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CANADIAN COLLEGE OF PHYSICISTS IN MEDICINE
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CANADIAN MEDICAL PHYSICS NEWSLETTER / Le BULLETIN CANADIEN de PHYSIQUE MEDICALE

Juillet / July 1993

From the editor:

The seventh issue of the Canadian Medical Physics Newsletter to come out of my office has set a record; it is over 40 pages in length. Much of the issue is devoted to the recent medical physics meetings held in Canada. As we can all see there is a lot going on right now.

Many of us were able to attend the excellent meeting in Ottawa in May. I think we can all congratulate Paul Johns and the local arrangements committee for a job well done. One development from the Ottawa meeting was the switch to the CMBES format of the proceedings. I hope that this format will be adopted for future meetings. It was so nice to be able to read an abstract and actually get some information from it. The scientific content of the meeting will be reported in an upcoming issue of *Medical Physics*. In this issue the business end of things is reviewed.

Of particular concern are some of the professional and accreditation issues now developing. Take the time to read the reports by Peter Dunscombe and Martin Yaffee. The mammography accreditation is an especially important issue since this will be one area where medical physicists will be able to serve the community and raise their profile. Martin is actually trying to get things off the ground quickly with a course in Toronto, I trust he will have the support of the COMP/CCPM membership.

I also congratulate all the graduate students whose work is reviewed in this issue. It is obvious that medical physics research continues to be a strong activity in this country.

Presently I have one report from HARP for the next newsletter in the fall. I know I can rely on Jake Van Dyk and Aarron Fenster for two more. But please submit your own articles. The articles from McGill in this issue gives you an idea of the news we are trying to report.

After the suggestions at the general meeting this issue has been compiled with extensive help from a secretary. You will most likely find much fewer typos and glitches in this and future issues of the Newsletter. I thank Heather Schreiner for the hours she put in arranging this issue.

John Schreiner
McGill University

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INFORMATION EXCHANGE

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Professional Standards and Related Issues

As you will read elsewhere in this Newsletter the development of national standards for our profession is high on the Agenda of COMP's Professional Affairs Committee. While these standards are being developed, and this will involve extensive consultation across the country, many Medical Physicists with managerial responsibilities will be obliged to formulate positions on such issues as staffing, progression through grades and training in advance of approved national standards. Physicists in Ontario (and no doubt elsewhere) have grappled with these issues for many years and have generated several relevant documents. As these will be of assistance to Physicists in other Provinces who are either dealing with related issues locally or - and I trust this is the case - getting prepared to contribute to the development of national standards, the Ontario documents are being made generally available. Having the current versions of these documents formally approved by the Ontario Cancer Treatment and Research Foundation is, in some cases, in progress so they should be regarded as drafts at this time.

The documents available are;

1. OCTRF Physics Staffing Survey
   (based on a model developed by Mike Patterson and Jake Van Dyk) Author: Lee Gerig

2. Commissioning and Quality Assurance of Treatment Planning Computers (this has been accepted by the Red Journal).
   Authors: Jake Van Dyk et al

3. The Training of Medical Physicists in the Physics of Radiation Oncology.
   Authors: G.P. Raaphorst et al

4. The Medical Physics Career within the Ontario Cancer Treatment and Research Foundation.

5. Quality Assurance for Medical Linear Accelerators
   Authors: Jean Robins et al

This contribution to the Newsletter is submitted in my capacity as Chairman of the OCTRF Medical Physicists Association. Changing hats to that of COMP's PAC I would welcome receiving any Provincial documentation relating to the above issues which may assist in developing national standards.

You can obtain the documents above either from the first author indicated above or from me via a faxed request.

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Sudbury, Ontario
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ACCREDITATION OF MEDICAL PHYSICS GRADUATE PROGRAMS AT McGILL UNIVERSITY

In April 1993, the accreditation Commission of the American Association of Physicists in Medicine issued a full 5 year accreditation to the M.Sc. and Ph.D. Medical Physics programs at McGill University in Montreal. McGill thus becomes one of six North American universities with an accredited graduate program in medical physics. The other programs are at the University of Colorado, Denver; University of Oklahoma, Oklahoma City; M.D. Anderson Cancer Center, University of Texas, Houston; Wayne State University, Detroit; and University of Wisconsin, Madison.

At McGill, the graduate programs leading toward M.Sc. and Ph.D. degrees in medical physics are given under the auspices of the Medical Physics Unit (MPU), a unit in the Faculty of Medicine. The main objective of the MPU is to join in one academic unit the medical physicists who hold their primary appointments in various clinical departments at McGill or in McGill teaching hospitals. Currently, the MPU consists of 12 faculty members and is split into two divisions: *clinical*, with offices and laboratories at the Montreal General Hospital, Royal Victoria Hospital and Jewish General Hospital and *imaging*, with offices and laboratories at the Montreal Neurological Hospital. The main MPU office is located at the Montreal General Hospital.

The *M.Sc. program in medical physics* is nominally a two year program in which students take 12 mandatory medical physics courses (28 credits) during the first year and work on their M.Sc. theses (32 credits) during the second year under the supervision of an MPU member. The prerequisites for admission to the M.Sc. program in medical physics are a B.Sc. degree in physics or related science with an undergraduate studies GPA of 3.00 or more.

The current M.Sc. thesis program is structured such that, in addition to the basics of medical physics, the students get some practical knowledge through the mandatory laboratory work in radiation oncology,

radiology and nuclear medicine. The students are also given some research training through their thesis work. Thus, the program gives the students the basic theoretical and practical knowledge of medical physics required to enable them to either enter the job market in clinical physics at an M.Sc. level or continue their studies toward a Ph.D. degree in medical physics. The continuation toward a Ph.D. is of course recommended only to students who excel during their M.Sc. studies.

During the 14 years of its existence, the M.Sc. program developed from an initial applied program with emphasis on didactic work to the current thesis program, which gives equal weight to academic and practical knowledge of medical physics (first year) and research training (second year). Between 1979 and June 1993, 48 students graduated with M.Sc. degrees in medical physics, 43 directly through the MPU, 4 through the Physics department, and one through the Electrical Engineering department.

The *Ph.D. program in medical physics* is open to students with M.Sc. degrees in medical physics from McGill or other institutions. The students register in the McGill Physics department but work on a medical physics project toward a Ph.D. degree under the supervision of an MPU staff member in one of the two hospital-based MPU divisions. To receive a Ph.D. degree in medical physics the student must fulfill all course requirements of the Physics department including the *"preliminary examination in physics"* and successfully defend a Ph.D. thesis on a medical physics subject.

During the 1992-93 academic year, 27 graduate students were enrolled at various levels of medical physics studies at McGill, 21 students in the M.Sc. degree program and six in the Ph.D. degree program.

Ervin B. Podgorsak
McGill University
Montréal, QC

High dose-rate brachytherapy at McGill

In the past few years the brachytherapy service provided by the medical physics department at McGill has dramatically increased following the receipt of a second remote high dose-rate (HDR) afterloading device (microSelectron, Nucletron). In addition to the scheduled source calibration and QA required for the operation of this afterloading device, the medical physics department is intimately involved in both the patients treatment planning and treatment delivery with this unit. We would be interested to know if other centres in Canada have had the same experience, and if similar approaches to high dose-rate brachytherapy are in place.

As a brief overview the medical physics department provides service to the three McGill teaching hospitals with radiotherapy departments (Jewish General Hospital, Montreal General Hospital and Royal Victoria Hospital). Equipment includes three Cobalt units, three low energy linacs, one high energy linac with electrons , one dual energy linac with electrons, three simulators, one orthovoltage unit, one superficial unit, one high dose-rate Cobalt afterloading unit, one high dose-rate Iridium afterloading unit, two commercial treatment planning units, one custom treatment planning unit and various dosimetry equipment. All therapy machine service is done in-house.

The number of new patients seen in our combined clinics is about 3800, and the present staff includes four clinical physicists and two dosimetrists. Special procedures include total body irradiation (photons and electrons), stereotactic radiosurgery, pseudo-arc electron techniques as well as standard protocol procedures.

High dose-rate brachytherapy has been performed since 1984 with a Selectron HDR Cobalt unit and prior to the acquisition of the microSelectron unit, our yearly brachytherapy treatment load was around 130 treatments with over 90% of treatments being for gynecological malignancies. Gynecological patients are usually treated once a week for three weeks, and due to the necessity of spinal anesthesia, treatments are scheduled for one morning a week where up to four patients may be treated in the morning. The Selectron HDR Cobalt machine continues to be the unit used for intracavitary gynecological treatments.

A microSelectron Iridium HDR afterloading unit began clinical use in 1990. The advantage of the HDR Ir-192 unit is the small source size, which has made the surgical insertion of steel and plastic catheters in previously inaccessible body sites a possibility. The Ir-192 HDR unit has a single stepping source with 18 channels and it is not uncommon for us to treat patients with interstitial implants in ENT and GYN sites with all 18 catheters implanted. Because of the high dose-rate nature of the procedure, treatment plans are often required immediately following the receipt of simulation films. In our centre all treatment planning is performed by physicists using a treatment planning program developed in-house especially for high dose-rate brachytherapy. Producing a treatment plan may take minutes to hours depending upon the number of catheters, the complexity of the treatment volume and the constraints imposed on dose limiting organs. The shaping of the isodose curves is done with the radiation oncologist and care is taken with the use of

non-standard catheters to ensure proper source positioning in the catheter.

Treatment regimes and fractionation schedules vary depending upon the site of treatment, however multi-catheter patients are usually treated twice a day over the course of four or five days. Routine weekly procedures include the treatment of main-stem bronchus and esophagus. For bronchial treatments, patients undergo catheter insertion with the aid of bronchoscopy and the video image is recorded and compared over the course of the treatment. During a morning two to four patients may be treated with one to three catheters placed in the bronchial region of interest. The treatment of the esophagus follows a similar pattern whereby one to two patients undergo gastroscopy for catheter placement. Both bronchus and esophagus patients may have up to four separate treatments all of which receive a custom treatment plan.

All treatments (source insertions) are monitored by a physicist, and following the Omnitron accident of November 1992, we now routinely check for the safe source position with a hand held radiation monitor following every treatment. This is in addition to monitoring with a secondary wall mounted radiation meter. Rumour has it the NRC (U.S.A.) may require a physicist to be present for all radioactive source insertions or removals for brachytherapy procedures where the source activity exceeds a certain value. This sort of regulation would almost certainly implicate HDR users in the U.S.A.

During the 1992 calender year our department produced treatment plans for the following sites on the microSelectron: 70 Bronchus, 27 esophagus, 16 ENT, 12 GYN, 4 extremities, 3 brain and 2 abdominal. During the same twelve month period the following number of treatments were delivered: 70 Bronchus, 27 esophagus, 124 ENT, 48 GYN, 31 extremities, 16 brain and 12 abdominal.

Since our first high dose-rate treatment in 1984 over 2000 treatments have been administered with both afterloading units, (approximately 1200 with Cobalt and approximately 800 with Iridium) and with one exception this has been without incident. This year (1993) we would seem to be aiming for about 500 microSelectron (Iridium) treatments, and about 130 Selectron (Cobalt) treatments.

Michael D.C. Evans
McGill University
Montréal, QC

WESCAN '93

WESCAN '93 took place from the 18th to the 20th of March, 1993 in Saskatoon. A total of about 45 participants enjoyed a fairly traditional program. The Thursday evening informal discussion on High Dose-Rate Brachytherapy involved a number of centres which are about to start HDR programs. None of the participants had treated patients yet, which limited the ability to make definitive pronouncements, however it was useful to share ideas on this new equipment. Friday morning's scientific session included an invited talk by Rock Mackie who stimulated everyone's imagination with his views on "External Beam Radiotherapy in the Year 2000". The afternoon technologists' paper competition was of high quality with Wanda MacDonald and Ann Fitzpatrick, both from Regina, sharing the first prize. To close the afternoon Doug Cormack presented an interesting travelogue on his trip last year to Chernobyl. Saturday morning comprised another scientific session and then an informal tour of the Saskatoon Cancer Centre. The conference including the social program was made possible by generous support from Best Industries Inc, Multidata Systems International, Nucletron Corporation, Philips Medical Systems, Siemens Electrical Limited, Theratronics International, Varian Oncology Systems, and the Saskatchewan Cancer Foundation.

Alistair Baillie
Saskatoon Cancer Centre

WESCAN ABSTRACTS

Jim Clark: **HIGH DOSE-RATE BRACHY-THERAPY: Practical Considerations for Establishing a Program.** Nucletron Corp., Walton Hills, OH

Canada has been involved with remote afterloading devices since the development of the Selectron-LDR in 1977. All but three radiation therapy clinics in Canada have at least one device. Since the development of the microSelectron-HDR in 1987, all new purchases have been high dose, with the exception of new start-up clinics and the newly developed microSelectron-PDR at Princess Margaret Hospital. A review of the history and

development of remote afterloading in Canada will be given with special emphasis on the following:

- HDR - what is it?
- Room design
- Imaging options
- Quality assurance
- Training
- Clinic uses
- Shielding requirements
- Source calibration
- Safety features

Ron S. Sloboda: **PREPARATIONS FOR HDR BRACHYTHERAPY AT CROSS CANCER INSTITUTE.** Cross Cancer Institute, Edmonton, AB

In each of the past two years more that 150 low dose rate (LDR) brachytherapy procedures have been performed in our institute. These treatments have been delivered almost exclusively with remote afterloading equipment, which presently includes a 6 channel Selectron LDR and two MicroSelectron LDRs. Later this year, we are expecting to take delivery of a Selectron HDR and PLATO Planning System, and to begin a clinical programme of high dose rate (HDR) intracavitary and intraluminal brachytherapy.

The initial intent is to treat cancers of the lung and oesophagus, and selected cancers of the cervix, at high dose rate. For patients receiving (predominantly palliative) therapy at the first two sites, HDR brachytherapy is thought to be advantageous both from the perspective of patient tolerance of the procedure, and because it affords the opportunity to better shape the dose distribution to the target volume. These prospective advantages in turn are expected to increase the number of patients who are candidates for brachytherapy. For cervix treatments, the literature suggests that HDR therapy can be equally as effective as the conventional LDR approach in several cases, while offering the advantages described above.

Although the Cross Cancer Institute is currently in a redevelopment phase, the use of HDR afterloading was not anticipated in the planning process, so that its introduction now mostly requires the coordination and preparation of existing facilities and equipment. An overview of these latter preparations within the context of resources available to the HDR programme constitutes the central theme of this presentation.

Ron S. Sloboda, Sherry Connors and Todd Ariss: **FIRST IMPRESSIONS OF A MULTI-LEAF COLLI-MATOR.** Cross Cancer Institute, Edmonton, AB

Just over a month ago Varian multileaf collimator (MLC) serial no. 14, delivered as a factory-installed accessory on a model 2300CD linear accelerator, passed acceptance testing in our institute. Justification for a MLC can be found in the inability of conventional collimation systems to shape radiation beams to accurately match the projections of required target volumes without recourse to expensive and time-consuming beam blocking. The MLC also represents an important step towards the practical realization of conformal radiotherapy, which strives to limit the volumes of normal tissue irradiated and protect adjacent sensitive structures while delivering maximum dose to the target volume.

The Varian MLC is of the downstream type and can be used in conjunction with either symmetric or asymmetric jaw arrangements. It constitutes an independent subsystem of the accelerator that is both hardware and software controlled. The collimator itself consists of 52 moveable and independent leaves on 2 moveable and independent carriages. Interface software operates on a standard PC, and communicates with a second PC that controls and monitors MLC operation. A third PC is supplied to input field shapes, while a fourth is dedicated for diagnostic purposes.

Since accepting the MLC, we have been working to measure and document its performance characteristics. Parameters of clinical interest include the radiation leakage, penumbra, and the positional accuracy of the leaves. In this talk we report on our early experiences with the Varian MLC and present baseline data that has been measured to date.

Matthew Schmid: **THE ABMC OPTICAL CONTOURING DEVICE,** Allan Blair Memorial Clinic, Regina, SK

In order to produce missing tissue compensators for radiation therapy it is first necessary to measure the patient surface. Generally speaking, the patient surface must be sampled with a grid spacing of about 1 cm to produce an adequate compensator. This implies that a large number of data points must be acquired during the process.

In the past, electro-mechanical devices have been used for this purpose at the ABMC. These devices used a mechanical pointer that was manually placed on the patient surface at the point to be sampled. The x and y coordinates of the point were then read electronically. Gathering the required number of data points to produce a compensator usually took at least 20 minutes.

