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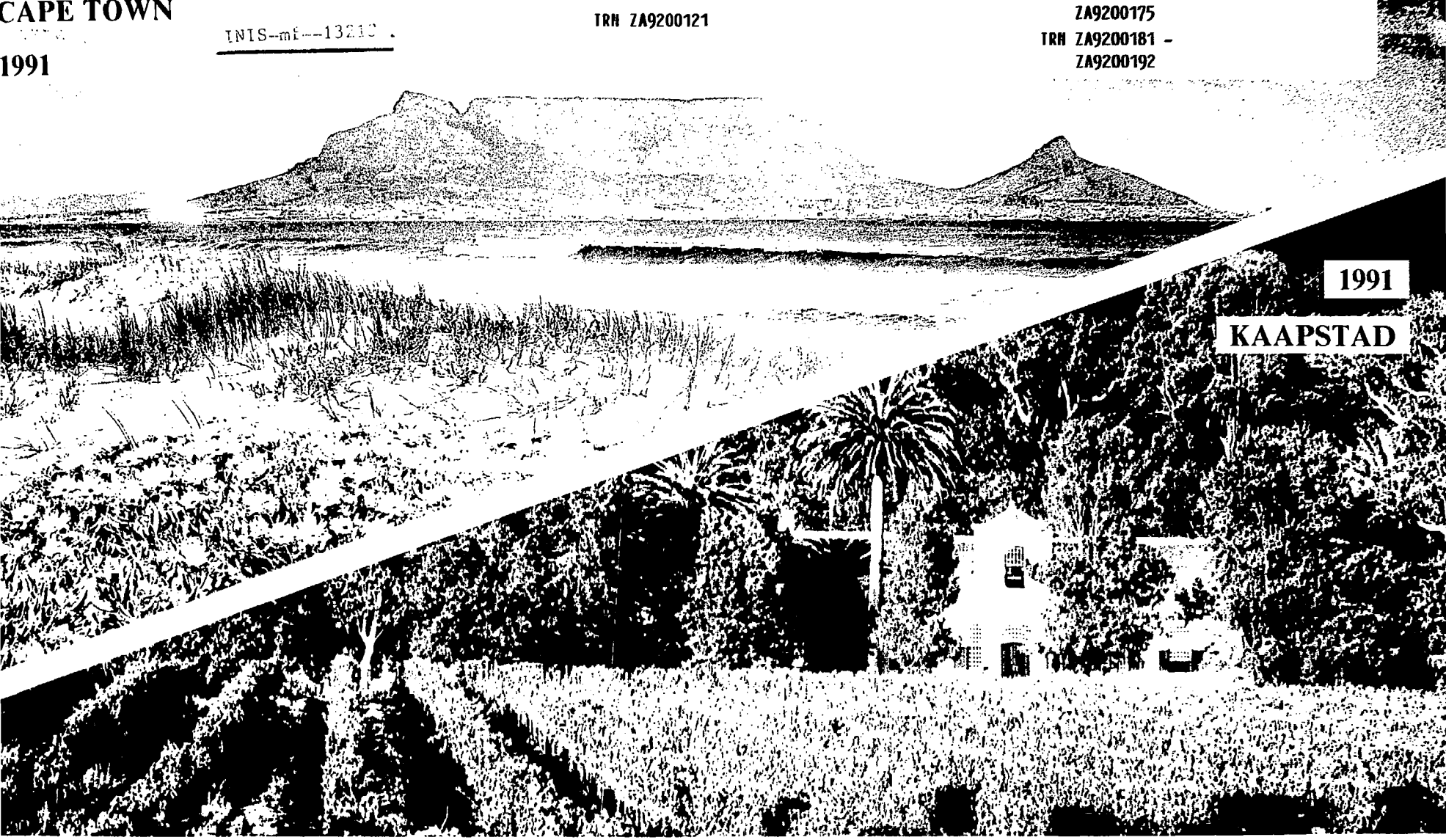

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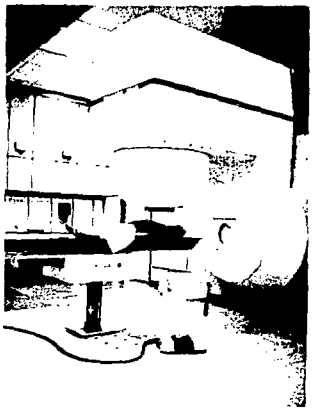

