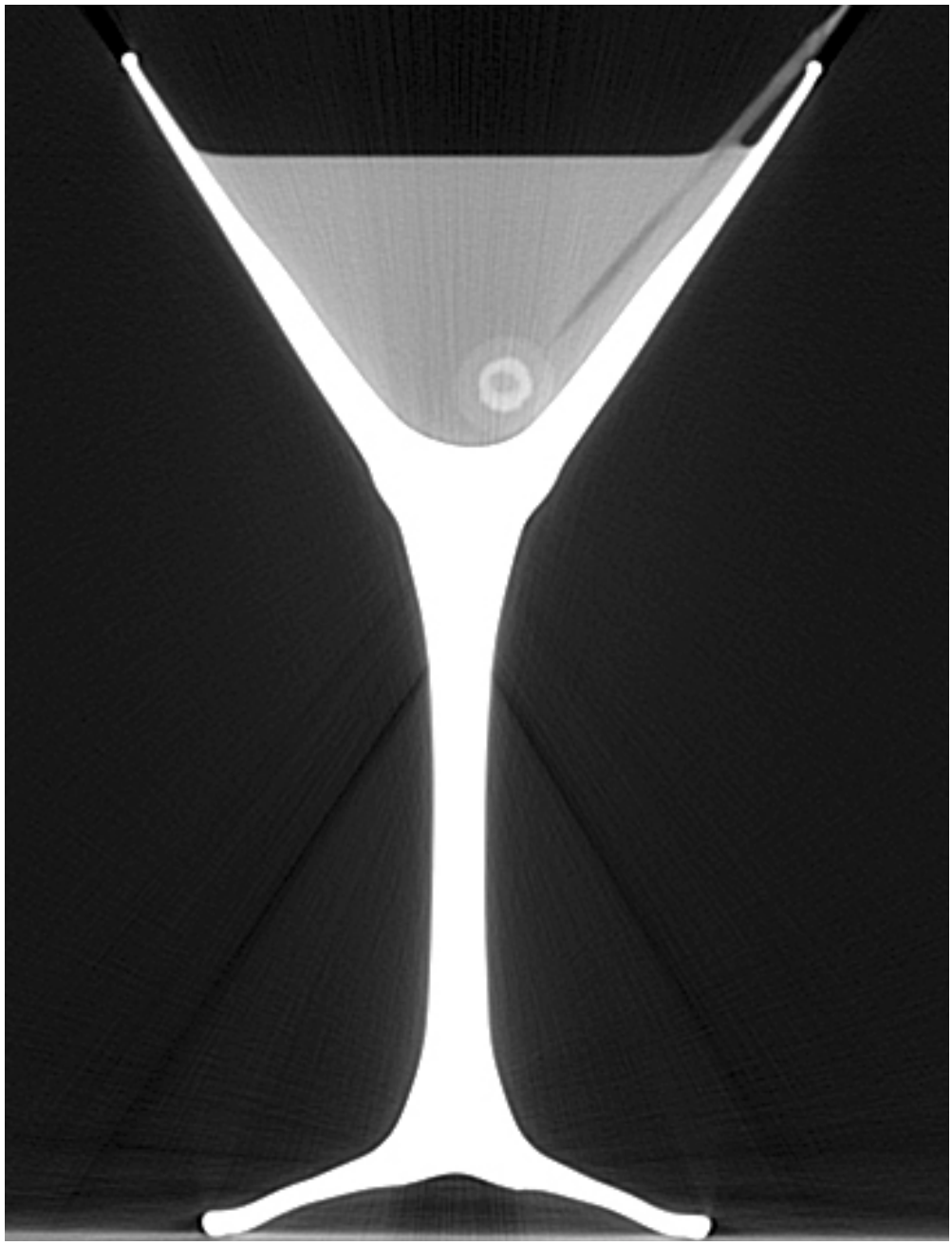
InterACTIONS

CANADIAN MEDICAL PHYSICS NEWSLETTER
Le BULLETIN CANADIEN de PHYSIQUE MÉDICALE



Stirred or Shaken?

COMP OCPM

A publication of the Canadian Organisation of Medical Physics and the Canadian College of Physicists in Medicine

CANADIAN COLLEGE OF PHYSICISTS IN MEDICINE
LE COLLÈGE CANADIEN DES PHYSICIENS EN MEDECINE

45 (1) janvier/January 1999

About our Cover

Shaken or Stirred? The cover depicts a CT scan (120 kVp, 1.5 mm thick slice) of a martini in the classic funnel glass, with the requisite olive and toothpick. Some CT artefacts such as beam hardening caused by the stem of the martini glass are visible. The scan was generated by Ian Cunningham and Jerry Battista at the London Health Sciences Centre on July 23 1998. This imaging challenge was triggered as a result of a chance meeting between Jerry Battista and Patrick Tevlin at the CAP Congress in June 1998. Both of these individuals were speakers at a session entitled "Non-Traditional Physics Career Opportunities", where Jerry described his life as a medical physicist and Patrick described his life as a "entertainment physicist" charged with designing and testing displays at the Ontario Science Centre in Toronto. They decided to investigate the analytical abilities of CT imaging to distinguish between different bar-tending practices in the preparation of martinis. Jerry reports that Ian Cunningham prepares a fine drink indeed: James Bond would have been pleased! If all goes as planned, these images might one day be a part of an imaging display – perhaps in the "human body" display – at the Ontario Science Centre.

Image courtesy of Ian Cunningham.

The Canadian Medical Physics Newsletter, which is a publication of the Canadian Organisation of Medical Physicists (COMP) and the Canadian College of Physicists in Medicine (CCPM) is published four times per year on 1 Jan., 1 April, 1 July, and 1 Oct. The deadline for submissions is one month before the publication date. Enquiries, story ideas, article submissions, and advertising submissions can be made to:

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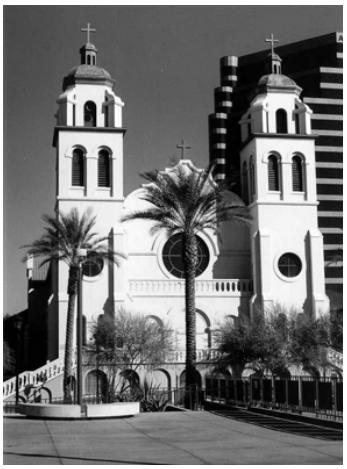

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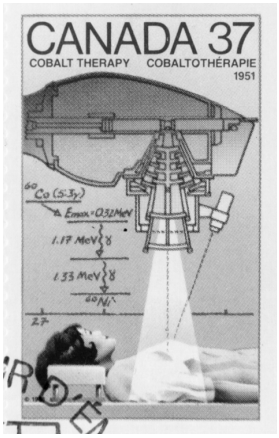

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Message from the COMP Chair:

… the executive approved a job description for the new (part time) position of executive director. ...so if you know someone who would be qualified and interested, please draw the advertisement to their attention.

Let me start this message with a wish that all our members enjoy a happy and prosperous New Year. As you read this you will have about 350 days to get ready for the apocalypse - otherwise known as Y2K. But that is not the subject of this message; instead I wanted to bring you up to date on the activities of the executive and other committees. We spent two busy days at Carleton University in Ottawa on Friday, November 20 and Saturday, November 21.

The first group to meet was the conference committee and four hours were packed with details of the meeting in Sherbrooke. As you know, we are meeting with the APIBQ and the conference is somewhat more complicated to organize because of this. However things are falling into place nicely, and you will have received the detailed announcement and call-for-papers with this newsletter. I hope as many of you as possible will submit papers and posters and plan to attend. It would be great to maintain the momentum of our very successful London meeting.

After a short break, the COMP executive began a six hour meeting interrupted only by the finest delicacies available from Carleton's cafeteria. I won't bore you with the many administrative issues dealt with at this meeting but a few points will be of general interest. First, the executive believes that the criteria for membership in COMP, and the distinctions between the various categories of membership, need to be more clearly expressed. This will require a revision of the bylaws and hence must be voted on by the general membership. The proposed changes will be distributed in the near future. Second, the executive approved a job description for the new (part time) position of executive director. A joint CCPM/COMP search committee has been struck to fill this position, and elsewhere in the newsletter (*pp. 22*) you will find an advertisement. We believe that the best candidate will likely be found through the personal contacts of our members, so if you know someone who would be qualified and interested, please draw the ad to their attention. Third, the executive discussed the current relations with CAP and reactivation of the Division of Medical and Biological Physics. Little appears to have happened with this since my last message, so stay tuned for details. Finally, the executive endorsed the establishment of an *ad hoc* committee to examine TG 51, the new AAPM dose protocol, and to recommend to COMP whether (and how) it should be adopted. As of this writing, I am still trying to finalize the membership and mandate for this group.

While the executive meeting was drawing to a close, Peter Raaphorst left to chair a meeting of the Professional Affairs Committee. This group has focused recently on writing a number of documents which detail the role and function of medical physicists in therapy and diagnosis (*see 44(4) octobre/October 1998 pp. 130-136 of the Newsletter*). In the future the committee would like to move more towards an advocacy role in

which they will vigorously promote the profession. The committee recognized the need to update some of our promotional material and to ensure that it will be accessible on the COMP/CCPM website.

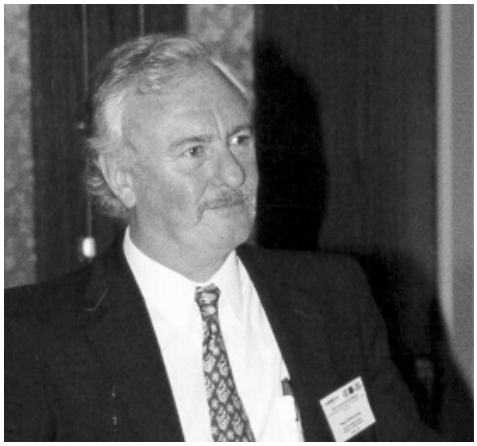
Speaking of websites, this was the major item of discussion at the meeting of the communications committee on Saturday morning. I attended as an ex officio member and was most impressed by the work this group has already done under the leadership of Peter Munro and Darcy Mason. The group decided on the structure and initial functions of the website and it is hoped that it will go "public" early in 1999. I believe it will prove to be very useful to our members and should improve both our internal communications and our visibility as an organization.

Following that meeting (and more cafeteria sandwiches) the radiation regulations committee gathered with Peter O'Brien in the chair. There was considerable discussion about the changing environment of radiation regulations and quality assurance in diagnostic radiology and the lack of

(Continued on page 23)

Message from the CCPM President:

The Board of the Canadian College of Physicists in Medicine held its midwinter meeting in Ottawa on the 21st November 1998. As has been the tradition for the last few years, the Board meets in conjunction with the COMP Executive and our joint committees. Such an arrangement is economical in both time and money as many of us participate in several meetings over the day and half set aside for these activities. My report in this edition of the Newsletter will be an outline of what transpired at the recent Board meeting.



Gino Fallone has overseen the revision of the Membership exam booklet. The new version will be used for examinations starting this year. Any prospective applicants for the Membership examination should obtain a copy of the revised booklet from Alistair Baillie and not rely on hand-me-down copies from colleagues. The marking of the oral exam for Fellowship in the College was discussed at some length. As more physicists go through the exercise, more opportunities for improving the examination process become apparent. A revised scoring form is under development and this should clarify, both for the candidate and the examiners, the numerical basis upon which candidates are evaluated.