A new device referred to as the ABMC Optical Contouring Device has been developed. As the name implies, this device employs optics to measure the patient surface. The device fits into the block tray holder of our treatment simulator. A laser fan beam is projected down onto the patient surface. Two video cameras image

the surface from oblique angles and the video signals are digitized and analyzed by a computer. The position of the projected laser line in the digitized images is used to calculate the distance to the patient surface. The laser beam is swept over the entire patient surface by rotating the simulator gantry around the patient.
This optical device can measure the entire patient surface of interest in a few minutes including setup time. The actual scan time is approximately 30 seconds. The accuracy of the device over its useful range is +/- 4 mm. The new device has been used in our department for about 4 months.
The principles of operation of the device will be outlined along with other technical details. A quality assurance program for the device will be described. Test and patient results will be presented.

Vaidy Bala, Mohan Doss and C. Rangacharyulu: **PRELIMINARY STUDIES ON THE USE OF CsI (TL) PHOTODIODE INMEDICAL PHYSICS,** Radiation Laboratory Services, Radiation Safety Unit, Dept of Labour and Nuclear Medicine Dept, Regina General Hospital, Regina, SK; Dept of Physics, Univ.of Saskatchewan,Saskatoon, SK

A CsI(TL) photodiode/preamplifier detector module has been tested for a variety of medical physics applications such as in Diagnostic Radiology, Nuclear Medicine, Radiation Therapy, and Radiation Safety. Compact size, requirements of low power, and no gain drifts are excellent features for practical work. A typical resolution of 8.7% for Cs 137, and 4.0% for both the energies of Co 60 were determined. Manufacturer claims a value of 6% for Cs 137. Co 57 gave a resolution of 27%. These values compete with a conventional NaI(Tl)system. For (Am^{241}, 5.4 Mev) alpha spectrum, a value of 13% was obtained. Practical advantages are no cooling of detector and room temperature operation, compact design, and negligible weight. The only disadvantage, at this time, is the temperature dependence of the photdiode response, which limits its usefulness to more controlled temperature environments such as in hospitals, laboratories and other areas inside the buildings.

T. Rock Mackie: **EXTERNAL BEAM RADIATION THERAPY IN THE YEAR 2000,** Medical Physics and Human Oncology, University of Wisconsin, Madison, WI

The goal of radiation therapy has always been to deliver enough radiation so that the tumour volume is adequately treated yet neighboring sensitive tissue is spared critical damage. This goal will continue to guide radiotherapy.
A major theme for research in the next few years will concentrate on integration of imaging science, radiotherapy treatment planning (RTP), treatment delivery and verification. With modern computation and networking, integration of RTP into the delivery and verification process is underway on several fronts. Networks connect image acquisition systems such as MRI and CT scanners, and treatment simulators. Verify and record systems connect planning with a computer-controlled treatment unit. Digital portal systems images may be compared to simulator images and radiographs reconstructed from CT images. Monte Carlo simulation will characterize the entire process of radiation therapy from the vacuum window to the portal image detector. The calibration process will be nearly entirely based on Monte Carlo simulation.
Using multi-modality imaging, including MRI spectrometry and radiolabelled immunodiagnosis, the extent of disease will be much more evident. It will be routine to test rival plans on the basis of predictions of local control and complication probabilities. Inverse RTP methods will automate the planning for radiotherapy involving local and regional disease. These methods predict that beams should not only have an irregular shape but have non-uniform intensities.
Treatment systems which can deliver highly modulated beams are under development. Robot-controlled treatment units will deliver frameless stereotactic radiotherapy for small target volumes. Another methodology, called "tomotherapy" will embody the integration of planning, delivery and verification. It will be the marriage of a diagnostic CT scanner with a slit-beam megavoltage treatment unit that temporarily modulates the beam with multiple rapidly-moving leaves. An on-board diagnostic CT scanner would produce verification tomographs just before or during treatment. It should be possible to reconstruct the dose distribution actually delivered to the patient. Tomotherapy and other dynamic radiotherapy techniques will only make a significant impact to the market if the cost of its delivery is comparable or lower than contemporary radiotherapy.
Enhanced radiotherapy precision should have an impact in the control of local and regional disease because localization will be more accurate and tumour dose can be

escalated. Improved quality assurance and verification will enable better estimation of tumour control probabilities and more reliable analysis of patterns of failure.

Rhonda Sweet: **MANTLE TECHNIQUE: ARM POSITION AND THE PRACTICE OF SUPINE VERSUS PRONE TREATMENT DELIVERY AND THEIR EFFECT ON AXILLARY NODE LOCATION**, Allan Blair Memorial Clinic, Regina, SK

Positioning and immobilization play an important role in the treatment of Hodgkins disease and the techniques by which these are achieved vary greatly between clinics.

Relapses have been noted in a number of sites under a variety of conditions; the most common site of relapse being the axilla. Despite efforts of the various clinics to provide a reproducible technique and depending on their method of treatment delivery, a number of set up and dosimetry inconsistencies can be introduced, such as: 1) How does arm position effect node location?, 2) How does a chosen treatment position supine versus prone effect node location?, 3) What physical changes occur when the patient turns over, (change in separation and alteration of internal anatomy)? and 4) How does this effect a patient's treatment.

Accurate daily positioning and reduction of patient movement during treatment are essential to deliver the prescribed dose and achieve the planned dose distribution. Arm position and supine versus prone treatment delivery of the Mantle technique were studied to evaluate the preceding questions.

Anne Fitzpatrick: **INTUITIVE FREE BREAST TECHNIQUE FOR TANGENTIAL FIELDS AND DEMONSTRATION OF IMMOBILIZATION FOR STANDARD AND LARGE PATIENTS**, Allan Blair Memorial Clinic, Regina, SK

Over the past three years the A.B.M.C. has been evolving a breast technique that has ease of simulation, accuracy in dosimetry, easy reproducibility for daily treatment as well as being clinically acceptable for our physicians. Simulation, treatment planning and daily treatment setup will be discussed.

Our angle board with arm support for our standard patients will be demonstrated as will the construction of an angled alpha cradle which is used for our large patients.

Colin Ladyka: **BEAM'S EYE VIEW PROJECTION AND NAVIGATION**, Allan Blair Memorial Clinic, Regina, SK

The projection of the patient, internal structures, and beam onto a plane orthogonal to the central axis provides a useful way to depict beam information and to modify beam parameters. Rotations of the beam about the isocenter are handled particularly well. The advantages and implementation of this technique will be discussed.

I. Tavares, B. Arjune and M.S.A.L. Al-Ghazi: **THE DOSIMETRIC EQUIVALENCE OF SOLID WATER TO WATER**, Department of Medical Physics, Thunder Bay Regional Cancer Centre, Thunder Bay, ON

Tissue equivalent plastics are attractive alternatives to water in view of their convenience of use in routine clinical dosimetry. Of all these plastics solid water is particularly useful. It requires no additional corrections in the calculation of dose. It resembles the dosimetric characteristics of water very closely. It has the additional advantage over polystyrene in that it does not exhibit charge storage behaviour. A solid water phantom requires an acceptance testing procedure before it can be used clinically. This presentation focuses on the dosimetric equivalence of solid water to water throughout the dose distribution in a volume as well as at a predetermined reference point in the phantom. The main result of this work is that $D_{(\text{solid water})}/D_{(\text{water})}$ is unity to within 1% used for absolute dose determination at a reference point. This level of accuracy is applicable to the range of photon and electron beams investigated (Co^{60}-20 MV photons and 6-21MeV electrons). These results compare favourably with those obtained by The Radiological Physics Centre and other published data. Relative dosimetry in the two media agree to better than that stated above. Such level of accuracy can only be maintained over time with a proper quality assurance protocol on the solid water phantom which is outlined.

Doreen Anderson: **ELECTRON ARC THERAPY**, Department of Medical Physics, Cross Cancer Institute, Edmonton, AB

In radiotherapy, target volumes which lie close to the surface of the patient and cover a large sloping area have traditionally presented a challenge to treatment planning. These targets are especially difficult to cover adequately if they overlay sensitive organs. The use of

electron arc therapy provides a potentially useful treatment technique for these areas. Until this year, the use of electron arcs at the Cross Cancer Institute was restricted to being a developmental project; however, we have recently completed the first clinical application of electron arc therapy. Patient workup, including the use of CT and involvement of treatment planning and mould room will be presented as well as showing isodose distributions and a time frame for preparation of this form of treatment.

Wanda MacDonald: **PATIENT SET-UP AND TIME SAVING IMPROVEMENTS IN BASIC MOULD ROOM TECHNIQUES**, Allan Blair Memorial Clinic, Regina, SK

As the numbers of patients requiring mould room services increase, it becomes more and more important to streamline the procedures used in the mould room. Time, or lack thereof, becomes an important factor, as is dealing with the patients effectively and efficiently, with the least amount of time and inconvenience to the patient as possible.

Improvements in shielding block manufacturing techniques have reduced manufacturing time up to by 75%. The implementation of an air cooling system which reduces the temperature of the cutting wire exposed beneath the styrofoam mould all but eliminates the need to sand or file the cooled blocks. The cooling of the wire on the undersurface of the styrofoam mould allows the cutting wire to make a thin, crisp cut into the styrofoam and thereby diminishes the presence of flashings that otherwise form on the base edge of the blocks. The cooling period for the shielding blocks is reduced by placing the styrofoam mould onto an aluminum cooling plate through which a cold water supply constantly flows. The cooled shielding blocks can be mounted in the correct position as marked on the plexiglass trays in seconds by using an industrial double-sided adhesive tape.

New immobilization techniques and materials have considerably reduced the time spent on producing immobilization shells. An immobilization shell can be completely manufactured in the mould room in 8 - 10 minutes, thus allowing the patient to be simulated during the same visit to the Clinic. A lightweight thermoplastic is softened in hot water and stretched over the patient's face. The plastic cools in seconds, conforming to the contours of the patient's face creating a rigid and accurate method of patient immobilization.

These time saving devices, in conjunction with other improvements to basic mould room techniques, have considerably reduced the time spent on mould room procedures and have allowed more versatility of mould room staff.

D. V. Cormack: **A TRIP TO RUSSIA AND UKRAINE - 1992**, Tom Baker Cancer Centre, Calgary, AB

Last August a group of 60 physicists, physicians, engineers, radiation safety consultants etc. visited research institutes and hospitals in or near Moscow, Kiev and St. Petersburg. The "delegation" was under the auspices of People to People International and was led by Dr. Warren Sinclair, President Emeritus of the NCRP and long-time member of the ICRP. At the Nuclear Research Centre at Obninsk we got a first-hand account of the hectic activity in the hours following the Chernobyl accident in 1986 and the steps taken to assess radioactive contamination, estimate lifetime doses and set criteria for evacuation. As a side trip from Kiev we visited the Chernobyl plant, changing buses at the perimeter of the 30-km evacuation zone, where we had a scientific session and a brief stop near the "sarcophagus" enclosing the remains of Reactor IV. In St. Petersburg we had a session in the Institute of Radiology and Roentgenology where they design, manufacture and use medical linear accelerators. We were able to engage in a limited amount of dialogue with our Russian and Ukrainian counterparts in the various centres, thanks to their abilities in English and the able assistance of our two technical interpreters. In general, we were quite impressed by the way daunting radiation problems have been tackled in spite of a dearth of financial and technological resources.

C. B. Kwok, J. A. Bews, D. Abrams, R. Buist, R. Gordon: **CEREBRAL BLOOD FLOW MEASUREMENT USING INTRA-ARTERIAL BOLUS INJECTION OF ^2H_2O WITH 7 T MAGNETIC RESONANCE SPECTROSCOPY**, Manitoba Cancer Treatment and Research Foundation, Winnipeg, MB

The ultimate goal of our research project is to utilize tracer based magnetic resonance techniques to study cerebral blood flow (perfusion) in the vicinity of brain tumors in order to facilitate diagnosis, improve the effectiveness of treatment and assess treatment response. To this end, a protocol has been developed to measure the blood flow in rat brain using ^2H spectroscopy. A 7 Tesla magnetic resonance spectrometer records the time course accumulation/dissipation of deuterated water in the brain following an intra-arterial bolus injection. This data is then input into a suitable mathematical model to yield an estimate of cerebral blood flow. Measurements have been conducted on normal rats and the results obtained are similar to those published in the

literature clearly establishing, as have others, that deuterium MR based techniques for measuring blood flow are possible. However, before this technique can be considered a useful research tool, its accuracy and precision must be determined and its strengths and limitations more fully understood. Its effectiveness as an aid in differentiating normal and abnormal flow (diagnosis of disease), optimizing treatment as well as monitoring treatment response will depend critically on such investigation. Much effort is still required in this area. In particular, one area which needs attention is the choice of tracer compound. At present, all ^{2}H MR methods for measuring cerebral blood flow utilize deuterated water as a tracer. Unfortunately, water is not a freely diffusible tracer as is assumed in the mathematical models upon which the techniques rely (the models estimate flow from the measured accumulation-dissipation data). This leads to the underestimation of flow. Our research group proposes to investigate the suitability or an alternative tracer for use in ^{2}H based MR blood flow measurements, deuterated butanol, a compound which more closely satisfies the underlying assumption of a freely diffusible tracer.

Y. Mandelzweig, V. Feygelman, E. Baral: **LARGE FIELD TREATMENT USING ELECTRON BEAMS WITHOUT SECONDARY COLLIMATION,** Manitoba Cancer Treatment and Research Foundation, Winnipeg, MB

Electron arc is considered to be the modality of choice for radiation treatment of extensive recurrent chest wall carcinoma. Unfortunately, this treatment is complex and not every institution can implement it. Alternative approaches include "wraparound" techniques with conventional electron beams, with or without beam modifying devices (penumbra generators). While the latter technique may result in significant dose inhomogeneities, the former avoids it at the expense of added complexity. We hereby suggest a technique for treatment of extensive chest wall disease with electron beams which is similar to that suggested previously for total skin irradiation. The secondary collimator (electron applicator) is eliminated. The resulting electron beams have wide penumbras and therefore are easily matched at the 50% intensity level without producing hot or cold spots around the junction region. The predicted dose uniformity at d_{max} is +/- 4% and is insensitive to positional errors. Two or three angulated beams at 100 cm SSD may be used to cover the target arcs, depending upon the extent of the disease and curvature of the chest wall. The technique is simple, and treatment planning and dose prescription are very straightforward, yet the resultant isodose distribution is clinically equivalent to that achievable with the standard electron arc or with the penumbra generators, while is superior to that obtained when conventional beams are joined up. No clinically significant dose inhomogeneities were detected by film dosimetry in the Rando anthropomorphic phantom. The gross treatment field is defined on the patient by a lead cutout. The clinical setup consists of marking the field junction line on the patient and arranging the light field edges to be at a specified distance from this line, since the light field is narrower than the radiation field width at half maximum.

Terence Chu: **A TECHNIQUE FOR THE EVALUATION OF A MISSING TISSUE COMPENSATOR SYSTEM,** Northeastern Ontario Regional Cancer Centre, Sudbury, ON

A new evaluation technique has been developed for acceptance testing of a missing tissue compensator system. It is a two-dimensional approach based on Dose Area Histograms generated by scanning films irradiated under compensated and uncompensated conditions. It can provide quantitative measures of the system's two-dimensional performance. The technique and representative results will be described.

Vaidy Bala: **APPLICATION OF HEAT TRANSFER - CONDUCTION EFFECTS USING MICROWAVE ABSORBERS AND REFRIGERATED COOLING ON LIF TLDS IN DIAGNOSTIC X-RAY QUALITY ASSURANCE MEASUREMENTS,** Radiation Safety Unit, Occupational Health and Safety Branch, Dept of Labour, Regina, SK

Preliminary studies, using individual TLD 100 LiF CHIPS, 1/8 X 1/8 X .035 inch, indicate the feasibility of microwave annealing to replace the conventional 100-C/ten minutes post exposure annealing and 400-C/sixty minutes in oven - post readout annealing; this is achieved by direct heat transferred conduction using a microwave browning dish, as an efficient microwave energy absorber. This procedure provided instantaneous high temperature annealing giving reproducible readings. Reproducible glow curve measurements and sensitivities were determined. Furthermore, a refrigerated cooling produced a consistent decrease in sensitivity by a factor of 1.5. Rapid heat conduction based microwave studies showed a consistent increase in sensitivity by a factor of 1.4. These are under

the terms of TL response when compared to a brass metal rack high temperature annealed (400–C) and cooling in a refrigerator. These results are currently applied in postal quality assurance tests carried out in all diagnostic radiology facilities throughout Saskatchewan.

