasia on the basis of uncontrollability had a front leg fractured, and a dose of Sr-85 injected. A scan of both legs was carried out at regular intervals, together with radiographs for comparison. The most surprising find was that even after 18 months had elapsed, there were still signs of bone activity, even though the radiograph showed a normal healing. A wonderful end to the experiment was that the animal, with so much tender loving care, became a most tractable dog, so much so that the vet assistant took her home as her pet. Although the hospital authorities sanctioned the use of the scanner etc, various subterfuges had to be adopted to get the dog in and out of the building, to avoid any public outcry which might have eventuated in those days. Another problem was that in the early days, the dog never really recovered from the tranquillisers from one scan to the next. The students were rostered to keep turning her over regularly throughout the day and night to prevent pneumonia setting in. The dog thus became known as "Hippy" - our little flower girl.

In the mid-60's, I was approached by Dr Kamla Pandey, a geneticist at DSIR, to assist him in solving a plant breeding problem. The main difficulty in breeding a specific strain, even using manual pollination techniques, was the appearance of multiple varieties. His intention was to irradiate pollen to such a level that the genetic traits were destroyed, but the germination properties were retained. This required doses in the range 20-100 kilorad. The only way to get these doses in a reasonable time was to invert the Theratron-80 and pop the pollen containers down its throat. Dosimetry was a bit of a headache, but was eventually solved.

When Dr Pandey's results were published, they created considerable interest internationally, and he was invited to speak at several conferences. A few years on, certain genetic properties, notably colour, seemed at times to be passed on, which initially raised doubts on our respective techniques. However, it was soon thought that sometimes the DNA would repair itself, at least in respect of certain simple genes. Further exhaustive studies proved that this was indeed the case. These findings saw Dr Pandey again travelling internationally talking about this work.

After much hard work and investigation, with some help from me, he was eventually able to convince DSIR to purchase a purpose-built irradiator for his work. An AECL unit was installed down among the glass-houses. It was a tragedy that shortly after this, he suffered a fatal heart attack, and that so much of his creative thought has been lost.

Dr Pandey's work created a lot of local interest. I carried out irradiations on various plants and cuttings from research laboratories in Rotorua and Hastings, as well as for Massey University.

Computers:

In 1963, a laboratory technologist, Ken Couchman, sought my assistance to get the Hospital Board to move into the computer world. They responded by forming a committee which included a pathologist, a physician, and an administrator, as well as ourselves. The first 'computer' was installed without any consultation with this committee (surely not!), but was really only an electronic accounting machine. It coped with the payroll for a while, but was soon found to be quite inadequate. The payroll operation was then transferred to Auckland Hospital, using an ICL 'dumb' terminal, and still later an ICL 1902A machine was purchased to run the payroll in-house.

The first clinical application of computers was a study in the Coronary Care unit. This was carried out by Massey independently from the Board. The clinician behind the scheme, Dr Des Dickson, found that even before the data was analysed, he knew far more about his patients than previously. This was simply because a positive response was required to every question, rather than the old way of just concentrating on the particular patient's needs.

The next step came when the Pathology Department managed to get a PDP 11/40 machine to run the CHOPS (Christchurch Hospital On-line Pathology System). This computer had a two-place replaceable disk drive unit; the Pathology people were very generous in allowing Radiotherapy use of the second drive, in return for help with programming, mathematics, etc.

Phil Morris had just joined the staff, and one of his earliest tasks was to analyse the isodose curves of the Co-60 unit to derive an algorithm to calculate the dose at any point. This work was done on a Wang programmable calculator. The PDP 11 computer enabled Phil to advance his work, and he used the Christchurch planning program to create a version which would run on 'our' computer. He was able to solve the discontinuity problem that had beset Sterling and others trying to get a better algorithm. Unfortunately, when he submitted his work for publication, better computers were available, not to mention programs such as Jack Cunningham's, so the need for Phil's work had largely disappeared.

Touche-Ross came and went, leaving behind a lot of dissatisfied staff. Despite radiotherapy planning fulfilling all the criteria for a computer as set by Touche-Ross, the department never purchased a full system for any hospital.

Palmerston North Radiotherapy eventually obtained Health Dept approval to install a dedicated computer purchased with Cancer Society funds. Auckland also obtained approval under the same conditions at the same time. We both used the Hamilton version of the original Christchurch planning program, which worked very well for many years. In 1988, a dedicated computer planning system was acquired, but by then every office in every hospital department had a computer - such is progress!

Nuclear Medicine:

The first foray into the use of radioactive materials (other than radium) was in 1950, when P-32 was used to treat a Hawkes Bay patient with polycythemia vera. Dr Urquhart was assisted in the dispensing of this material by Dr Athol Rafter from Nuclear Sciences.

In the mid-1950's, Campbell Begg set up the first nuclear medicine department with a collection of Philips PW-series modules, a Philips probe with a 1" (25 mm) crystal, and an Ekco annular crystal unit for in-vitro samples. This equipment was housed in his office, which unfortunately was adjacent to a radiographic X-ray room - much frustration! Dr Gomez-Crespo had a frustrating time on his international survey of thyroid uptake equipment, as the Philips probe had a very small field-of-view which lowered the count-rate, and lacked adequate lead shielding behind the collimator, which increased the count-rate. These two defects exactly cancelled each other, and our results were among the best he had seen, and this with sub-standard equipment. Subsequently we had a new shield made by NRL to IAEA specifications.

The advent of kitset-type in-vitro thyroid tests (triomet) saw a close liaison with Christchurch Hospital established. The material had a very short shelf life, and the two departments shared staggered 2-weekly shipments. This worked very well for a number of years.

It did bring about its own problems. One shipment leaked on its way up to Palmerston North, and after discussion it was decided to invoke the proper safety testing procedures. National Airways (as it then was) was notified, and the first of the trans-shipment planes arrived in Palmerston North at 5 pm. All the luggage and freight was removed, and I checked for contamination, watched by a very attentive audience. The other aircraft was not due back in Christchurch until 8 pm, and Tom Rogers duly presented himself there. However, the weather had deteriorated, preventing the plane from landing, so that after flying in circles for an hour, it went back to Wellington. The physicist there was unfortunately not available so Dr John Logan, radiotherapist, was hauled out from the comfort of his home to deputise. As the survey meter in use was quite new, Dr Logan had never used it, and so had to request my assistance. At this time (11 pm), my advice was more in the nature of "set the thing on the highest range, and if the needle doesn't move, go home!"

In the late 1960's, a variety of other diagnostic tests had been introduced. The first attempts at thyroid scanning had been made with a manual technique, using a perspex template to position the probe. It was decided to invest in a commercial scanner, and in 1965 the first Picker Magnascanner unit was installed. As a seminar on nuclear medicine was being held in Auckland the week it arrived, it was decided to try to get some results on display. Watson Victor were keen for commercial reasons, and the Hospital was keen to try to compete with Auckland, who were displaying their new IDL scanner. The machine was unpacked and assembled on the Monday night by Wat-Vic's Ron Chisnall; the next day and night were spent learning to work it and then calibrate it. Wednesday was spent playing with the new toy, and looking for suitable patients, with a thyroid, and a liver scan possibility being located. Thursday was the big day, and eventually good scans were achieved, which were duly displayed at the Auckland seminar on the Friday.

During the 60's and 70's, a very good service was established for the Taranaki, Hawkes Bay, and Nelson Hospitals for in-vitro thyroid studies. The old Triomet tests had been replaced with the improved Triosorb tests, so the sharing of supplies had been abandoned, but not the very close liaison with Christchurch. Eventually these areas developed their own departments, but Palmerston North continued to supply Taranaki and Hawkes Bay with supplies and technical expertise.

A major research project involving nuclear medicine was carried out at this time in conjunction with Dr Dick Wigley, rheumatologist. Vitamin B12 levels were investigated using the Schilling excretion test, which was in regular use at this time. A very large number of normal levels were established, still probably the largest group ever assembled. Some discrepancies were noticed which could not be explained until it was pointed out that all the anomalous patients were on a pain relief drug 'Indocid'. A further series was carried out, which demonstrated that the drug was indeed responsible for a lowering of the B12 levels, which was clinically significant.

In 1968, a Picker Autowell automatic sample changer was installed; apart from improving the hospital service, work was carried out for the Veterinary School of Massey University. Don Flux, Professor of Animal Husbandry, approached me for help, as he wanted to establish whether assays using radionuclides would have any place in his work. It was agreed that he would do all the work relating to the samples, labelling, etc; bring them to the hospital, and I would do the counting. He would then collect the numbers and analyse the results. This continued for almost a decade until they obtained their own equipment.

In 1970, liquid scintillation counting was established; surveys for cortisol was the main interest.

In 1976, Dr Kevin Smidt returned from post-graduate studies, and took over the running of the Nuclear Medicine section; the physics input then dwindled.

Ray Trott
Palmerston North
April 6 1995

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MEDICAL PHYSICS AND BIOENGINEERING AT CHRISTCHURCH HOSPITAL

1954 - 1995

A personal overview by Jack Tait

The beginning:

The Christchurch Hospital had been using X-rays and radium for therapeutic purposes, rather unsuccessfully, since 1909. Finally in 1924, Dr C Fenwick was appointed as radiotherapist in order to put radiation treatment on a firmer basis. With a benefaction of 4000 pounds ($8,000) from Sir Arthur Sims, the Board purchased radium and a 200 kVp deep therapy X-ray machine.

With the arrival of the radium came the danger of sources being lost - a problem that seems to have plagued the hospital for the next 30-odd years. Dr Fenwick's son, Chris, a teenager at the time, recalls being recruited to help his father search for lost radium. The instrument they used was a borrowed gold-leaf electroscope! Needless to say, their search was unfruitful.

During the 1930's, there was a growing awareness of the hazards associated with ionising radiations used for the diagnosis and treatment of patients in hospitals.

In 1936, the original deep therapy unit at Christchurch Hospital was replaced by a 250 kVp 'Maximar' machine, and later a 250 kVp 'Quadrocondex' machine was added. In 1938, the old 200 kVp machine was donated to the BECC Travis Laboratory to form the basis of a NZ X-ray Standards Laboratory. In that same year, G E (George) Roth joined John Strong at the Laboratory and, at the outbreak of war in 1939, he assumed charge when John Strong (who was on study leave in the UK) joined the RAF. John Strong was killed in an air crash in 1941, while carrying out radar research for the RAF. The Travis Laboratory was renamed the 'Dominion X-ray & Radium Lab' (DXRL), and later after it moved to Victoria St, it became the Health Department National Radiation Lab (NRL).

When Dr Fenwick retired from the hospital in 1943, Charles Hines, who had been appointed as technician in 1925, acted as Technician-in-Charge until April 1946, when Dr A J (Jim) Campbell, an Australian doctor who had served as Medical Officer in the RAAF during the war, was appointed as Radiotherapist-in-Charge. Chester Ashworth became the Charge Radiographer.

In 1948, Dr Campbell was the first in NZ to use radioisotopes for medical purposes. He imported three shipments of radioiodine-131 from Oak Ridge, USA, for diagnostic and therapeutic applications. J F (Jim) McCahon from the DXRL provided dispensing and measuring facilities for Dr Campbell. Jack Tait recalls in 1953 going with Jim to do I-131 patient measurements in one of the padded cells, used to house violent patients, in the Annex beside Ward 13.

In 1953, Dr A M (Tony) Goldstein joined the Christchurch Hospital staff as assistant radiotherapist. He continued to expand the uses of radioisotopes, and in that year the Board ordered its own radioisotope counting equipment from Ekco and the UKAEC at Harwell. The requisitions for these items were placed with Philips, Ekco, and the Ministry of Supply at the Atomic Energy Research Establishment (AERE), Harwell, UK. Jim McCahon was named as the contact person, and the orders were signed by Tony Goldstein on behalf of the Hospital Board.

Plans were also being made for the setting up of an 'Isotope Laboratory' in the basement (where else?) under Ward 13. Estimated expenditure for the Isotope Laboratory, excluding the above counting equipment, was 1479 pounds ($2958).

In 1953, Sir Arthur Sims made another generous (30,000 pounds ie $60,000) donation, this time for the purchase of a cobalt-60 teletherapy unit for Christchurch Hospital.

The first Christchurch Hospital physicist:

By 1954, the increasing use of radioisotopes and the prospect of the new Co-60 teletherapy machine arriving, together with memories of expensive (6,500 pounds ie $13,000) litigation in the early 1940's over two cases of patient overdosing, created the need for a full-time physicist to be appointed to the Radiotherapy Department. The duties of the medical physicist were to be (and still are):

1. To ensure the correct calibration and functioning of sources of ionising radiation used to treat patients, and to solve the associated problems of dosimetry.
2. To be responsible for radiation safety aspects of the use of ionising radiation for both patients and staff throughout the Board's institutions.
3. To provide physics help to other clinical departments where needed.
4. To give lectures to medical and paramedical trainees on medical physics subjects.

R A (Bob) Borthwick, an MSc(Hons Physics) graduate from Victoria University College in Wellington, took up the post in July 1954. Bob had previously worked in the DSIR with Jim McCahon, then as the first hospital physicist at Wellington Hospital, and from 1951 at the DXRL as head of the Diagnostic Section.

Bob's first task was to set up the 'Isotope Lab' and the associated physics workshop in the basement under Ward 13. Initially this was housed in two rooms at the north end of the building near to the tennis courts. The area consisted of a 'hot' lab, where the radioisotopes were dispensed, and an office/workshop, where measurements were made, and physics construction work was carried out.