Elsewhere in this edition of the Newsletter are proposed By-law amendments submitted by Alistair Baillie. The Board approved the amendments in November and they will come up for a vote at our AGM in Sherbrooke. Continued efforts are being made to clarify the entry requirements for Membership in the College. A perennial issue is that of patient related experience and exactly what that means. Wording changes in the information sent to both applicants and references will hopefully further clarify this particular issue. By 2000 we hope to have the Applicant Assessment Form more closely linked to the Role and Function Statements approved by COMP and the College enabling us to more accurately assess whether or not an applicant has been functioning as a Medical Physicist.

The Job Description for the proposed part time Executive Director for COMP and the College was discussed. Agreement was easily reached with COMP thanks to a comprehensive draft job description prepared by Paul Johns. A resource person of the type proposed could be a major help in moving both organizations forward.

From my last contribution to the Newsletter you will have learnt of the demise of the joint initiative with the CAMRT. I mentioned at that time that the Board was not in favour of abandoning the issue. It was further discussed in Ottawa and the following statement was unanimously supported by the Board.

> *The Board of the Canadian College of Physicists in Medicine regrets the failure of the CCPM-CAMRT initiative on the certification of dosimetrists. However, given that medical physicists are responsible for the accuracy and appropriateness of individual computerized treatment plans, the Board of the CCPM intends to provide guidance on the identification of qualified dosimetrists. In developing national guidelines for identification of qualified dosimetrists, alternative certification processes will be reviewed.*

This statement is self-explanatory. We will keep you informed of progress.

A new issue that emerged shortly before our Board meeting was that of the College's role in accrediting residency programs in medical physics. It transpires that funding for an expanded program in Ontario may be influenced its accreditation status. Rather than embark on such an initiative ourselves it may be simpler to join the Commission on Accreditation of Medical Physics Education Programs which currently has the following as member organizations: AAPM, ACMP and ACR. The Commission already recognizes certification by the College in its by-laws. We are currently reviewing the by-laws and already there is enthusiasm amongst the Board for this approach.

One other topic that was raised by a Fellow of the College currently residing south of the border was that of limited or misunderstanding of the College, its mandate and activities outside of Canada. One task I accepted was to prepare a

(Continued on page 23)

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Imaging is the Focus of the 1998 Taylor Prize

The two winners of the prestigious J. Allyn Taylor International Prize in Medicine were announced at a media conference at The John P. Robarts Research Institute in November. Renowned for their work in the area of medical imaging, Dr. Charles Mistretta and Dr. Graeme Bydder each received a cheque for $10,000, a medallion and a certificate.

The Taylor Prize is awarded annually to scientists who have made significant contributions to a field of basic or clinical research in one of the Robarts Research Institute's principal areas of research. These include cardiovascular science, immunology, neuroscience, clinical trials / clinical pharmacology, gene therapy & molecular virology, and advanced imaging. Each year a topic is selected and the international scientific community is invited to nominate candidates. A peer jury including John Dirks – president of the Gairdner Awards – deliberates and then selects the prizewinner or winners from among the many nominees.

This year's topic is medical imaging, a field that has revolutionized medicine this century. This year's Taylor Prize winners, have made major contributions to both magnetic resonance imaging and digital subtraction angiography. One of the winners, Dr. Graeme Bydder, Professor of Diagnostic Radiology, Imperial College School of Medicine, Hammersmith Hospital, London, England (originally from New Zealand) was one of the pioneers in developing the applications of magnetic resonance imaging to the investigation of neurological diseases. He has brought together high quality magnetic resonance techniques with his clinical practice, for the diagnosing of brain disease. Although contributions have been made by many other neuroradiologists around the world, Dr. Bydder stands out as a consistent and innovative contributor to MRI.

The second winner, Dr. Charles A. Mistretta, Professor in the Departments of Medical Physics and Radiology at The University of Wisconsin in Madison, has been a major force in the development of innovative techniques for vascular imaging. His research into basic x-ray physics and techniques, as applied to image formation and storage, led to digital subtraction techniques that are nowadays indispensable in vascular imaging. Dr. Mistretta is indeed a key figure in the scientific developments that have made many of the advances in vascular imaging over the last three decades possible, and is now at the forefront of exploring the use of MRI for vascular imaging.

The award was established by Mr. J. Allyn Taylor, Founding Chair of the Board and one of the Founders of The John P. Robarts Research Institute, through a contribution from the C.H. Stiller Memorial Foundation. The award was established 14 years ago in 1986, and the first award presented even before the building currently housing the Robarts Research Institute was completed.

K. Cunningham

Recipients of the J. Allyn Taylor International Prize in Medicine, Dr. Charles Mistretta (left) and Dr. Graeme Bydder (right) along with Mr. J. Allyn Taylor (centre), the Founding Chair of the Board of the Robarts Research Institute and one of the founders of the Institute.

40th Annual Meeting of ASTRO – Phoenix, AZ

By Peter Munro

The 40th Annual Meeting of the American Society of Therapeutic Radiology and Oncology was held at the Phoenix Civic Center, 25-29 Oct. 1998. As usual there was too much going on to see more than a small fraction of the commercial displays and scientific presentations. While there are relatively few scientific sessions dealing with physics topics, I continue to be impressed by the calibre of the refresher courses and of the guest speakers. It is clear that the ASTRO organisers are able to attract some of the brightest and most capable scientists to their meeting. This year two topics were of special interest to me: the work of Dr. Judah Folkman and organ motion in radiation therapy.

Dr. Judah Folkman

Originally a paediatric surgeon, Folkman became interested in the relationship between angiogenesis and tumour growth as a result of some side experiments that he performed in 1960 while he was investigating the properties of blood substitutes. While studying the ability to keep rabbit thyroids alive using a cell-free blood substitute, he introduced rabbit melanoma cells onto the surface of the thyroid. The melamona cells grew, but stopped their growth once they reached a certain size. Trying to understand why the melanoma cells stopped growing has dominated Folkman's research activities for the past 38 years. [For a more detailed biography of Folkman, readers are encouraged read the profile in the October 1998 issue of Scientific American pp. 33-34.]

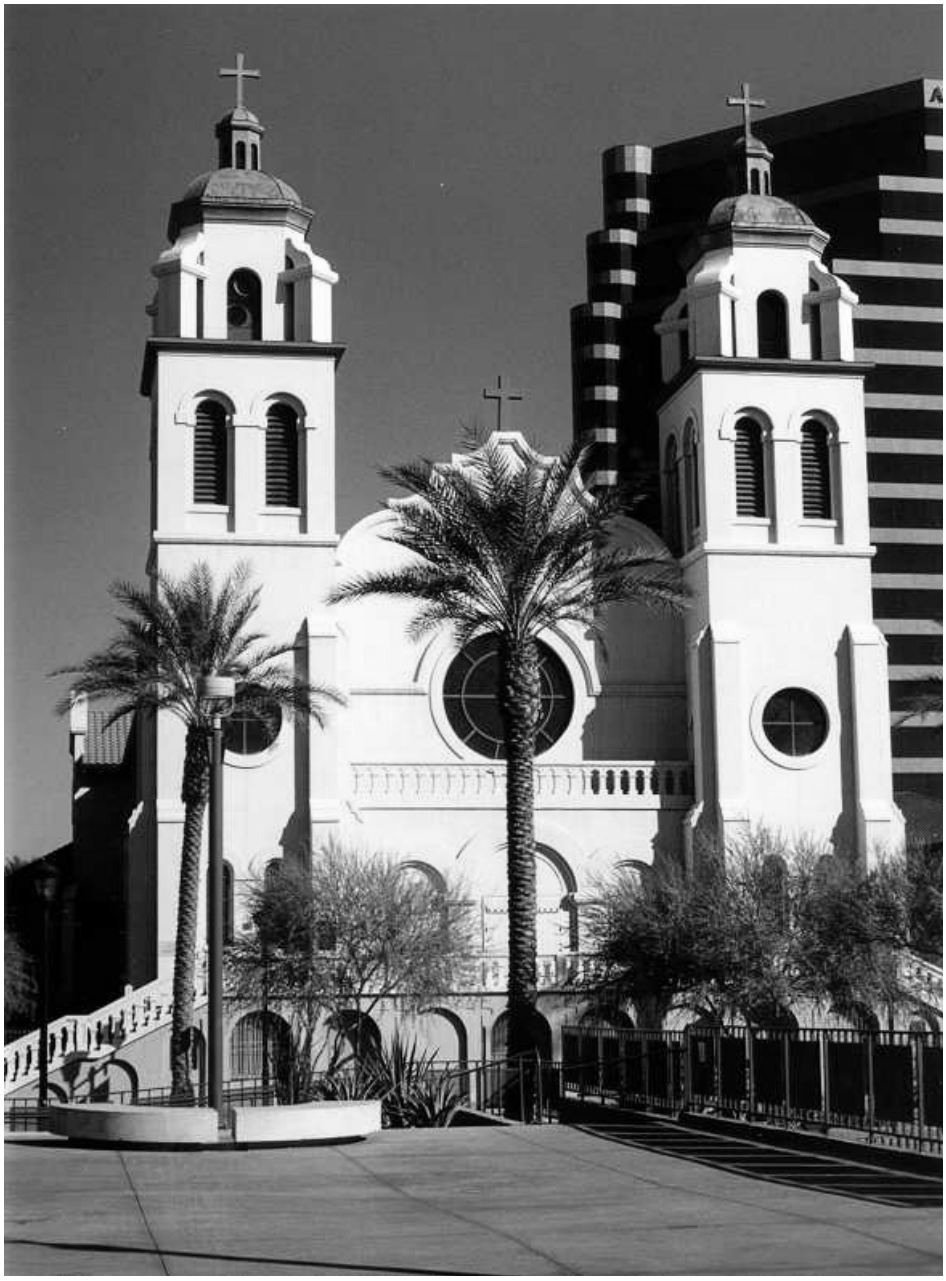
Folkman presented a novel hypothesis on how tumours should be treated. He believes that tumours can be divided into two compartments: tumour cells and the endothelial cells that form the vasculature of the tumour. His hypothesis was that treatment should focus on destroying the tumour vasculature not the tumour cells directly. He had a number of arguments why the vasculature would be a better target. One was that normal endothelial cells are not normally in cycle, so that there is a big difference between the cycle times of normal endothelial cells (1,000-10,000 day turn over time) compared to the very active endothelial cells found in tumours (5 day turn over time). Therefore, treatments that specifically targeted the active endothelial cells in the tumour could generate few side effects. Another argument was that while tumour cells have a high mutation rate, and thus the opportunity to develop drug and radiation resistance, endothelial cells have a low mutation rate and thus would be expected to not develop resistance to treatment. Finally, Folkman suggested that tumour cells were uniquely vulnerable to injury of the endothelial cells forming the vasculature. In normal tissues, the ratio of tissue cells to vascular endothelial cells is quite low (e.g., 1:1, 2:1). However, in tumours, this ratio can be as high as 50:1. Thus, tumour cells are dependent on a much smaller number of vascular endothelial cells for their survival.

One of Folkman's claims to fame is the discovery of the drugs angiostatin and endostatin in his laboratory – two drugs that exhibit strong anti-angiogenic properties. These drugs are fragments of naturally occurring polypeptides such as collagen XVIII and fibrinogen. These drugs were discovered by a fascinating experiment [see O'Reilly MS et.al. "Angiostatin: a novel angiogenesis inhibitor that mediates the suppression of metastases by a Lewis lung carcinoma." Cell 1994 Oct 21;79 (2):315-28]. If one implants a tumour in a mouse, after some time micro-metastases can be found throughout the animal. However, these micro-metastases are dormant, there is a balance between cell growth and cell death, and there is no sign of angiogenesis. If, however, the primary is removed (and this is a phenomenon that is sometimes observed in humans), then the mouse will die approximately 15 days later because of sudden growth of the metastases. After three years of purification, it was found that the primary tumour releases compounds (angiostatin and endostatin) that inhibit angiogenesis in the metastases. Once the primary tumour is removed, the anti-angiogenic compounds are removed, too and the metastases can grow unchecked.