B. A. Faddegon†, G. Ding*, J. Sun*, D. W. O. Rogers*, T. R. Mackie+: CHARACTERIZATION OF CLINICAL ELECTRON BEAMS USINGMONTE CARLO METHODS, †BC Cancer Agency, Vancouver, BC; *National Research Council of Canada, Ottawa, ON; +University of Wisconsin, Madison, WI

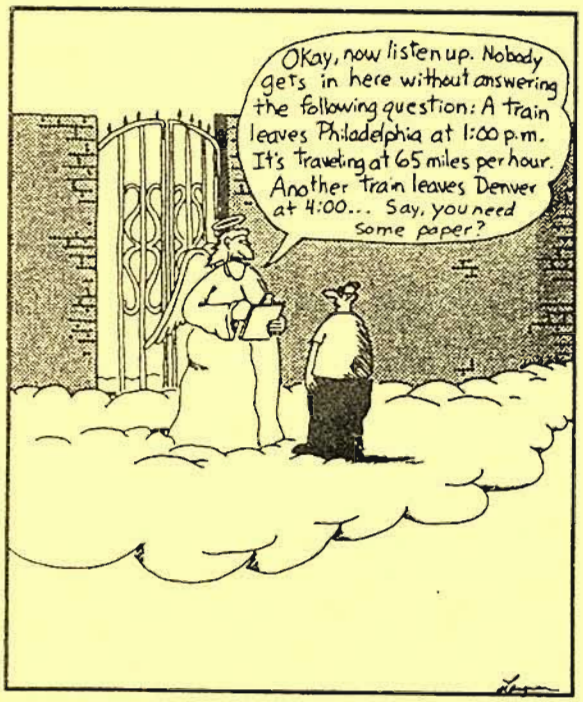
Monte Carlo methods provide the most accurate means of treatment planning for radiotherapy with electron beams. The OMEGA project[1] involves a collaboration between several research centres and cancer clinics to bring Monte Carlo treatment planning to the clinic. User-codes are under development to utilize the EGS4 Monte Carlo system to calculate (1) the character of the beam that emerges from the treatment head of the linear accelerator and (2) the resulting dose distribution in the patient or in phantoms. The EGS4 user-code BEAM facilitates the modelling of accelerators of widely different design, providing considerable detail of the clinical beam. This includes the energy, position, and direction of each emerging particle as well as information on where the particle originated and which components of the treatment head were traversed. These details are known to significantly influence dose distributions. Implementating BEAM on a fast desk-top computer with large memory resources allows us to study in detail the relationship between the design of the treatment head and dose distributions. The talk will focus on the novel design aspects of BEAM and results will be presented on the character of electron beams from a typical linear accelerator.

D. A. Viggars[1], K. Jones[2], A. Sourkes[1]: MANITOBA HDR PROJECT - PROGRESS REPORT, Depts of [1]Medical Physics and [2]Radiation Oncology, Manitoba Cancer Treatment and Research Foundation, Winnipeg, MB

Since 1990 brachytherapy in Manitoba has been restricted to gynecological intercavitary ^{137}Cs insertions carried out in the Winnipeg Health Sciences Centre by staff of the Manitoba Cancer Treatment and Research Foundation. The desire to replace this technique with remote after-loading and to widen the range of available treatments led to the discussion of the installation of HDR. When the AECB published its consultative document C-122 it became apparent that continuation of the present manual after-loading program would be difficult when the reduced dose limits for non-radiation workers were enforced. This is because nurses on the brachytherapy wards at present receive a dose close to the proposed limit and because shielding of public areas adjacent to the brachytherapy wards would be marginally adequate. The Health Sciences Centre and the Cancer Foundation then agreed to prepare a joint submission to Manitoba Health Services Commission for replacing the present manual after-loading program with high dose rate remote after-loading.

The resulting proposal requesting capital equipment and operating costs for HDR was presented to the Manitoba Health Services Commission in May 1992. The equipment requested consisted of an HDR device and appropriate bed, an X-ray localization device in the treatment room, a treatment planning computer and other ancillary equipment. The case was based on the safety problems associated with low dose rate manual after-loading, the expected need to comply with the dose limits in C-122 and with facility shielding limits of 50_Sv/yr for the general public, and the need to provide a wider range of brachytherapy treatments. An analysis of projected workloads was carried out to support the case and to allow an estimate of the additional staff and operating budgets required. Based on this analysis the proposal included a request for 1 FTE physicist, 0.5 FTE radiation therapist and 0.5 FTE nurse.

Approval has recently been received for the capital expenditure and for a physicist to carry out the detailed planning of the installation.



Annual Canadian Medical Physics Conference
COMP/CCPM
May 12-15, 1993, Ottawa ON

The 1993 COMP/CCPM conference was held May 12-15 in Ottawa in conjunction with the annual meeting of the Canadian Medical and Biological Engineering Society (CMBES). This was the first formal joint conference of the Canadian medical physics and biomedical engineering communities. Over 110 members of COMP/CCPM and over 200 members of CMBES attended. The conference was held at Carleton University, and most attendees stayed on campus in residence.

The conference opened Wednesday May 12 with a symposium of 9 invited speakers on the topic "Lasers and Electro-Optics in Medicine", jointly sponsored by the CCPM and the CMBES. There then followed two days of parallel scientific sessions for the COMP and the CMBES. A total of 72 papers were submitted for the COMP sessions; because of common interest, these were augmented by 5 papers which had been submitted to CMBES. A special information session was also held on The Role of Medical Physicists in the CAR Mammography Accreditation Program.

A Commercial Exhibit was open from Wednesday afternoon through Friday lunch. Of the 24 organizations which purchased booths, 6 were of direct interest to medical physicists: Hilferdine Scientific (representing Harshaw/Bicron and other companies), Keithley Instruments, Nucletron, Siemens, Theratronics, and Victoreen. In addition, material was on display on the three organizations at the conference (COMP, CCPM, CMBES), the Carleton medical physics program, and the University of Ottawa medical engineering program.

The social highlight of the conference was the Banquet, held the Friday evening at the Canadian Museum of Civilization in Hull. Dinner was followed by the presentation of the Sylvia Fedoruk Award to Darcy Mason, Jerry Battista, Rob Barnett, and A. Porter of the London Regional Cancer Centre (and now Bayview), the Harold Johns Travel Award for Young Investigators to Yunping Zhu from PMH, and the awarding of various honours of the CMBES. The evening's entertainment was the IMAX movie *Titanica*.

The conference wrapped up Saturday morning with a choice of tours to the Theratronics assembly plant in Kanata, the NRC Ionizing Radiation Standards labs, or the University of Ottawa/Ottawa Civic Hospital Heart Institute.

As the Conference Co-Chair for COMP/CCPM, I thank all members of the Conference Committee for their hard work and patience in preparing for and running this conference. I thank also all attendees for making the trip to Ottawa and thus helping by their presence and participation make the conference very successful.

COMP/CCPM Members of the Organizing Committee:

Paul Johns	Conference Co-Chair
Aaron Fenster	Scientific Program Chair
Peter Munro	Scientific Program
Robert Clarke	Finances, Local Arrangements
Peter Raaphorst	Commercial Exhibits
Ken Shortt	Banquet, Commercial Exhibits
Dennis Heller	5km Run, Local Argmnts
Ruth Brown	Local Arrangements
Julia Wallace	Local Arrangements

Paul Johns
Conference Co-Chair, COMP/CCPM
Ottawa ON

Minutes of the Annual General Meeting Canadian Organization of Medical Physicists
Ottawa, May 13, 1994; 17:30

1. **Agenda**
   The agenda was accepted.

2. **Minutes of last meeting** held in Calgary, August 24, 1992.
   The minutes were unanimously accepted.
   Moved: J. Van Dyke
   Seconded: J. Andrew

3. **Committee Reports:**

   3.1 Radiation Regulations:

   J. Aldrich summarized G. Dean's report. In essence, it specifies the response given by the Radiation Regulation Committee of COMP to the AECB about the Consultative Document C121.

   3.2 Professional Affairs:

   P. Dunscombe discussed the various areas in which the committee will focus upon. This includes Licensing and staffing, liability issues, the role of physics in quality assurance programs, and codes of ethics. I. Cunningham was invited to be a member of this committee which he accepted.

The COMP executive is presently considering the articles of reference for this committee, and K. Breitman agreed to search newspaper clippings for discussion of medical physics.

It has also been agreed that the committee contact its counterparts in the USA to consolidate respective efforts. The Committee and COMP should be very visible, and the become the prime movers for the 1995 Centennial of Roentgen's discovery of x-rays.

4. **Representatives:**

4.1 BRMD Advisory Committee of Radio-pharmaceutical Quality Assurance

The representative to this committee has been changed from the CCPM to the COMP. T. Cradduck is the COMP representative for two years.

4.2 IOMP:

The next IOMP meeting will be held in Rio de Janeiro, Brazil. J. Cunningham will attend on his own behalf. D. Rogers who will also attend has been designated as the COMP representative.

4.3 CAMRT: No representative.

4.4 National Consortium of Educational Societies:

Our representative to the NCES, P. Johns presented his report. The main activity of this body to "lobby" Parliament Hill for its concerns throughout the year. Every November "lobbying" sessions are conducted to allow individuals from various related organizations to voice their opinions. P. Johns extended invitations to any member wishing to attend these sessions.

The COMP presently pays an annual fee of S 175.50 for membership into the NCES.

5. **Secretary's Report:**

The Secretary, G. Fallone, presented his report .

At the time of the meeting there were 256 members. It was felt that there is some confusion about Corporate fees, and that a flat $500 should be levied for Corporate membership.

Because of irregularities that exist in joint membership claims with the CAP (joint membership entitles a 30% discount in COMP membership fee), joint membership will be verified by the secretary, and members whose joint membership is found to be irregular will be notified.

It has been agreed that a fee of $ 25.00 be issued for non-members wishing to advertise in the Newsletter for medical physics positions.

6. **Newsletter Report:**

The Newsletter Editor, J. Schreiner presented his report. The costs of printing 275 copies of two isses amounted to $1143.00.

The Editor reminded the audience that thesis titles should be sent to him so that they can be published in the Newsletter.

A vote of appreciation was extended to the Editor for his excellent work.

7. **Treasurer's Report:**

7.1-.2 The Treasurer, S. Hussein presented his report. Our assets as of March 31, 1993 are $35, 107.04. It has been agreed that the $108.00 fee for annual subscription to PMB will be increased to $130.00 due to the decrease of the Canadian dollar. The annual subscription fee for COMP is $100.00 US.
Responding to a question from B. MacParland concerning methods to increase interests rates of our accounts, S. Hussein stated that he has been deligent in obtaining the best rates for our accounts.

7.3 Young Investigator and Travel Awards

The executive suggested the institution of The Young Investigator and Travel Awards. The following awards have been instituted:

> Young Investigator's Award: An amount of $350.00 for the combined awards of the first, second and third place ($200 for first place; $100 for second place; $50 for third place)
>
> Travel Award Amounts up to $2000 will be awarded for young scientist to present at annual COMP meetings. These scientists must be either students are be two (2) years after graduation.
>
> Motion: A. Fenster
> Seconded: E. El-Khatib

K. Breitman reported on the 1992 AAPM/COMP meeting in Calgery. The gross income was $568,000 US with expenses totalling $436,000 US for a net income of $130,000 US. The COMP/CCPM share had been agreed upon to be 2 % of the gross income which would total $11,353

US. The AAPM must audit their accounts before this amount be sent to COMP/CCPM. Twenty-five (25) % of this amount is to be placed in trust for the Western Canada "section" of COMP/CCPM. The remaining 75 % would be sent to COMP/CCPM. This amount would then be divided up between the COMP (70 %) and the CCPM (30 %).

D. Rogers raised the possibility of decreasing annual membership fees because of the apparent solid financial situation of COMP. The majority of the audience strongly suggested that the fee remain. The audience suggested possible usage for the monies:

Legal Counsel (Raaphorst)
Professional Affairs Committee expenses for 1995 (Aldrich)
Emergency fund similar to AAPM (Breitman)
Permanent secretariat (Shortt)
Executive expenses (Clarke)
Conference subsidies (P. Johns)

It was proposed (Aldrich) that the executive investigate the means of instituting some form of permanent secretariat. This proposal was unanimously approved.

There was some discussion of the 30% penalty for late payment of membership dues. It was agreed that the deadline for late payment be March 31.

8. Chairman's Report

The Chairman, J. Aldrich presented his report. One of his suggestions was that young COMP members participate in COMP affairs.

9. CCPM President's Report

The CCPM President, J. Van Dyke presented his report only briefly, the full report being presented at the CCPM Annual General Meeting.

This year, fourteen of seventeen individuals who wrote the Membership examination passed, while the only Fellowship examinee was successful. The overall passing rate for Members and Fellows is 70 % and 78 %, respectively. Changes have been instituted within the examination procedure: the membership examination time has been extended by one hour and will be taken in two sittings, subspecialties have been instituted, etc.

The Harold E. Johns Travel Award has been attributed to Dr. Y. Zhu of The Princess Margaret Hospital in Toronto.

10. Retiring Members

Dr. R. Beique from l'Hôpital Notre-Dame in Montreal is retiring this year. He has been the Director of the Département de Physique Biomédicale at this institution and Professor at l'Université de Montréal for many years. An official letter from COMP will be sent to him by the COMP chairman, J. Aldrich.

11. Sylvia Fedoruk Prize

The prize will be given at the Annual Banquet.

12. X-ray Centennial Celebrations (1995)

a) J. Aldrich mentioned that the Book he is co-publishing for this occasion is basically 75 % complete.

b) Although, the COMP/CCPM has contributed $1,000 on a 70/30 % basis to the X--ray Centennial Foundation of Canada, we are not aware of any activites related to this organization. Furthermore, although we had been promised a seat on the Board upon payment of our contribution, we do not have one. It has been suggested by J. Aldrich that our financial contribution to this Foundation for next year should be reconsidered.

c) Cent-X-95 is a group attempting to put a major display at the 1995 Canadian National Exhibition. The COMP and the CCPM do not support this initiative directly.

13. COMP official journal

Discussion was raised whether we would like to change our official journal from Physics in Medicine and Biology to Medical Physics, because of our closer association with the latter. This is especially true since Medical Physics has agreed to publish COMP abstracts. Some members, however, still preferred PMB. J. Cunningham also stated that we may lose reduced fee privileges if we cancel our official journal status with PMB.

We voted unanimously to investigate the possibility of having two official journals.

Motion: M. Yaffe
Seconded: D. Drost

14. Elections

This year, nominations to Chairman-elect and Teasurer were to have been given by the membership to the Nominating Committee presided by E.. El-Khatib. Nominations for chair-

elect and treasurer are S. Connors and G. Mawko, respectively.

By acclamation, the following are declared elected **Sherry Connors** to the position of chairperson-elect, and **George Mawko** to the position of treasurer.

15. **Gavel to the new Chair**

Dr. John Aldrich passed the gavel to the new chairman: Dr. Aaron Fenster.

16. **Future Meetings**

16.1 COMP/CCPM/CARO (Toronto, 1994)

J. van Dyke discussed the proceedings of this meeting: COMP/CCPM meetings would be held on Thursday, September 15; Scientific papers would be held on Friday (Sept. 16) and Saturday Sept. 17), with one joint session.

16.2 COMP/CCPM/CAR (Montreal, 1995)

G. Fallone and E. Podgorsak were asked to coordinate this meeting. It is expected that the meeting would be held in the Palais de Congrès in Montreal.

16.3 Western Canada (Vancouver, 1996)

E. El-Khatib would coordinate this conference.

17. **Other Business**

Since only 12 people registered for the NRC Radiation Dosimetry Course, the course has been cancelled. The course required at least 18-20 registrants for it to be held. It appears that the cost of registration (when compared to the AAPM Summer School, for example) may have been the cause of the low number of individuals who registered.

18. **Adjournment**

The meeting was adjourned at 19:40.

Motion: M. Yaffe
Seconded: S. Hussein

Minutes prepared by B.G. Fallone,
Secretary COMP
Montreal, QC

The various reports given at the general meeting follow in the order in which they appear in the minutes.

PROFESSIONAL AFFAIRS COMMITTEE

Report to the Annual Meeting of COMP
Ottawa, May 13th, 1993

PAC MEMBERS:

John Aldrich	Karen Breitman
Ian Cunningham	Peter Dunscombe
Maryse Mondat	Peter Raaphorst

1. Ian Cunningham was invited to join the Committee to achieve broader representation across Medical Physics.

2. Proposed Terms of Reference for the PAC have been developed for consideration by the COMP Executive.

3. The Professional and Manpower Survey Forms have been redistributed. Responses are currently being collated and a summary should be available for the Fall Newsletter.

4. Karen Breitman is maintaining a file of reports, newspaper cuttings, etc. related to medical radiation incidents. COMP members are invited to contribute to this file by contacting Karen.

5. Contact with the Professional Affairs Committees of the ACMP and AAPM has been made. The exact level and form of our interaction with these groups remains to be defined.

6. The PAC has been actively considering COMP's role in the 1995 x-ray Centennial. No firm decisions have been made and we would welcome the opinions of COMP membership on this issue.

7. A major issue which the PAC needs to tackle in the near future is the establishment of national professional standards for Medical Physicists across Canada. This particular issue is closely related to licensing which is a currently active area in Ontario.

8. Other topics identified by the PAC for discussion and the formulation of a position are;

   i) Professional liability
   ii) The role of Physicists in Quality Assurance (particularly relevant to Ontario's HARP legislation)
   iii) Code of Ethics for Medical Physicists
   iv) Licensing
   v) Dismissal without due cause.