An assistant physicist, J J (Jack) Tait, joined the Radiotherapy Department in March 1956. He had just gained his BSc(Physics & Radiophysics) degree from Canterbury University College. He had previously trained as a radio engineer at Radio Corporation of NZ Ltd in Wellington, and worked for a year at the Seismological Observatory, DSIR, before joining the electronics section at the DXRL in 1951.

One of Jack's first tasks was to help Bob Borthwick to search for another lost radium needle which had been presumed to have been thrown out with dressings to be disposed of in the hospital's incinerator. A search through the ashes with a geiger counter showed no sign of the lost radium.

The salary offered Jack on his appointment was less than that he was earning as a technician at DXRL, and this prompted him to protest to the Board. He was told by the Board's Deputy Secretary that he was "getting pathological" about his salary grading, and that with only a BSc degree he could never become a medical physicist anyway! This was a challenge to Jack, who began a part-time MSc(Physics) degree course the next year. He was given leave to attend lectures, on the condition that he made up the time by working late in evenings and on Saturdays. There was no financial support given by the Board. In return for this, he was required to sign a bond to remain with the Board for two years. He successfully completed the degree in 1959.

From May to December 1956, Bob Borthwick travelled to the USA, Canada, and the UK, to gain experience in the physics of Co-60 teletherapy. Tony Goldstein also travelled to the UK for clinical experience at the same time.

The Isotope Laboratory:

In the Isotope Lab, the physicists' duties consisted of handling, dispensing, and administering oral radioactive 'doses' to patients for both diagnostic and therapeutic uses.

Thyroid diagnosis involved giving a patient a tracer dose of 100 microcuries of I-131 (100 uCi = 3.7 MBq). The neck uptake of I-131 at 24 and 48 hours was measured using a crudely collimated scintillation counter. The tracer doses were given in a weak (pink) sodium iodide carrier solution. A much stronger solution, coloured blue, was used for washing the glassware. Unfortunately, the pharmacy on one occasion made the pink solution up to wash-solution strength, and it took some detective work to discover why the patient uptakes were all very low! Most patients given oral I-131 tracer doses accepted them without complaint, but much to the embarrassment of the staff, one young female patient announced to the other six patients in the waiting room that "it tasted like cats pee!"

Blood tracer levels were also measured at 48 hours. Blood was centrifuged to obtain the plasma, which was measured in a glass well-type beta-sensitive GM counter, and the plasma was then re-processed to obtain the protein-bound iodine (PBI) fraction. Protein was first precipitated with trichloracetic acid, washed with distilled water, redissolved in NaOH solution, and re-counted in the beta counter. Pulses from the GM counter were fed to a binary scaler which used neon tubes as indicators. The results had to be manually converted from binary to decimal format. All measurements were repeated three times to ensure accuracy of results. Timing of total counts was done by means of a mechanical clock and a stepping switch indicator. The electronic measuring equipment at the time utilised vacuum tube technology, and was therefore rather less reliable and more difficult to maintain than modern instruments.

I-131 therapy for thyrotoxicosis and cancer of the thyroid was being performed, as well as phosphorus-32 therapy for leukaemia and polycythaemia rubra vera. One salutary lesson learned quickly was the need for great care in giving therapy doses. A patient from Nelson was given P-32 for polycythaemia. Minutes after the patient had left to return home, Jack realised that he had used the wrong pipette to dispense the dose, and the patient had received only one- tenth of that prescribed! It was fortunate that the dose given was too small, and not too large. The patient was called back from Nelson a week later, and given the remainder of his dose amid profuse apologies.

In 1957, a well-type scintillation counter was purchased. This valuable new measuring instrument opened up a whole range of new tests. Bob collected some rainwater from the hospital roof, and discovered that it contained significant radioactivity when measured in the new well counter (due to fallout from above-ground nuclear weapons testing). The results were picked up by the local Press, and began a debate in the newspapers. No doubt partly as a result of this, the DXRL soon increased its radiation monitoring service around the country.

About this time, the department purchased a single channel pulse height analyser, which was modified to scan across a wide spectrum of energies and plot this on a chart recorder, making it a useful gamma-ray spectrometer.

The use of the well scintillation counter, together with an ion exchange resin method of extracting the protein-bound iodine, had made the thyroid tracer tests much simpler and more accurate; tracer doses were reduced to 10 uCi (370 kBq). The introduction in 1957 of an in-vitro (triomet) test for thyroid function, using tri-iodothyronine-I-131, was a further improvement as it did not subject patients to any radiation exposure.

Often the doctors required to know the radio-iodine distribution in a patient's thyroid gland. The difficulties of plotting I-131 distribution in patients' necks using a heavy handheld detector was making Jack think of ways to build an automatic scanning device, and he was looking at overseas developments in this area, particularly scintiscanners and the Anger gamma camera.

Tony Goldstein had introduced several new radioisotope therapy techniques, including gold-198 bladder and intraperitoneal infusions. These entailed a lot of sterile preparation and operating theatre work for the physicists. The Au-198 shipments were obtained from the Radiochemical Centre, Amersham, UK, and flown via Canada to Sydney, Auckland, and on to Christchurch. Jack spent many hours, mainly in evenings, awaiting the arrival of shipments at the airport; on several occasions with the patient and operating theatre staff waiting at night, ready to proceed as soon as the Au-198 shipment arrived. Only one shipment was totally lost - in an air crash at Honolulu Airport. The staff of National Airways Corporation (NAC) were always very helpful in tracking down lost shipments, and once even put a package on an unscheduled flight to Christchurch.

In 1957, G N (George) Gates, an ex-DXRL technician, was appointed as the first medical physics technician to the Christchurch Hospital. Jack and George at this time designed and built a radioisotope standardisation meter, and a background radiation monitor for the Isotope Lab. Both instruments remained in regular use for the next 15 years before being replaced by commercial instruments.

The radioisotope usage between 1956 and 1960 had undergone nearly a 400% increase with the numbers of treatments and tests (18 different kinds) and variety of radioisotopes (10 different compounds) used. Over 4,400 measurements were carried out in 1960; 49% of all radioisotopes imported into NZ during that year were used at Christchurch Hospital. The work of the Isotope Lab was by now attracting much outside interest. In 1960, three physics staff from DXRL and physicists from other hospitals came for short training periods.

Radiotherapy physics:

The physicists' duties in radiotherapy initially involved dosimetry for radium and radon implants, routine calibration of the therapy X-ray machines, and the investigation of causes of any high-dose recordings on the protection film badges. The radium tubes and needles were stored in the department, and were handled by the radiographers. High doses on film badges were usually caused by the badges on lab coats being left hanging beside the radium safe overnight or at weekends. Radon, encased in gold tubing, was obtained from the DXRL, where it was extracted to order from their own radon plant (the rebuilt one, which was originally transferred from Wellington Hospital by John Strong). When NRL closed down this service in 1967, supplies were still available from Brisbane. By then, Au-198 seeds were being used instead of radon.

Supervoltage radiotherapy, 1956:

An Atomic Energy of Canada Ltd (AECL) 'Theratron-B' 2000-curie cobalt-60 teletherapy unit (isocentric rotation model) was purchased with the money donated by Sir Arthur Sims, and was installed by the end of 1956. This was the first supervoltage unit to be located in NZ. The installation was done by an Australian mechanical engineer who knew little about electrical circuits. Hence there were a number of electrical wiring mistakes. As a result of this, and the concrete dust from the building construction which penetrated into the mechanism, an engineer from AECL, Len Downes, was flown out from Canada to correct matters. (This was another lesson learned - new high-tech equipment should not be installed until the dusty building construction work is completed).

Among the equipment ordered by Bob Borthwick for the Physics Lab was a manual field plotter being manufactured by a local firm. When this arrived in mid-1956, Jack, always keen to make equipment work more efficiently, modified the device to become the first automatic isodose plotter in the country. Initially a home-made ion chamber was used. It was constructed with a thin aluminium wire as collecting electrode in a perspex rod, with a graphite-coated gelatine drug capsule as the outer thimble electrode. This plotter served its purpose of quickly obtaining the isodose curves during the commissioning of the cobalt unit.

The first patient was treated in early March 1957, and the cobalt unit was officially opened by the Prime Minister, then the Rt Hon S G Holland, on March 12 1957.

During his overseas training in the UK, Bob gathered information on supervoltage dosimetry, including techniques for rotation therapy, which became one of the major applications of the cobalt teletherapy unit. This method was used also for arc therapy, and later was modified for the 'double arc' technique, used for treating the pelvic region following radium therapy. All the dose calculations were done by the physicists using a Facit electric calculator and slide-rule. The treatment planning work was very tedious, involving many hundreds of mathematical operations, and each new patient treatment took from half to a whole day or more to calculate.

A UK Newton-Victor 300 kVp 'Resomax' X-ray machine was installed later in 1957. This machine had a synchronous motor-generator set which converted the 50 Hz mains power supply to 1000 Hz for the resonant HV transformer. Later, around 1965 when the NZ Electricity Department commissioned its Cook Strait power cable, there was a problem each time the North Island load was switched up or down. This caused a change in the supply frequency, which resulted in large fluctuations in the Resomax's X-ray output. There was correspondence with NZED without much success. The local agents, Turnbull & Jones, designed a compensating circuit which helped, but the problem was never fully resolved.

With George's help, over the next two years Jack built an improved version of the isodose plotter, employing two tiny ion chambers built into the ends of probes containing the electrometer pre-amplifiers, one as a reference and the other as the search probe.

In addition to plotting sets of Co-60 isodose curves, it was also employed for obtaining isodoses for the Resomax-300 and other X-ray machines, and to plot iso-response curves for radioisotope probes and collimators.

They also built an automatic couch control for Co-60 scanning field treatments. The couch scanner control was designed to treat long fields such as spine and limbs, which were much longer than the largest field available (15 cm square at 75 cm SSD) on the cobalt unit. The treatment couch was driven back and forth at a constant speed under the stationary cobalt beam. During the dosimetry measurements for this technique, it was discovered that the moving field technique gave a significant increase in % depth dose - something not previously reported in the literature.

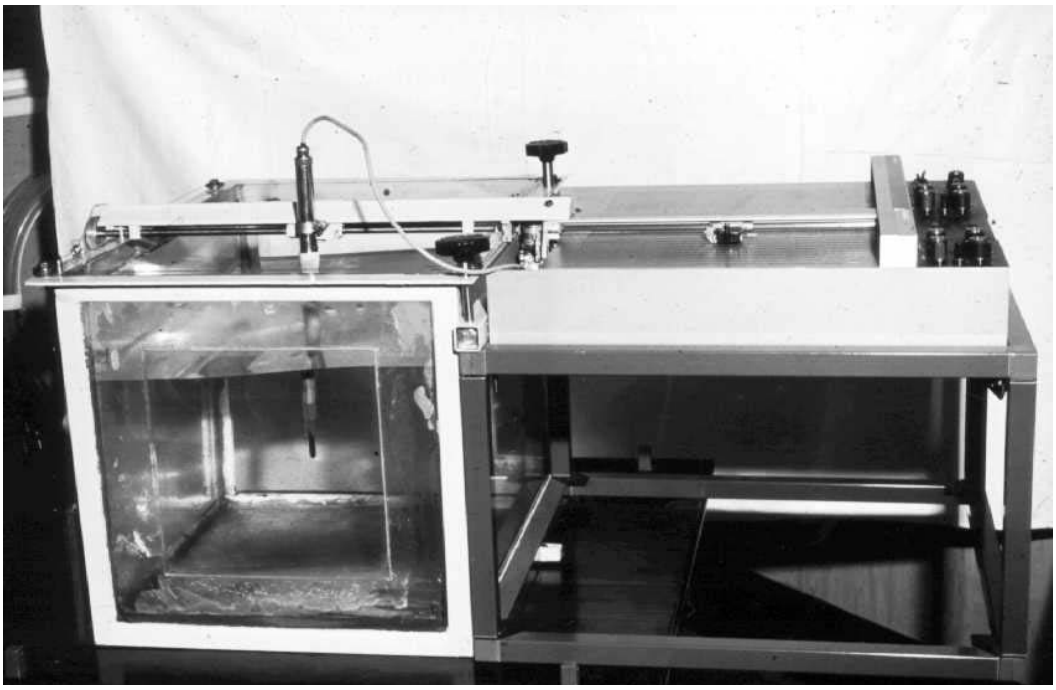
Staffing changes:

Bob Borthwick departed overseas in October 1959 on a two-year assignment in Pakistan, as an International Atomic Energy Agency (IAEA) consultant. (This was the first of a number of UN overseas assignments taken up by NZ medical physicists in years to come).