Folkman suggested two ways that these compounds could be used. The most obvious one is to use these agents either alone or in combination with traditional therapies such as radiation therapy [see Mau-

A view typical of the Sonoran Desert surrounding Phoenix. The Saguaro cactus in the foreground acts like a desert apartment building housing a large number of birds and animals. Photograph courtesy of Janos Szanto.

ceri HJ, "Combined effects of angiostatin and ionizing radiation in antitumour therapy." Nature 1998 Jul 16;394(6690):287-91] or chemotherapy. Initially, this might seem to defy conventional wisdom, because destroying the tumour vasculature would be expected to increase the hypoxic fraction of the tumour. However, studies by RK Jain have shown that the anti-angiogenic compounds reduce leakage of lymph, which in turn reduces intra-tumour pressure and thus can increase blood flow. Furthermore, the anti-angiogenic agents lead to endothelial cell death (apoptosis) resulting in tumour cell death around the capillaries, thus unpacking the tumour bed and also leading to increased blood flow. Folkman presented very convincing evidence that targeting the tumour vasculature would be a better treatment. One of the most convincing arguments was the absence of resistance in a wide number of experiments that target the vasculature [e.g., see T. Boehm et. al. "Antiangiogenic therapy of experimental cancer does not induce acquired drug resistance." Nature 1997 Nov 27; **390**: (6658) 404-7]. The study that most intrigued me was one where the dose and timing of cyclophosphamide were changed so that the treatment specifically targeted endothelial cells rather than tumour cells (i.e., no new drugs were used). The dose of cyclophosphamide was selected empirically to optimise its killing of endothelial cells and this treatment proved to be much more effective than the typical treatments that targeted the tumour cells. Interestingly, the better treatment used a less intense regimen, which spared the bone marrow.



Phoenix architecture. This church , the oldest Catholic church in the Phoenix area, was opened in June 1881. It is located immediately beside the Phoenix Civic Center where the annual ASTRO meeting was held.

What impressed me most about Folkman was the second role that he suggested for these compounds (and that spoke to his scientific integrity). Rather than promote these current anti-angiogenesis compounds as agents to cure cancer, he emphasised that their most important role might be to improve our understanding of how tumours depend upon their vasculature. It is these further studies that Folkman thinks will lead to a real clinical breakthrough. His ability to keep his current findings in perspective was, for me, one of the most impressive parts of his entire presentation.

Folkman ended his presentation with a "physicists view" of anti-angiogenesis therapy.

> *"Tumours, for all of the classic diversity of phenotypes that they possess, depend absolutely on the delivery of survival factors and the removal of catabolytes by the comparatively well-organised, low-diversity process called angiogenesis. Therefore, the low diversity population of endothelial cells upon which tumour cells are dependent, can serve as a targetable weak link to which the diverse tumour cell population has little or no evasive response."*

It seems clear that the developments discussed by Folkman will influence cancer care and in turn the role of medical physicists in the years to come.

Organ Motion

Every year at ASTRO a theme emerges

and this year's theme in the physics presentations was organ motion. Many talks examined ways to minimise the effects of respiratory motion or ways to measure the potential benefits of reducing this motion. Three methods were discussed. John Wong and the group from the William Beaumont Hospital described ABC – active breathing control. This is a respirator that controls a patient's breathing and can lock their respiration at one position in the respiratory cycle. The Beaumont group showed that for Hodgkin's lymphoma treatments one could reduce the mass of lung irradiated by up to 14% and for treatment of liver nodules one could reduce the mass of liver irradiated by 18-28%. Mark Sontag, now at the St. Jude Children's Research Hospital in Memphis, described a respiratory monitor that uses air flow, lung volume, air pressure, CO_2 concentration, and changes in CO_2 concentration to identify the various stages in the respiratory cycle. The device is non-invasive, consisting of a sensor that is placed in the mouth of the patient and used to gate the output of the (Siemens) linear accelerator. Sontag presented radiographs showing how diaphragm motion could be reduced from 3 cm without respiratory gating to 2-3 mm with gating. Finally, Scott Johnson from the University of Chicago described a video camera method to detect respiratory motion. Using CT scans, a "camera eyes view" of the surface of the patient is rendered and used as a reference for identifying breathing motion. Johnson claimed that motions of 1 mm could be identified and used to gate the linear accelerator.

Organ motion at other sites was also discussed, with prostate getting the majority of attention. John Wong and David Jaffray discussed the use of on-line corrections (corrections immediately before treatment) to minimise set-up errors and allow treatment margins to be reduced in prostate treatments. Jaffray showed how a reduction in the treatment margin to 4 mm could allow large increases in prostate dose (from 75 Gy to 89 Gy) for the same normal tissue complication rates. Wong showed how the use of kilovoltage imaging and on-line corrections could reduce set-up errors to ~ 2 mm. Joos Lebesque from the Netherlands Cancer Institute reviewed the factors that could influence positioning of the prostate including rectal filling, bladder filling (small effect), and position of the legs. One surprising thing that I learned was that gas in the bowel can move the prostate rapidly, and sometimes in unpredictable ways. For instance, one might expect that gas in the bowel would push the prostate in the anterior direction, however, if the patient is being treated prone, then sometimes gas in the abdomen can move the prostate in the opposite (posterior) direction. And Janos Szanto from the Ottawa Regional Cancer Centre showed how respiratory motion could move the prostate by up to 5 mm when patients were immobilised (using vac-fix) and treated prone. My impression is that there is a lot of uncertainty in prostate positioning and that certain dogmas (e.g., prone treatments are better) are being challenged. The more we learn the more uncertain we become!

Commercial Trends

There were some interesting trends in the exhibitors booths. One of the most interesting trends, for me, was the improvements in EPIDs (electronic portal imaging devices). Varian is about to announce (available by mid 1999) its first generation amorphous silicon EPID. This device will have a pixel pitch of 786 microns, a pixel matrix of 512 x 384, and cover a field of view of 30 cm x 40 cm. Varian admits that its first generation electronics will not be as radiation resistant as desired, so conservative buyers might want to wait until the second generation amorphous silicon EPID is available - in about mid 2000. This more advanced device will feature radiation resistant electronics, a pixel pitch of 393 microns, a pixel matrix of 1024 x 768, and the same 30 cm x 40 cm field of view. EG&G is also making major advances in their amorphous silicon developments. Initially the EG&G EPID will be available on Elekta accelerators, although I am sure that EG&G would like other accelerator vendors to sell their amorphous silicon device as well. The device will have a pixel pitch of 800 microns, a pixel matrix of 512 x 512, and a field of view of 41 cm x 41 cm. From all reports, the electronics of the device should be well designed and should also be very radiation resistant. I received sample images from prototype devices from both Varian and EG&G and the image quality is unbelievably good. This high level of image quality should be a big stimulus to the clinical utility of portal imaging. For a long time I have been stressing the importance of image quality in making portal imaging practical. While good image quality alone will not solve all of the problems that have lead to poor clinical acceptance of portal imaging, it is currently an important impediment to widespread clinical utility. I think that these new devices should make a big difference in the clinical utility of EPIDs. The only difficulty with the amorphous silicon EPIDs is that the pulsing of the accelerators creates horizontal line artefacts in the images - if the timing between image readout and accelerator pulsing is not perfect. It remains to be seen how this problem is solved. [My solution is to have the EPID interrupt the output of the accelerator while the image frame is being readout so that no accelerator pulses occur during the short 50-100 ms period when the EPID is being readout. However, accelerator vendors are reluctant to introduce this solution.] Siemens seems to be bucking the amorphous silicon trend and instead are looking at an improved TV camera. They are studying the use of a Pasecon (cadmium selenide) TV camera made by Video-Optics; a camera that I characterised over four years ago. In our hands the camera gave excellent image quality and the only problem was lag, both photoconductive and beam discharge lag, which reduced the measured signals substantially. The Siemens camera seems to have solved these problems (perhaps with the use of a bias light) and the sample images that I saw were quite remarkable. There will be some very impressive improvements in portal imaging systems in the next couple of years.

Editors Note: I would like to thank Janos Szanto for his efforts in supplying photographs of the Phoenix area for this article.

Cobalt-60: A Canadian Perspective
Part 1: The Development of Kilocurie Sources

By Doug Cormack with Peter Munro

Note: This is the first of a four part series describing the development of, and initial clinical experiences with, ^{60}Co sources for radiation therapy.

Atomic Energy and Cobalt-60

An essential ingredient in giving Canada the opportunity to seize and maintain the lead in ^{60}Co beam therapy was the high-flux, heavy-water-moderated reactor, known as the National Research Council Experimental, or NRX**,** reactor (Fig. 1). While the credit for developing the medical applications of ^{60}Co must go to H.E. **Johns** and A.E.C.L., the credit for generation of the ^{60}Co material itself must go to the many scientists who contributed to the development of nuclear reactors and atomic energy.

The story of nuclear reactors is intimately associated with that of World War II and the events immediately preceding it (e.g. see Stuewer, 1985). In late 1938 two German scientists – Otto **Hahn** and Fritz **Strassman** - working in the Kaiser Wilhelm Institute in Berlin, identified barium as one of the products produced when uranium was bombarded with neutrons. These observations baffled the scientific community of the day including giants like Niels **Bohr**, Enrico **Fermi**, and Frederic **Joliot**. The conceptual breakthrough was made by Lise **Meitner**, an Austrian citizen of Jewish descent who had been spirited out of Germany after Hitler's Anschluss in March 1938. Despite personal risk, Hahn had kept Meitner informed of the results of his experiments. During the Christmas holidays of 1938, Meitner and her nephew, Otto **Frisch**, who was working in Bohr's laboratory in Copenhagen, hit upon the idea that uranium might split into two nearly equal fragments under neutron bombardment. Their calculations showed that this was energetically possible and they dubbed the process "fission" by analogy to biological cell division. Frisch returned to Copenhagen and related the idea to Bohr who received it with great excitement. About a week later Bohr boarded a ship for the U.S.A. after urging Frisch to submit a letter to Nature without delay. Bohr went to extraordinary lengths to keep the fission story under wraps until Meitner and Frisch's paper had been published but the news was too hot to handle and the cat got out of the bag. At a conference on theoretical physics organised by George Gamow and Edward Teller and held in Washington, DC, Jan 21-30, 1939, discussion of fission and its implications dominated the agenda.

By January 1939, Hahn and Strassman had suggested that thermal neutron-induced fission of uranium could release secondary neutrons and that these might give rise to a chain reaction if they were slowed down (moderated) to increase the chance of capture leading to further fissions. In Paris, Joliot with his colleagues Hans von **Halban** and Lew **Kowarski** (see Fig. 3) had also observed the secondary neutrons. They detected increased fission when uranium oxide was immersed in ordinary water although neutron capture by hydrogen prevented the onset of a self-sustaining chain reaction.