Peter Dunscombe, Chairperson
Northeastern Ontario Regional Cancer Centre
Sudbury, ON

National Consortium of Scientific and Educational Societies,

Report on 1992/1993 Activities:
28 April 1993.

1. The National Consortium continued its lobbying activities this year in much the same way as in 1991/92. I represented COMP as a member organization. There are a total of 35 member organizations.

2. The November Lobby - The main activity of the Consortium is an annual lobby of federal politicians, usually in November. Meetings between individual MP's or senior civil servants and pairs of scientists and educators are scheduled. In November 1992 I met with 4 MP's:

David Kilgour	Lib., Edmonton Southeast
William Casey	Con., Cumberld.-Colch. (NS)
Mac Harb	Liberal, Ottawa Centre
Lee Richardson	Conservative, Calgary South

Despite the 'No' result of the October 1992 constitutional referendum and the House of Commons coming to session during the same week as the Lobby, 95 of the 106 scheduled meetings were held.

Five recommendations were made to parliamentarians:

(i) negotiate with the provinces to ensure that federal government education transfer payments to the provinces are used for that purpose,
(ii) protect and augment the granting council budgets (NSERC, MRC, SSHRC),
(iii) facilitate industry investment in research,
(iv) stop eroding R & D in federal government facilities, and
(v) create a new scientific advisory body to the government.

3. Other Lobby Activities - The Consortium also does behind the scenes lobbying throughout the year. I was not a participant in these.

4. Monthly Meetings - The Consortium holds monthly meetings from September through June. The meetings are used to plan strategy and to share information between the member organizations. Many of those present represent large organizations and are involved full time in science and education policy and government lobbying. Very few of the small member organizations such as COMP are represented each month. This year I attended only the September meeting.

5. Fees - As given in my annual report last year, the Consortium has adopted a sliding scale for its fees based on the number of members in the constituent organization. The COMP fee for the current 92/93 year is $ 175.50.

6. Perspective - This sort of activity is needed now more than ever. We are all aware of the deficit crises facing all levels of government. The temptation to reduce spending, for example by cutting the granting councils' budgets, is strong. On 20 March 1992 the councils were told they would have increases of 4 % / year for 4 years, which allowed them to keep slightly ahead of inflation. Canada's R&D performance is still quite poor per unit GNP compared to other industrialized countries, but at least with stable funding we were not getting any worse. However, on 2 December 1992 the government announced that the granting councils' budgets would instead be frozen, so that the purchasing power of grant monies will in fact decrease for the next few years.

As a small organization, COMP does not have very much manpower to use for an activity such as government lobbying, and would be able to do very little if acting in isolation. By lending its support to the activities of the Consortium, with only modest time and financial outlay COMP helps strengthen science and education in Canada, and makes its own name more visible to both the federal government and other scientific organizations. This is an efficient approach.

Any individual interested in participating in the next Lobby, please contact me. It can be quite interesting.

Paul Johns, PhD FCCPM
Dept. of Physics
Carleton University

Secretary's Report

Annual General Meeting COMP
Ottawa, May 12-15, 1993.

The present reporter replaced Mr. Raymond Carrier as secretary of the COMP at the COMP/AAPM annual meeting in August 1992, and he wishes to thank the last secretary for introducing him to his functions.

A summary of specific tasks performed by the secretariat since August 1992 involved:

1. The maintenance of the membership data base

a	Full members:	171
b.	Emeritus members:	12
c.	Student Members:	71
d.	Corporate Members:	2
e.	Total Membership:	256

2. Modifying and Mailing of Invoices and Reminders

3. Production of Receipts

4. Production of mailing labels for Newsletter, and labels for paid advertisements (job and information)

5. Communication with external societies:
   a. IOMP:
   The secretaries of all member organizations are the contact person for the IOMP membership directories. A list of COMP and CCPM officers has been submitted to the IOMP. A list of COMP membership has also been submitted to IOMP for distribution for the announcement of the 1994 World Congress on Medical Physics and Biomedical Engineering (August 21-26, 1994). A request has been sent to the IOMP for copies of the newsletter Medical Physics World which is to be distributed to the COMP membership.

   b. AAPM:
   Communication exists to verify joint COMP/AAPM membership.

   c. CAP:
   Actions have been initiated to verify. joint COMP/CAP membership (confirm eligibility for reduced COMP fees), since the secretary believes it is COMP's responsibility to authenticate claims of joint membership. As of December 1992, 20 of the COMP members who claimed membership with the CAP were found not to be members of CAP. The 1993 COMP/CAP joint membership will be verified, and members whose affiliations are not confirmed will be notified.

EXPENSES		
Invoices for renewals (260 x S0.05 photocopies)	S 13.00	
Invoices for renewals (260x S0.042 mailings)	S 109.20	
Adhesive: labels	S 50.67	
TOTAL		$172.82
INCOME (labels)		
membership labels for IOP	S 150.00	
Hôpital Notre-Dame, Mtl.	S 150.00	
Hôpital Hôtel Dieu, Mtl.	S 150.00	
TOTAL		$ 450.00
NET INCOME		$277.18

The expenses incurred by the secretariat totalled $172.87. while revenues for distribution of printed labels of the COMP membership totalled $450.00.

The secretariat intends to complete a new membership directory by the end of 1993. The projected costs would be from $800.00 to $1000.00 depending on the format.

Respectfully,

B.G. Fallone, Secretary
Montreal, QC

Newsleter Editor's Report

AGM of COMP May 13, 1993
Ottawa, ON

The past year was the second that the Newsletter was produced in Montreal. The Montreal General Hospital continued to be very supportive, especially the personnel in the printing department, the mail room and in the Medical Physics Department.

Two issues were distributed from the Montreal office since the last general meeting. This is 1 less than was forecast. However, both issues were longer than the average of last year and a total of about 60 pages were published. The number of subscribers to the Newsletter increased from about 240 last year to about 275 presently. The regular columns by the President and Chairperson of the CCPM and COMP which review issues of importance to the community continued and I thank the three authors for their prompt submissions. There were about 8 unsolicited articles submitted by different members of our organizations in the last two issues and one article from outside our community. The Newsletter also published the results of the annual salary survey, announcements of upcoming meetings, and job postings.

The next issue is expected about one month from now. Currently there have been no articles submitted but the reports from this meeting and the annual review of medical physics theses will be included.

I thank all contributors to the Newsletter and look forward to continued support in the next year which will be the last of my tenure as editor.

Outline of Newsletter Expenses

This is meant as an indication of the cost of producing the Newsletter. It is not a financial statement accurate to the last penny.

November Issue	
Printing:	150.00
Supplies and mailing:	337.00
February Issue	
Printing:	225.00
Supplies and mailing:	431.00
TOTAL	~1143.00

Newsletter Income
There were 5 paid job postings and meeting announcements and one paid insert in the last two mailings of the Newsletter. These generated $850.00 in income.

Respectfully Submitted:

L. John Schreiner
McGill University, May 1993

Report of the COMP Chairperson May 1993

Canadian Medical Physics has certainly come a long way!

For my term as chairperson of COMP it started with my picture being posted in very prominent positions at the Calgary Stampede. Fortunately no-one turned me in for the $500 reward! The reward for Calgary should definitely go to Karen Breitman and her committee that spent so much effort in ensuring that AAPM came to Canada and that the conference was a great success! Since the meeting in Calgary AAPM officials that have spoken to have expressed only warmth about our joint meeting (even if they had cold fingers during the 6 AM run). This close working relationship can only help us in the future.

There were 82 active medical physicists in 1977 and a prediction was made for this to more than double to 169 in 1987; this outrageous number was actually reached sometime in 1988! Gallup - eat your heart out! As you will know from the recent manpower survey there were 195 medical physicists and 158 students and residents in 1991. Now the membership of COMP has exceeded 250, and Gino Fallone will give a complete analysis of the membership.

This is the first year that the Professional Affairs Committee has met and it has already gone full tilt into the Professional and Salary Survey for 1993, relieving Karen Breitman of the burden which she has so capably handled for the last few years. The committee has mapped out an impressive range of items that it would like to deal with and we look forward to their results which will be part of the Newsletter from time to time.

The Newsletter has continued to provide many of us with ample bedtime reading as it continues to more and more resemble the Yellow Pages both in colour and size. John Schreiner has done a marvellous job to keep up to date on this onerous task, but one that can keep both CCPM and COMP members feeling together in such a large country.

In the radiation regulations area there is quite feverish activity at the AECB where numerous documents are in preparation or out for comment. These include the log-awaited General Amendments to the Regulations and the new form of C-122, including revised dose limits.

1993 means that we are only two years away from celebrations to mark the discovery of x-rays by Roentgen. As medical physicists are well represented on the various groups set up to organize the activities we have a great opportunity to engender some well-earned recognition for our profession. So if you have any special ideas for activities in your region or the country as a whole please let one of the executive know.

Canadian medical physicists have made outstanding contributions to their fields, and are well recognized in international meetings, organizations and the world's literature. How many issues of Medical Physics are there with no contribution from a Canadian centre? In 1990, for example, 25% of the Articles and 10% of the Technical Reports in Medical Physics came from Canadian centres, very much more than one would expect on a per capita basis.

In its early history the first medical physics group the Canadian Association of Medical Physics was fought over by the CAR and CAP and as you know eventually became a division of the CAP. We have now matured into the symbiotic groups of CCPM and COMP which in many ways met our scientific and professional needs. In the near future I expect that we will have to examine our ties with the many other organizations, the CAR, CARO, CAP, CRPA, the AAPM and perhaps the CMBES that we meet with here.

I would like to acknowledge the many hours put in by all the executives, boards and committees of both CCPM and COMP. It is by such selfless effort that medical physics has been able to grow in Canada.
Certainly there will be many challenges over the next few years; it is only by working as a coordinated group of medical physicists that it will be possible to continue the great progress that has been made over the last ten years.

John Aldrich
Chairperson

CANADIAN ORGANIZATION OF MEDICAL PHYSICISTS
ORGANISATION CANADIENNE DES PHYSICIENS MEDICAUX

FINANCIAL REPORT
AUGUST 01, 1992 - MARCH 31, 1993

CHEQUING/SAVINGS ACCOUNT

Balance as of August 1, 1992			**19,960.14**
Add Credits:			
Membership Dues (incl. HEJ Fund)		18,102.86	
PMB Subscriptions (incl. GST Refund)		4,111.83	
Proceeds from 1991 COMP/CCPM Meeting		777.80	
Donation from Phillips (Summer School)		2,000.00	
Advertising Revenue		900.00	
Sale of Labels		188.87	
Sale of Brochures		34.50	
Interest Received:	Term Deposits	300.82	
	Chequing Account	97.65	**26,514.33**
			46,474.47
Less Debits:			
Transfer to Term Deposits		15,000.00	
PMB Dues Paid		4,821.34	
Monies Remitted to CCPM		1,793.26	
Newsletter Publishing Cost		2,010.90	
Travel Expenses		1,711.07	
IOMP Annual Dues		275.75	
Postage, Stationery, etc.		196.10	
National Consortium Annual Dues		175.50	
Post Box Rental		149.80	
NSF Cheques (incl. bank charges)		315.00	**26,448.72**
Balance as of March 31, 1993			**20,025.75**
			46,474.47

ASSETS AS OF MARCH 31, 1993

Chequing/Savings Account	**20,025.75**	
Term Deposits	**15,000.00**	
Equity Shares	**82.09**	**35,107.84**

Sherali Hussien
Vancouver BC

CCPM PRESIDENT'S REPORT

ANNUAL GENERAL MEMBERSHIP MEETING
MAY 13, 1993, OTTAWA, ON

The CCPM has undergone another successful year. This is manifested in a variety of ways but mostly by the large number of members who successfully completed the 1993 Membership examination. The following highlights 1992/93 activities of the CCPM.

1. New Members and Fellows

In March, 17 candidates wrote the Membership examination and 14 successfully passed. This year, we had only 1 application for the Fellowship examination and he was successful. The overall pass rate over the last 11 years for the Membership Examinationhas been 76% and the corresponding pass rate for the Fellowship Examination over the last 14 years has been 78%. In view of this pass rate, the candidates who joined this year are congratulated on their success. At the present time we have 125 people who are on the official roles of the College of whom 45 are Members and 80 are Fellows. This represents a majority of those Medical Physicists who work in a clinical environment across thecountry.

2. Examination Process

Since one of the two major roles of the College is certification, the Board is vigilant in ensuring that a good examination process is in place. In this context, the Board is constantly reviewing the adequacy and the fairness of this process. As a result, the Board has agreed to slightly modify the exam to reflect changing needs and to ensure competency of those Medical Physicists working in a clinical environment. The examination will be lengthened by 1 hour and will be written in 2 sittings in one day. While it is substantially the same as before, a new section is being added to specifically address practical problems that may confront the Medical Physicist working in a clinical environment.

In this context, the Board is also maintaining close contact with the American Board of Radiology and the American Board of Medical Physics to attempt to maintain a level of overall consistency across North America.

3. Harold Johns Travel Award

The Harold Johns Travel Award is given annually to a new Member or Fellow of the College upon meeting the appropriate credentials. This year's winner of this award is Dr. Yunping Zhu of the Princess Margaret Hospital in Toronto. We congratulate him on his success and look forward to an interesting report in the Canadian Medical Physics Newsletter of his experience.

4. College Administration

There are number of administrative issues that need continuous review and adjustments for the sake of good management. This year, the Board has undertaken to review the entrance application forms, to develop a formal registry of those who are certified and their corresponding specialties, to draft an information booklet on the CCPM and its entrance requirements and to modify the bylaws to reflect the changes in the examination process and clinical experience requirements. The appropriate changes either have been implemented or are in the process of being finalized.

5. Recertification

There is an increasing demand by regulatory agencies that professionals who need certification for practicing their profession maintain a formal ongoing certification assessment. The Board is developing a proposal that all College Fellows and Members would have to be recertified every 5 years to maintain their official status. The process being considered consists of developing a questionnaire with a corresponding point system which proves that the candidate continues to be a competent practicing Medical Physicist and maintains ongoing professional development. More information will be forthcoming as this process is finalized.

6. Communication With Accreditation and Legislative Organizations

The College is in close communication with and has official representation on various committees and task groups of organizations that deal with professional accreditation and legislation. These include the Healing Arts in Radiation Protection (HARP) Commission of the Province of Ontario, the Canadian Medical Association Conjoint Accreditation Services, the Canadian Council on Health Facility Accreditation, and the College of Clinical Scientists of Ontario. While these activities can be very time consuming and sometimes not overly productive, we feel it is extremely important that Medical Physicists continue to maintain a high profile in these organizations especially if decisions made by these bodies can have an impact on the practice of Medical Physics or conversely if the participation of Medical Physicists can enhance the profile and stature of our profession.

7. New Ventures

(a) Mammography Accreditation

Screening for breast cancer using mammography has recently become a major public issue. One of the important requirements of such a mass screening program is that high quality mammograms or produced with a minimal exposure to the patient. The Canadian Association of Radiologists(CAR) is establishing an accreditation program for mammographic facilities in analogy to the program provided in the United States by the American College of Radiology. This accreditation program sets standards for providing mammographic imaging services. These standards relate to the training and qualifications of personnel, the performance of mammographic equipment and the on-going quality control program carried out at each facility. In the U.S., the program specifies that technical image quality must be supervised by a qualified Medical Physicist. Since the CAR wants to implement an analogous process, the CCPM has initiated a Mammography Committee which is setup to (i) define the educational and experience requirements to be a qualified Medical Physicist in Mammography, (ii) to develop training programs to increase the number of such qualified Medical Physicists so that we can meet increasing demand, and (iii) to develop continuing education programs to maintain the accreditation status of a qualified Medical Physicist in mammography. This committee is chaired by Raymond Carrier and consists of Cupid Daniels, Ian Cunningham and Martin Yaffe. The initial work of this committee has been to put on an information session at our Annual Meeting in Ottawa. More information will be forthcoming in the Canadian Medical Physics Newsletter as the activities of this important work progress.

(b) The Canadian Radiation Protection Association(CRPA)

The CRPA is in the process of implementing a certification process in radiation protection. The CCPM has radiation protection as a substantial component of its certification process. Thus there appears to be an overlap between the interests of the CRPA and the CCPM. The Board is presently communicating with the CRPA to clarify this potential area of overlap and its corresponding concerns.

8. Tributes

Stepping down from the Board this year after 4 years of service is Alan Rawlinson. Alan has represented the CCPM as an active participant of the Radiation Therapy Advisory Committee of the HARP Commission of the Province of Ontario. He has also been an excellent contact person for us in the context of AECB's consultative document C-122. We would like to thank Alan for his participation and we hope he will continue to represent the College in these organizations.