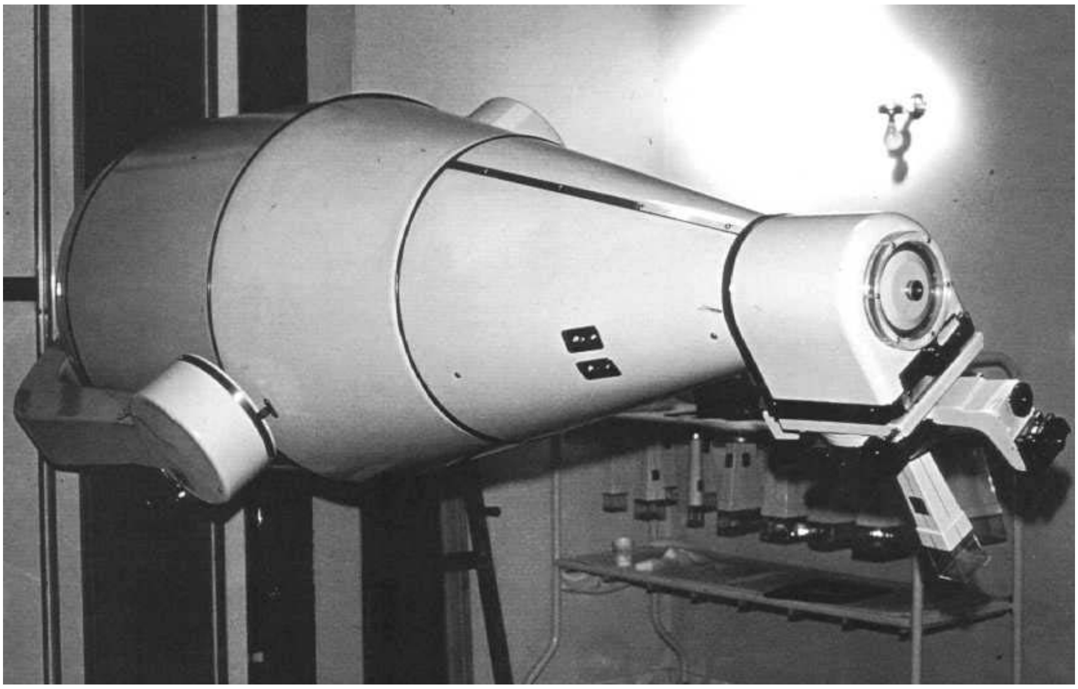
During Bob's absence, two more radium needles were thrown out in the rubbish and taken to the Bromley landfill tip. Tony Goldstein and Jack spent two cold, wet, muddy, miserable hours in a southerly storm with geiger counters, searching through the previous day's rubbish fill. On this occasion they were successful - the bulldozer driver finally uncovered the two missing 5 mg radium needles from beneath about a metre of earth and rubbish. This last event prompted Jack to build a radium radiation alarm beside the door of the Charge Radiographer's office/radium handling room. It would emit a loud squawk when even the smallest amount of radium was taken through the door. The monitor solved for ever the 'lost radium' problem which had troubled the department for so many years.

An English physicist, Miss Joan Hands, joined the staff in December 1959. Joan graduated with a BSc(Physics) degree from London University. She had also worked as a radio-isotope technician at St Thomas' Hospital, London, before completing an MS degree in Radiological Physics at the Memorial Hospital in New York.

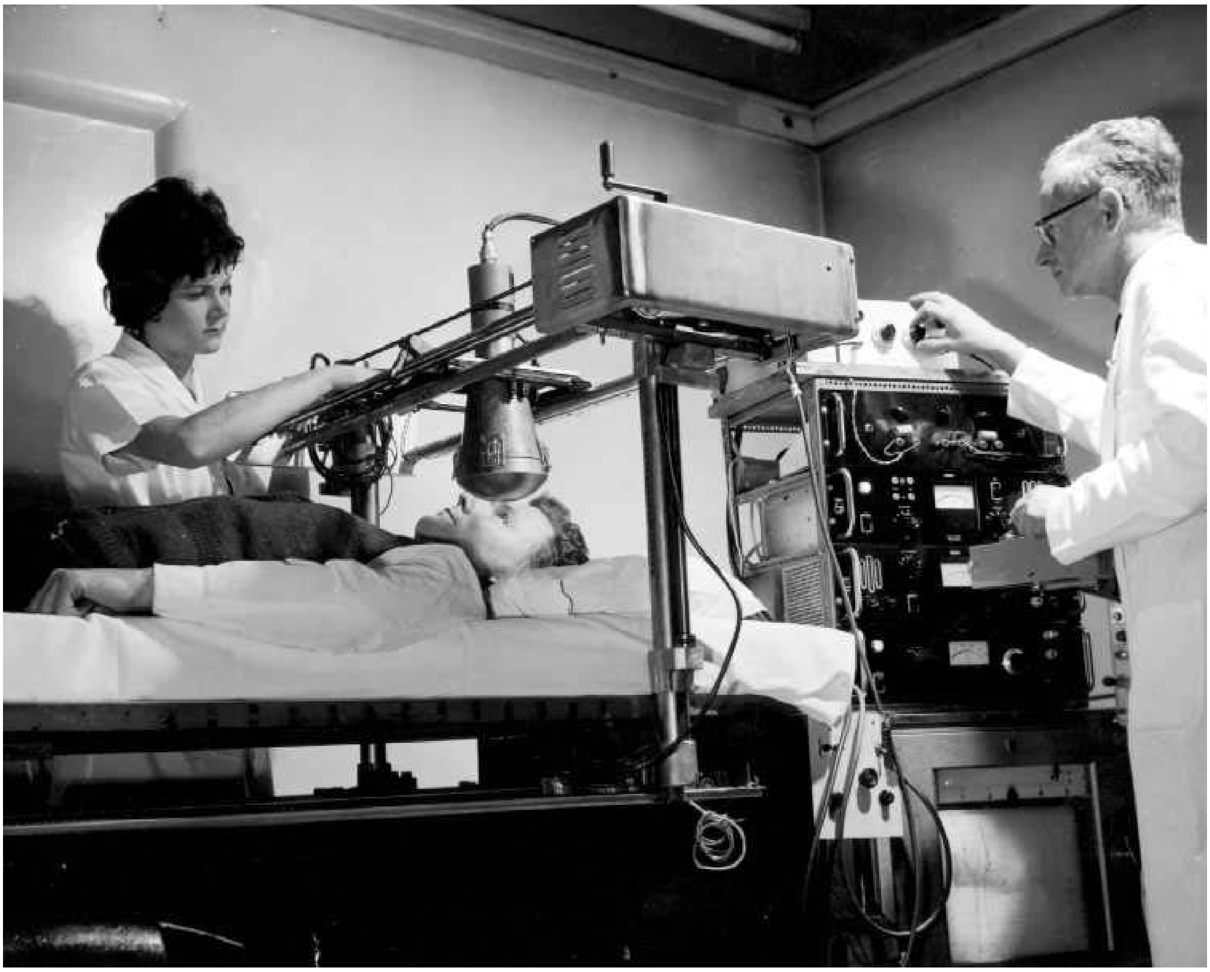
In 1961, a replacement Co-60 source was obtained for the Theratron-B cobalt unit. In the middle of the week before it arrived, Jack ruptured his Achilles tendon while playing tennis at the hospital during lunch break. He was taken to the operating theatre the next day and had the tendon surgically repaired. His leg was encased in plaster, and he was told to take two weeks off work. Because of the new Co-60 source being installed that



Early automatic isodose plotter, built by Medical Physics staff at Christchurch Hospital



Resomax 300 kVp radiotherapy unit, Christchurch Hospital - installed 1957. The last of the so-called 'deep therapy' units built, with 'supervoltage radiotherapy' taking over.



Early rectilinear scanner, designed and built by Medical Physics staff, Christchurch Hospital, with Jack Tait at the controls, and Tom Rogers as a 'simulated' patient.

weekend, he came back on the Monday morning to begin calibration. It was one occasion when he felt bitter with the Board's administration, who refused to allow him to take a taxi to work, so he was dependent on another Board employee for transport.

Physics staffing, and the shortage of physicists:

By 1961, when Bob Borthwick had still not returned, the Hospital Board wrote to him enquiring as to his future plans. Bon decided to resign, and subsequently took IAEA assignments in the Philippines, Thailand, and elsewhere, before joining the staff of United Nations (UNDP) where he remained until his retirement in 1989. On Bob's resignation, Jack Tait was appointed as Senior Physicist in May 1961.

In addition to the routine radiotherapy, radiation safety, and radioisotope work, Jack and Joan were kept busy giving lectures to radiology and dermatology registrars, to diagnostic and therapy radiographers, and to trainee nurses. (The lectures to all nurses seemed advisable when it was discovered that one senior nurse believed that the radiation protection film badges actually absorbed all the dangerous radiation and that, when the badges were returned to NRL for reading, the radiation was somehow 'squeezed out' and the film badges returned.) It was obvious that extra graduate physics help was required at that time to meet the growing demands of the work. In spite of gaining approval for an additional full-time physicist, and advertising in all the major NZ newspapers, none seemed to be available. The apparent general shortage of physics graduates around the country prompted Jack to write to Universities and other Hospital Boards, to assess the availability and prospects for getting young graduates to be employed in hospital physics.

Finally, a young MA(Cambridge) physics graduate, who had been lecturing at the Canterbury University Music Dept, applied and was appointed to the department in February 1962 as junior physicist. At the time, he did not see the job as a permanent one. He wished to get another position in the University if a suitable one arose. That young man was T G H (Tom) Rogers. In fact, Tom remained with the Medical Physics Department for the next 31 years, to become a key member of the staff!

Joan Hands resigned in April 1962 to marry, once more leaving the department with only two physicists.

Overseas study leave, 1962:

Jack received an IAEA Fellowship in 1962, and from October that year undertook a six-month study at the Donner Lab, University of California, at Berkeley, California. In addition to attending lectures on biophysics and bioengineering, he worked at the Lawrence Radiation Lab, building an automatic isodose plotter for measuring the 910 MeV alpha beam from the 110-inch synchro-cyclotron. This machine, which had been used to purify uranium for the first atomic bomb, was now being used peacefully, for treatment of pituitary tumours. During this time, Jack also had the opportunity to observe the work of Hal Anger and colleagues in the development of the gamma camera and other nuclear imaging devices. He visited the Stanford University Hospital Radiotherapy Dept, and the Varian Associates linear accelerator factory in Palo Alto. At the conclusion of the fellowship, he spent a month visiting medical physics departments in the UK, including Hammersmith Hospital, where Dr John Mallard had built a whole-body radioisotope scanner. (One of these scanners was later purchased by Auckland Hospital).

In Jack's absence, Tom Rogers continued to run the Isotope Lab with the promise of help in radiotherapy physics from NRL staff, although this was never required. During the 1962 University summer vacation, Bob Vincent came to help Tom. Bob was doing postgraduate work towards a PhD in physics. He returned to medical physics again for vacation employment in 1963 and 1964. On completion of his PhD, he was employed as temporary physicist in October/November 1967.

The radioisotope scanner project, 1963-66:

On Jack's return to NZ, a big effort was put into developing and building a radioisotope scanner capable of whole body imaging. An old diagnostic X-ray couch was obtained from the private radiology clinic, and formed the base of the scanner. George built all the scanning mechanism in the Physics workshop. It was first used clinically in 1964; after several modifications and improvements it was finally completed in 1966. This machine used cake-mixer drive motors as these were the only variable-speed motors readily available at that time. Nuclear Medicine legend has it that the best speed setting for bone scanning was '#5 - Mashed Potatoes'!

Printout of the images was originally via an oscilloscope screen and photographic camera, but this was soon replaced by a mechanical dot printer, and finally by an amplitude modulated pen scan on an X-Y plotter. At first a 1-inch diameter NaI crystal detector was used. This was replaced in 1966 by a 3-inch detector. Tom designed, and George built, a fine multihole focussing collimator for this new detector. The scanner functioned very satisfactorily for 10 years before being replaced by a Nuclear Data Gamma Camera in 1974.

Organ imaging development, 1967:

The scanner stimulated the rather conservative medical staff to request more organ imaging. When technetium-99m became available in early 1967, the Isotope Lab became very busy. Jack and Tom at first prepared Tc-labelled compounds themselves for scanning, and Tom carried on doing so for many months. It was always of concern that the labelled compounds should remain sterile. This was achieved by passing them through a sterilised millipore filter before injection. Retrospective testing always showed the injections to be free of any bacterial contamination. It became apparent, though, that a radiochemist or radio-pharmacist was needed to do this work. Sue Caldwell, with BSc(Chem), was appointed as the first radiochemist in 1969.

Growth in 'nuclear medicine' requirements:

A second medical physics technician, Eddie Fuller, joined the Department in 1964. Eddie had also previously worked as an electronics technician at DXRL; he became responsible for maintaining our electronic counting equipment as well as making new electronic devices for the Department. It became his task, over the next 30 years, to look after all the automatic beta- and gamma-counting equipment for the Department, as well as for the Medical Unit at Princess Margaret Hospital, and the Christchurch Clinical School.

In parallel with the imaging developments at Christchurch, there was a growing use of radioisotopes in other areas as well. Yttrium-90 was used for pituitary implants, and for infusion into the lymphatic system. I-131 use continued to grow, both for diagnostic and for therapy purposes. A big workload also developed for other departments such as the Renal Unit and Haematology Department. In particular, much work was undertaken with the Medical Unit at Princess Margaret Hospital. especially in the metabolism of radioiodinated hormones, albumin, and fats; or following the simultaneous administration of sodium-22 and potassium-42, or of calcium-45 and calcium-47. Equipment, mostly of local design and construction, was set up to do surface counting for renal function testing (renograms).

With all the routine radioisotope work in the department, the student radiotherapy radiographers were called in to assist, on a rotation basis, as part of their training. By 1965 a full-time radioisotope technician was needed, and Sue Burt, a qualified English radiographer, joined the staff. In 1967 she was replaced by Betty Sparks.

The 'Himalayan experience', 1966-67:

From October 1966, Jack was invited to be associated with Dr H K Ibbertson of Auckland, on a three-month study of goitre among the Sherpas of Nepal. This involved living in a tent at an altitude of 13,000 ft in the Himalayas, about 10 miles from Mt Everest, with one of Sir Edmund Hillary's expeditions. The team took radioisotope counters, portable X-ray, and laboratory equipment with them to investigate the incidence and cause of the thyroid disease which is endemic to the region. Tom once more acted as Senior Physicist, and Dr Dawn Seed, PhD(Physics), worked as locum.

Continuing expansion:

A third physicist, A H (Alun) Beddoe, was appointed in late 1967. Alun worked mostly in radiotherapy physics.

Mary Glasgow, BSc(Maths), joined the staff in 1968 to help with the radioisotope and radiation protection duties for the hospital. She was responsible for producing a radiation safety handbook for hospital staff.