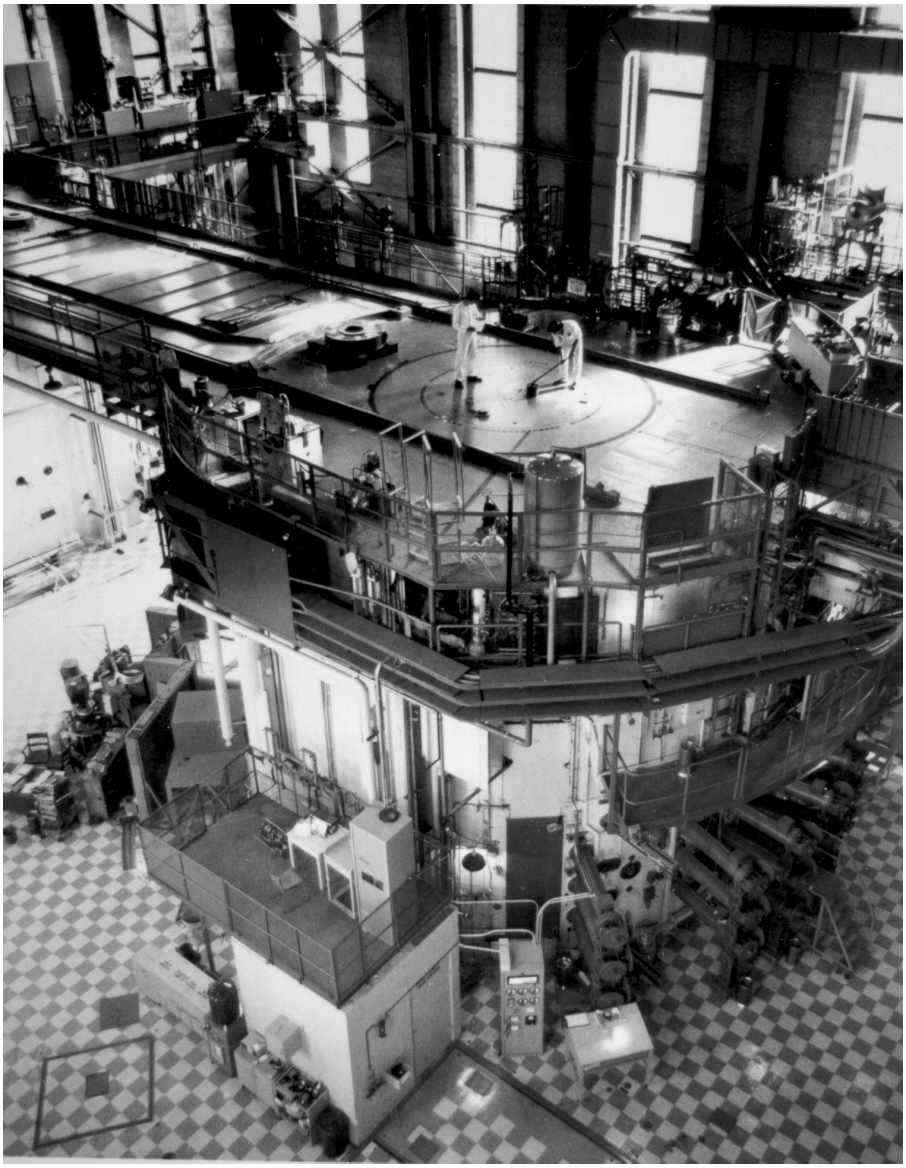


Fig. 1 The National Research Council Experimental (NRX) reactor, located at Chalk River. The reactor, which went critical in 1947, remained in active service for over 30 years.

In late August 1939 German troops invaded Poland and World War II had begun. There was considerable fear in the Western democracies that Nazi Germany would use its head start in the nuclear fission field and its potent military-industrial complex to develop nuclear weapons. Nuclear scientists in the U.S.A. and the U.K. imposed a voluntary moratorium on the publication of the results of experiments that might be relevant to weapon production. Joliot, however, refused to comply and in April 1939 published information on the average number of neutrons released in a fission of ^{235}U. By January 1940, the main thrust of the Paris group was to achieve a chain reaction using heavy water as a moderator. [Deutermium is second only to hydrogen for slowing down neutrons by elastic collisions but has a much lower cross section for neutron capture than hydrogen.] At that time the only large-scale producer of heavy water was the **Norsk Hydro** plant in Rjukan and arrangements were made to transport 185 kg of the material to Paris. After a roundabout trip the heavy water arrived in Paris but Joliot, Halban, and Kowarski had little time to make use of it in their experiments. The German army invaded the Netherlands, Belgium, and France in May 1940 and as France collapsed the French government ordered that the heavy water be evacuated from France along with the scientists. While Joliot chose to remain in France in the Resistance, Halban and Kowarski – along with the heavy water -succeeded in reaching Britain where they formed a group in Cambridge to continue work on the feasibility of a heavy-water "pile".

"Cannons", "Howitzers", and "Bombs"

It is not clear how the term "bomb" became associated with tele-therapy sources. It may have been the result of Koenig (see Breslau 1912) - one of the first people to use radium at a distance - who called his device a radium "cannon". In 1922, Lysholm in Stockholm constructed what he called a radium "howitzer" - a device that used 2 g of radium to produce a beam with a dose rate of 4 cGy/min at a distance of 6 cm from its end. Names such as cannon and howitzer made sense, since the radium was contained in thick walled tubes. By the 1930's most such devices, especially in the U.K., were referred to by the colloquial (and misleading) name radium "bombs", with or without quotation marks. One possible explanation is that at the time the term "cannon" was used synonymously for the term "bomb".

The Canadian Connection

By early 1942 it was clear that the major player in the "atomic" energy program would be the U.S.A. and that the Cambridge group should move across the Atlantic. The first choice - to join Compton's "Metallurgical Lab" in Chicago - was over-ruled by American concerns about military and industrial security. "Canada was a workable alternative" (Laurence, 1975). Canada was geographically close to the U.S.A. and had the advantage that the National Research Council already had an established research program in fission under the guidance of G.C. **Laurence** (Fig. 2) and B.W. **Sargent** from Queen's University, who joined Laurence during the summer vacations of 1941 and 1942 (see also sidebar– Going Critical). [Indeed, given more time, more assistance, and purer materials, the first man-made nuclear chain reaction might have been achieved in Canada. G.C. Laurence made the first Canadian experimental attempt in 1940-1942.] Montreal was chosen as the site and in late 1942 the staff, having braved the Battle of the Atlantic, began to arrive. As noted by Laurence (1975) the wartime nuclear "co-operation" between the Americans, the British, the French and the Canadians was often marked by major political differences and acrimonious arguments. The first two years of the "Montreal Lab" were not happy ones with Halban as the director. In April 1944 J.D. **Cockroft** (see Fig. 2) replaced Halban as director, the lab was reorganised, and a sense of purpose was restored. Kowarski, who had refused to serve under Halban, rejoined the group. The pilot heavy-water reactor, known as NRX (National Research Council Experimental) was designed in the Montreal Lab and in 1945 construction started on the newly chosen Chalk River site. The first self-sustaining

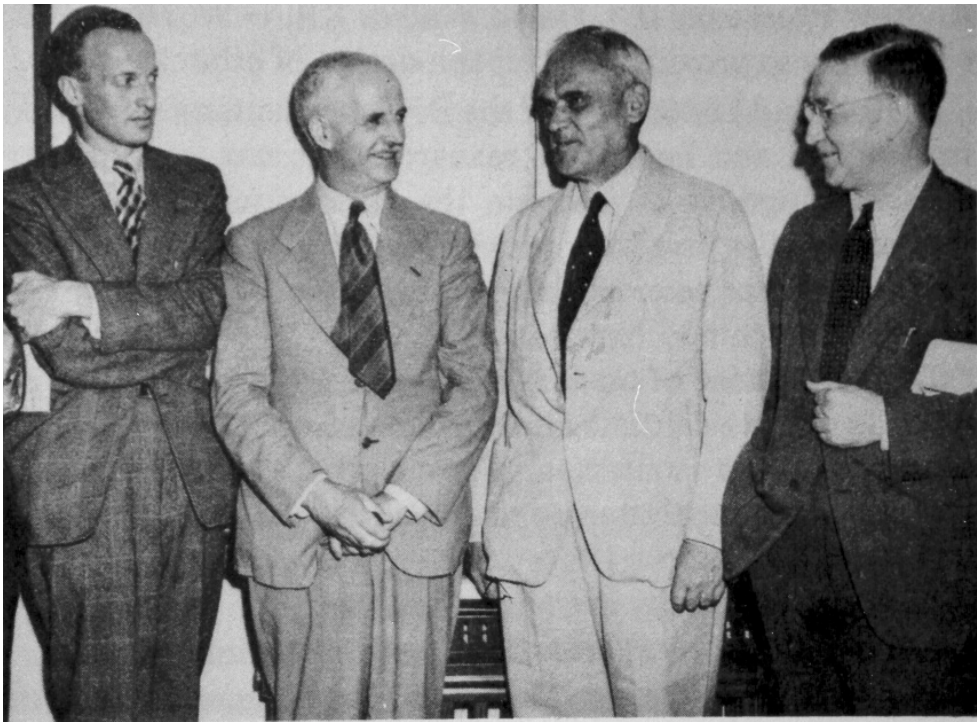


Fig. 2 Dr. G.C. Laurence, Dr. C.J. MacKenzie (President, NRC), Honourable C.D. Howe (Minister of Reconstruction), and Dr. J.D. Cockcroft in August, 1945, a few weeks before ZEEP started up.

chain reaction in Canada (and, in fact, anywhere outside the U.S.A.) did not, however, take place in NRX but in its "little brother" ZEEP (Zero Energy Experimental Pile). Kowarski had led the team for the ZEEP project. ZEEP "went critical" in September 1945, about a month after the misnomer "atomic energy" had been added to the general vocabulary by the news of the Hiroshima and Nagasaki bombs. Heavy water for both ZEEP and NRX was produced in the Cominco plant in Trail, BC. NRX, its team directed by B.W. Sargent, went critical in July1947 with a power of 10 MW; which was increased to 40 MW over the course of the next few years. The thermal flux, a closely guarded secret at the time, was about 3 x 10^{13} neutrons per (cm^2 s) - by far the world's highest.

Kilocurie Cobalt-60 Sources

The biological effects and hazards of the radiations generated in the operation of nuclear reactors were of great concern. In preparation for the opening of the Chalk River Laboratory, advice was sought from several internationally recognised experts. In 1944, J S Mitchell, Professor of Radiotherapeutics and Regius Professor of Physics at Cambridge, was appointed adviser to the Biological and Medical Branch of the Atomic Energy Project in both Canada and the UK. Mitchell was uniquely qualified having a medical degree, a Ph.D. in physics, and training in radiology and therapy at the Christie Hospital under R. Paterson – of brachytherapy fame (Robison 1995). While at the Montreal Lab in 1944-45 Mitchell was asked by Cockroft to prepare a report on the production of radioactive isotopes by both "pile" and cyclotron and to assess their relative merits for medical applications. The resulting report, secret at the time, formed the basis of a paper in the BJR a year later (Mitchell, 1946). In it Mitchell concluded that ^{60}Co was the most promising substitute for radium and that the "Canadian pile could easily produce several hundred curies of radiocobalt every six months"

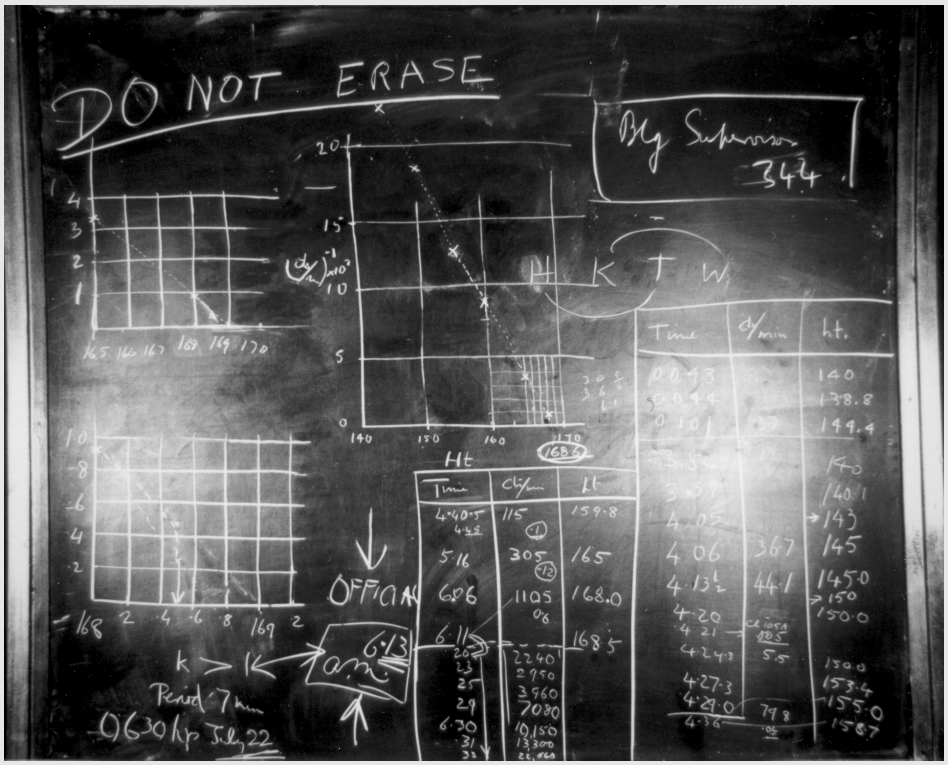
In 1945 Mitchell was replaced as adviser by W V Mayneord, Professor of Physics Applied to Medicine in the University of London and one of the pioneers in medical physics. He is credited with a major role in the development of the “rad” as a radiation unit (Robison 1995). Mayneord joined A J Cipriani who had recently been appointed Director of the Biology Division of the Chalk River Laboratory after service in the Army Medical Corps.