I would like to thank all of the Board members for their participation and diligence. Again I would like to extend a special thank you to John Andrew for the many hours he puts in as registrar and to Terry Peters for his role as Chairman of the Examining Committee. These two roles represent the major activities of the College and the College would not be able to function without them. In addition, I would like to thank the various physicists who represent the College at various Commissions and organizations. The quality of these individuals continues to enhance the stature of the College within the broader medical community in Canada.

Jake Van Dyk
President, CCPM

Sylvia Fedoruk Award for 1991 and 1992

For 1991, the Sylvia Fedoruk Award Committee had a difficult time in selecting the best paper published in 1991 by a medical physicist. The Committee reviewed 40 publications and were left with 6 outstanding papers. Two were from the area of radiotherapy physics and 4 from diagnostic imaging. Scoring was very close and of the 5 Committee members, only 2 agreed on which was the best paper. Notwithstanding, the Committee's decision for best paper was: Xiang Q-S, Henkelman MR. **Motion artefact reduction with three-point ghost phase cancellation.** *J Mag Res Imag* , 1991, 1, 633-642. This paper came from the Department of Medical Biophysics at Sunnybrook Health Science Centre, Toronto, Ontario. Dr. Xiang was the recipient of a Medical Research Council of Canada Post-doctoral Fellowship and Dr. Henkelman is Vice-President of Research at Sunnybrook Health Science Centre. The Committee considered this to be a "concise and useful paper providing an elegant solution to an important imaging problem".

The Committee also had praise for the paper that came a very close second: Faddegon BA, Ross CK, Rogers DWO. **Angular distribution of bremsstrahlung from 15MeV electrons incident on thick targets of Be, Al and Pb.** *Med Phys* , 1991, 18, 727-739

For 1992, the Award Committee again had a challenging time in selecting the best medical physics paper The Committee reviewed 80 publications and were left with 4 outstanding papers. Two were from the area of radiotherapy physics and the 2 were from the area of diagnostic imaging. Scoring was very close and of the 4 Committee members, only 2 agreed on which was the best paper. Nonetheless, the Committee's decision for the best paper is: Mason DLD, Battista JJ, Barnett RM, Porter AT. **Ytterbium-169: Calculated physical properties of a new radiation source for brachytherapy.** *Med Phys* , 1992, 19, 695-703. Darcy Mason did this work while he was a graduate student in the Department of Medical Biophysics in London, Ontario. His supervisor, Jerry Battista is Head of Radiotherapy Physics Research at the London Regional Cancer Centre. The Committee considered this a careful and thorough work on an interesting new radionuclide with possible clinical applicability.

The Committee would also like to mention 2 papers which were tied for second:

Rogers DWD. **Calibration of parallel-plate chambers: Resolution of several problems by using Monte Carlo calculations.** *Med Phys* , 1992, 19, 889-899. Dave Rogers works at the National Research Council of Canada in Ottawa. The Committee considered this to be a comprehensive work which may lead to improved accuracy and precision in radiation dosimetry. It should be noted that last year, Dave Rogers was also one of the authors of the runner-up paper.

Cunningham IA and Reid BK. **Signal and noise in modulation transfer function determinations using the slit, wire and edge techniques.** *Med Phys* , 1992, 19, 1037-1044. This work originated from the Department of Radiology, Victoria Hospital and the Imaging Research Laboratories of the John P Robarts Research Institute in London, Ontario. Brian Reid was a graduate student in the Department of Medical Biophysics at the University of Western Ontario working under the supervision of Ian Cunningham. Tragically, Brian Reid died before he could graduate.

Chairperson, Sylvia Fedoruk
Award Committee

Medical Physics E-mail Server List

Dear fellow COMP members:

At the recent COMP/CCPM meeting a suggestion was put forward that we institute a Canadian based electronic mailing list of medical physicists. I have been asked if I will manage this list but I can ONLY do so if I have YOUR cooperation. I cannot guess at your e-mail address and you may, in any case, not wish to be included.

In order to be included on the list please send an e-mail message to: cradduck@uwo.ca and in the Subject: line put the words "subscribe canada-l" (that is an ell for List, not a one). The rest of the message can be left blank (I will ignore it anyway!). Once I have a list created I will inform you collectively by e-mail, giving instructions for its use. If you have any comments about the use of the list, or to what use it should be put, please send these in a separate message (with a different Subject:!).
Thank you for your cooperation,

T.D. Cradduck, PhD, FCCPM, ABMP
cradduck@uwo.ca

Mammography Accreditation for Medical Physicists

On Wednesday, May 12, at the COMP/CCPM Conference in Ottawa, a meeting was held of members interested in the practice of Medical Physics in Mammography. At the meeting, it was agreed that it would be valuable to have an accreditation program for medical physicists working in this area to ensure that those who evaluated mammographic installations were appropriately qualified. The CCPM has agreed to administer the Mammographic Physics Accreditation Program including the setting of standards for the program, maintaining a register of qualified physicists and providing this information to mammography facilities when requested.

The College has defined a qualified medical physicist in mammography as follows:

Definition of Qualified Medical Physicist in Mammography for CAR Mammography Accreditation Program:

A medical physicist is qualified to practice diagnostic radiological physics in mammography if he/she:

1.a) is certified in diagnostic radiological physics by the Canadian College of Physicists in Medicine (CCPM), by the American Board of Radiology

(ABR), or by the American Board of Medical Physics (ABMP)

or

b) has a post-graduate degree in physics or related discipline from an accredited institution and has demonstrated experience in diagnostic radiological physics as determined by the CCPM ;

2. has training and experience as deemed appropriate by the CCPM in conducting mammography equipment performance evaluations.

In addition to the above qualifications, any individual practising diagnostic radiological physics in mammography shall have received documented continuing education or have demonstrated continuing competence specifically in mammography physics in the last three years.

The assessment of adequacy of training, experience and continuing education will be determined by the CCPM.

Physicists applying for accreditation would request an information package from the College. The package would contain requirements for a curriculum vitae to be provided by the applicant, as well as other evidence of appropriate education and training in the area of mammography physics. The accreditation process would also include a personal interview with an accreditation panel of the college. Such interviews would be carried out at convenient times such as at the annual meeting.

To maintain accreditation, the candidate would be required to receive at least a minimum number of hours (probably 15 hours every three years) of approved continuing medical education in the area of mammography physics.

The problem of how applicants would receive appropriate education and training in mammography physics was discussed at the meeting. Several suggestions were made including didactic courses, training programs offered by COMP/CCPM, etc. The issue of practical training was also discussed, and mechanisms such as an annual course at an academic centre in Canada, commercial courses and production of a training video were considered as possibilities.

A reading list of material in the Physics of Mammography, is enclosed for those wishing to prepare for accreditation.

1) *The Radiologic Clinics of North America - Breast Imaging Current Status and Future Directions*, Vol. 30, No. 1, 1992, Lawrence W. Bassett. Published by W.B. Saunders Company, The Curtis Center, Independence Square West, Philadelphia, PA 19106-3399.

2) *Screen Film Mammography - Imaging Considerations and Medical Physics Responsibilities*, Proceedings of SEAAPM Spring Symposium, 1990, Columbia, South Carolina, Gary T. Barnes and G. Donald Frey. Medical Physics Publishing, 27B, 1300 University Avenue, Madison, WI 53706, (608) 262-4021.

3) *Syllabus: A Categorical Course in Physics Technical Aspects of Breast Imaging*, presented at the 78th Scientific Assembly and Annual Meeting of the Radiological Society of North America, Nov. 29 - Dec. 4, 1992, Arthur G. Haus, Rochester, NY, and Martin J. Yaffe, Toronto, Canada. Produced by RSNA Publications, 2021 Spring Road, Suite 600, Oak Brook, IL 60521.

4) *Ontario Breast Screening Program - Quality Control in Mammography*, (This document can be obtained from Imaging Physics Research Group, Sunnybrook Health Science Centre, 2075 Bayview Avenue, Toronto, Ontario M4N 3M5, Attention Gordon Mawdsley, Rm SB12, for $7.00 to cover reproduction costs.)

5) *American College of Radiology, Mammography Quality Control: Medical Physicists Manual* (available from the American College of Radiology, 1891 Preston White Dr., Reston, Virginia 22091. This comes as part of a set of manuals for the physicist, radiologist and radiologic technologist, which costs $75 US + postage. Unfortunately, the physics manual is not available separately, however, it has been reproduced in Reference 3).

Martin J. Yaffe, Ph.D.
Senior Scientist, Imaging Research
Asso Prof, Medical Biophysics, U. Toronto

(Editors's Note: Please see advertisement on page 27 of this issue of the Newsletter for more on this topic.)

Moves and Changes

The Medical Physics Newsletter will be happy to publish new addresses and locations of persons or departments on the move. Keep your colleagues informed and advertise your developments.

New E-mail Addresses at Cross Cancer Institute

The Medical Physics Department of the Cross Cancer Institute in Edmonton now has a direct connection to the Internet. As a result, all our email addresses have changed. Please use the following addresses for future correspondence.

Sherry Connors	sconnors@phys.ualberta.ca
Colin Field	cfield@phys.ualberta.ca
Rick Hooper	rhooper@phys.ualberta.ca
Brent Long	blong@phys.ualberta.ca
Brendan McClean	bmcclean@phys.ualberta.ca
Brad Murray	bmurray@phys.ualberta.ca
Don Robinson	donrob@phys.ualberta.ca
Ron Sloboda	rsloboda@phys.ualberta.ca

Rick Hooper
Cross Cancer Institute

Physicists on the Move

Sanjiv Samant is moving to Radiation Oncology, St Jude Childrens Hospital, 332N Lauderdale, PO Box 318, Memphis TN, 38101-0318, USA, as of May 1993

John Aldrich is moving to the Department of Radiology, Vancouver General Hospital, 855 West 12th Avenue, Vancouver, BC, CANADA V5Z 1M9, as of August 1993

COMP/OCMP Corporate Membership

The Canadian Organization of Medical Physics would like to acknowledge the support given by our 1993 corporate members:

Kodak Inc.

Varian

Theratronics

Oldelft

Gammex-RMI

We hope to continue our association with these and new corporate members in this new year. To encourage this affiliation we are implementing new benefits for our corporate members.
Details are available from the COMP office..

Newsletter Announcements

Addresses for Submissions:

Submissions should be sent to

L. John Schreiner
Medical Physics Department
Montréal General Hospital
1650 Avenue Cedar,
Montréal, QC.
H3G IA4

tel: (514) 934-8052
fax: (514) 934-8229

E-mail can be sent to me at McGill University at:
CXLS@MUSICA.MCGILL.CA.

When making Submissions to the Newsletter, please confirm that your submission arrives at our office by phone or FAX.

Newsletter Submissions
Format for contributions:

Articles for the Newsletter are best submitted by E-mail (at CXLS@MUSICA.MCGILL.CA.) or on computer disk. The Newsletter is produced on a MacIntosh computer so submissions must be on Mac compatible disks or on 31/2 inch IBM disks *in text or ASCI* format. Please send a hard copy by mail or FAX so that any symbols or special characters can be verified.

Good print quality submissions are also welcome. Newsletter articles should be single column on 8 1/2 by 11 inch paper with suitable margins on all sides. Contributions should be double spaced in a clear font or type (not dot matrix), the font size / pitch should be ≥ 12 to facilitate scanning and reading with OCR software. Please end your submission with your name and institution. Advertisements should be submitted camera ready for direct reproduction in Newsletter.

FAX submissions must be supported by original copy and will not be used directly.

DEADLINE FOR NEXT ISSUE OF THE COMP NEWSLETTER

The next Medical Physics Newsletter will come out in the fall. Please submit articles by the third week of September.

Calendar of Events

August 8 - 12, 1993
Washington, DC, *AAPM ann mtg*
Contact: AAPM, 335 East 45 St, NY, NY, 10017

August 16 - 20, 1993
New York, NY, *SMRM ann mtg*
Contact: SMRM, 1918 University Ave, Berkeley CA 94704

Sept 8 - 11, 1993
Bristol, UK, *50th Ann Mtg IPSM-HPA*
Cntct: IPSM-HPA, 4 Campleshon Rd, York YO2 1PE

Nov 28 - Dec 3, 1993
Chicago, IL, *Joint Mtg AAPM / RSNA*
Contact: AAPM, 335 East 45 St, NY, NY, 10017

April 24 - 27, 1994
ARLINGTON, TX, *Assessing impact of nucl facilities on human health and environment*
Contact: Randall Hanne, TU Electric, 400 N Olive, LB-81, Dallas, TX 75201

REPORT FROM THE CCPM EXAMINING COMMITTEE
MAY 1993

This year there were 17 applications to sit the CCPM membership exam, and of these 14 were successfull. We congratulate the following candidates :

Ms. Hamideh Alasti	Toronto, ON	Dr. Adrian Crawley	Calgary, AB
Mr. Gary Doswell	Toronto, ON	Mr. Trevor Fitzgerald	Englewood, CO
Dr. Leszek Hahn	Calgary, AB	Dr. Brendan McClean	Edmonton, AB
Dr. Jim Meng	Halifax, NS	Mr. Brad Murray	Edmonton, AB
Dr. Alina Popescu	Thunder Bay, ON	Mrs. Jean Robbins	Kingston, ON
Dr. D. Salhani	Ottawa, ON	Dr. Sanjiv Samant	Halifax, NS
Dr. Janos Szanto	Ottawa, ON	Dr. J. Thekkumthala	London. ON

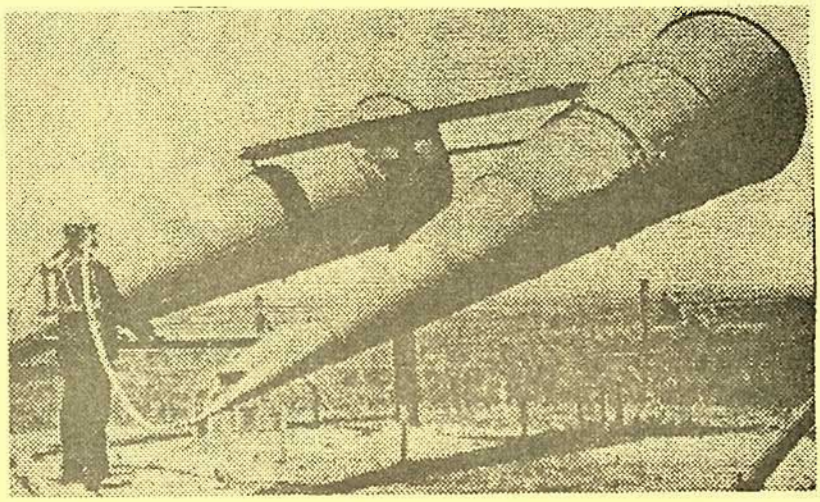
There was only one candidate for Fellowship, Dr. Milton Woo, of Toronto, who successfully completed his oral examination this year.

Note that from next year the examination process will be changed to reflect the desire of the CCPM Board to accredit individuals in a specific specialty. See advertisment with exam schedule in this issue of the Newsletter for more details.

Terry Peters
McGill University, Montreal QC

From the Medical Physics Archives:

In the spirit of the X-ray Centennial which is quickly approaching, the Newsletter will be happy to publish your old photographs.



Pictured above is the first documented stereotactic radiosurgery treatment in the UK (circa WW I). The opposing field treatment utilised giant cosmic ray collectors to provide a combined photon / high energy charged particle radiation field. Note that the stereotactic frame was attached to the patient's back in this early naive approach.

CCPM COURSE IN THE PHYSICS OF MAMMOGRAPHY

A course in the physics of mammography is being planned for Sept 18,19, 1993 to be held at the Reichmann Research Building, Sunnybrook Health Science Centre, Toronto. This course will review the principles of medical physics applied to mammography and focus on selection, acceptance testing and quality control for mammography. The course is intended both as a review for physicists already involved in mammography as well as for diagnostic and clinical medical physicists who intend to work with mammography facilities in the future. The course is designed to prepare physicists for CCPM accreditation in mammography physics.

Enrolment for the course is limited. The tuition fee of $175 includes course handout material as well as lunches and coffee breaks on Saturday and Sunday. Lectures will be supplemented with practical demonstrations and review of images and test data.

If you wish to take the course please forward a cheque for $75 payable to CCPM Mammography Physics Course as a deposit, which is refundable if there is insufficient enrolment. Cheques should be sent to COMP/CCPM, Box 369, Station K, Toronto. Attention Ms Evelyn Tika.

For further details, please contact me by phone at (416) 480-5715 or FAX at 480-5714.

M.J. Yaffe,, Course Organizer
Sunnybrook Health Science Centre, Toronto

Canadian Graduate Programs in Medical Physics

Jeff Bews has updated the CCPM publication Canadian Graduate Programs in Medical Physics. This document provides perspective graduate students with an overview of the medical physics graduate programs currently offered by Canadian universities. Each formal Canadian medical physics program is outlined in terms of its members, courses offered, current research activities, requirements for graduation and local sources of student funding. Programs at the following universities are included: University of Alberta, University of British Columbia, Carleton University, Dalhousie University, Laurentian University, MacMaster University, University of Manitoba, McGill University, University of Toronto and University of Western Ontario.