By 1969 the Radioisotope Lab staff had grown to include three more radioisotope technicians, a third workshop technician and a secretary - a total of 13 medical physics staff. The Isotope Lab was now performing over 10,000 diagnostic tests per year, and seeing about 1,000 patients per year for treatment or diagnostic tests. There were over 40 different kinds of radioisotope studies being undertaken. The laboratory by now had built up a reputation for excellence which attracted requests for training from other NZ centres, as well as from Thailand, Indonesia, and the Philippines, under the Colombo Plan.

First NZ gamma camera, 1969:

Because of the success of the home-made radioisotope scanner, the workload for imaging was now becoming very large. It was obvious that a gamma camera would soon be needed. Using the fact that we had made our own scanner, approval was gained from the Dept of Health in mid-1969 to purchase the first Gamma Camera in NZ. By this time it was becoming obvious, too, that the work was becoming a clinical one requiring a full-time doctor. Jack had for some time tried to interest the diagnostic radiologists in the work. They did become responsible for reporting scan results, and their registrars administered the Tc-99m imaging doses, but there was little interest in a deeper involvement from the head of department. A more positive response was forthcoming from the physicians however, and Dr Bevan Brownlie, an endocrinologist from the Dept of Medicine, was sent for nuclear medicine training in Glasgow during 1970/71.

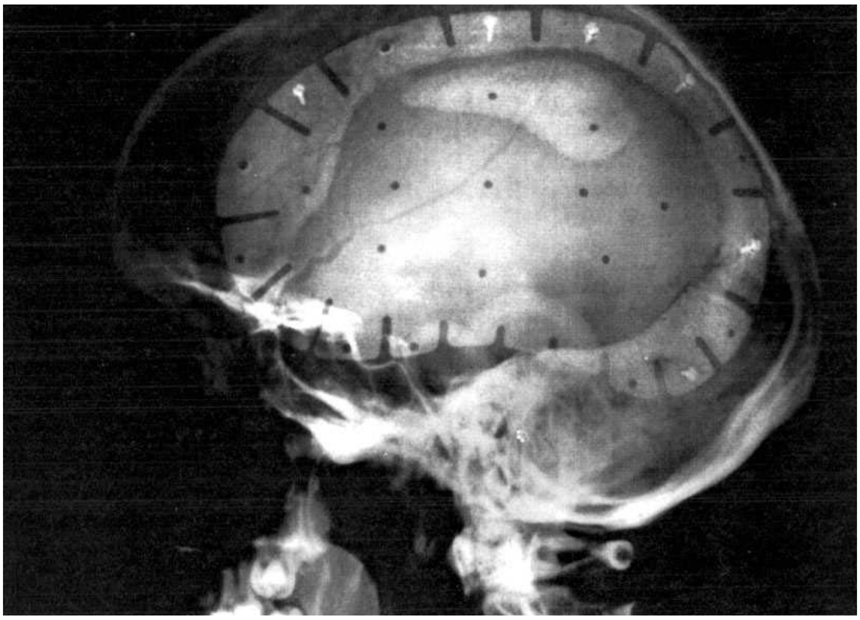
Overseas assignment, 1969/70:

At the end of 1969, Jack was invited to take up a Colombo Plan consultancy at the newly-built Ramathibodi Hospital in Bangkok, to help establish a Nuclear Medicine Department there, and to train staff in the work. He left with his family in December, and spent the next 13 months away, while Tom continued as acting Senior Physicist.

Gamma camera + computer system, 1970:

During this year, a Nuclear Enterprises gamma camera was ordered and installed, along with the first dedicated medical computer system. The computer was a PDP-8I based system, complete with magnetic tape storage facilities - the first such equipment to be installed in Australasia for gamma camera imaging.

'Himalayan interlude', showing some of the equipment carried on willing backs up into the mountains, and the view!
People (L-R): ? ; Kaye Ibbertson ; Jack Tait ; Ed Hillary



Titanium fabricated skull plate, made by Medical Physics staff, Christchurch Hospital

Christchurch Hospital - 'Radioisotope Lab' staff photo, 1969

Isotope Lab problems:

Space in the Isotope Lab was always short; slowly, more room was gained along the basement area by expelling the commercial cleaners and then the ward storerooms. By 1969, approval had been given to take over the whole area, and the alterations were completed in 1970. Although it was great to have the extra space, this was not without its problems. Frequent leaks and floods of water came down from the ward above - from overflowing sanitisers, showers, and toilets!

It is worth quoting from one of Mary Glasgow's notes:-
"Weekly Alluvial Report: 21st - 25th Sept 1970:
"Total number of floods - five.
"Monday 21st Sept - one flood outside Mr Rogers' Office, apparently occurred during weekend. Later in day, a flood in Ruth's office.
"Thursday 24th Sept - One small puddle of brownish liquid dripping for half-an-hour between 4 & 5 pm on Mary's desk. Soaked some papers. Soon began to affect the olfactory organs of several persons. Suspicion confirmed by Frank's discovery of THE puddle in the ward above. (This illuminates a perplexing recurrence: that of finding my papers & books dry but slightly crinkled and with an-er-distasteful odour when opened.)
"Friday 25th Sept - Very minor flood to greet us in the morning. Appeared in several places. Details from Alun:- 'Appears to be only water'. But somebody said that certain rooms smelt like a farmyard. VIPs came and looked and said something should be done, and shook their heads and said this was no good. Alun wrote a letter. Betty peered through a curtain of dripping water in the office doorway and asked Sue if she was expecting a patient from Niagara St, and everyone convulsed at the coincidence. Nobody felt like working. Some people couldn't anyway."

Growing demands on medical physicists:

Meanwhile a growing amount of work was developing in the radiotherapy and other clinical areas. In 1964, the medical physicists were urgently called upon to assist Dr Rod Suckling, eye specialist at the hospital, in removing a small copper fragment from a patient's eye. Within 24 hours, George and Jack produced a small set of forceps, connected to an audio amplifier and meter, so that the ophthalmologist would know when he had made contact with, and grasped, the metal fragment. The operation went very successfully, saving the young man's eye from permanent damage. His father was most grateful, and donated money for the purchase of a set of Stallard applicators. These radioactive Co-60 applicators were used to treat the eye tumours of infants suffering from retinoblastoma, a serious and often fatal eye disease. Alun Beddoe undertook the task of accurately calculating the dose distribution around the Stallard eye applicators. By this time, the applicators were being used nationally, on a loan basis to other hospitals.

During the 1960's Jack became heavily involved in radiation protection plannng for Radiotherapy additions; a Radium Suite at Christchurch Women's Hospital; the Clinical Services Block at Christchurch Hospital; Christchurch Clinical School; and an extension radioisotope laboratory at Princess Margaret Hospital.

The 'Clinac-6' linac, 1969:

A 'Clinac-6' linear accelerator was purchased from Varian Associates, Palo Alto, California, and installed in the expanded Radiotherapy Dept during 1969. George Gates was sent for training to the Varian factory, and on his return he took responsibility for the maintenance of the machine. Jack and Alun were involved in the commissioning of the linac and for measuring dose-rate and isodose data.

Some staffing changes from 1971:

Alun Beddoe resigned in early 1971; his place was filled by D I (David) Armstrong, an Australian with BSc(Physics) DipEd from Melbourne. David carried out radiotherapy physics routine duties. Later he was given time off to undertake a BE(Elect) degree, which he gained with honours. David left in 1978 for a position in Cardiff, Wales; Peter Watson, an ex-NRL physicist, took his place in Radiotherapy until David returned in 1980 for a further two years. His place was then filled in 1982 by E J (Eric) Browne, another physicist who had previously worked at NRL for many years. Eric remained with our department until he retired in January 1990.

Computer developments:

Tom's aptitude and keen interest in computer applications prompted him to make a private visit to USA and UK in 1972, to talk with computer manufacturers and hospital departments using computers for radiotherapy treatment planning, and for other medical applications. He was also able to see the UK prototype EMI X-ray CT scanner at Wimbledon. On his return, Tom set about planning for a dedicated treatment planning system at Christchurch Hospital. In spite of constraints being put on by the Health Dept's EDP Section, he managed to obtain authority to purchase a PDP-11 16-bit computer, and with help from Terry Peters (who joined the staff in 1973), they had it operational by August 1975 - to their knowledge the first operational 16-bit radiotherapy treatment planning programme in the world. David Armstrong had rewritten the treatment planning software when in Cardiff, using a similar algorithm; when the Oncology Department obtained a new VAX 750 computer in 1983, David's software was applied, utilising the same beam data as the previous system. It was hoped that other centres could copy and use the same package, but Health Department bureaucracy had by now stopped any such prospects, except at Waikato where Martin Pracy developed a system along Christchurch lines. The successive versions of the Christchurch planning system (later also with appropriate beam data for a Varian Clinac

2100 machine) were in use for twenty years, until being replaced by a commercial system in 1995.

New Delhi associations, 1972-80:

In 1972, Jack was asked to make a short (6 week) exchange visit to the Nuclear Medicine Dept at the All India Institute of Medical Sciences (AIIMS) in New Delhi. Dr A K Basu, Head of Nuclear Medicine at AIIMS, paid a return visit to Christchurch in 1976. Tom followed this up in 1980, with a visit to AIIMS to advise on medical physics.

The separation of Medical Physics from 1973:

With Dr Brownlie's return in 1971, and the splitting away of Nuclear Medicine from Radiotherapy Dept, space for Medical Physics was becoming a huge problem. Finally, in 1973, accommodation was obtained for Medical Physics at 20 Cashel Street. This 2-storied house was modified to suit the needs of the Department. At first only the ground floor was made available; it was not until 1974 that they were given the whole building. Dr Cambell did not at the time favour separation from Radiotherapy, but the move to Cashel Street meant de facto autonomy for a section of his Department which he had pioneered and nurtured for the last 18 years.

With the advent of the Nuclear Medicine Dept, changes also had to be made to the space in the Clinical Services Block which was now under construction. Bevan Brownlie and Jack Tait redesigned the area; Medical Physics managed to retain some space at the west end of the 2nd floor for its main offices. The workshops were relocated on the lower ground floor of the Riverside Ward Block. In exchange for this fragmenting of medical physics, promise was given that in the Stage 2 rebuilding, they would be given additional space. Unfortunately this promise was never kept, and the split between workshop and scientific staff remains.

Further computer and software development:

When the Nuclear Medicine section separated in 1972, Tom remained as their consultant physicist, while Jack concentrated more on 'bioengineering' work. Tom was involved in developing software for many applications in nuclear medicine imaging techniques, for three successive nuclear medicine computer systems between 1970 and 1993. Several papers appeared written by Tom, David Armstrong and Nuclear Medicine staff, especially with regard to their world-leading work on early uptake of Tc-99m. Tom also became the advocate for 'networking', although his plan for a computer network for the whole hospital didn't materialise until 1994 – thanks to the development of the notorious Health Dept EDP Division! There were some lesser achievements. First, several radioisotope counters belonging to various departments were linked together so that data could be transferred to a common microcomputer (this was produced and programmed by electronics technician Sinclair Bennett), and thence for processing of results to a PDP-11/23 computer. When the PDP-11 was due for replacement in 1989, Tom was able to persuade the departments concerned to obtain a Novell network of IBM-type PC microcomputers instead, which extended around the departments on the second floor of the Clinical Services building, and to the Electronics workshop on the lower ground floor.

Biomedical Engineering:

From the beginning of his appointment to the hospital, Jack had been keenly interested in medical electronics. With his radio engineering background, he could see all sorts of applications around the hospital. A paper to the NZ Medical Physicists' Association (NZMPA) conference in 1960 was on this subject.

In addition to the radiotherapy and radioisotope equipment, he and George produced many devices for other clinical departments during 1957-58 (much of it done in their own time in evenings and weekends). These included an ultrasonic dosemeter for Physiotherapy Dept; a temperature monitor for the Bacteriology Dept ovens; and an audible ECG monitor, which did not seem to attract the expected interest from the cardiologists. (It did however receive interest from one of the radiologists, and Jack fitted it to a chest X-ray machine as a cardiac trigger to synchronise chest radiographs with the heart cycle. A variable time delay enabled the radiologist to select a preset time for the X-ray exposure after the R-wave.) One of Tony Goldstein's patients required bone marrow to be saved prior to radiotherapy. The physicists were called on to help, and produced at short notice a cryofreezing unit. When tested months later, the cells still proved viable, but they were never required for reinjection.

On his return from the USA in 1963, Jack had endeavoured to interest the University Physics Dept with thoughts of starting a Masters degree in Medical Physics, but there was little response. However, the vacation employment scheme was supported by the Hospital Board, and was taken up each year by a young physicist. At that time Jack also built up a liaison with Professor Leslie Kay, Head of the Electrical Engineering Dept at the University of Canterbury. Both were then members of the NZ National Council of the IERE.

The venturing into biomedical engineering created a conflict with the Hospital Engineers Department, and much time was spent over territorial disputes. These were partially resolved with some demarcation lines set, but they remained as a continuing barrier to the proper development of the discipline.

The Christchurch Clinical School building commenced in the early 1970's, and the medical physicists became involved as consultants in the design of the radioisotope handling areas. Later when the School was operational, staff were involved in many aspects of scientific instrumentation, building a paediatric whole-body plethysmograph, and helping with the installation and maintenance of the electron microscope and radioisotope counters. Jack became a member of the Laboratory Services Committee, the Technical Sub-committee of the Medical Illustrations Committee, and the Computer Committee. Annual lectures were also given on radiation safety to final year medical students.