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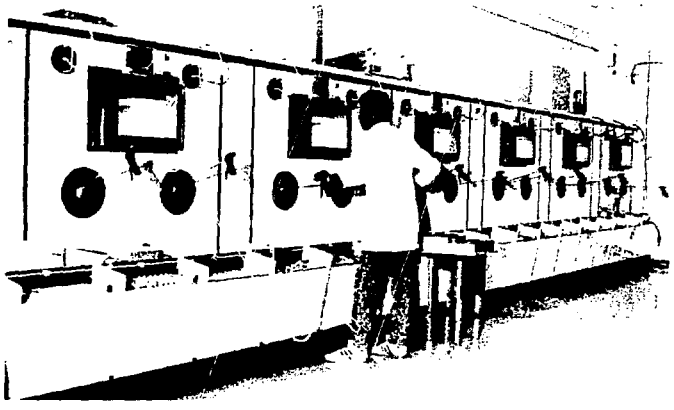

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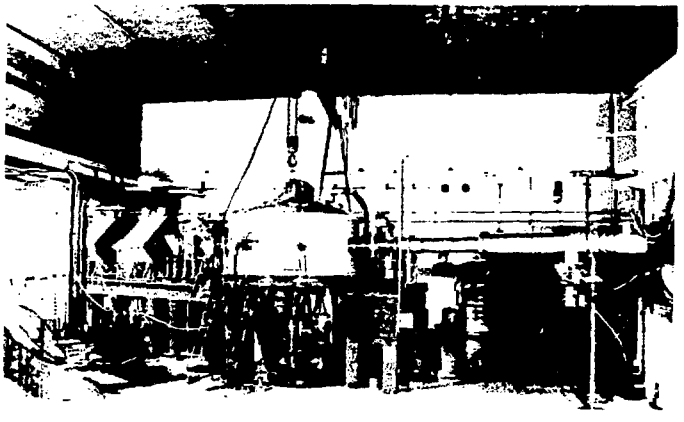

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PRESIDENT'S MESSAGE

It is fitting that in this year, the first of the next decade, we should meet in Cape Town where our Association held its first Congress a generation ago. Who could have foreseen that from its humble beginnings it would develop into the dynamic professional association it is today. The Summer School this year addresses a very specialised topic, but one that is highly relevant to members of our Association. I express our sincere gratitude to the Medical Research Council for their support. On behalf of the Association I also express our thanks to Dr Dan Jones and his team for their dedication and hard work in organizing this week's events.

To one and all of you, but in particular to our distinguished guests from abroad, a sincere welcome. May this Congress and Summer School be as fruitful as in the past.

B C WINKLER
PRESIDENT

BOODSKAP VAN DIE PRESIDENT

Dit is gepas dat ons in hierdie jaar, die eerste van die volgende dekade, weer in Kaapstad vergader waar ons Vereniging sy eerste Kongres 'n geslag gelede gehou het. Wie kon voorsien dat dit van sy nederige begin sou ontwikkel tot die dinamiese professionele vereniging wat dit vandag is. Die Somerskool handel vanjaar oor 'n baie gespesialiseerde onderwerp, maar een wat hoogs relevant is vir lede van ons Vereniging. Ek spreek ons opregte dank uit aan die Mediese Navorsingsraad vir sy ondersteuning. Namens die Vereniging betuig ek ook ons dank aan dr Dan Jones en sy span vir die toewyding en harde werk met die reël van hierdie week se verrigtinge.

Aan een en almal van u, en meer in die besonder aan ons gesiene gaste vanuit die buiteland, 'n hartlike welkom. Mag hierdie Kongres en Somerskool so vrugbaar soos in die verlede wees.

B C WINKLER
PRESIDENT

Dr Hans Blattmann

Hans Blattmann studied physics at the Federal Institute of Technology (ETH), Zurich and radiobiology at the Institute for Radiobiology of the University of Zurich. He was awarded a Diploma in Nuclear Physics (1963) and a Ph.D (1974) in Radiobiology by ETH. From 1974 to 1975 he was a guest scientist at the Lawrence Berkeley Laboratory, USA where he worked under the "father" of charged–particle therapy, Cornelius Tobias. Thereafter he was appointed Senior Scientist at the Institute for Radiobiology of the University of Zurich, where he was responsible for the physics and radiobiology on the pion beam at the then Swiss Institute for Nuclear Research (SIN). In 1979 he joined the staff of SIN as head of the Physics and Biology Section of the Pion Medical Project. Since 1987 he has been leader of the 250 MeV proton therapy project and is currently a member of the management of the Department of Radiation Medicine at the renamed Paul Scherrer Institute (formerly SIN). Dr Blattmann has made a major contribution to the fields of pion and proton therapy and is the author of more than 100 papers.