Universities which offer medical physics research projects but no formal medical physics graduate program are also listed and include: Queens University, University of Calgary and University of New Brunswick

There is also an attempt to list the centres offering medical physics residency programs. Programs at the Ottawa Regional Cancer Centre, Nova Scotia Cancer Centre, London Regional Cancer Centre and Kingston Regional Cancer Centre are included. Other centres wishing to be added to this list should write to the Registrar.

Copies of the revised document will be sent to the program representatives listed in the document. Copies can be obtained by writing to the Registrar.

John Andrew
Registrar, CCMP

HAROLD JOHNS TRAVEL AWARD

The Board of the Canadian College of Physicists in Medicine is pleased to honour the Founding President of the College by means of the Harold John's Travel Award for Young Investigators. This award, which is in the amount of $1,000.00, is made to a College member under the age of 35 who has been a member for not more than two years. The award is intended to assist the individual to extend his or her knowledge by travelling to another centre or institution with the intent of gaining further experience in his or her chosen field, or, alternately, to embark on a new field of endeavor in medical physics.

Further information can be obtained from:

BOURSE de VOYAGE HAROLD JOHNS

Le Conseil du Collège Canadien des Physiciens en Médecine est heureux d'honorer son président fondateur en offrant aux jeunes chercheurs la bourse Harold Johns. Cette bourse, d'une valeur de $1000,00, est éligible aux membres du Collège agés de moins de 35 ans et qui sont membres depuis deux ans ou moins. La bourse a pour but d'aider le récipiendaire à parfaire ses connaissances dans son domaine ou à démarrer dans un nouveau champ d'activités reliées à la physique médicale, en lui permettant de voyager vers un autre centre specialisé.

Les demandes seront addressées à:

The Registrar / Le Registraire
CCPM
c/o NSCC
5820 University Ave
Halifax, NS
B3H 1V7

The deadline for the next award is May 15, 1994.

La date limite pour les demandes du prochain concours est le 15me Mai 1994.

Past recipients:

Récipiendaire anterieur:

1990	Dr. L. John Schreiner, Montreal
1991	Ms. Moira Lumley, Kingston
1992	Dr. Donald Robinson, Edmonton
1993	Dr. Yunping Zhu, Toronto

Members of the COMP/OCMP and/or the CCPM can make a donation to the fund by volunteering to increase their 1994 membership dues.

Les membres du COMP/OCPM et\ou du CCPM peuvent faire un don à la cotisation de 1994 un montant additionel de leur choix.

CANADIAN COLLEGE OF PHYSICISTS IN MEDICINE

LE COLLÈGE CANADIEN DES PHYSICIENS EN MÉDECINE

C/O Nova Scotia Cancer Centre
5820 University Avenue
Halifax, Nova Scotia, Canada, B3H 1V7

CCPM Exam Schedule

The application and exam schedule for 1994 is:

Membership Exam:

Apply by: March 18, 1994
Exam Date: June 18, 1994

Fellowship Exam:

Apply by: June 14, 1994*
Exam Date: September 14, 1994

* Note: Those writing the membership exam on June 18, 1994 should confirm their fellowship application and pay the fee within one week of receiving the exam results.

New CCPM Membership Exam Format

The membership exam will be given in two 2 1/2 hour sittings separated by a lunch break. The first sitting will have two parts: one hour of general medical physics short answer questions and 1 1/2 hours of questions specific to the applicant's sub-speciality. The afternoon sitting will require the candidate to answer two questions selected at random by the chief examiner from the applicant's sub-speciality question bank.

The exam book will be revised and divided into four sections to provide approximately 30 questions in each of the sub-specialities of radiation oncology, diagnostic imaging, nuclear medicine and magnetic resonance imaging. The new books will be available from the Registrar early in the Fall of 1993.

For those looking for a head start, many of the new sub-speciality questions will be similar to those in the present book for the same sub-speciality.

The application form for membership and fellowship has been revised for 1994 and is available from the Registrar.

WORLD CONGRESS ON MEDICAL PHYSICS AND BIOMEDICAL ENGINEERING 21-26 AUGUST 1994

X International Conference on Medical Physics

XVII International Conference on Medical and Biological Engineering

Announcement

The Rio '94 World Congress on Medical Physics and Biomedical Engineering will be held in Rio de Janeiro, Brazil, from 21st to 26th August 1994 and is planned to cover virtually all areas of Medial Physics and Biomedical Engineering. It is the first time this World Congress takes place in a developing country. It will certainly bring a major contribution to the growth of these fields in the whole world, and specially in Latin America. We invite you to come and share your scientific work with colleagues from the four corners of the world. We are sure you will enjoy becoming acquainted with the latest developments in the two specialities and basking in the warm hospitality of Rio de Janiero.

Sponsored by

ABFM - Brazilian Association of Physicists in Medicine
SBEB - Brazilian Society of Biomedical Engineering

Under the Auspices of

IUPESM - International Union for Physical and Engineering Sciences in Medicine
IOMP - International Organization for Medical Physics
IFMBE - International Federation for Medical and Biological Engineering

Scientific Program

The Scientific Events include Oral and Poster Presentations, special session such as Refresher Courses, Mini-Symposia, Round Tables and State-of-the-Art Presentations. The Scientific Program is based on a set of 38 topics - see attached list - each one coordinated by two experts. Within each topic, for both Medical Physics and Biomedical Engineering, the sub-topics give more detail on the subject covered and should help the author to choose the most suitable session. The author will be asked to indicate two topics and may propose a new one if none is thought to be adequate. This allows flexibility to create new sessions following the latest trends.

Competitions

Two competitions are included in the Scientific Program:

1. Young Investigator's Award: participants must be 32 years old or less.
2. Latin American Student Competition: for graduate and undergradute students.

Information for Authors

The two types of presentation, oral and poster, will be considered as equally important. Oral sessions will be opened by an invited review paper. Poster sessions will have an organizing chairperson who will promote better interaction among authors and public. Abstracts shall be submitted on special forms and posted before 20th December 1993. Detailed instructions will be included in the *Call for Papers* to be available in August 1993.

Language

All Congress activities will be held in English.

CROSS CANCER INSTITUTE INVITES APPLICATIONS FOR

MEDICAL PHYSICIST

The Department of Medical Physics, Cross Cancer Institute, has an opening for a medical physicist. The applicant should have a Ph.D. in medical physics or a closely related discipline, or a masters level degree with Canadian College certification.

The individual selected will work with seven other physicists to provide service in radiation oncology physics, with shared responsibility in the areas of treatment planning, machine calibration, quality control, and development of new treatment techniques. The Cross Cancer Institute is closely associated with the University of Alberta and participation in research is encouraged. Teaching in an in-house RT therapist training school, radiation oncology residency program, and medical physics graduate student program is also expected.

The facilities of the Cross Cancer Institute include six Varian linear accelerators, one cobalt unit, superficial and contact x-ray machines, three simulators, and CT, MRI and SPECT imaging systems. There is also a busy brachytherapy program including a Selectron LDR, two MicroSelectron LDRs, and an NPS brachytherapy treatment planning system. A MicroSelectron HDR is on order. External beam treatment planning is carried out on an in-house system based on VAX and Sun computer systems. Beam data is acquired with a Wellhofer beam scanning system, and a number of microcomputers are available.

The medical physics department consists of over thirty people including machinists, technical equipment officers, radiation safety officer, dosimetrists, mould room technicians, physics technicians, software developers, secretarial and administrative support, graduate students, and post doctoral fellows.

The level of the appointment will be dependent on the qualifications and experience of the applicant.

Please address inquiries to

Dr. R. Hooper
Director
Department of Medical Physics
Cross Cancer Institute
11560 University Avenue
Edmonton, Alberta
T6G 1Z2 Canada

The competition for this position will close on August 31, 1993.

NS CANCER CENTRE

5820 University Avenue
Halifax, Nova Scotia
B3H 1V7

Radiation Oncology Medical Physicist

An experienced radiation oncology medical physicist is required for the Nova Scotia Cancer Centre. The department of medical physics presently employs eight medical physicists and nine support staff and provides radiotherapy physics services to the Centre and imaging physics services to adjacent hospitals.

The radiotherapy equipment includes 25 MeV and 6 MeV accelerators, two cobalt-60 teletherapy units, an orthovoltage x-ray unit, a simulator, two Selectrons and two treatment planning systems. A third accelerator will be installed in early 1994. Electronic and mechanical workshops are also available. The imaging departments are very large and provide a full range of imaging modalities including ultrasound, nuclear medicine, x-ray, CT and MRI.

Candidates must possess a postgraduate degree. Demonstrated experienced or training in medical physics is required. Appointments can be at the intermediate or senior levels. Certification by the Canadian College of Physicists in Medicine (or equivalent) must be obtained within two years. Appointment to the faculty of Dalhousie University Medical School will be available to appropriately qualified individuals and staff are encouraged to further their academic, teaching, and research careers. Opportunities for graduate student supervision are available.

Salaries are competitive and professional allowances and a study leave program are also available. In accordance with Canadian immigration regulations, priority will be given to Canadian citizens or permanent residents of Canada. The application deadline is July 31, 1993.

The Halifax metropolitan area has a population of 250,000 and is pleasantly situated on the Atlantic coast of Canada. Exceptional cultural and recreational facilities are close at hand.

Please send all correspondence to:

Dr John W Andrew
Director of Medical Physics
Nova Scotia Cancer Centre
5820 University Avenue
Halifax, Nova Scotia, Canada B3H 1V7
Telephone: 902-428-4217; FAX (902) 428-4277

RADIATION PHYSICIST

We are currently seeking a qualified Radiation Physicist to join a Regional Cancer Center in the United States. Applicant must be a graduate physicist with clinical experience in radiation oncology physics. Duties will involve technical supervision and quality control in the areas of 1) machine calibration; 2) equipment purchases and repair; 3) treatment planning and dosimetry; 4) chart checking; 5) brachytherapy services; and 6) stereotactic radiosurgery.

Equipment includes a Varian Clinac-1800, Varian 4/100, Siemens orthovoltage unit, Philips RT-50 contact unit, and a Siemens Mevasim simulator. Stereotactic radiosurgery utilizes dynamic rotation technique. A full array of Cs-137 is available for brachytherapy. Other equipment includes a dual station Prowess 2000 treatment planning system, a Wellhofer 600C water tank system with densitometer and phantoms, and a full array of electrometers and chambers. Staff includes two radiation oncologist, two dosimetrists, ten radiation therapist and two registered nurses. All staff are certified in their respected fields.

Competitive U.S. salary commensurate with level of education and amount of experience. A full benefit package is included. Located 70 miles north of Chicago in lake country, Waukesha is a rapidly growing suburb of Milwaukee with a low-cost of living and excellent school system. Contact Douglas King, M.D., F.R.C.P.(C), 725 American Avenue, Waukesha, WI 53188, (414) 544-2439.

CANADIAN MEDICAL PHYSICS THESES

1992

The Canadian Medical Physics Newsletter is pleased to publish the following review of medical physics graduate work completed at Canadian Universities in 1992. Twenty-two authors have submitted their work for this report. I thank them for their submissions and congratulate them on their research efforts. I trust that this resource will be useful to other researchers in the community.

I now invite submissions for next year. The newsletter will publish a report of theses completed in 1993 in the June 1994 issue.

John Schreiner
McGill University
Montréal, QC

University of Alberta, Edmonton, AB
Department of Physics

John Antolak
Evaluation and Modification of Electron Beam Treatment Planning Algorithms
Ph.D.

Megavoltage electron beams are commonly used for radiotherapy treatment due in part to their advantageous dose deposition characteristics. Because electrons interact heavily with the electromagnetic field of the medium traversed, electron beams have a characteristic maximum penetration into the material, which is quite shallow compared to megavoltage photon beams.
This thesis deals mainly with the experimental verification and further development of the electron dose calculation algorithms implemented in the Alberta Treatment Planning (ATP) system (Battista et al 1984). The stationary beam algorithm is based on the pencil beam algorithm developed at the M.D. Anderson Hospital (MDAH) by Hogstrom et al (1981). The theory on which the algorithm is based is reviewed, and the necessary approximations in the theory and its computer implementation are discussed.
Chapter III presents a series of three studies investigating the performance of the stationary beam algorithm. Experimental data is presented which shows that the MDAH algorithm performs reasonably well, but has deficiencies in certain circumstances. The progression of phantoms from 2D to 3D geometry is also discussed, with implications for 3D treatment planning.
The MDAH arc electron pencil beam algorithm (Hogstrom et al 1989) is validated in chapter IV. The results show some systematic discrepancies compared to measurement. A qualitative argument is presented to show that the discrepancies occur as a result of the algorithm's failure to model both large angle scattering and range straggling of the electrons.
The final component of the thesis presents an empirical solution to the problem of range straggling in the MDAH algorithms. The solution is similar to methods proposed by Werner et al (1982) and Lax et al (1983), but is derived from measured data. Incorporating the empirical modification into the stationary beam and arc electron algorithms gives better agreement with measurement for homogeneous phantoms. Monte Carlo experiments show that this method is valid for heterogeneous slab media, which implies that the empirical modification should apply to heterogeneous phantoms.

Supervisor: John Scrimger

McMaster University, Hamilton, ON
Department of Physics

Robert Anthony deKemp
Attenuation Correction in Positron Emission Tomography using Single Photon Transmission Measurement
M.Sc.

Accurate attenuation correction is essential for quantitative positron emission tomography. Typically, this correction is based on a coincidence transmission measurement using an external source of positron emitter, which is positioned close to the detectors. This technique suffers from poor statistical quality and high dead time losses, especially with a high transmission source strength.
We have proposed and tested the use of single photon transmission measurement with a rotating rod source, to measure the attenuation correction factors (ACFs). The singles projections are resampled into the coincidence geometry using the detector positions and the rod source location. A nonparalyzable dead time correction algorithm was developed for the block detectors used in the McMaster PET scanner.
Transaxial resolution is approximately 6 mm, which is comparable to emission scanning performance. Axial resolution is about 25 mm, with only crude source

collimation. ACFs are underestimated by approximately 10% due to increased cross- plane scatter, compared to coincidence transmission scanning. Effective source collimation is necessary to obtain suitable axial resolution and improved accuracy. The response of the correction factors to object density is linear to within 15%, when comparing singles transmission measure-ment to current coincidence transmission measurement.
The major advantage of using singles transmission measurement is a dramatically increased count rate. A factor of seven increase in count rate over coincidence scanning is possible with a 2 mCi transmission rod source. There are no randoms counted in singles transmission scans, which makes the measured count rate nearly linearly proportional with source activity. Singles detector dead time is approximately 6% in the detectors opposite a 2 mCi rod source.
Present hardware and software precludes the application of this technique in a clinical environment. We anticipate that real time acquisition of detector singles can reduce the transmission scanning time to under 2 minutes, and produce attenuation coefficient images with under 2% noise. This is a significant improvement compared to the current coincidence transmission technique.

Supervisor: C. Nahmias

Linda Marie Wahl
Dopamine Metabolism Quantified in the Human Brain: Tracer Kinetic Analysis of Positron Tomographic Studies
M.Sc.

Mathematical models are used to estimate physiological parameters which are otherwise inaccessible to measurement. When applied to tracer kinetic data obtained in positron tomographic studies, these methods allow for the quantitative analysis of regional metabolic rates in the human brain during life.
Dopamine, a neurotransmitter in the mammalian central nervous system, is synthesized by the action of aromatic amino acid decarboxylase on L-dihydroxyphenylalanine (L-dopa). A fluorinated analogue of L-dopa, 6-[^{18}F]fluoro-L-dopa, is used as a tracer in positron tomography to study the nigrostriatal dopaminergic system. Although this tracer has been in use in man for over ten years, a definitive method of quantitative analysis has not yet emerged. The comparison of quantitative results obtained by this approach has been confounded by the diversity of mathematical modelling techniques employed. These techniques range from simple graphical analyses, which yield a single rate constant for the entire system, to complex compartmental approaches, which may not present a unique solution.
The goal of this research has been to develop an approach to quantitative analysis which is both informative and mathematically justifiable. Compartmental models of increasing complexity have been evaluated by statistical methods (F-test) to determine the simplest model which adequately fits the data. This strict methodological approach indicates that a two-compartment, three-parameter model produces the best fit, in a statistical sense, to the measured data. This data has also been analyzed by a simple graphical method to yield an influx constant for the system. The influx constant has also been calculated, for comparison, from the results of the compartmental analysis.
The two methods were found to be in excellent agreement; both responded predictably to physiological perturbations of the system. While the compartmental method yielded a more informative analysis of the system, the graphically determined influx constant was found to be less sensitive to measurement errors. It is recommended that these two methods be applied in parallel, such that the comparison of results may serve as an internal measure of the integrity of the analysis.