Jack attended the International Conference of IBME in Melbourne in 1972, and on his return founded, and for several years was chairman of, the Biomedical Engineering Society in Canterbury. This Society attracted many members, medical and scientific, from the University, Hospitals, and local companies. A much closer link developed between the Medical Physics Dept and the University Electrical Engineering Dept, with joint undergraduate and postgraduate projects being generated. Two young graduates, Richard Jones (BE) and Richard Tremewan (BSc Hons Physics) became the forerunners of many students associated with the Department from 1972, working on postgraduate theses and vacation projects.

Developments in CT imaging:

At this time, a new and important personality appeared on the scene - Professor R H T (Richard) Bates. Richard had been awarded a Personal Chair at the Electrical Engineering Dept. His particular expertise was in signal and image processing. He became a strong supporter of biomedical engineering, and over the next few years trained many students in the discipline. One graduate student, Terry Peters, was undertaking a PhD thesis on computed tomography imaging. This work was contemporaneous with the pioneering work on the first commercial X-ray CT scanner by Geoffrey Hounsfield in the UK, but its significance was not then recognised - certainly not by the local Radiology Department. However, Jack was an external examiner for Terry's thesis, and he immediately saw the importance of it as a means of obtaining patient cross-section images for radiotherapy treatment planning (which had always been a problem since early days). When Terry graduated in 1973, he joined the Medical Physics staff and, together with Richard Bates, they began developing ideas for building an X-ray CT scanner at Christchurch Hospital.

Some other activities:

For a few years from the 1970's, there were Government Employment Schemes to enable the employment of temporary staff, both in the workshop and also in the office. This enabled many projects to be undertaken, with the help of additional University students during their summer vacations, which would otherwise not have been possible. It obviated the need for Hospital Board funding for vacation employment. With a change of Government in the early 1980's, funding for these projects evaporated, and the Board would also no longer support the scheme.

X-ray CT scanner developments:

Terry Peters worked closely with the Radiology Dept, being a strong advocate for the purchase of an X-ray CT scanner for Christchurch. He worked for a year in Switzerland, and later travelled overseas on behalf of the Health Department to assess the state of commercial X-ray CT's (there was a 'rash' of commercial developments, with many firms racing to enter this prospective lucrative major market; it was a strange era), and to advise on their application in NZ. While in California, Terry arranged for a xenon-filled detector array to be constructed for Christchurch Hospital's own CT scanner. The original detector design proved unsatisfactory, and he and Jack modified it to be usable. The old Theratron-B unit was taken out of service, and replaced by a Theratron-780 in 1976. The rotation motor and mountings made an ideal stable base for the home-made CT scanner, and plans were made for its installation in the now decommissioned Resomax room.

Terry left to take up a position in the Montreal Neurological Institute in Canada in mid-1978, before the CT scanner was completed. Marshall Clark (ME), who had been working with Richard Bates and Terry on theoretical aspects of CT, joined the staff in Terry's place, and continued the work with the help of several University student projects. Marshall remained as scientist attached to the Radiology Dept, and helped with the commissioning of the commercial X-ray CT scanner when it was installed. His place was taken in turn by Trevor Knopp in 1981, when Marshall left to join NZED in Wellington. Jack filled the slot for Radiology duties when Trevor left in 1987, to work in the Hospital Board's DP Division.

Medical Physics Department developments from 1978:

With funding from local supply companies, Tom travelled overseas in 1977 to look at various items of equipment which would be needed for the Medical Physics Department in its new premises.

The Department moved to its new building on the hospital site in 1978. The move heralded another increase in staff to a total of 18, with additional mechanical and electronics technicians. In the same year, the department became involved in the design of a patient communication system for the new Burwood Spinal Injuries Unit. David Armstrong, Richard Jones, and Chris Fisher (one of the electronics technicians) developed a microcomputer-based system enabling patients to select radio and TV programmes, or to call nurses for help. A physics technician, Barry Woods, was appointed to maintain this and other equipment in the Spinal Unit.

Meanwhile Richard Tremewan continued with a medical degree course. He interrupted his final year of medicine in 1976 to gain an ME degree, undertaking a thesis project on Doppler ultrasound in the O&G Dept at Christchurch Women's Hospital. On completion of his medical degree, he joined the Radiotherapy Dept and, with technician Bernie Mentink, finally made the CT scanner operational in 1980, where it served usefully for the next 8 years. A commercial X-ray CT scanner (GE 8800) was finally installed in the Radiology department in 1981.

Richard Jones, as a thesis project, worked on a reaction-time tester for the Occupational Therapy Dept. He gained his ME degree and joined the Medical Physics Dept as biomedical engineer in 1975. Richard developed a battery of tests for the assessment of neurologically-impaired patients. Some of these were applied in a Neurology Department computer system, and involved patients carrying out tracking tasks, similar to a simple driving simulator, with the steering wheel interfaced to the computer. This work contributed to his PhD thesis. Richard was also involved with development and setting-up of a clinical computer system for the Intensive Care Unit. In this, he was partnered by Dr Richard Fright, who joined the Department in 1987, and who wrote the software for this project.

The availability of X-ray CT head scans from the new GE machine led John Hinton in 1981 to pioneer the construction of titanium prostheses in NZ. John was one of the Department's precision mechanical technicians; he had trained as a sheet metal worker at the Royal Aircraft Establishment, Farnborough, UK. Mr Martin MacFarlane, neurosurgeon, inserted these prostheses to repair severe skull injuries. At first, John constructed a 3-dimensional model of each patient's head from CT slices photographed to scale onto cardboard. The prosthesis was then fashioned by hand to fit the model. This was a long painstaking process, eased much later by the work of Richard Fright, using 3-D computer modelling. The purchase of a computer-controlled milling machine enabled direct fabrication from the computer images. The titanium is now formed in a high-pressure press - a much faster process.

In 1982, the Board's two surgical instrument technicians, Neville Turner and Brian Temple, were transferred from the Orthotic Department to the Medical Physics staff. By now the total staff had reached twenty-two.

For Jack and Tom, the next few years saw them becoming ever more involved in administration, committees, meetings, and planning. The other scientists and technicians continued to establish and develop their areas of responsibility.

No mention has been made of the considerable efforts by many staff members over the years in professional matters. Like physicists in other centres, they have been concerned with conditions of employment, salary scales, and grading committees, both for themselves and for their technical staff, and for professional organisations such as the NZMPA, which evolved into the NZMPBEA (with the inclusion of biomedical engineers); the ACPSEM (which came to 'absorb' the NZMPBEA into its NZ Branch); NZHPA(Inc); and NZHSOA.

The End of an Era:

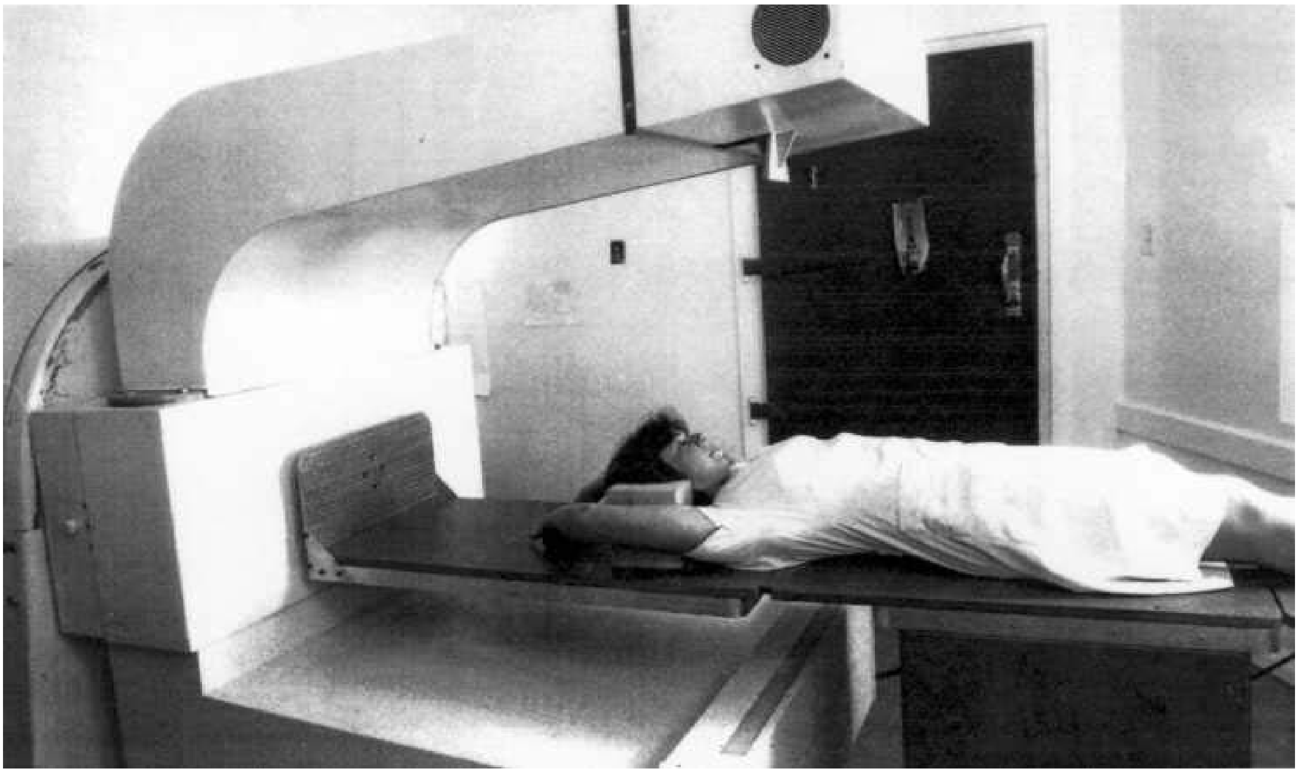
Jack Tait retired as Chief Physicist in March 1988 after 32 years with the hospital. He could foresee changes within the health system which would be best left to a younger scientist to cope with. This did not end his contact with the department though, and he was back in 1990 helping with the commissioning of the Varian 2100-C linac in the new Oncology building. Tom acted as Chief Physicist until a new appointment was made. George Gates, Tom Rogers, Eric Browne, and Eddy Fuller all retired by 1994, bringing to a close the first 40 years of medical physics at Christchurch Hospital.

Sadly, John Hinton died in 1994.

Dr Richard Tremewan, by now holding degrees in Physics, Medicine, Electrical Engineering, and Health Administration, was appointed as Director of the Department in late 1988. In that position, he has had to face the effects of changes from Hospital Board to Area Health Board to Crown Health Enterprise management. Each of these changes has imposed needs for additional budget constraints and restructuring, resulting in recent depletion, particularly of technical staff.

Richard Jones in 1987 completed a PhD(Medicine) through the Department of Medicine at the Clinical School, and from 1989 became a member of the Faculty in that Department. In the restructuring which followed Richard Tremewan's appointment, Richard Jones became Manager, Scientific Section. Since 1988 he has been actively involved as a committee member of IEEE, Engineering in Medicine & Biology Society, and with the ACPSEM. He has recently been awarded Fellowship of the ACPSEM - only the third New Zealander (all from Christchurch!) to receive this distinction.

John Turner joined the Department in 1989 as Principal Physicist in the new Oncology Department. Also with him in that department are Shaun Baggarley, Diana Mannering, and Andrew Faid. Darin O'Keeffe took over Tom Rogers' place as Nuclear Medicine and Diagnostic Radiology Physicist. Richard Dove now heads the Electronics Section, and Dr David Evans is responsible for radiation protection. So Medical Physics and Bioengineering at Christchurch Hospital is therefore in very capable hands. The future is largely beyond their control in the commercial environment which has now descended on our public health service. It will be up to the two Richards and their colleagues to write the next chapter in this story.



Christchurch designed-and-built X-ray CT scanner

Christchurch - Medical Physics & Bioengineering staff, 1992

CHRISTCHURCH STAFF LIST: PHYSICISTS AND ENGINEERS

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R A Borthwick (Bob)  Jun 1954 - May 1961 (from Wgton Hosp,
                          and NRL; Went o'seas to IAEA and UNDP)
J J Tait      (Jack) Mar 1956 - Mar 1988  (retired)
J M Hands     (Joan) Dec 1959 - Apr 1962  (BSc (UK);
                   MS (Memorial, NY); left to be married)
T G H Rogers  (Tom)  Feb 1962 - Mar 1993 (retired)
D P Seed      (Dawn) Oct 1966 - Dec 1966 (relieving only)
A H Beddoe    (Alun) Nov 1967 - Mar 1971 (to Auckland Hosp)
M G Glasgow   (Mary) Oct 1968 - Jun 1976 (to ...
(C Barber     (Cynthia) 6 months exchange from Oxford,
                              UK, while Mary Glasgow overseas)
D I Armstrong        Mar 1971 - May 1978 (to Cardiff, Wales)
                   (David) Mar 1980 - Jul 1982 (to computer firm)
                           Dec 1982 - Feb 1983 (to Chch 'Press')
G Wynn-Williams      ... 1972 - Apr 1973 (to Dunedin, MSc
             (Giles)                     under John Read)
T M Peters   (Terry) May 1973 - May 1978 (to Neurological
                                         Inst, Montreal)
R D Jones  (Richard) Feb 1975 - present (1995)
P Watson   (Peter)   May 1978 - Mar 1980 (retired to Motueka)
J M Clark (Marshall) May 1978 - May 1981 (to NZED, Wgton)
D H Goode  (David)   Jun 1978 - present (1995)
R N Tremewan         Mar 1981 - present (1995)
           (Richard)
T C Knopp  (Trevor)  Aug 1981 - Mar 1987 (to Ch Hosp Board;
                                          Admin, Computers)
E J Browne (Eric)    Oct 1982 - Jan 1990 (from NRL; retired)
P J Bones  (Phil)    Oct 1984 - Jul 1985 (to Elect Eng,
                                         Cant'y University)
S P Baggarley        Apr 1985 - present (1995)
           (Shaun)
D L Evans  (David)   Aug 1985 - present (1995)
W R Fright (Richard) Aug 1987 - present (1995)
A J Faid   (Andrew)  Feb 1988 - present (1995)
R A Dove   (Richard) Nov 1988 - present (1995)
D M Mannering        Nov 1989 - present (1995)
           (Diana)
D S O'Keeffe (Darin) Jun 1993 - present (1995) (Grad QIT;
        Princess Alexandra Hosp, Brisbane, and Hammersmith Hosp)
K Packer   (Katy)    Feb 1994 - Nov 1994 (to Cant'y Univ)
J Turner   (John)    May 1989 - present (1995) (from Auck)
A Dingle   (Alison)  Nov 1992 - Nov 1994 (to Perth, WA Univ)
N A Oien   (Niles)   Mar 1992 - present (1995) (from Canty
                                                  University)
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Acknowledgments:

It is not possible to list all those who have contributed to the success of Medical Physics & Bioengineering at Christchurch Hospital, but a few deserve special mention.