Cipriani was born in Trinidad and obtained an honours degree in Mathematics and Physics at McGill in 1932 and an MD in 1940. (Keys 1957).

Cipriani and Mayneord spent a year in active collaboration including examining the possibilities and problems of using ^{60}Co as a source for beam therapy (Mayneord and Cipriani, 1947). Johns and Watson (1982) credit Cipriani with the design and fabrication of the "wafers" of ^{59}Co, which were activated in the NRX reactor to produce the source for the units installed in London, Ontario and

Going Critical

It was decided that there would be no spectators in the control room of the NRX reactor when it was started up. So only a small number of physicists, including B.W. Sargent (in charge), D.G. Hurst, B. Pontecorve, D.D. Stewart, G.M. James, and others were present to read the gauges and manipulate the controls. Since a number of the senior staff wanted to be present during this historic occasion, an observers’ room was set-up below the NRX control room, where readings from the control room were relayed via telephone. A blackboard was set-up in the observers’ room and the readings were tabulated and plotted. As the level of heavy water in the calandria was raised the number of fissions (recorded as counts/min) increased. The initial data predicted that the reactor would go critical at a level of 168.5 cm of heavy water. As the heavy water level neared this value, it was increased by 1 millimetre at a time. The blackboard records the time (6:13 a.m. 22 July 1947) when the reactor when critical, at a level of 168.6 cm of heavy water. During the all night vigil (the photo below suggests that the experiment started around midnight) some of those present had time to play bridge, while waiting for new readings from the control room.



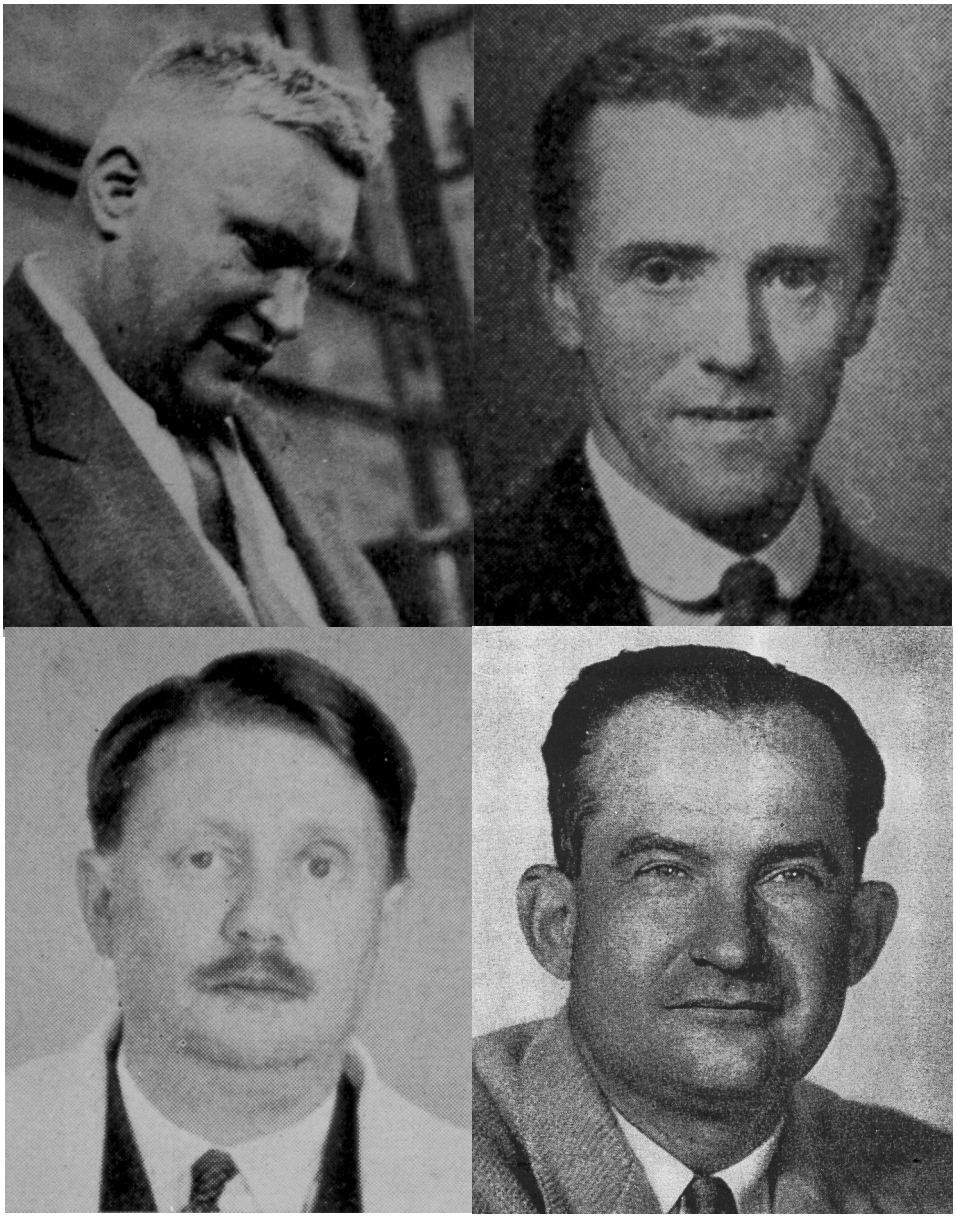


Fig. 3 From upper left, clockwise: Dr. L. Kowarski who directed the ZEEP project project which provided the experimental verification for the theoretical calculations upon which the NRX design was based; Dr. W.V. Mayeord who recognised the potential of ^{60}Co in 1945 and passed his enthusiasm onto Harold Johns; Dr. A.J. Cipriani who played a key role within the Chalk River Nuclear Labs as an advocate for ^{60}Co therapy; and Dr. J.S. Mitchell who identified ^{60}Co as "the most promising substitute for radium" and the "practicability of the Canadian pile" for producing it – more than two years before NRX went into operation.

Saskatoon in 1951. The wafers were sufficiently thin that self-shielding would reduce the average neutron flux by only about 20%. Mayneord returned to London in 1947 but Cipriani continued to play an active role in the ^{60}Co drama until his untimely death in 1956. As Jean Bouchard, of the Royal Victoria Hospital, Montreal, remarked in the special issue of the JCAR commemorating the fifth anniversary of the first ^{60}Co units "Cipriani played an important part in the promotion and development in the Chalk River Laboratories of compact, powerful sources of ^{60}Co for radiation therapy".

By 1946-1947 it was becoming widely recognised that ^{60}Co might be an excellent alternative to radium and that the NRX reactor was ideally suited for generating kilocurie ^{60}Co sources. In the summer of 1946 Harold Johns attended a two week course on radiotherapy physics given by Mayneord. At the course Mayneord extolled the virtues of the betatron and the use of ^{60}Co as a radium substitute in telegamma therapy (Robison 1995). Also interested in ^{60}Co were the Commercial Products Division of Eldorado Mining and Refining Limited, which at the time was responsible for processing and selling radium products. [Eldorado eventually became responsible for the processing and handling of NRX-produced isotopes (Robison 1995).] In addition, Gilbert Fletcher, one of the first radiation oncologists at the MD Anderson Hospital in Houston was also interested in ^{60}Co. This was as a result of a nine month period where he visited London, Manchester, Paris, and Stockholm to gain further training in radiation oncology.

As a result of this interest Cipriani received three independent requests to produce kilocurie ^{60}Co sources in the NRX reactor. In August 1949 H.E. Johns and T.A. Watson, M.D., submitted a formal written request to the Chalk River Nuclear Labs. In 1950, Cipriani received two more requests, one from R. Errington, and D.T. Green of Eldorado Commercial Products along with Ivan Smith of the London Cancer Clinic and the second from G. Fletcher and L.G. Grimmett of the M.D. Anderson Hospital. It was these three sources, which were used clinically on 27 Oct. 1951 (London), 9 Nov. 1951 (Saskatoon), and Feb. 1954 (M.D. Anderson), that ushered in the megavoltage era in radiation therapy.

Ackowledgments:

It is a pleasure to acknowledge the contributions of Sylvia Fedoruk, Clive Greenstock and David Spencer. Thanks go also to Peter Munro who provided the incentive to retrace some old trails and explore some new ones. Thanks also to Jack Cunningham for useful discussions about the organisation of this series. Figures 1-2 were supplied by courtesy of AECL.