Supervisor: C. Nahmias

Christopher L. Gordon
The Accuracy of Dual Photon Absorptiometry Measurements of Soft Tissue Composition
M.Sc.

During routine measurements of body composition using a ^{153}Gd based dual photon densitometer, it was observed that negative values were being obtained for the body fat fraction in some adults, in children and in small animals. In these three groups, there appears to be a body size dependent error whereby the measured fat fraction becomes increasingly negative as subject size becomes smaller.
The fat fraction is derived from relating the measured mass attenuation coefficient of soft tissue to an internal calibration based on the use of water and lard as substitutes for muscle and fat. To investigate whether this procedure for instrument calibration is the cause of the fat fraction errors, soft tissue phantoms which contained known amounts of fat, water and protein were prepared. Over the range of fat fractions used, accurate results were obtained.
By using prepared soft tissue and water phantoms it was established that the measured fat fraction incorrectly became progressively smaller as object thickness decreased and incorrectly increased with object thickness. However, accurate measurements were obtained if the equivalent tissue thickness is greater than 9 cm and less than 16 cm of water. Equally reproducible measurements are obtained at all thicknesses investigated.
When dual photon measurements of body composition in 13 adolescent females were compared with measurements obtained from skinfold thicknesses or bioimpedance, there was good agreement between techniques but dual photon results demonstrated a broader range of variation with body size. Comparisons between dual photon absorptiometry derived body composition measurements of 52 male athletes with results obtained from under water weighing allowed for derivation of a simple correction factor for the accuracy errors due to body size.

Supervisor: Colin Webber

Rafael Janica
Measurement of Dose Distribution of a ^{32}P Point Source in Isocyanurate Using a Special Ionization Chamber
M.Sc.

To investigate dose rate distribution at far distances from a ^{32}P beta point source in an "infinite" medium (foamed isocyanurate / urethane of mass density 0.03 g/cm^3), a customized ionization chamber was built in a slab of foamed isocyanurate / urethane.
Measurements of ionization currents were carried over 6 order of magnitude so as to cover the whole continuous-slowing-down approximation (CSDA) range of the most energetic beta particles in the polymer, approximately 890.7 mg/cm^2. The point source dose distribution derived from the ionization measurements was compared with Monte Carlo calculations for water (Cross W.G. et al, Health Phys.63,160-171, 1992) scaled for isocyanurate urethane. For distances between 200 and 600 mg/cm^2, both our data and calculations agree well with previously published experimental data which covered up to approximately 68 % of the CSDA range. At distances greater than 660 mg/cm^2, our data are significantly greater than the Monte Carlo calculations. The discrepancy is about 100% at 760 mg/cm^2 in isocyanurate / urethane, the maximum distance for which Monte Carlo values were calculated. The discrepancy increases with distance from the source.

Supervisor: C.S. Kwok

University of Manitoba
Department of Physics

Kiaren P. McGee
The Application of Fourier Domain Techniques in On-line Portal Imaging
M.Sc.

The efficacy of radiotherapy as a treatment technique in the control of cancer is strongly dependent upon the ability of the modality to deliver a sterilizing dose of radiation to cancerous tissue while sparing surrounding healthy tissue.
The use of Fourier domain techniques to improve the quality of portal images has been investigated and discussed in this thesis. Digital image processing techniques using Fourier domain techniques have been shown to be effective in removing periodic artifacts from portal images as well as enhancing image features such as anatomical detail or removing noise. The effect of image processing on portal images has also been investigated. The results showed that for a number of spatial and frequency domain image processing techniques, image processing can improve the accuracy of observers when asked to detect the presence or absence of an object in a phantom image. The study also showed that the greatest improvement in observer accuracy is obtained when experienced observers are employed.
The ultimate goal of on-line portal imaging is the fully automated verification of treatment field set-up. A semi automated computerized technique has been developed to detect the location of the radiation beam incident upon the patient as well as the location of superficial landmarks placed on the exterior of the patient.

Supervisor: Shlomo Shalev

McGill University, Montréal, QC
*Medical Physics Unit, Faculty of Medicine and Department of Physics**

Marc R. Bussière*
Monte Carlo Study of Photon Scatter for Determination of Depth Doses at Diagnostic Energies
M. Sc.

This thesis is concerned with the creation, verification and implementation of a computer programme for simulating photon transport in diagnostic radiology. The programme is based on the Monte Carlo technique in which probabilistic problems are solved using random numbers. For this reason mathematical number generators along with a few standard tests which enable the randomness of the numbers to be evaluated are introduced. A discussion on sampling from probability distributions is presented with emphasis on the physical aspects of the Monte Carlo technique applied to low energy photon transport. The validity of the computer programme is established by comparisons with previously published Monte Carlo work, with predictions from an analytical photon transport model and with experimental measurements. The application of Monte Carlo simulations to specific radiographic problems are illustrated by the modeling of percent depth doses.

Cette thèse a pour objectifs la conception, la vérification et l'application d'un logiciel afin de simuler le transport de photons en radiologie diagnostique. Ce logiciel utilise la méthode Monte Carlo qui repose sur les nombres aléatoires pour résoudre certains problèmes probabilistes. Pour cela, le concept de générateur de variables aléatoires, ainsi que divers tests visant à examiner le caractère stochastique des grandeurs sont introduits. Ainsi, quelques techniques d'échantillonnage de distributions probabilistes sont présentées et plus particulièrement l'utilisation de ces techniques avec les distributions reaétant l'aspect physique des trajectoires de photons aux basses énergies. La concordance des résultats obtenus avec ceux de simulations documentées, avec les prédictions d'un modèle analytique et finalement avec les résultats expérimentaux démontre la justesse de l'approche utilisée. L'application de la méthode Monte Carlo en radiologie diagnostique est démontrée par la caractérisation du rendement de dose en profondeur.

Supervisor: John Schreiner

Patrick F. Cadman

Target Localization and Treatment Set-up Verification in Linear Accelerator Based Radiosurgery

M. Sc.

The stringent demands for accuracy in radiosurgery impinge on all aspects of the radiosurgical procedure. A computer program, used to determine target coordinates from planar stereotactic image pairs, has been developed. Digital subtraction angiography images, obtained with a localizer attachment affixed to the stereotactic frame, are analyzed with the program for the localization of certain malformations. During treatment set-up verification, the center of the radiation disiiribution is determined using portal linear accelerator images of the collimated radiosurgery beam, with the patient in the final treatment position and without removal of the radiosurgical collimator. A custom portal localizer attachment has been developed in-house for this purpose. Localization results obtained with a test phantom show a maximum deviation of 0.4 mm from the known target locations. The program has also been shown to be effective in detecting a misalignment beLween a localized target and the treaCiment radiation center during set-up verification.

En radio-chirurgie, des exigences strictes sont imposées sur la précision du traitement donné. L'auteur a développé un logiciel qui permet de déterminer les coordonnées spatiales de la cible à partir de deux clichés stéreotactiques, planaires. À l'aide de ce logiciel et d'un système d'immoblisation stéréotactique, les malformations vasculaires intracraniennes peuvent être localisées en trois dimensions en utilisant une technique d'angiographie digitale par soustraction. Lors de la vérification du positionnement avant le traitement, le centre du faisceau de radiation utilise en radio-chirurgie est déterminé à partir de doux clichés du faisceau collimé obtenus après le positionnement du patient pour le traitement, mais sans retirés le collimateur pour la radio-chirurgie. Pour cette fin, un accessoire pour la localisation de la cible à partir de l'image de contrôle a été développé. Le logiciel développé permet la localisation précise de la cible traitée. Une déviation maximale de 0.4 mm est obtenue sur les coordonnées précises de cibles d'essai placées dans un phantom. Le logiciel peut aussi déceler toute séparation spatiale entre la cible et le centre du faisceau de radiation avant le début du traitement.

Supervisor: Ervin Podgorsak

Jorge J. Moreno-Cantú

Optimization of Positron Imaging Systems Through the Use of Tapered Collimators

M. Sc.

A Monte Carlo simulation system was enhanced in order to analyze photon transport in tapered geometries. This system was used to evaluate the performance of new tapered collimator designs, for multi-slice positron emission tomography (MS-PET) and positron volumetric imaging systems (PVI-Systems). For each imaging modality, the performance of the new collimators was compared to those of the current collimators of choice. Collimators were evaluated based upon their: (1) trues detection efficiencies; (2) scatter detection efficiencies; (3) scatter fractions; and (4) total singles to trues events ratios. In MS-PET, collimators with a diamond-like cross section - double tapered collimators - were introduced and their performance compared to those of.single tapered and cylindrical collimators . Double tapered collimators yielded better performance than single tapered ones. In PVI systems, external tapered collimators were simulated and their performance compared to those of cylindrical ones. External tapered collimators did not improve the scanner performance.

Un système de simulation Monte Carlo fut modifié dans le but d'analyser le transport de photons dans une géométrie conique. Ce système fut utilisé pour évaluer la performance des nouveaux collimateurs coniques pour la tomographie par la émission de positrons (TEP) à plusieurs tranches (MS-PET: multi-slice positron emission tomography) ainsi que pour les systèmes d'imagerie volumétrique de positron (PVI-Systems: positron volumetric imaging systems). Pour chacune des modalités, la performance des nouveaux collimateurs fut comparée à celle des collimateurs choisis couramment. Les collimateurs furent évalués selon: (1) l'efficacité de détection des vrais événements; (2) l'efficacité de détection des événements dispersés; (3) la fraction de dispersion; et (4) le rapport du total des événements singuliers sur celui des vrais événements. Pour la TEP à plusieurs tranches (MS-PET), les collimateurs ayant un profil en diamant - collimateurs coniques doubles - furent introduits et leur performance comparée aux collimateurs coniques simples et cylindriques. Les collimateurs coniques doubles produisent une meilleure performance que les collimateurs coniques simples. Dans les systèmes d'imagerie volumétrique (PVI), des collimateurs externes coniques furent simulés et leur performance comparée à des collimateurs externes cylindriques. Ceux-ci n'ont pas améliorés la performance des systèmes.

Supervisor: Chis Thompson

Alexander Markovic

X-Ray-Induced Currents and Conductivity Effects in a Radiation-Charged Electret Ionization Chamber

M. Sc.

Studies of Radiation-Induced Conductivity (RIC) in the Teflon film of a radiation-charged electret ionization chamber (EIC) are discussed. An EIC measures dose from the amount of electret surface charge neutralized by ions created in the chamber's sensitive volume. A semi-empirical equation is presented for the calculation of prompt time-dependent RIC as a function of air-kerma rate and electric field. Measurements showing the dependence of radiation-induced current on electrode material show a tenfold difference in current between aluminum and graphite electrodes. RIC permits charge migration through the polymer which can cause an

overestimation of dose. Intermittently heating and charging the electret will cause surface charges to be deposited at deep energy levels and therefore improving electret charge retention. This study demonstrates the influence of radiation induced currents on the performance of the radiation-charged EIC.

Des études de la conductivité provoquée par l'irradiation (CPI) dans une pellicule de Teflon qui se trouve dans une chambre d'ionization à electrets (CIE) sont discutées. Le CIE mesure la dose d'après la quantité de charge electrique sur la surface de l'electret qui se fait neutralizée par des ions crées dans le volume sensible du CIE. Une nouvelle equation semi-empirique est presentée qui sert à calculer au début de l'irradiation le CPI, qui dépend du temps en fonction du debit d'exposition et du champs electrique. Les mesures qui demontrent la dependence sur le material de l'électrode du courant provoquée par l'irradiation indiquent que le courant produit avec l'électrode d'aluminium est dix foix plus large que celui produit avec l'électrode de graphite. La CPI permet une fuite de charge à travers le polymèr qui peut causer une estimation de dose excessive. En chauffant et chargeant l'electret à intervals, des charges de surface sont déposées dans des niveaux d'energie profonds. Ansi, la conservation des charges est ameliorée.

Supervisor: Gino Fallone

Ian Crooks

PC-Based Contrast Enhancement of Portal Films

M. Sc.

The enhancement of portal images using digital image processing techniques is discussed. The previously developed techniques of adaptive histogram equalization, interpolated adaptive histogram equalization, Gordon's algorithm, and modified Gordon's algorithm, are applied to digitized double-exposure portal films and the resulting images analysed. These techniques were found to be limited in their ability to provide good local contrast enhancement without excess noise amplification or long processing times. Two new techniques are proposed. The first, selective histogram equalization, produces excellent local contrast enhancement and an increase in intensity of details within the field region while minimizing noise amplification and processing time. An accompanying automatic segmentation algorithm is also discussed. The second, histogram shifting, enhances the edge detail in the image and can display the contours of objects in both the field region and surrounding region with the same intensity. Enhanced portal images display fine details better, simplifying the task of beam verification.

L'utilization de techniques de traitements d'image pour l'amélioration des images portaux est discutée. Les techniques basées sur l'égalization adaptive de l'histogramme, l'égalization adaptive interpolée de l'histogramme, l'algorithme de Gordon et l'algorithme modifié de Gordon, developées au paravent, sont appliquées à des images portaux a double exposition, et les résultats sont analysés. Ces techniques sont jugées limitées dans leurs capacité de produire une bonne amélioration de contraste locale sans souffrir d'une excessive amplification de bruit ou de longs temps de traitement d'image. Deux nouvelles techniques sont proposées. La première, l'égalisation selective de l'histogramme, produit une excellente amélioration locale de contraste et une augmentation d'intensité des détails dans la région du champs avec un minimum. d'amplification de bruit et de temps de traitement d'image. Un algorithme de segmentation automatique utilisé est aussi discuté. La deuxième, le déplacement de l'histogramme, améliore la définition des bordures des objets dans l'image et peut présenter les périmetres des objets dans la région du champs et la région annèxe avec une même intensité. Les images portaux améliorées permettent aux détails moins distincts de l'image d'être plus facilement repèrés, ainsi facilitant la vérification d'un faiscaux.

Supervisor: Gino Fallone

Alain Gauvin*

Geometrical Distortion of Magnetic Resonance Images

M.Sc.

The problem of geometrical distortion in MR images is addressed in the context of the applicability of stereotactic techniques. For this purpose, the distortion of phantom images is measured at various readout bandwidths and the spatial linearity is evaluated in view of the use of a stereotactic frame. The presence of a contribution to the overall distortion of non-linear magnetic gradients is shown from the data, although the distortion observed seems to be mostly attributable to the main field inhomogeneity. The specific problems of distortion of the fiducial markers due to bulk magnetic susceptibility effects is addressed. The occurrence of such effects is characterized with the help of imaging, and the role of the phenomenon on proper target localization is demonstrated. In addition, a method of bypassing the detrimental aspect of these effects is presented.

Various distortion correction approaches are discussed, and their benefits and drawbacks are evaluated. In the light of this discussion, a recently reported correction method is then presented. This method allows the calculation of an image free from geometrical and intensity distortion from the combined effect of main field inhomogeneity, susceptibility effects and chemical shift. Two input images acquired at two different readout gradient strengths are necessary to allow the post-processing from which the final image is obtained. The general details of the implementation of this method are discussed along with the considerations related to its adaptation for stereotaxy. A program based on this technique was developed and tested with the images of a phantom of known geometry mounted in the stereotactic frame. This allows for the evaluation of the linearity of the processed images with the help of stereotactic techniques. The effectiveness of the program is thereby demonstrated. Degradation in image quality, observed with the presented adaptation, is discussed and a remedy is suggested.

Le problème de la distorsion des images de résonance magnétique est étudié en vue de leur adaptation pour les besoins de la stéréotaxie. Ainsi, la distorsion des images d'un fantôme est évaluée à différentes largeurs de bande de codage en fréquence et la linéarité spatiale des images est vérifiée pour l'utilisation d'un cadre stéréotactique. La contribution de l'effet caractéristique de gradients magnétiques non-linéaires est mise en évidence, bien qu'il soit démontré que la non-uniformité du champ magnétique principal est dominante à cet égard. Le problème particulier de susceptibilité magnétique des marqueurs stéréotactiques en terme de distorsion est abordé. La présence de ce type de phénomène est démontrée et son impact négatif sur l'aptitude à localiser une cible avec exactitude est souligné. De plus, une solution au problème est présentée.
Plusieurs methodes de correction de la distorsion des images de résonance magnétique sont discutées. Les avantages et inconvénients des différentes techniques sont énoncés et ceci est suivi de la présentation d'une récente méthode de correction. Cette méthode permet l'obtention d'images exemptes de distorsion spatiale et d'intensité due à l'effet combiné de la non-uniformité du champ principal, la susceptibilité magnétique et le décalage chimique de la fréquence. Deux images acquises à l'aide de deux différentes bandes de codage en fréquence sont requises pour procéder au traitement conduisant à l'obtention de l'image finale. Le détail de l'implantation numérique de cette technique est discuté de même que les considérations plus directement reliées à la stéréotaxie. Un programme basé sur cette méthode a été développé et testé avec les images d'un fantôme de géométrie connue placé dans un cadre stéréotactique. Cette façon de faire permet l'évaluation de la linéarité des images ainsi traitées grâce aux techniques stéréotactiques. L'efficacité de cette approche est démontrée. La détérioration de la qualité de l'image suivant l'application du traitement est discutée et une solution est proposée.