Dr Jim Campbell must take credit for starting it all. It was his foresight which led to the beginnings of nuclear medicine and to supervoltage radiotherapy in this city. He always offered good sound 'Aussie' advice.

Two other people who contributed significantly were Dr Tony Goldstein and Dr Lyn Berry. Both were far-sighted doctors who understood the importance of strong scientific infra-structure and made full use of the physicists.

Tony Goldstein was a most appreciative advocate of medical physics nationally, and was responsible for achieving much in the way of improving salaries and regular grading reviews. He served on the physicists' grading committee for a number of years until his death in 1976. He and Jack had many 'brain-storming' sessions after the rest of the department staff had gone home in the afternoon.

Dr Lyn Berry was Medical Superintendent-in-Chief from 1964 until his sudden death in 1979. He involved the senior physicist on a number of planning and advisory committees. There is no doubt that his support enabled the department to expand so successfully during his term in office.

References:

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The History of Christchurch Hospital 1862-1962
F O Bennett North Canterbusy Hospital Board - 1962

"Radiation Protection & Dosimetry in New Zealand"
A History of the National Radiation Laboratory
A C McEwan NRL, NZ Department of Health - 1983

"The Last Thirty Years"
The History of The Canterbury Area Health Board
Editor Alice Silverson Canterbury Health Ltd - 1995

Jack Tait
Sumner, Christchurch
October 1995

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HOSPITAL PHYSICS / SCIENTIFIC SERVICES AT WAIKATO HOSPITAL

A personal overview for 1965-1985 - Gordon Monks

Introduction:

In preparing this account of hospital/medical physics at Waikato Hospital - prompted by the Centenary of Roentgen's discoveries - it was suggested that it should attempt to record some of the information which would not normally be found in official records. A full and authoritative account would require a study of many records, and this would be undertaken better by an objective writer at a later date. Much of the material has been collected in the booklet by Dr Alan Lomas (the first Director) - "History of the Radiotherapy Department, Waikato Hospital 1984".

Any set of observations is influenced by the observer, and so I should begin by a brief remark on the circumstances that eventually led to my contribution at Waikato Hospital, so that a reader may have some idea of the kind of viewpoint from which I observed and shared.

It is relevant to record that I was born on Sunday, May 24 1925, in London within sound of Bow Bells, but not socially eligible to be a Cockney. Whereas the nursery rhyme says that Sunday's child is "bonny and bright", I was not. For the first ten years, I was a sickly child, and was in and out of doctors' surgeries and hospitals etc in constant succession. It was as if my life's share of poor health was concentrated in those first ten years, and ever since I have been blessed with excellent health. This is important to what followed, because it conditioned in me a permanent and profound interest in medical affairs.

My father was a pharmacist, with a modestly comfortable income, which made it economically possible for me to study medicine, with arrangements made to enter medical school late in 1941. However, a German bomb dropped on May 10 1941 demolished in one bang most of the family home, most of our income, and my prospects of entering med school. In a hurry, I had to find a job to help the family finances, and I was so fortunate as to obtain employment with the General Electric Co as a student in their Research Laboratories, at the princely wage of 12 shillings ($1.20) a week. They encouraged young impecunious students to study for suitable university degrees, by part-time study, and in due course I graduated from London University in Physics, in 1946.

This event occurred during our recovery from the Second World War, and I was able to revive my old interest in medicine (interrupted by the war) and combine with my new (unplanned but self-supporting) status as a physicist by entering the arcane sphere of Medical Physics, and did so at Lambeth Hospital, and later at Kent & Canterbury Hospital. My wife and I had been keen to emigrate to New Zealand for some years, but it was not until 1965 that the opportunity occurred at Waikato Hospital. I applied, fearing the most intense competition, obtained the job, and learned rather later the unflattering fact that I was the only serious applicant! There followed the shattering intensity of preparing for a permanent migration, and for reasons of time, I left my wife to pack and sell our house, while I flew hurriedly to Hamilton.

The peace and quiet of Alan Lomas' home was too much for me on the evening of my arrival. I fell asleep at their dinner table. I can just remember drifting blissfully off, and heard Alan's voice: "He's gone to sleep! It must be that damned Vermouth!" I could not rouse myself to tell him that it was more probably due to the 56 hours since I had last got out of bed. At that time, the sophisticated discomfort of long distance air travel was not as widely appreciated as now. If the 747 Jumbo is described as 'cattle class', then the older 707 was definitely 'sardine tin'.

Foundations for radiotherapy at Waikato:

Early in the 1960's (before my advent), there had been public pressure for a Radiotherapy Dept at Waikato Hospital; Alan Lomas had been a central figure in this, with his particular interest as Senior Surgeon at that time. Much fund-raising took place; approval for a department was obtained; planning and building began, while Alan went to London (Royal Marsden) from 1963-65 to qualify as a radiotherapist. The publicly raised funds were vested in the Waikato Cancer Society, which thereafter played a vital part in the whole exercise, although the main costs were undertaken by the Health Dept (through the Waikato Hospital Board).

During this period of preparation, Waikato engaged the services of Howard Tripp, from Dunedin, as the physicist (elect); he moved to Hamilton in June 1965 to oversee the final building, and then act as Physicist. After only a few days on site, Howard had the profound misfortune to be knocked over by a taxi in the hospital grounds, suffering moderate injuries. He had a congenital heart defect (which had been corrected later by surgery), and the effect of his injuries with this condition caused his death. In personal terms, this was a tragedy of prime proportions, but in addition it left the Hospital Board with the difficulty of a partly built new Department, without a physicist to guide the commissioning. At that time, there were too few hospital physicists to be able to appoint another from within NZ, and the search for a replacement went overseas, leading eventually to me. I was personally delighted at the appointment, but have for ever regretted the course of events which created the opportunity.

I reached Hamilton on October 20 1965, to find Alan Lomas lately returned from London, wrestling with the problems of a concrete shell of the Radiotherapy building, with the builders demanding all sorts of answers, some of which he found very difficult, particularly as the main machine (Co-60 Theratron-80) had been delivered in crates in the treatment room - unopened. From the first moment, we found each other the best of companions in double harness, and we developed this system, relieving each the other to undertake whatever we were better prepared for, and sometimes holding each other's hand when neither of us was sure what to do. I was considerably astonished by the generosity of attitude in providing the best equipment and accommodation reasonably obtainable, in contrast to my English experience, where money was unbelievably tight. (As a comparison, I should remark that my initial accommodation in Canterbury was a converted bicycle shed, while my predecessor there (Peter Orchard) was confined for all his work to a toilet without pan.) It was absolute bliss to have the prospect of a complete suite of rooms to work in.

While Alan concentrated on preparations for radiotherapy, I attended to some of the matters of building and equipment, where some of Howard Tripp's inventory had been delivered; some needed detailing while other items needed proposal. Gradually the whole chaotic scene took a recognisable shape. The Theratron technicians arrived to install the unit, which was near 'state of the art' at that time, and we awaited the arrival of the Baldwin-Farmer electrometer to conduct some calibrations. This was of considerable importance beyond Waikato, because there had been some uncertainty about the fundamental accuracy of calibration (including some problems at the UK NPL). This instrument had been sent to NPL for calibration before shipping to Hamilton. With this new calibration in sight, the NZ NRL was very keen to make some direct comparisons with established NZ instruments. This became possible early in 1966, and to our relief it appeared that there had not been any significant errors previously. I borrowed a plotting tank from Wellington Hospital to make a few spot checks on the Theratron-80 with the aid of the comprehensive set of isodose curves, and we were vaguely ready to begin treatments in February 1966. The word 'vaguely' is chosen because the building was far from finished, and all functions were conducted from the control room of the Theratron for some weeks. I will leave to the reader's imagination the potential for confusion when three or four different conversations were in progress within a few feet of one another, separated only by a cotton screen or by nothing at all.

I personally missed the historic first treatment, as my family had just arrived by ship, and I went off to collect them during those first few days of operation.

The Caesium-137 Unit:

After the initial treatments were launched, there was much discussion regarding the choice of a second deep-therapy unit. Opinion was firmly against 250 kVp orthovoltage equipment, which was just on its way out, in general. None of us wanted the complications of servicing that kind of unit. If you discount the doubts of the Health Dept, quite quickly the choice narrowed down to a Cs-137 unit, and the Cancer Society stepped in to provide finance for it. The order was confirmed, and all we had to do at first was to wait with such patience as we could. Time showed the need for patience, as the Cs-137 unit did not become operational until 1970.

There were no isodose curves available for a Cs-137 unit, so we set to with Eddie Graham (physics technician) to build a plotting tank to carry out the necessary measurements as soon as we had a machine to measure. It was the greatest blessing that Valentines had a surplus military equipment shop (since destroyed by fire) in Hamilton, and this enabled us to obtain some sophisticated remote control gear (servo motors with mechanical torque amplifiers) at ridiculously low prices - and quickly too. I must remark that a plotting tank was virtually unobtainable by simple purchase at that time, and a great deal of individual ingenuity went into such things, sometimes with a definite flavour of the legendary Heath Robinson. Ours was no exception.

Eventually the Caesium unit arrived, and after another year the Cs-137 source arrived, rendering the thing usable. A positive frenzy of isodose curve measurements then began; I must pay the warmest tribute to the team of radiographers (mostly students) who carried out the somewhat tedious plotting, but even more to the way they picked up the necessary skills in draughtsmanship (should I say, draughts-womanship?) when drawing the curves and lettering the legends. NZ Forest Products had a very large photocopier, and they did an excellent job of printing our sets of isodose curves onto transparencies. Then they added the kindly touch of not charging for their work. After this session of calibration, the unit went into service and was used consistently over many years.

Apart from the usual arguments over the units of radiation measurement to be used (roentgens, rads, or even 'water rads') the process of radiotherapy then settled on a fairly even keel, until the need for expansion, which will constitute another section later in this account. Over a period of years, the concept that the difference between, for example, 160% and 170% was not 10%, was imperfectly appreciated by some of us, but this technical detail never seemed to cause significant problems.

Treatment planning, and Simulator:

From the first, we had devoted much attention to treatment planning, and with the help of the Radiology Dept we had been able to make some progress with the problems of localisation. But there were of course patients who were of a size or shape, or of treatment site, which defied our best efforts, and left us in doubt of our assessment, while the time demands in these rather primitive arrangements were very severe. In one extreme but not untypical case, we had to insert a brass rod into a man's unmentionables before we could locate his prostate with any confidence.

Again, the Cancer Society came to our aid with financial support, and at a fairly early date a Siemens Simulator was purchased. This unit was essentially based on the mechanical design of the contemporaneous Siemens orthovoltage unit, and it did provide for rotation of the source around the patient, and flexible arrangement of beam direction (simulated). At that time, this was a real advance, although within a few years the design and supply of treatment simulators developed almost beyond recognition. This machine was used constantly for tumour localisation, and made our overall planning far more certain, in spite of its relative simplicity. It was not replaced until the Radiotherapy Dept was rebuilt in 1982.

Intracavitary and interstitial treatment:

A moderate stock of radium had been obtained at the commissioning of the unit, partly by transfer from other centres in NZ, and partly by new purchase, together with a Marsden gold-grain 'gun'. Radon was rapidly vanishing from use, and we made no attempt to use it. Alan Lomas did most of the surgical work in this direction, and followed fairly orthodox patterns. He had obtained in Europe a set of applicators for gynaecological insertions of radium, based on the Manchester ovoid technique, but improved by a 'scissor' attachment of the two ovoids.

These were of interest in themselves, but they also caused an example of the fact that many of our worst problems were of simple practicalities rather than high-powered expertise. In this instance, we needed to cover the two parts of the scissors with a protective sleeve, and nothing available was suitable, until Alan thought of trying to get some old-type condoms. He consulted some local pharmacists, and soon came in gleefully carrying a box of half-a-dozen which one of his friends had found forgotten in a storeroom. They were perfect for the purpose of covering the applicators, as they had a consistency appropriate to the inner tube of a bicycle tyre (robustness was clearly paramount) but we only had these few with no hope of replacing them. Consequently, we had to wash and dry them with great care. Things went well for some time, but one day Alan was conducting a group of District Nurses around the Department, including the radium preparation room. To his dismay, the set of half-dozen condoms was spread out on the bench to dry, to the stifled delight of a collection of mature and forthright ladies. Almost nothing was said, but I did feel that Alan seemed less keen about these applicators after this event.