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Keys, DA (1957) "Obituary: André

Chronology

November 12, 1945-46 W.V. Mayneord Adviser to Biological & Medical Research Branch of the Atomic Energy Project (in Canada &UK)

1945-46 J.S. Mitchell replaced [by] W.V. Mayneord as Adviser in Canada (Mitchell recruited A.J. Cipriani and G.C. Butler in 1945-46)

September 4, 1945 ZEEP goes critical

January 7, 1946 J.S. Mitchell returned to UK

1946 Mitchell publication proposing Co-60 teletherapy (Brit. J. Radiol. 19, 481-487, 1946)

1946 Mayneord publication, Therapeutic Gamma Ray Sources, Report MM-237 Chalk River (NRC No. 1595) March 1 1946

April 1946 A.J. Cipriani joined the Atomic Energy Project

September 4, 1946 W.B. Lewis appointed Director of the Chalk River Labs (succeeding J.D. Cockcroft)

October 1946 R.F. Errington set up Commercial Products Division of Eldorado Mining & Refining Ltd. Ottawa

1947-56 A.J. Cipriani appointed Director of the Biology Division CRNL

July 22 1947 NRX started up

1947 Mayneord & Cipriani publication on Co-60 physics/dosimetry (The absorption of gamma-rays from Co-60 Canad. J. Res. A25, 303-314, November 1947)

October 31, 1947 First shipment of research isotopes from NRX [isotope(s) unspecified but probably included small amounts of Co-60 to University of Saskatchewan]

January 31, 1948 First production of I-131 and S-35 in NRX

June 8, 1948 Shipments of P-32, I-131, Na-22, Ca-45 from NRX to Canadian researchers on request (followed shortly by C-14)

1948 NRX up to full power

1949 Two Co-60 therapy machines designed independently (H.E. Johns, R.F. Errington)

June 1949 H.E. Johns visits CRL to discuss his Co-60 therapy unit with A.J. Cipriani and W.B. Lewis

July 15, 1949 H.E. Johns presents written proposal to W.P. Thompson, President, University of Saskatchewan

August 13 1949 H.E. Johns & T.A. Watson submit written request to NRC CRNL for kCi Co-60

1950 R.F. Errington, D. Green & I.H. Smith request kCi Co-60

1950 A.J. Cipriani elected first Canadian member of ICRP (his work led to the adoption of the Standard Man)

Fall/winter 1949-51 First large-scale irradiations of Co-60 in NRX

1950 R.F. Errington contracted Canadian Vickers, Montreal to build the first AECL Eldorado A unit for use in London Clinic ON (purchase price ~$25K US)

June 6, 1951 First teletherapy sources removed from NRX

Summer 1951 Three kCi source shipped (probably via train) from CRL to Ottawa, for subsequent shipment to Saskatoon, London and Houston TX

July 30 1950 First kCi source arrives in Saskatoon (by rail)

October 16, 1951 Second source arrives in London ON

1951 Johns et al publication on 1000 Ci Co-60 (Nature 168, 1035, 1951)

August 18 1951 First teletherapy unit installed in the Saskatoon

Clinic (commissioned October 23, first patient treated November 8)

Joseph Cipriani" Trans Roy Soc Can. pp 65-69

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Quebecers Deserve Better

Health-Care Budget Cuts Have Led to Heavy Staff Workloads at Radiation-Therapy Centres

ERVIN B. PODGORSAK

Note: The following is a commentary published on Saturday, 3 October 1998, in the Montreal Gazette.

Once world-class and now steadily declining toward mediocrity, Quebec's health-care system has been much in the news lately. And with good reason. Quebecers are finally beginning to notice that the Bouchard government is not only ignoring the two most important assets of modern societies - health care and higher education - it is unwittingly diminishing both by focusing chiefly on independence and a balanced provincial budget.

Yet, rather than being blamed for the deterioration in hospital services resulting from indiscriminate budget cuts, the government until recently somehow succeeded in creating the perception that there still was fat to be cut in hospitals and greater efficiency to be gained with better management of resources and better organization of services. Moreover, the government has also maintained that the healthcare situation in other provinces is no better than here.

This is wishful thinking.

A recent study dealing with equipment and staff workloads in all Canadian radiotherapy centres provides a case in point. The study, carried out under the auspices of the Canadian College of Physicists in Medicine, drew attention to much higher staff workloads in Quebec than the rest of Canada. It would be hard to suggest to that there is any fat to cut there. Radiation therapy is one of three medical specialities used in cancer therapy and as such is obviously very important to cancer patients and their relatives in particular, and to society in general. More than half of all cancer patients receive radiotherapy either as their primary cancer treatment or as secondary treatment in combination with surgery and chemotherapy

TEAM OF PROFESSIONALS

Radiotherapy treatments are provided with sophisticated, high-technology equipment, such as linear accelerators, by a team of professionals consisting of radiation oncologists, medical physicists, radiation dosimetrists, and radiotherapy technologists. There are 28 radiotherapy centres in Canada. In 1997, they treated close to 64,000 cancer patients, 24.5 per cent (or 15,700) of them in Quebec. All provinces except Quebec recognized decades ago, through establishing provincial cancer treatment and research foundations, that not providing state-of-the-art cancer therapy to their patients simply was not an option. These foundations operate under protected budgets, separated from provincial health-care budgets, and are generally shielded from cuts that are applied to over-all hospital budgets.

In Quebec, on the other hand, there are seven radiotherapy centres, which operate as radiotherapy departments of major general hospitals. As such, they are subjected to the vagaries of budget constraints and cuts that are applied to over-all hospital budgets.

A comparison of radiotherapy equipment and staff workloads between Quebec and the rest of Canada illustrates very well the results of the two very different approaches to management of cancer therapy While Quebec, through an injection in the early 1990s of a substantial amount of money for equipment and infrastructure, currently matches the average equipment workloads for the rest of Canada, it exceeds the average staff workloads for the rest of Canada by a substantial margin. Excessive staff workloads, of course, are of concern because of their direct impact on quality of care, waiting lists, staff burnout, and staff resignations.

Despite its 24.5-per-cent share of the Canadian population and, coincidentally, its 24.5-per-cent share of patients treated with radiotherapy in Canada over-all, Quebec has only 16 per cent of Canada's radiation oncologists (37 of 234); 20 per cent of clinical physicists (30 of 149);. 23 per cent of radiotherapy technologists (197 of 855); and 16 per cent of radiation dosimetrists (20 of 123).

Radiation oncologists in the rest of Canada treat, on average, 244 cancer patients annually, while Quebec radiation oncologists treat, on average, 424 patients. Some treat close to 600 patients annually.

LOWER PER-PATIENT SPENDING

The disparity between Quebec and the rest of Canada can also be highlighted in another way. The rest of Canada has one radiation oncologist per 116,000 people, but in Quebec the number is almost double at 200,000 people per radiation oncologist Considering that similar discrepancies also exist for clinical physicists and radiation dosimetrists, the underfunding that results in the severe understaffing in Quebec radiotherapy centres becomes obvious. In comparison with all other provinces, Quebec's per-patient spending on radiation therapy is considerably lower, not only as a result of much lower salaries for Quebec professionals, but also because of much heavier staff workloads that are in effect in Quebec.

Rather than planning further cuts to hospital budgets, which will only exacerbate the already difficult situation in Quebec radiotherapy centres, the Bouchard government should start ameliorating conditions in those Quebec services that lag behind Canadian averages. Cancer therapy is one important area that needs immediate attention.

No big, time-consuming, expensive studies are necessary; the facts are well known and the solution is obvious. To approach the staff workloads found in the rest of Canada, Quebec should increase the number of its own cancer-therapy professionals to 33 per cent of the total number employed in the rest of the country (which would leave it with about 25 per cent of the national total). This implies increasing the number of radiation oncologists to 65 from the current 37; radiotherapy technologists to 217 from 197; clinical physicists to 39 from 30; and radiation dosimetrists to 34 from the current 20.

In the early 1990s, Quebec made a valiant and successful effort to bring its radiotherapy equipment and infrastructure to Canadian standards. The time has come to do the same for staff workloads, if the government is serious at all about providing timely and state-of-the-art therapy to its patients afflicted with cancer.

Ervin B. Podgorsak is a professor and director of medical physics at McGill University.

In Brief

News from Nova Scotia

The Nova Scotia Cancer Center at the QEII Health Sciences Centre has been carrying out an equipment up-dating program for the last several years. A Varian 2100C was brought into clinical use in the spring of 1995. Since then we have installed three additional accelerators, a Varian 600C (6MV), a Varian 2100C/D and a Varian 600C (4MV). All have MLC and portal imaging and are linked via a Varian Varis system. We also purchased a Varian/Picker AcQsim and a Theraplan Plus planning system, both of which went into clinical use early in 1998. The new Cape Breton Cancer Clinic at the Cape Breton Healthcare Complex opened in September 1998. The radiotherapy equipment includes a Varian 2100C/D, a Varian 600C (4MV) and a Varian simulator. The accelerators have MLC and portal imaging systems and all equipment is linked via Varis and Varis Vision networks.

John Andrew

From Winnipeg

Pediatric teleradiology is here! Thompson General Hospital, approximately 750 km North of Winnipeg, has not had the benefit of pediatric radiology services. That is now changing with an effort supported by the Manitoba Telephone System who are donating time on a dedicated T1 line, Agfa Canada who have contributed a laser digitizer (100 mm spot size) and 1K monitors, and the expert staff in Pediatric radiology and the Dept of Medical Physics. The first phase of the project, which we expect to last 6 months, will determine changes in protocols or equipment.

Jacqueline Gallet

Kelowna

WesCan '99 will be held in Kelowna, BC, March 25-27th 1999. A symposium on Treatment Planning will be held on Thursday the 25th; the scientific program will run all day Friday and Saturday until noon including an invited talk on Prostate Brachytherapy. The call for papers will be sent to participating centres in western Canada; others can download it from the

(Continued on page 17)

Medical Physics E-mail and WWW Services

The canada-l mailing list is now being managed by Majordomo. Send messages to:

canada-l@irus.rri.on.ca

If you want to subscribe or unsubscribe, you can send mail to <Majordomo@irus.rri.uwo.ca> with the following command in the BODY of your e-mail message:

subscribe canada-l you@your.email.address
unsubscribe canada-l you@your.email.address

For more information, you can send mail to <Majordomo@irus.rri.uwo.ca> with the following command in the body of your e-mail message:

help
end

This will give you a list of all the commands you have access to. If you have any other questions or concerns please send e-mail to canada-l-owner@irus.rri.uwo.ca , and someone will get back to you.

Shidong Tong
tong@clinphys.pmh.toronto.on.ca

COMP/CCPM Web Site

In addition to the Canada-l burster, CCPM and COMP now maintain a www site that can be accessed via

http://www.bic.mni.mcgill.ca/ccpm

It contains descriptive pages on CCPM and COMP, and plans are to expand the range of information available on this Web site.

Suggestions for improvement of the Web site are welcomed and should be forwarded to Peter Munro in London (pmunro@lrcc.on.ca).

In Brief *(Continued from page 16)*

web site at http://cancercentre.com/wescan. For further information contact dmason@bccancer.bc.ca.

Radiation Physics Educational Tools

Professor Russell Hobbie, recently retired from the U. of Minnesota and well known for his text on Intermediate Physics for Medicine and Biology made a contribution to radiation physics education by development some years ago of a simulation program called **MacDose**. Macdose is available as freeware by contacting Russ's web site: http://umn.edu/~hobbie/. MacDose is a computer program designed to teach about the interaction of radiation with matter. It provides a two-dimensional simulation of the photoelectric effect, coherent scattering, Compton scattering, and pair production. It distinguishes between stochastic quantities, such as the energy transferred and the energy imparted, and average quantities such as the kerma and absorbed dose. It runs on any Macintosh. It used to be distributed by Medical Physics Publishing Company, but now it is freeware. An Apple Macintosh DiscCopy image is available at the web site as a binhex file and includes MacDose, the Student Manual, and the Instructor's Guide.

John Cameron
e-mail: jrcamero@facstaff.wisc.edu

Staffing and Workloads

Ervin Podgorsak has published a very interesting summary of radiation therapy facilities and staffing in Canada. This summary is the result of a survey of all Canadian centres providing radiotherapy services, which was carried out under the auspices of COMP and CCPM in 1997. The survey reveals how staffing and equipment are unevenly distributed throughout the country. Please see E.B. Podgorsak, "Radiotherapy services in Canada: Equipment and staff workload", Current Oncology 5(4) 208-215.

Peter Munro

News From NRC

As promised at the London COMP meeting last June, a new NRC standard for ab-

(Continued on page 18)

HAROLD E. JOHNS RESEARCH PRIZE IN MEDICAL BIOPHYSICS

The Department of Medical Biophysics, University of Toronto, in consultation with the Johns family, has determined that donations received in Harold's memory will be placed in a fund which will be used to provide annual awards for the best graduate student seminars. The family has chosen this course to honour Harold's lifelong love of, and commitment to, his students, their research, and the department in which he spent the last 25 years of his professional career. This will be an ongoing fitting tribute to his memory.

The family is very grateful for the many donations and words of comfort already received. Donations may be sent to:

The Ontario Cancer Institute
610 University Avenue
Toronto, Ontario
M5G 2M9

Please indicate that your donation is for the Harold E. Johns Research Prize in Medical Biophysics.