Supervisor: Terry Peters

University of Toronto
Department of Medical Biophysics

Donald A. Christopher
The Effects of Refraction and System Constants on Doppler Ultrasound Blood Velocity Measurements
M.Sc.

This thesis consists of an investigation of the effects of three factors (refraction and the two system constants programmed into commercial doppler ultrasound systems for the speeds of sound in blood and tissue, respectively) on blood velocity measurements made with commercial Doppler ultrasound systems. A theoretical relationship is derived, using a theoretical model of multiple tissue layers separated by straight, parallel boundaries, for the total error introduced to the blood velocity measurements by the combined effects of these three factors. The theoretical relationship is investigated experimentally using a moving string test target and a commercial Doppler ultrasound system. The effects of other sources of error on the string phantom experiments are discussed as is the sensitivity of the theoretical model and experiments to angular perturbations of the parallel tissue boundaries and blood velocity vector. Several important conclusions concerning the accuracy of clinical blood velocity measurements, design of experimental flow phantoms, and calibration of Doppler ultrasound system are discussed.

Supervisor: Stuart Foster

Christina K. Haston
The Effect of Fraction Spacing on Radiation-Induced Lung Damage in Rats
M.Sc.

The dose which can be delivered in radiotherapy involving the thoracic region is limited by the radiation tolerance of the lung. Clinically, it is assumed that each same size treatment fraction has an equal effect, independent of the time at which it was delivered in the treatment. Previous work by our group has indicated that this assumption may not be valid in the context of radiation-induced lung damage. The focus of this thesis was to determine how the radioresponse of lung tissue changes during a radiation treatment.
A modified breathing rate assay was developed to monitor the development of radiation-induced lung damage, in addition to lethality. An ultrasound breathing rate measurement technique and a computer analysis algorithm have been developed to reduce the amount of time needed to collect and analyze animal breathing rate data, as well as to improve the testing environment. In this system breathing rate is measured using the signal from two ultrasound transducers to track the movement of the rat thorax. The breathing rate of an animal is then determined from user or computer selected regions containing regular breathing on the stored trace. To test the validity of the assumption that each fraction has an equal effect, independent of the time it is delivered within the treatment, an experiment was completed in which fractionated irradiation was given to whole thoraces of Sprague Dawley rats. All treatment schedules consisted of eleven equal dose fractions in thirty-six days, with some groups receiving the bulk of the doses early in the treatment time and others receiving most of the dose toward the end of the treatment schedule. The treatment schedules did not yield significantly different LD_{50} or ED_{50} values. The results indicate that for conventional daily fractionation and within the range of experimental uncertainties, the effect of a treatment fraction does not depend on the time at which it was given in the treatment. The conclusion of this thesis and of a literature review support the use of the linear-quadratic model with the addition of an exponential time component (accounting for tissue regeneration) to describe lung response to radiation.

Supervisor: Jake van Dyk

Claudio Gambetti
Correction of Phase Aberrations in Sectored Annular Array Ultrasound Systems
M.Sc.

Two methods for correction of unknown phase aberrations induced by inhomogeneous acoustic velocities in tissues are explored for the two dimensional geometry of a sectored annular array ultrasound system. The methods employed are adaptations of a cross correlation technique and a speckle brightness maximization technique. The methods correct for phase distortions via the introduction of phase shifts in the timing sequence at the beamformer stage of a sectored annular array transducer. The techniques are investigated employing software models and a computer controlled automated scanning system. A 65-element sectored annular array is modelled via a rotating 5 element transducer. Tissue equivalent materials were moulded into a double layer aberrating medium to simulate rectus abdominis phase distortions encountered in vivo. A comparison of the effectiveness of the two correction methods is presented. Contrast of an anechoic region is increased from 0.48±0.08 to 0.48±0.06 for the cross correlation technique and up to 0.62±0.05 for the speckle brightness maximization method. The performance of these correction techniques on target phantoms suggests considerable improvements in image quality should be possible for clinical systems.

Supervisor: Stuart Foster

David W. Holdsworth
A TDI-CCD system for slot-scanned digital radiography and computed tomography
Ph.D.

A digital radiographic imaging system, based on a time-delay integration (TDI) charge coupled device (CCD), has been developed. The TDI-CCD optical camera has been coupled to a conventional x-ray image intensifier (XRII) to provide improved image quality and quantitative information in clinical applications and in basic research programs.
The TDI-CCD camera consists of a 512 X 96 element detector, mounted on a computer-controlled translation stage. The detector scans over the optical output of the XRII, in synchrony with a lead collimator which scans an x-ray fan beam across the object of interest. In this manner a 512 X 512 digital radiograph is obtained, in about 4 seconds. Furthermore, if the object is rotated through 360° and many projection images are obtained, a three-dimensional computed-tomographic reconstruction can be obtained. Finally, if the TDI-CCD camera is held stationary and the object is rotated quickly, a transaxial reconstruction of a single slice can be obtained in about 4 seconds.
Results of performance evaluations show that the TDI-CCD optical camera has higher resolution (50 mm^{-1}) and greater dynamic range (2100) than existing video cameras. When used to produce projection radiographs of excised arterial tissue (submersed in iodinated contrast agent) the TDI-CCD system provides quantitative thickness measurements with precision as high as ±0.3%. In computed tomography applications the TDI-CCD system can produce volume reconstructions with $(0.025\ mm)^3$ volume elements and provide quantitative measurements of attenuation coefficients to within ±0.02 cm^{-1}. The geometric precision in perimeter measurements from transaxial reconstructions is ±0.1 mm. We conclude that the TDI-CCD radiographic system is useful in a variety of research projects, including in vitro analysis of arterial properties and quantitative investigations using small animals, such as rabbits and rats.

Supervisor: Aaron Fenster

Geoffrey R. Lockwood
High Frequency Ultrasound Imaging with Applications to Intravascular Imaging
Ph.D.

This thesis describes the design of high frequency ultrasound imaging systems and the application of these systems to intravascular imaging for the management of atherosclerosis.
New methods were developed to design the circuit which separates an ultrasound transducer from the pulsing and receiving electronics. Optimizing the design of this circuit is important since losses at high frequencies and difficulties transferring power to and from a transducer can significantly degrade the noise performance of a high frequency imaging system. A new transducer model, based on network theory, is proposed as an alternative to conventional models which are difficult to use and often inaccurate for a miniature or high frequency transducer.
Two high frequency imaging systems were built; a 50 MHz C-scan backscatter microscope and a 45-55 MHz needle based imaging system. The C-scan backscatter microscope was used to characterize the acoustic properties of vascular tissues and blood. This information is important for image interpretation and for determining the imaging frequency of an intravascular imaging system. The needle based imaging system was used to make images from within the lumen of an artery. These images demonstrate the feasibility of intravascular imaging at high frequencies and allowed an accurate comparison with corresponding histologic sections.
Two areas of future work are described; the development of a numerical program to optimize the design of a high frequency imaging system and the design of a miniature high frequency linear phased array. Each area should contribute to the development of high frequency imaging systems and lead to new clinical application of ultrasound imaging.

Supervisor: Stuart Foster

Colin Shiu-On Poon
Relaxation Time Measurement and Fat/Water Quantification Using Magnetic Resonanace Imaging: Technical Development and Clinical Applications
Ph.D.

A number of parameters which reflect tissue composition, the biophysical and biochemical environment in biological tissues, can be measured using magnetic resonance (MR) imaging. The parameters, including the relative fat and water content, and the MR proton relaxation times, have been shown to be sensitive to pathological conditions in biological tissues. It has been hypothesized that measurement of these parameters may be useful for characterizing biological tissues to give more specific diagnosis in MR imaging. This proposition has not yet been realized. One of the major impediments is the use of unreliable techniques in previous human studies, leading to results which are incorrect and inconsistent.
In an attempt to remedy the limitations in previous studies, we have developed special techniques which are capable of producing accurate and reproducible measurements in vivo. Moreover, these techniques are less sensitive to experimental imperfections such as static and radiofrequency (RF) magnetic field nonuniformities within the patients.
With appropriate suppression of the MR signal from water or fat, we demonstrate that the relative fat and water content can be quantified to within 8% of the results from chemical extraction and histological examination. Accurate measurement of T2 relaxation time is facilitated by the use of a significantly improved multi-echo sequence which includes a special magnetic field gradient pattern for suppression of image artifacts, and new RF refocusing pulses which are insensitive to both static and RF field inhomogeneity. These RF refocusing pulses were designed using numerical optimization and a comparison with prior pulses show that they have significantly improved performance. The potential of these new techniques for clinical applications is demonstrated in two clinical studies. Quantification of the relative water content in the female breasts suggest that the water content is significantly elevated in breasts with increased risk for breast cancer. The differentiation of post-irradiation fibrosis from recurrent tumor, which has been a difficult problem in the follow-up of patients with cervical carcinoma, can be aided by distinct T2 relaxation times in the two tissue types.

Supervisor: Mark Henkelman

John M. Sabol
Mammographic Scanning Equalization Radiography
M.Sc.

By overcoming film latitude limitations, scanning equalization radiography improves the clinical efficacy of chest imaging. We have investigated the application of scanning equalization radiography to mammography of the dense breast, where the narrow latitude of high contrast mammographic film limits the detection of early breast cancer. We have developed a prototype mammographic scanning equalization radiography system (MSER), to image breast phantoms. MSER increases the effective dynamic range of film/screen mammography by a factor of 25. MSER images of anthropomorphic breast phantoms exhibit up to 6-fold increases in contrast in regions of the breast that are conventionally over- and underexposed. The average entrance exposure delivered by MSER is comparable to that delivered in a conventional non-grid exam. The peak exposure delivered to a dense region of the breast is comparable to that of a conventional grid technique, where the contrast is only improved by a factor of about 1.55. Thus, the radiation risk to the patient with MSER and conventional mammography are comparable, however, MSER offers the potential for increased benefit. Observer performance in the detection of fibrils, microcalcifications, and low contrast discs, is improved with MSER. The performance of the observers was relatively independent of the x-ray transmission of the object, in comparison with conventional mammography where the observer performance decreases rapidly with changes away from the optimally exposed transmission region. A dose efficiency analysis shows that MSER varies the incident exposure so as to maintain consistent observer performance over the entire breast. MSER delivers precisely the required dose at all points over the breast. We have shown that it is feasible to construct a clinical multiple-beam MSER system with only minor modifications to existing technology. Such a system, with a dynamic range similar to that of our prototype, could have a scan time of ~ 7s.

Supervisor: Donald Plewes

Blake Walters
The Importance of Diffusion Relaxation Components in the NMR of Tissue: An Experimental Investigation Using Hollow Fibre Bundles
M.Sc.

It has been proposed that the multiple relaxation components observed in the nuclear magnetic resonance (NMR) of tissues could be due to exchange of water between relaxation environments via random Brownian motion (diffusion). Spin-spin (T2) relaxation components were investigated experimentally in bundles of hollow fibres, with walls permeable to water, to gain insight into the importance of diffusion components in tissue relaxation. When water was placed in the lumens of the fibres and a relaxation sink was created in the extralumen, diffusion components were resolved. They appeared as multiple (i.e. more than 2) components with relaxation times intermediate between that of water and that of the sink. However, when the geometry was made more irregular--and, possibly, more tissue-like--by reversing the pure water and sink compartments, relaxation components asociated with the fibre walls obscured potential diffusion components. While diffusion components might occur in irregular geometries, their small amplitudes and the difficulty of

resolving them in the face of components arising from a third environment (the wall) even in the simple fibre system indicate that their role in tissue is limited.

Supervisor: Mike Bronskill

University of Western Ontario, London, ON, Department of Medical Biophysics

Crystal A. Plume

The Relative Biological Effectiveness of Ytterbium-169 at Low Dose Rates
M.Sc.

The radionuclide Ytterbium-169 (^{169}Yb) has been proposed as a brachytherapy source with potential applications to either temporary or permanent brachytherapy implants. The half-life (32 days) and the average photon energy (93 keV) of ^{169}Yb are intermediate compared with those of other radionuclides currently in use. Consequently, ^{169}Yb offers the advantages of improved dose distribution versus that of ^{125}I and ^{103}Pd, which emit lower energy photons (28, 21 keV), and reduced radiation protection requirements versus those of ^{192}Ir, which emits higher energy photons (360 keV).

In the first series of experiments, the relative biological effectiveness (RBE) of photon radiation from encapsulated ^{169}Yb was determined by exposing Chinese hamster ovary (CHO) cells, in exponential growth, to graded doses of either ^{169}Yb or standard ^{60}Co radiation. Clonogenic cell survival was determined for continuous low dose rates ranging from 6.5 cGy/hr to 52 cGy/hr. The RBE value for ^{169}Yb, with respect to ^{60}Co, was determined to be 1.2± 0.3 and did not vary significantly over the dose rate range from 13 cGy/hr to 50 cGy/hr. An inverse dose rate effect was observed, but only for ^{60}Co irradiation at 8.9 cGy/hr. Therefore, RBE values could not be determined reliably for dose rates less than 13 cGy/hr.

In the second series of experiments, the effects of low dose rate irradiation, with ^{169}Yb or ^{125}I, were investigated in vivo using a murine RIF-1 tumour model. Response of the RIF-1 tumour to a single seed implant of ^{169}Yb or ^{125}I was assayed by the time required to achieve complete tumour regression (determined by palpation), and by the dose delivered during this treatment time. Tumours were exposed to total doses ranging from 50 Gy to 240 Gy, at initial dose rates of 9 cGy/hr to 57 cGy/hr. These dose rates are compatible with those prescribed in clinical brachytherapy. The time required to completely regress 50% of the tumours was independent of the radiation used. Since ^{169}Yb has a shorter half-life than ^{125}I (32 days versus 60 days), less dose was delivered during the ^{169}Yb treatments (for fixed initial dose rates). ^{169}Yb treatments, at the lowest initial dose rate, were significantly more effective than ^{125}I treatments. We hypothesize that the improved dose distribution of ^{169}Yb is responsible for this difference in effectiveness.

As a result of the work reported in this thesis, we have established an in vitro RBE value of 1.2 ± 0.3 for ^{169}Yb with respect to ^{60}Co. We have also demonstrated equivalence of tumour response in vivo to either ^{169}Yb or ^{125}I radiation in terms of tumour regression. At the lower dose rates, however, ^{169}Yb proved to be more effective than ^{125}I, in vivo. It is hoped that these findings will guide the introduction of ^{169}Yb into clinical brachytherapy practice.

Supervisor: Jerry Battista

Miller S. MacPherson

Absolute and Relative Dosimetry of Ytterbium-169 Brachytherapy Sources
M.Sc.

The isotope ytterbium-169 has recently been introduced for medical use as a brachytherapy source. Its average photon emission energy (93 keV) and half life (32 days) are intermediate when compared with other radionuclides currently in use. This intermediacy is believed to be advantageous in terms of relative dose distribution and radiation protection. Previously, all clinical work with this isotope has relied on theoretical values of physical parameters which are of importance in treatment planning. This thesis reports on experimental studies which will allow clinical implants of ytterbium-169 to be performed with greater confidence in its physical properties.

Ytterbium-169 (^{169}Yb) source strengths are determined using an activity-based approach. Activities are measured using a High Purity Germanium (HPGe) spectrometer as a photon detector. The photopeak efficiency of the HPGe is determined by theoretical modelling of radiation interactions inside the detector, using both analytic and Monte Carlo techniques. Using this system, activities and hence source strengths of ytterbium-169 sources can be determined with an accuracy of approximately ± 2%.

Lithium fluoride (LiF) thermoluminescent dosimeters (TLD) are used to measure the specific dose constant, Λ, for ^{169}Yb seeds. Two new seed designs were provided for study (Amersham Types 6 and 8). Measured values for the specific dose constant of 1.27 ± 0.07 cm^{-2} for the Type 6 seed and 1.30 ± 0.07 cm^{-2} for the Type 8 seed are in poor agreement with the published theoretical value of 1.19 cm^{-2}. More precise modelling of the seeds has yielded a new theoretical value of 1.25 cm^{-2}, in much better agreement with the measured results.

Relative dose distributions around two new seed types were also measured using lithium fluoride TLD in a solid water phantom. Measured dose distributions are found to agree within 5% with those predicted using the Monte Carlo method. As expected, dose distributions around ^{169}Yb seeds are more isotropic than those encountered around palladium-103 or ^{125}I brachytherapy sources.

With more accurate knowledge of source strengths and the specific dose constant, coupled with confirmed relative dose distribution for ytterbium-169 sources, more widespread medical applications of this isotope become possible.

Supervisor: Jerry Battista