Towards the end of the period covered by this account, there was considerable discussion regarding a change from radium to Cs-137, but nothing definite had been done by 1985.

Nuclear medicine:

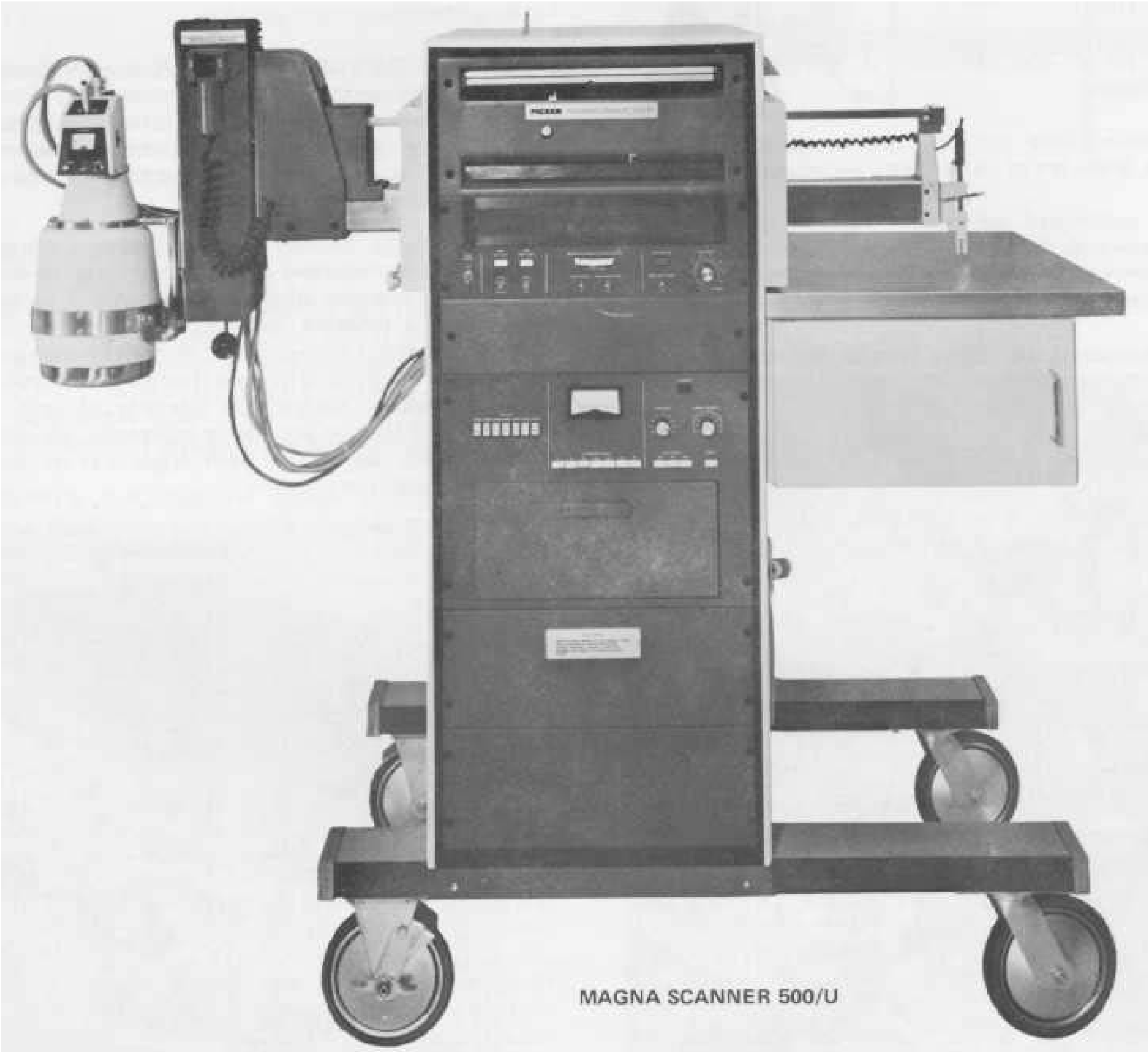
In 1965, it was common practice that Nuclear Medicine formed a part of Radiotherapy, and Waikato followed this convention. Alan and I had both had previous experience in this area, so we pooled our resources and set about beginning some activities. The first obvious area lay in thyroid function testing; we opted to avoid the difficulties of measuring thyroid uptakes or urine output, particularly in a rural area. So we took up the commercial kitsets for saturation analysis. There was not at first very much choice, but soon several companies were offering systems, and we had to wrestle with differentiating the tongue-twisting horrors of the various thyroid hormones. The proof of its success lay in the rapid growth of demand by local physicians. This caused us many headaches of time and supply, but gradually we mastered the new techniques. I doubt if the Budget Committee ever loved us for our demands for money for supplies and personnel.

My own knowledge of organic chemistry was limited, and I had to learn some techniques as best I could. Happily, there was much goodwill in the Pathology Dept, and they tolerated all manner of peculiar enquiries. But again, sometimes it was the simple things that were difficult. For example, when labelling red blood cells with Cr-51, the early process was somewhat tedious and slow, necessitating a prolonged and vigorous shaking near the end of the exercise. The only suitable shaker was a paint shaker in the Engineers' Dept, and it was extremely difficult to arrange the timing of labelling blood to allow access to the paint shaker before the paint shop shut for the day. At this time, such a problem sounds a little silly, but it was far from silly then.

Somewhat later, we had the good fortune to engage John Speed, a well-qualified technologist, and he was able to take over with skillful ease where I had been struggling, with great success. I heaved a huge sigh of relief at this point. John developed the application of radioassay to a very high degree of proficiency which progressed steadily and rapidly.

At a very early date in 1966, we were eager to obtain a rectilinear scanner; the Cancer Society did an excellent job of financing this quickly, ordering one of the ubiquitous Picker Magnascanners. The technical problems of making a serviceable scan were moderate, and with the assistance of Ray Trott (Palmerston North) who gave us much advice, we were soon producing results. Christine Reid, physicist, joined us from England early in 1967, and she devoted a great deal of time and effort to the scanner, with every success.

Alan knew that I had been involved in England with designing and building a simple scanner, and he asked if I was 'expert' in reading the scans. I hastily assured him that I was not, and that I could not help him in that direction. To this day, it seems to me almost miraculous that he and his colleagues in the trade were able to make reliable (more often than not) diagnoses from those early images. Nevertheless, they did it with such success that again demand rose rapidly. For at least ten successive years, both radioassay and imaging rose by about 20% per annum.



Picker 'Magna Scanner' rectilinear scanner, of the type installed at Waikato Hospital in 1966. This was universally regarded as the 'workhorse' scanner, with excellent reliability; most centres purchased one.

Waikato Hospital, Hamilton - early construction work (1981-82) on the redeveloped Radiotherapy Dept. The floor shown here later housed the Electronics Section of Scientific Services. Equivalent sights familiar to all hospital physicists; also showing delivery of the Varian linac through the roof, 1981.

In due course, the Magnascanner needed replacement, and this caused a good deal of controversy. Gamma cameras were becoming considered the right development, but they still had significant unreliabilities, and we finally opted for the Israeli Elscint rectilinear scanner - possibly the most developed rectilinear unit of any. If it had been produced a little sooner, and from a different country, I am sure it would have gained a superb reputation. As it was, we obtained an excellent machine and a long saga of hopeless maintenance. Israel was then in a state of almost perpetual war; their servicing base in Australia was erratic. Consequently George Coalter, who was running the imaging, had a nightmare in keeping the service in operation, and he earned the greatest respect for his ingenuity and determination.

This situation became intolerable, and we moved to a gamma camera, rather behind the prevailing practice, but at least by this time cameras were vastly improved. There were no serious problems with this advance, but the Budget Committee had another shock at the cost of stabilising the room temperature to safeguard the costly crystal in the camera head. I must confess that I was becoming somewhat inured to submitting proposals of high cost.

The other high cost which we were continually trying to contain was the technetium 'cow'. The commercial suppliers were competitive in cost, but the real problem lay in getting regular delivery. There had been discussion as to the feasibility of setting up a national base to provide a daily supply of Tc-99m, after the fashion of the 'milk run' operated from Lucas Heights, Sydney, but a dispassionate assessment of the weather and air services in NZ made it clear that it would be, at best, unreliable. With considerable regret, this idea was abandoned.

As the time approached for Alan's retirement, there was a move to re-organise Nuclear Medicine, with particular reference to organ imaging becoming part of a broader Radiology Dept. This concept was active in other centres, and was not driven by Alan's retirement, but it was coincident with it. This was almost the only time over a twenty-year period that Alan and I disagreed; he was adamantly opposed to such a change, while I, disliking the concept, accepted that the tide of change was unstoppable. Arguments reverberated around the hospital, and sometimes were too acrimonious to be desirable, but finally Nuclear Medicine was separated into parts, with organ imaging joining Radiology, while radio-immunoassay joined Pathology.

Division of Scientific Services:

The combination of Alan Lomas's retirement and the changes in Nuclear Medicine had a far-reaching effect on myself and those few people who were officially responsible to me. The hierarchy from 1965 was simple, as Alan was Director of both Radiotherapy and Nuclear Medicine, while I was responsible to him with the little band of physicists and technician. In the circumstances of 1981, these changes made my position impossible, as it would be necessary for me to serve at least three masters. Keith Cochrane (Medical Supt-in-Chief) and Nick Harry (Medical Supt) both sympathised with my problem, and quite shortly it became clear that the best solution was to form a new department providing 'physics' services to any part of the hospital needing them. This produced the 'Division of Scientific Services', with myself labelled Chief Scientist. In practical terms there was little change in our daily work at first, but the potential for other areas of interest developed gradually.

It became apparent that several other departments had problems where we could help, and additionally there were groups of technicians who needed some relationship with a technical/scientific group. In a couple of years, we had collected about 30 people of technical and scientific bent, and were attempting to weld these into a single service. There were early benefits from the improved relationships, but the unity desired was slow in developing, and my own retirement intervened before I was satisfied in this respect.

In particular, after long discussion, it was decided to transfer the Electronics Workshop from the Engineers' Dept to Scientific Services, as the work of this section was largely bearing directly on clinical situations, and the 'Scientists' were usually closer to the clinicians than the 'Engineers'. This proposal was simplified within legal requirements, because each of the tradesmen had their own relevant certification, George Coalter had become a Registered Engineering Associate (REA), while I was a Registered Engineer (from my UK experience). Tribute must be made to the attitude of John Richards (Electrical Engineer) who had done a tremendous amount of work over the years in developing Electronics, and who now was willing to relinquish his control in the broader hospital interests.

Computing:

So far, I have attempted to follow a chronological sequence of events, but in doing so I have bypassed one area of the greatest importance. We had been performing the computation of treatment planning by traditional methods, which required much time and patience. We had looked at some electronic computing proposals, but the cost and difficulties of access in the early 1970's were prohibitive. But in 1973, Martin Pracy joined us from England, and he soon developed a keen interest in computing, with particular reference to treatment planning. By this time, there were manageable commercial computers, and Martin did some sterling work in analysis and assessment of suitable equipment. Hardware and limited software were purchased, while Martin went into a long huddle to programme and commission the device, producing considerable software in the process. I was well out of my depth, and did my best to keep out of the way, but Martin seemed keen to discuss the pro's and con's of the possibilities, so that in due course I learned enough to be able to ask useful (?) questions, which helped to clarify his own thinking. Martin's interest was sufficient that he undertook an MPhil in Computer Science at Waikato University, to the delight of a host of us.

Later in this exercise, a number of other people played a significant part, but I must leave the assessment of their expertise to another writer - I am simply not sufficiently competent.

Martin's reputation throughout the hospital was soon recognised in computing, and he developed a wide variety of applications for other departments. This was a good deal easier to organise within the framework of the newly formed Division of Scientific Services than it would have been from within Radiotherapy.

Radiotherapy phantom:

For some years we had borrowed the phantom (alias tissue-equivalent manikin) from NRL as and when necessary, but the process had difficulties of timing, so that I conceived the idea of a phantom to be purchased and shared by four Radiotherapy centres. (I would assure the reader that this decision was not prompted by an unfortunate incident which may be of interest. On one occasion I telephoned NRL to discuss the shape of their phantom, which clearly had been modelled from a beauty queen. 'She' was universally and colloquially known as Cynthia. It was necessary for the relevant NRL officer to phone me back, and their telephone operator asked me to indicate the reason for my call. Flippantly (or whatever other adjective is appropriate) I said: "I want to discuss how I can make Cynthia pregnant". After a slight pause, the operator politely promised to convey my message. You may imagine my consternation later to learn that the operator in question was named Cynthia. No wonder she paused for a moment).

Anyway, after some high-powered discussion between the various hospital boards, it was decided that Waikato should buy and maintain the phantom, while the use of it would be shared between Dunedin, Wellington, Palmerston North, and Waikato. We made some robust boxes to keep the lady safe in transit, but even so we had a regular need to repair damage to the boxes - at least the phantom remained undamaged. The system worked well, and gave us all a much better facility to use the phantom when necessary. This phantom also had been modelled on a beauty queen, and later we made some additions, largely conducted by Howell Round. He cut some tissue- equivalent sheets to insert in the sections of the phantom, to make it nearer the proportions of a male when required, with great success. A little later, he also moulded some attachable mammary glands for 'her', as the manufacturers had sliced her chest flat, as if such things were unnecessary. With characteristic quiet competence, he undertook the task, and produced three pairs of attachable breasts large; medium; and small. I never enquired how he did it.