Professor Paul M DeLuca, Jr

Paul DeLuca was born in Albany, New York and obtained his first degree from LeMoyne College in Syracuse. His post–graduate studies took him to the University of Notre Dame in the state of Indiana where he was awarded a Ph.D. degree in Nuclear Physics in 1971. From the outset of his career his talents have been devoted principally to the application of fast neutrons in the fields of medicine and biology. The fact that his father was a successful surgeon could possibly account for his interest in the life sciences. His appointment as Chairman of the Department of Medical Physics at the University of Wisconsin–Madison in 1987 was preceded by an association with the University spanning almost two decades. During his professional career he has authored and co–authored some fifty publications and thirty–five technical reports. He is recognized for his contributions to the development of high flux neutron sources for radiation therapy, aspects of neutron dosimetry and neutron kerma measurements with proportional counters. As evident from the Summer School programme, he is now acting as a consultant to the Loma Linda project where three isocentric proton facilities are under construction.

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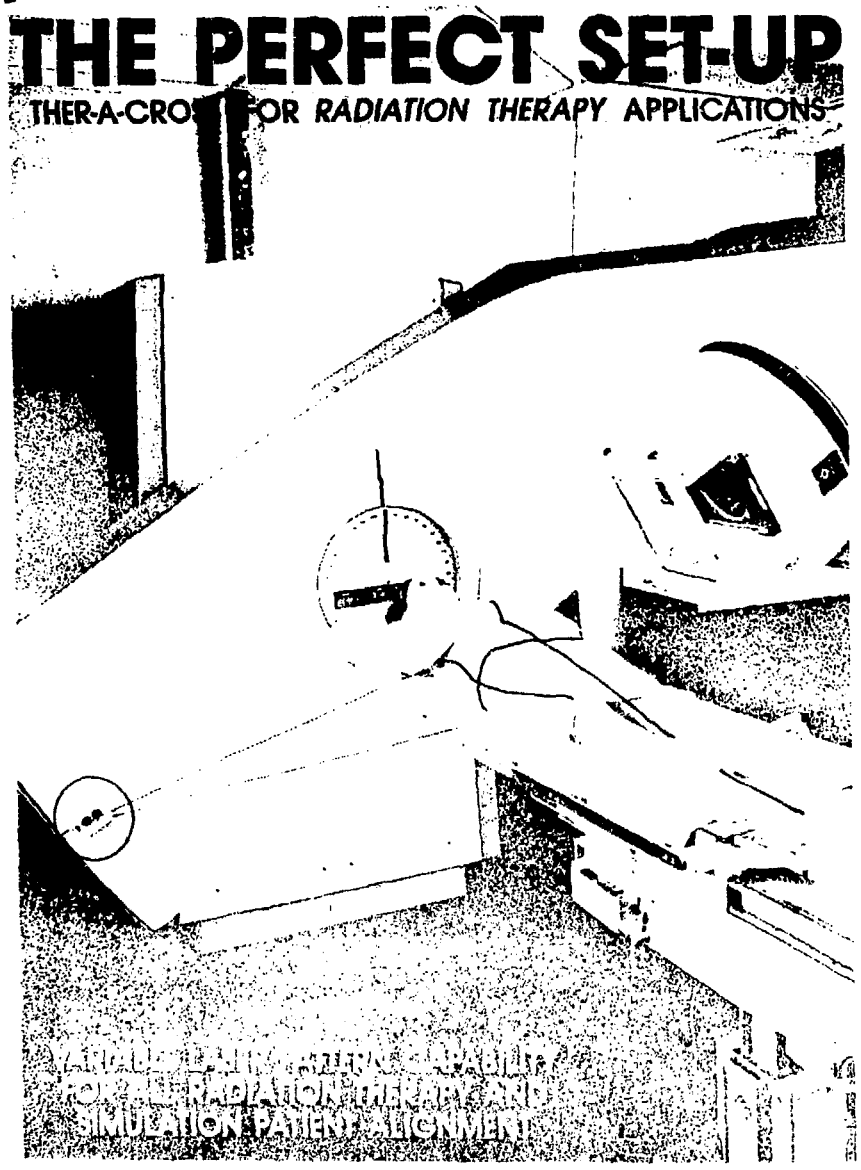

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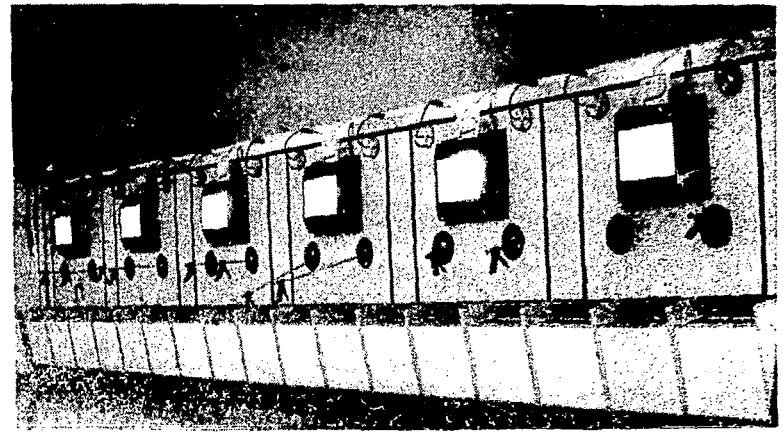