In Brief *(Continued from page 17)*

sorbed dose to water was declared on July 1, 1998. The new absorbed dose standard, which is based entirely on measurements made with a sealed water calorimeter, is 0.9% larger than previously disseminated. The results of a series of bilateral comparisons with the standards of five other primary standards dosimetry laboratories, including NIST, indicate a satisfactory level of agreement and will be published in the near future. New calibration reports will describe the effect of the change in detail as well as the inclusion of P_{ion} in the calibration factor.

The NRC-IRS Staff

CMBES Annual Meeting

The Canadian Medical and Biological Engineering Society (CMBES) will have their annual conference 24-26 June 1999 in London, Ontario. The conference will include a plenary session with the theme "New Frontiers" and will include (tentatively) Dr. Roberta Bondar and Dr. Alan Mortimer, past and current members of the Canadian Space Program. For more information contact the CMBES Secretariat at (613) 993-1686 or society.embes@nrc.ca.

Peter Munro

Computer Theft at LRCC

On the evening of the 18th Dec. 1998 three computers were stolen from the Physics Department of the London Regional Cancer Centre. Although one computer was a VARIS (Varian Information System) workstation that was not in use, the other two were servers. One was the main Theraplan Plus (Theratronics treatment planning system) server and the other was the main VARIS server. In all, an estimated $50,000 in computer equipment was lost. Fortunately, the VARIS system was not in clinical operation and a daily backup of the Theraplan Plus treatment plans minimised any loss of information. However, the last backup tape was stolen with the computer, so one day's worth of plans were lost. The loss highlights how vulnerable we at the LRCC and presumably other Cancer Centres are to major catastophes. Plans are in place to prevent such losses in the future.

Peter Munro

Canadian College of Physicists in Medicine Examination Schedule 1999

Membership Examination:

Applications due:	20 January 1999
Examination date:	10 April 1999

Fellowship Examination:

Applications due:	14 April 1999
Examination date:	14 or 15 June 1999

Sherbrooke, Quebec

Note: Fellowship applicants writing the membership examination should confirm their fellowship application and pay the fee within one week of receiving the membership examination results.

For further information, application kits, and membership examination study guides, contact the Registrar, Dr. Alistair Baillie, at:

Dr Alistair Baillie
The Registrar/ Le Registraire, CCPM
c/o Cancer Centre for the Southern Interior
399 Royal Avenue
Kelowna, BC, V1Y 5L3

WesCan '99

March 25-27,1999
Prestige Inn, Kelowna, BC

HIGHLIGHTS

March 25 Treatment Planning Symposium
Reception at Cancer Centre

March 26 Scientific Program
Guest Speaker: Prostate Brachytherapy
Banquet

March 27 Scientific Program (until noon)
Special local events?

Call for papers will be sent to Western institutions.
Deadline Feb 18.
Call for papers and other information available at:
http://cancercentre.com/wescan

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 Johns Travel Award for Young Investigators. This award, which is in the amount of $1500, is made to a College member under the age of 35 who became a member within the previous three years. The award is intended to assist the individual to extend his or her knowledge by traveling 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 endeavour 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 $1500, est éligible aux membres du Collège agés de moins de 35 ans at qui sont membres depuis moins de trois an. 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 spécialisé.

Les demandes seront addressées à:

The Registrar / Le Resistraire
CCPM
c/o Cancer Centre for the Southern Interior
399 Royal Avenue
Kelowna, BC, V1Y 5L3

The deadline for applications for the next award is **April 1, 1999**. The award will be announced at the 1999 CCPM Annual General Meeting in Sherbrooke.

La date limite pour les demandes du prochain concours est le **1er avril 1999**. Le récipiendaire de la bourse sera annoncé à la rencontre annuelle de 1999 du CCPM à Sherbrooke

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
1994 Dr. Brendan McClean, Edmonton
1995 Dr. George Mawko, Halifax
1996 M. Alain Gauvin, Montreal
1997 Dr. Katherina Sixel, Toronto
1998 Mr. Horacio Patrocinio, Montreal

Members of the COMP and/or CCPM can make a donation to fund by volunteering to increase their 1999 membership dues.

Les membres du COMP et\ou OCPM peuvent faire un don à la cotisation de 1999 un montant additionel de leur choix.

Canadian College of Physicists in Medicine
Proposed By-law Amendments

At the November 1998 meeting of the College Board, it was resolved that a number of by-law amendments would be presented to the membership of the college at the Annual General Meeting to be held in Sherbrooke in June 1998. The proposals address several issues which have been discussed by the Board over the past two years..

1) The Board is concerned that candidates for Membership could write the examination unsuccessfully as often as they wish. We wish to discourage candidates who are clearly unprepared. We propose to limit the frequency with which the examination may be attempted:

   Appendix III, 'Examinations - Membership', add a paragraph after the first …
   Candidates who are unsuccessful in the examination on three sittings must re-apply for permission to write. The candidate may not write the examination again until 3 years have elapsed since the last attempt.

1) The Board is aware that some medical physicists work part-time, and we wish to deal with their situations fairly. We therefore propose to add the words 'full time equivalent' to the requirements for membership:

   Appendix II, Section 1
   Only those with patient-related experience in physics as applied to medicine for two years **full time equivalent** after a post graduate degree are eligible to become members of the College.

1) The Board has discussed the possibility of members being certified in more than one speciality. We have agreed that individuals will be limited to holding two speciality certificates. We have determined the processes to be followed in the certification and re-certification of a member in a second speciality. These by-law modifications implement second certification:

   Article III, paragraph 2, replace …
   Members and Fellows will be recognised to have competence in **one or more** of the following sub-specilities …
   with …
   Members and Fellows will be recognised to have competence in **up to two** of the following sub-specilities …

   Article III, section 3, 'Recertification', add the sentence …
   … every five years. **This requirement exists independently for each sub-speciality certification.** Details of the process …

   Appendix II, section 1, change the second sentence to …
   The experience claimed must be relevant to the speciality under consideration and have been obtained within the last five years.

   Appendix II, section 2, add to the last item of guidance (ie before the last paragraph) …
   The experience claimed must be relevant to the speciality under consideration.

   Appendix III, add a paragraph before the final paragraph …
   Candidates for a 2nd speciality certification are not required to write Section I, and will have 1.25 hours to write Section II. The regulations above regarding Sections III and IV will still apply. Each section counts for one-third of the final mark.

   Appendix IV, section 1, add after first sentence …
   For members holding certification in two specialities, this recertification is required independently for each speciality certification.

   Appendix IV, section 3, part (i), add …
   Applicants certified in two specialities must have been engaged in the relevant speciality at least 40% full time equivalent during the preceding five years.

   Appendix IV, section 3, part (iii), add …
   Applicants holding dual certification may only claim specific credits once, and may only claim credits appropriate to the certification being reassessed.

1) The Board has recognised that practical problems arise when the Secretary-Treasurer changes during the financial year. We are proposing a housekeeping change so that the change of Secretary-Treasurer will occur at the end of the financial year:

   Article IV, 1st paragraph, replace …
   The new Board shall take office at the conclusion of the Annual General Meeting.
   With …
   The new Board, with the exception of the Secretary-Treasurer, shall take office at the conclusion of the Annual General Meeting. The Secretary-Treasurer will take office on the first day of the next financial year.

1) The Board has recognised that a graduate degree in Medical Physics is now the most common entry point into the profession, and this should be recognised in the by-laws

   Article III, section (1)(a), change…
   Only those who hold graduate degrees in Physics, Science with Physics as a major option, Medical Physics, or another field …
   to …
   Only those who hold graduate degrees in Medical Physics, Physics, Science with Physics as a major option, or another field …

   Remove the redundant 4th and 5th paragraphs in Article III, ie the paragraph beginning "Only those who …" and the subsequent paragraph beginning "From time to time …"

Alistair Baillie
Registrar, CCPM

COMP OCPM

CANADIAN ORGANIZATION OF MEDICAL PHYSICISTS

ORGANISATION CANADIENNE DES PHYSICIENS MÉDICAUX

CALL FOR NOMINATIONS

Nominations for Treasurer
(Term: From 1 January 2000 through 31 December 2002)

and

Nominations for Councillor for Professional Affairs
(Term: From Annual General Meeting of June 1999 until Annual General Meeting in 2003)

Nominations must be signed by two sponsoring members and by the nominee who by his/her signature agrees to accept the nomination.

Please send nominations to:

APPEL POUR MISES EN CANDIDATURE

Candidature comme trésorier
(Terme: Du 1er janvier 2000 au 31 décembre 2002)

et

Candidature comme conseiller aux affaires professionnelles
(Terme: De la réunion générale annuelle de juin 1999 jusqu'à la réunion générale annuelle de 2003)

La mise en candidature doit être signée par deux membres actifs et par le ou la candidat(e) qui indique par sa signature qu'il ou elle accepte la mise en candidature.

Envoyez vos mises en candidature à:

Dr. Paul C. Johns
COMP Past-Chair
Department of Physics
Carleton University
1125 Colonel By Drive
Ottawa, Ont. K1S 5B6
Tel: (613) 520-2600 x4317
Fax: (613) 520-4061
E-mail: johns@physics.carleton.ca

Nominations must be received by March 1, 1999.

An election by mail ballot will be conducted in the spring of 1999.
The results will be reported at the Annual General Meeting in Sherbrooke in June 1999.

Les mises en candidature doivent être reçues avant le 1er mars 1999.

L'élection se fera par la poste au printemps 1999.
Les résultats seront rapportés à la réunion générale annuelle à Sherbrooke en juin 1999.

COMP OCPM

CANADIAN ORGANIZATION OF MEDICAL PHYSICISTS
ORGANISATION CANADIENNE DES PHYSICIENS MEDICAUX

CANADIAN COLLEGE OF PHYSICISTS IN MEDICINE
LE COLLEGE CANADIEN DES PHYSICIENS EN MEDECINE

Applications Invited for Contract Position

The Canadian Organization of Medical Physicists (COMP), in conjunction with the Canadian College of Physicists in Medicine (CCPM), seeks to contract a part-time

Executive Director

With the growth of the COMP to over 400 members, with over 150 physicists now certified for clinical practice by the CCPM, and with the increasing profile and scope of our annual scientific meeting and professional activities, there is a need for increased support staff for both organizations.

Reporting to the Chair of the COMP, the Executive Director will be responsible for the management and administration of all operations and programs of the COMP and of the CCPM.

The Executive Director will supervise the COMP Secretarial Assistant, and will be responsible for many of the logistics of the annual scientific meeting. He/she will also be responsible for corporate liaison, will act as a research resource for all committees of the COMP and the CCPM, and will ensure that the administrative services of the COMP and the CCPM respond to changing business and communication technologies. The successful candidate will have prior experience in a managerial position. Experience working *as* a professional medical physicist, or experience working *with or for* a professional medical physicist, in a clinical or research setting, would be an asset. At least a minimal proficiency in both official languages would be an asset.

Initially a time commitment of 1 day per week, averaged over the year, is anticipated. The workload will be greater in the three months prior to the Annual Scientific Meeting, and will be less in the late summer and early fall. The position will be filled by one-year contract, renewable, with salary determined by negotiation.

Interested individuals should submit a resume before 15 February 1999 to:

Dr. Paul C. Johns,
Chair, COMP/CCPM Search Committee
Department of Physics
Carleton University
1125 Colonel By Drive
Ottawa, Ont. K1S 5B6
Tel: (613) 520-2600 x4317
Fax: (613) 520-4061
E-mail: johns@physics.carleton.ca

COMP Chair *(Continued from page 4)*

uniformity across the country. The committee is continuing to gather data and is communicating about the lack of standards with the Ministry of Health in one province. The committee also reviewed the status of a number of AECB documents and discussed the progress of Joint Working Group 11. If you recall my previous message, this is the group that is supposed to recommend a procedure to AECB by which quality assurance standards in radiation therapy are to be written and implemented. The committee is chaired by Peter O'Brien and George Sandison represents both COMP and CCPM on the committee.