Oddities:

In hospital circles, people often never quite know what we do, but accept that it is a little odd. Consequently, physicists should be well adapted to doing odd things! Most of the odd requests were of a minor nature, but one warrants comment. The ophthalmologists had difficulty with providing satisfactory false eyes, and a request appeared asking that we should work with the medical artist to make these prostheses. This proved to be an intricate and delicate process, where a mould must be taken from the patient, cast in acrylic, painted once, covered with more acrylic, painted again, covered again, etc. In my group, this work fell almost entirely to Eddie Graham, Physics Technician. His combined efforts with Mrs Dee Monrad, Medical Artist, were masterpieces of realism. Eddie had originally been employed in heavy engineering (ships), and his adaptation to these tiny delicate devices was a marvel. This arrangement continued for some time, and then a suitable technician was employed in the Orthotics Dept, where it seemed more appropriate to process prostheses, and the work was transferred there.

Rebuilding:

It would have been January 1975 in that blissful quiet period when patients decline to report sick that Donald Mackay (Charge Radiographer) came up to my office with his statistics for the previous year's radiotherapy treatments. It had been increasingly difficult to complete daily treatments within ordinary working hours, and these statistics suddenly showed how urgent it was to increase the capacity for radiotherapy. In our innocence, we thought it would take at least three years to organise, finance, and obtain an additional unit - but it actually took seven years. Our first proposal simply for another machine was soon converted into a plan to build a much larger department for Radiotherapy (and Physics), with added rooms for consulting, chemotherapy, larger simulator, and generally upgrade the whole exercise. I was deeply involved in the design of layout, with a keen eye on the ergonomics of patient movement, all in close association with the hospital architect, John Paterson. There was much discussion between all of us as to the choice of additional machine, whether another Co-60 unit or an accelerator, and if the latter, what energy. Gradually, the preference moved towards an accelerator, and some analysis (mainly by Martin Pracy) indicated that this would be cheaper if the total cost over twenty years was assessed.

In this period of discussion, which had of course included the manufacturers' agents, I was rather startled when the agent for Toshiba appeared in my office in early July 1977, and said that his principals would like to see me in Tokyo on August 26! I was even more surprised when, a few days later, the British Consulate in Auckland said that they wished to take me to Britain to examine suitable equipment, including the accelerators made by Philips and Radiation Dynamics.

Some hasty application for 'leave of absence' followed, and the Health Dept's initial reluctance was soon overcome, and a combined tour was in sight. Happily, a little diplomacy enabled us to include Varian (USA) in the tour, and a balance was kept by each of the interested parties paying part of the costs, thus avoiding problems of bias or obligation. I was strictly directed that the tour must not cost either the hospital board or me any money at all, and this condition was achieved. With a little frantic organising, I was on my way to Tokyo, Palo Alto, Boston, and London, arriving back in Hamilton in 30 days - exhausted but enlightened.

Inevitably, by the time I was at the finish I had learned what I should have been asking at the beginning, but even so we gained an enormous benefit from the combined study, and we owed the various companies a huge debt of thanks for their enterprise and generosity, even if their own interests were involved too.

Shortly after this, planning took a more precise stage, and we began to crystallise ideas for the building and equipment, the latter in principle at that point. Martin performed a prodigy of calculations for protection necessary for the likely accelerator energy, whereupon we asked that the walls should be of concrete six feet thick. Nobody really grumbled at this, but John Paterson subsequently put in foundations to a frightening depth - if my memory serves me correctly, some of the piles were 30 metres deep - to carry the weight.

Amicable argument continued on the question of providing electron therapy with the accelerator, particularly as this affected the price quite sharply. My own attitude was against electrons as I felt that the added cost per patient was uneconomic, particularly as electron beam therapy was available at a moderate distance from Hamilton (probably for a rather small number of people who might need to travel for treatment). Eventually, the Health Dept approved the electron beam facility, and this proceeded.

During this long planning/building period, we formed the Division of Scientific Services, and the rooms allocated to Physics were renamed for the new concept.

Part of my overseas tour in 1977 included a visit to TEM Ltd who manufactured an excellent if costly simulator, and to cut a long story short, we replaced our old Siemens simulator with a very polished Ximatron simulator. Between my visit there and our purchase, there had been a commercial arrangement between TEM and Varian, with the result that the Ximatron was marketed by Varian.

University of Waikato:

From the earliest time, we had enjoyed a good relationship with the University of Waikato. A number of undergraduate students spent time working in the hospital, either as vacation work or as 'industrial' experience towards the degree of BSc.Tech. One was

Howell Round, who developed an interest which led him to undertake medical physics as a career, and to maintain contact when he eventually entered the University professionally.

George Coalter had undertaken a marathon of study at the University, until he graduated MSc (Physics), and so metamorphosed himself from a very scientific technologist into a very technical scientist - a most potent combination.

There had always been an informal and flexible relationship, but in 1983, Prof Bruce Lylie approached me with the suggestion that we prepare a course in Medical Physics as a unit within the university curriculum, including making me an Honorary Lecturer. I gathered all the suitable manpower we could muster, as lecturers for two or three lectures each, to avoid overloading any one person, and soon it was possible to offer the course, which proceeded in 1984.

The course was to be entitled 'Medical Physics', and I was determined that its contents should attempt to encompass this subject, and that it should not be specialised to radiation physics. With the enthusiastic part played by all the co-opted voluntary lecturers, we managed to design a widely ranging course, which attracted a useful number of students who seemed very happy with the exercise. I had some regret that my retirement terminated my own part in this quite quickly.

Radiographers' Registration Board:

During the early 1970's, radiographers were working on a proposal to seek legislation for registration. I was unhappy that the 'working party' at that time did not contain any representation for scientific or technical content. Some correspondence followed, with the effect that it was proposed to add a scientific/technical person to the group. As I might have foreseen, it was proposed that the person should be me, in the first instance. Long discussions were undertaken in Wellington towards this end (and including a syllabus for training radiographers), with slow but gradual progress. Eventually the legislation was enacted, and the working party became a statutory Registration Board, on which I had the privilege of serving in its early days. Although much of this work was personal to me with regard to Waikato, it is relevant in the context of this account, because of the need for me to discuss informally with colleagues in Waikato Hospital and elsewhere, in order to be able to present some kind of consensus view to the meetings of the board. The contribution of many un-named people in this respect was invaluable.

My retirement:

For many years I had been aware that I had a hearing problem, insofar as I had a severe high frequency deafness. This was progressive with time (alias age!). My work was becoming continually more related to committee discussion, which became steadily more difficult to hear. I should add that it was not so much a question of hearing, but of hearing correctly - which could occasionally be hilarious, but contained the potential for serious error. This was not a satisfactory situation; hearing aids were of minimal assistance, so I decided to retire early, with regrets, but certain that it would be foolish to attempt to continue to age 65. My 60th birthday happened to be on a Friday in 1985, so I retired on my birthday!

The last few days were to be carved indelibly on my memory. Alan Lomas had been in seriously failing health, and I had not seen him for some time, so I went to his home on the Friday preceding my retirement to say my goodbyes. Mrs Heather Lomas received me, and said that Alan was asleep, so I was unable to see him. On Monday morning, Martin came into my office, and asked whether I had heard that Alan had died on the Saturday. He then said that the staff of Radiotherapy and Scientific Services wished me to write a note for the obituary section of the paper. By some inspiration, the words assembled themselves in a few moments. The funeral was held on the Tuesday, and to my dismay John Meade (lately Medical Supt-in-Chief, and Alan's long-time friend) while giving a eulogy, read to the congregation filling Waikato Cathedral my obituary note for Alan. I was undone.

The next couple of days were busy with the necessary finalities, and I attempted to speak to as many as possible of the multitudes who had helped me on many occasions – but I fear that this was sadly incomplete, especially as some of them were no longer there. On Friday evening, a large number of friends covering most of those twenty years assembled to give me dinner and a most memorable finale.

My last official action was to give Martin my key of the department door.

Retrospect:

In the ten years since the events described above, there have been dramatic changes in the NZ public health system, particularly after the Budget of 1991. While these have been seen as political events, they do contain material of direct concern to medical physicists. The difficulties of the system derive essentially from the excessively rapid growth of the cost of medical care. This is related to a shift of emphasis from 'relief of suffering' to 'prolongation of life'. This is a simplification, but contains a large measure of truth, which is of concern to physicists because the prolongation of life is involved with 'high tech' procedures and equipment. In this area, physicists have an essential and central part to play. I venture to suggest that my generation should have been conscious sooner of this feature, and that the present generation may be forced to address the human and moral conflicts attendant on this. Otherwise, the political forces will take charge again without adequate understanding.

Gordon Monks
Coromandel
April 1995

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WAIKATO HOSPITAL, HAMILTON, STAFF LIST:
(details from George Coalter)
Physicists and Engineers:

C G H Tripp	(Howard)	Jun 1965	(deceased June 19; accident one week after starting work)
G K Monks	(Gordon)	Oct 1965 - Sep 1967	(from / to UK;
		and Aug 1968 - May 1985	(from UK; retired)
C Reid (Mrs Koppens)	(Christine)	Jan 1967 - Nov 1969	(from UK; resigned; still in NZ)
D Robinson	(David)	Jun 1968 - Feb 1969	(from UK; to .....)
V Marsden	(Vera)	... 1968 - ... 1969	(from Auckland Hosp; to secondary teaching)
E Chao-Chin Chou	(Elizabeth)	... 1971 - 1972	(from Taiwan)
M Pracy	(Martin)	Jun 1972 - ... 1973	(from UK; to UK for study (1 yr); back to NZ 1974)
		Dec 1974 - present (1995)	
G Coalter	(George)	Jul 1974 - present (1995)	(from UK)
H Round	(Howell)	Dec 1977 - Aug 1979	(NZ; to Waikato University)
Chieng Chan	(Chieng)	... 1979 - ... 1981	(from/to? Malaysia)
P Metcalfe	(Peter)	May 1982 - Jul 1990	(NZ; to Australia)
S Conners	(Sherry)	Jan 1986 - May 1986	(from Canada)
W Beckham	(Wayne)	Jan 1986 - Jan 1990	(OU MSc (Med Phys); to Adelaide)
Lee Jaing	(Lee)	Dec 1990 - Dec 1992	(from China)
N Harper	(Nigel)	Aug 1990 - present (1995)	(NZ)
D Wilson	(Darren)	Sep 1993 - Dec 1993	(from Australia)
M Bird	(Mark)	May 1994 - present (1995)	(from UK)

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RETROSPECT AND CONTEMPLATION

There has been much stirring of old papers, documents, photographs, and memories, as our small group has brought forth this collection of writings.

A great amount of this material remains outside these pages, although some of it has had a considerable influence on the progress in these fifty years. One example is the report by Dr Ralston Paterson, of the Christie Hospital, in February 1944, on "Radiotherapy Services in NZ" - I think there have been echoes of such reports and the like in various ways down these past fifty years. Perhaps a more formalised history of the development of medical physics and biomedical engineering should be written, to include such material before it turns to dust.

Many humorous memories have also been stirred - like two earnest young physicists making radiation protection measurements on a private non-shockproof X-ray plant; when the HT was switched on, one saw the meter go hard over backwards, while the other felt his hair rise towards an inviting HT wire loop! Or the 'hot' radioisotope lab at a major overseas hospital; a willing architect who knew there were also 'cold rooms', had included wall heaters on every available surface. The stories could go on ....

November 1995 also draws together many threads - past, present, and future. November 1995 is the occasion of the Roentgen Centenary; it is also the 50th anniversary of the beginnings of hospital physics in NZ as we know it. It pre-dates, a year to the month, the centenary of Becquerel's announcement to the Paris Academy of Sciences of the results of his discovery of radioactive radiations emitted by uranium compounds. Which reminds us that this year is the 50th anniversary of the atomic bombing of Hiroshima and Nagasaki. And reminds us too of nuclear weapons testing at this present time by France and China.

I have also been thinking of John Read in relation to those events - some of us knew him and greatly appreciated him. Actually, he was of an age with John Strong, and as John Read said in his 1961 John Strong Memorial Lecture (well worth re-reading still), they were of much the same age and their early careers were similar, even to them both working in London hospitals at the same time in 1939-40, but unaware of each other although only 15 miles apart. Some of us in NZ were writing to John Read, in London, almost fifty years ago on questions of hospital physics data, so there has been an extended historical link.

John Read's work with L H Gray in the 1930's brought them both into international prominence, initially through their work on neutron and alpha particle dosimetry, and the RBE (relative biological effectiveness) of various radiations, including neutrons, alpha particles, X- and gamma-rays, and their continued work in radiation biology. In those early years, they actually built their own equipment, just as has been done by many of us in medical physics here - they built a neutron generator; oil diffusion pumps; wound their own transformers. Then the war intervened. John Read told me that at that time, he had a letter from John Cockroft (of Cockroft and Walton generator fame, and subsequent work), then head of the secret British work on the possibility of developing an 'atomic bomb'. The letter asked John Read if he would go to work in Canada on a project. As John told it to me: "I walked around London all night; why would he want me to go to Canada to work?" He thought out the answer: "They want to make a bomb!" He went home, and wrote to Cockroft asking if that was so, and entrusted his letter to British Post. (Security??) He told me he had the shortest letter he ever received: "Dear Read, Your surmise is correct. Cockroft." And he wouldn't go. Instead he took up war work at BTR, Rugby. In 1950, he came to NZ with his family.

Medical physics and biomedical engineering everywhere over this past 50-100 years has worked very hard in the application of serious scientific effort to make good use of ionising, and now non-ionising, radiations, and also modern technology, in the interests of patients. We have come a long way in New Zealand from small humble beginnings. There are serious questions ahead, which cannot get short answers by entrusting a letter with a 40 cent stamp to NZ Post. It will be interesting to follow ongoing events as they unfold.

Hugh Jamieson
November 1995

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