The final activity for the day was the joint meeting of the board of CCPM and the executive of COMP. At this stage I am tempted to refer you to Peter Dunscombe's column in hopes that he will include the details but, for completeness, let me note a few important points. The group reviewed detailed reports of each of the joint committees' activities. The executive director job description and recruitment strategy was approved, and finally, the plans for the 2001 conference in Kelowna were reviewed. After some eighteen hours of meetings, your executive staggered off into the Ottawa sunset for a well deserved pint…or two.

Michael Patterson

CCPM President *(Continued from page 5)*

short article on the College for publication in Newsletters of other national medical physics organizations. This is currently number 31 on my list of New Year's resolutions.

I think I've covered the main topics discussed by the Board in November. As usual, please contact any member of the Board if you have comments or suggestions on our activities.

On behalf of the Board of the Canadian College of Physicists in Medicine I would like to wish you all a Happy and Successful 1999.

Peter Dunscombe

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President

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Manager, Oncology Systems

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e-mail: marketing@theratronics.com
Contact: Ms. Denise Ashby
Regional Manager for Canada

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Fax: (503) 636-7774
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Northwest District Manager

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e-mail: xicl@headwaters.com
Contact: Ms. Lois Brown, ACR
President

Laurentian University / **Université Laurentienne**

The Department of Physics and Astronomy invites applications for a three-year limited term appointment to begin July 1, 1999. Applicants must be bilingual, as the position will involve teaching in both French and in English. Applicants should preferably have completed a Ph.D. in the area of Medical Physics. The department has recently initiated an undergraduate programme in Biomedical Physics and benefits from an increasingly close relationship with the Northeastern Ontario Regional Cancer Centre (NEORCC). NEORCC is situated a scant 2 kilometres from the university campus, and has active research programmes in neural nets, image registration, and dose optimization in treatment planning.

The University is committed to equity in employment and encourages applications from all qualified applicants, including women, aboriginal peoples, members of visible minorities, and persons with disabilities. In accordance with Canadian immigration requirements, this advertisement is directed first to Canadian citizens and permanent residents.

Please submit an application with a complete C.V. and the names, addresses, and telephone numbers of three referees to Chair of the department, Prof. N.I. Robb, Department of Physics and Astronomy, Laurentian University, Ramsey Lake Road, Sudbury, Ontario, P3E 2C6.

Additional information about this position and the department may be found at http://www.laurentian.ca/www/physics/hire.html, or by telephone (705) 675-1151 extension 2220 or by fax: (705) 675-4868.

Screening of candidates will commence March 30, 1999, but applications will be accepted until the position is filled. This position is subject to budgetary approval.

Le département de physique et d'astronomie de l'université Laurentienne sollicite des candidatures pour un poste de durée limitée à trois ans, commençant le 1 juillet 1999. Le candidat ou la candidate doit être bilingue puisque la charge de travail comprendra de l'enseignement de cours en anglais et en français. La préférence sera accordée à un candidat ou une candidate ayant complété un doctorat en physique médicale. Le département a récemment introduit un programme de baccalauréat en physique biomédicale et collabore avec des physiciens du centre régional de cancérologie du nord-est de l'Ontario (CRCNEO). Le CRCNEO, situé à 2 kilomètres de l'université, est un site actif de recherche sur les réseaux neuronaux, la reconnaissance d'images ainsi que le problème de l'optimisation inverse.

L'université Laurentienne adhère au principe de l'équité dans l'emploi et incite toutes les personnes qualifiées, y compris les femmes, les Autochtones, les membres des minorités visibles et les personnes handicapées à poser leur candidature. Conformément aux exigences d'Immigration Canada, cette annonce s'adresse aux citoyennes et citoyens canadiens et au résidentes et résidents permanents.

Prière de faire parvenir un curriculum vitae ainsi que les noms et coordonnées de trois répondants ou répondantes au directeur du département, Prof. N.I. Robb, Département de physique et d'astronomie, Université Laurentienne, Chemin du Lac Ramsey, Sudbury, Ontario, P3E 2C6.

Des détails supplémentaires sur cette position sont disponibles sur le site web à http://www.laurentian.ca/www/physics/hire.html ou par téléphone au (705) 675-1151, poste 2220 ou par télécopieur (705) 675-4868.

L'examen des candidatures débutera le 30 mars 1999, mais les candidatures seront acceptées jusqu'à ce que la position soit remplie. Ce poste est assujetti aux approbations budgétaires.

MEDICAL PHYSICS DEPARTMENT
KINGSTON REGIONAL CANCER CENTRE,
KINGSTON, ONTARIO
Cancer Care Ontario

TWO MEDICAL PHYSICIST POSITIONS

Applications are invited for two positions in the Medical Physics Department of the Kingston Regional Cancer Centre (KRCC):

1) **a full time Medical Physicist**, and
2) **a locum full time Medical Physicist** (minimum 12 month period ending May 2000).

The Centre is one of eight regional cancer centres operated by Cancer Care Ontario and is located at the Kingston General Hospital, on the campus of Queen's University. Cancer Care Ontario through its regional centres and partnerships, provides a province wide system of cancer care in Ontario, Canada.

Approximately 2,000 new cancer patients are registered annually at the Centre. The Radiation Oncology Programme operates one Clinac 600C and two Varian Clinac 2100C/D linear accelerators, a cobalt unit, an orthovoltage x-ray unit, an LDR remote afterloading unit, and a Theraplan Plus 3D treatment planning system. Members of the Medical Physics Department supervise medical physics graduate students in the Department of Physics at Queens University, and support a training programme in Radiation Oncology.

The successful candidates will be expected to participate in all clinical, educational and research activities of the Medical Physics Department. Clinical activities include acceptance testing and commissioning of new equipment, calibration, dosimetry data base maintenance, quality assurance, and treatment planning support. All medical physicists are expected to be active leaders in the development of technical improvements in the radiation planning and treatment program.

Candidates for these positions must be fully trained Medical Physicists, with a postgraduate degree (Ph. D. preferred) and a minimum of three years of post-training experience in clinical radiation therapy physics. Membership in the Canadian College of Physicists in Medicine or equivalent is preferred. Applicants for the permanent full time position must have good evidence of research and/or development activity, with credentials and experience which could lead to an academic appointment in the Physics Department at Queen's University. Experience with 3D planning, Monte Carlo computer simulation and expertise in networking and administering computer systems would be an asset.

Applications are invited from all qualified candidates; please indicate which position is being applied for. Priority will be given to Canadian citizens and permanent residents of Canada, in accordance with Canadian Immigration requirements. Please submit curriculum vitae and the names of three professional referees by 25th January 1999 to:

L. John Schreiner, Ph.D., FCCPM
Head, Medical Physics
Kingston Regional Cancer Centre
25 King Street West, Kingston, Ontario, Canada, K7L 5P9
FAX:(613) 544-9708
E-mail: jschreiner@cancercare.on.ca

From the Editor:

Newsletter News

It has been one year since I took over as Newsletter editor so it is a good time to reflect on the accomplishments of the past year. As you can see, this issue marks a new look for the Newsletter. In July I took a course on the design of newsletters and over the past six months I have been polishing my skills and developing a new look for the Newsletter. While I am sure that I could keep changing and improving the design indefinitely , I do not intend on refining the appearance of the Newsletter further. It is time to concentrate on content.

I also want to thank all of those COMP members who sent comments about the proposed changes to me. I think that over 15 people gave me feedback, both positive and negative, about the changes. Surely, this must be a record. From these comments I found out that "Interaction" is a popular name . It is used by Air Canada for one of their in-flight magazines and it is

also used by the Physics Department at the Université de Montréal for their Newsletter. Just to be slightly different, I have adopted the plural form, "Interactions", for the new name of the Newsletter.

This issue marks the beginning of two features that are new for the Newsletter. One of them is the "In Brief" section. I know that there is a lot happening in the world of Canadian Medical Physics, but often there is not enough time to write a comprehensive article about these accomplishments. So the "In Brief" section is a way of communicating these accomplishments without taking too much time. I look forward to receiving many contributions over the coming months from all parts of the country. Also new in the Newsletter will be a series of articles – about the history of ^{60}Co from a Canadian perspective. The first installment is one of the features of this issue of the Newsletter. Doug Cormack agreed to write the first article and, after many e-mail messages back and forth, I think that we have generated a very fine article indeed. I am hoping that COMP members will be anxiously waiting for the upcoming instalments after reading this first article in the series.

This issue also marks the end of two features: the "New Members" section and the "Calendar of Events" section. I think that COMP as an organisation is large enough now that we do not have to celebrate every new member and I find that the Calendar of Events is too much work for a feature that I think very few people read. However, I am always looking for feedback and if many of you feel strongly I would be willing to re-instate these features. And if there is some feature that you would like to see in the Newsletter – let me know. Perhaps it can be arranged.

Web Activities

When I took over as Councillor for the Newsletter I thought that I would only be responsible for the Newsletter. There was some mention that I could contribute to the COMP Web site, but that was being handled by Terry Peters, then at the Montreal Neurological Institute. Only later did I find out that Terry had "volunteered" to organise the Web site and was finding it very difficult to maintain the site. As a result, at the June 1998 annual meeting I was charged with the task of forming a Communications Committee to look after all aspects of COMP communications, including the Web site. At the end of the annual meeting I asked for volunteers and eventually six people agreed to help me with the Web site. So, I have continued to generate the Newsletter on my own, while the rest of the Communications Committee, led by Darcy Mason, have worked on a major revision to the COMP/CCPM Web site. After a frustrating time trying to communicate by e-mail, we eventually had our first face-to-face meeting on 21 Nov. 1998. By then we had had a conference call and much of the general design had been decided. However, that first and only meeting was incredibly useful in allowing us to refine the site. [It is interesting to note how poor e-mail is as a communication tool. A laugh or simple gesture can communicate so much more than pages of e-mail text.]

I think that COMP members will be impressed when the Web site finally does go live (tentatively scheduled for 15th Jan. 1999). There are several goals for the site: to help in recruitment of new COMP members and to encourage people to enter the field of medical physics; to provide member services such as an on-line directory; and, to act as an easily accessible archive for important COMP and CCPM documents. Most importantly, we feel that the Web site should be the communications hub during organisation of the annual meeting. My personal favourite feature is the on-line membership directory – an interactive form that one can use to look-up the phone number and address for any COMP member. My personal experience is that COMP members are very mobile and that the paper version of the membership directory is out of date, very soon after printing. I expect that if you are like me you will find that the on-line membership directory will become invaluable when trying to reach other COMP members. I also hope that people will become accustomed to updating their entry in the membership directory when changes are necessary. Another feature that we are developing is a method to send e-mail messages to all COMP members. While this may seem to be somewhat intrusive, we need a method of communicating with the members that does not depend on whether they are subscribers to the canada-l listserver or not (for instance for those reminders to pay your membership dues). [My congratulations to the technical genius of James Mainprize who has made most of these innovations possible.] It is clear that electronic communications are becoming essential to the functioning of the organisation and that we need to develop these capabilities even further.

Final Thoughts

I look forward to an exciting 1999 for both the Newsletter and for the Web site. My resolution is that I will try to refer to the Newsletter as Interactions (as in: have you read the latest issue of Interactions), so that the new name comes into common usage.

I wish everyone a happy and productive New Year.

Peter Munro