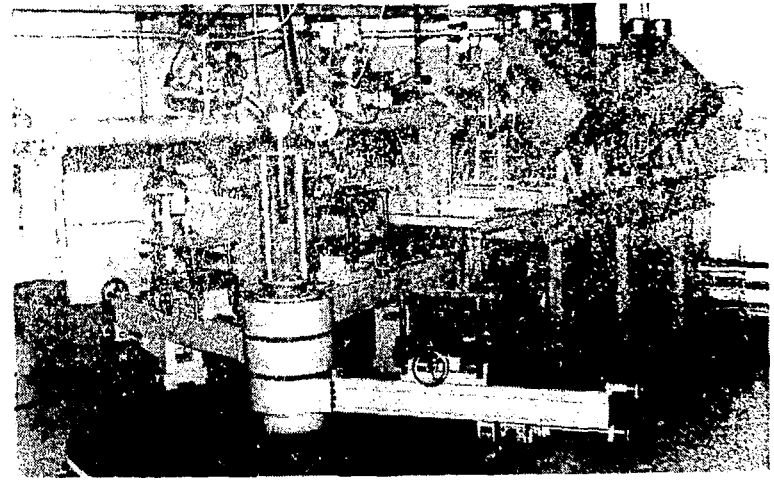

SAAPMB COUNCIL 1990/91 SAVFGB RAAD

ELECTED MEMBERS — VERKOSE LEDE

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Vice President	Dr H J Wasserman	Vise–President
Honorary Secretary	Miss/Mej M L du Preez	Ere–Sekretaresse
Honorary Treasurer	Dr D T L Jones	Ere–Tesourier
Immediate Past President	Dr E J van der Merwe	Pas Uitgetrede President
Members	Dr G P de Beer	Lede
	Mr/Mnr A E Houlder	
	Dr J Kruger	
	Prof M G Lötter	
	Prof W J Strydom	
	Prof A van Aswegen	

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Associated Technology	Mr/Mnr D W Netter	Associated Technology
CM Nuclear Industries	Mr/Mnr G A Corazza	C M Nuclear Industries
Council for Nuclear Safety	Mr/Mnr B C Winkler	Raad vir Kernveiligheid
DPT	Miss/Mej M L du Preez	DPT
ESKOM	Dr J C Botha	ESKOM
FRANSA	Mr/Mnr P Pynne–Mercier	FRANSA
General Diagnostic Imaging	Mr/Mnr E Brodie	General Diagnostic Imaging
Meditech	Mr/Mnr J D Tresling	Meditech
NAC	Dr D T L Jones	NVS
OEN Enterprises	Mr/Mnr M Smith	OEN Enterprises
PNI Scientific	Mr/Mnr M Andrews	PNI Scientific
SABS	Mrs/Mev H M Botha	SABS
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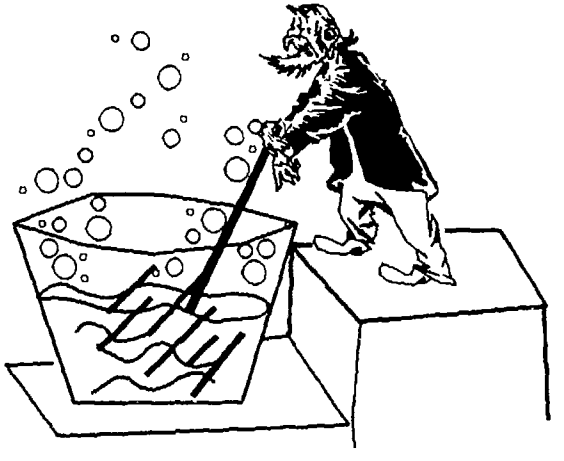

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EXECUTIVE COMMITTEES OF SAAPMB GROUPS 1990/91 UITVOERENDE KOMITEES VAN SAVFGB–GROEPE

GROUP OF MEDICAL PHYSICISTS / GROEP VAN GENEES–KUNDIGE FISICI

Chairman	Prof W J Strydom	Voorsitter
Honorary Secretary/Treasurer	Prof A van Aswegen	Ere–Sekretaris/Tesourier
Member	Dr W A Groenewald	Lid

GROUP OF HEALTH PHYSICISTS / GROEP VAN GESONDHEIDSFISICI

Chairman	Dr A H Leuschner	Voorsitter
Honorary Secretary/Treasurer	Dr W Truter	Ere–Sekretaris/Tesourier
Member	Mr/Mnr P E Metcalf	Lid
Co–opted member	Dr J Kruger	Gekoöpteerde lid

CONGRESS COMMITTEE 1991 KONGRESKOMITEE

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Members	Dr F J Haasbroek	Lede
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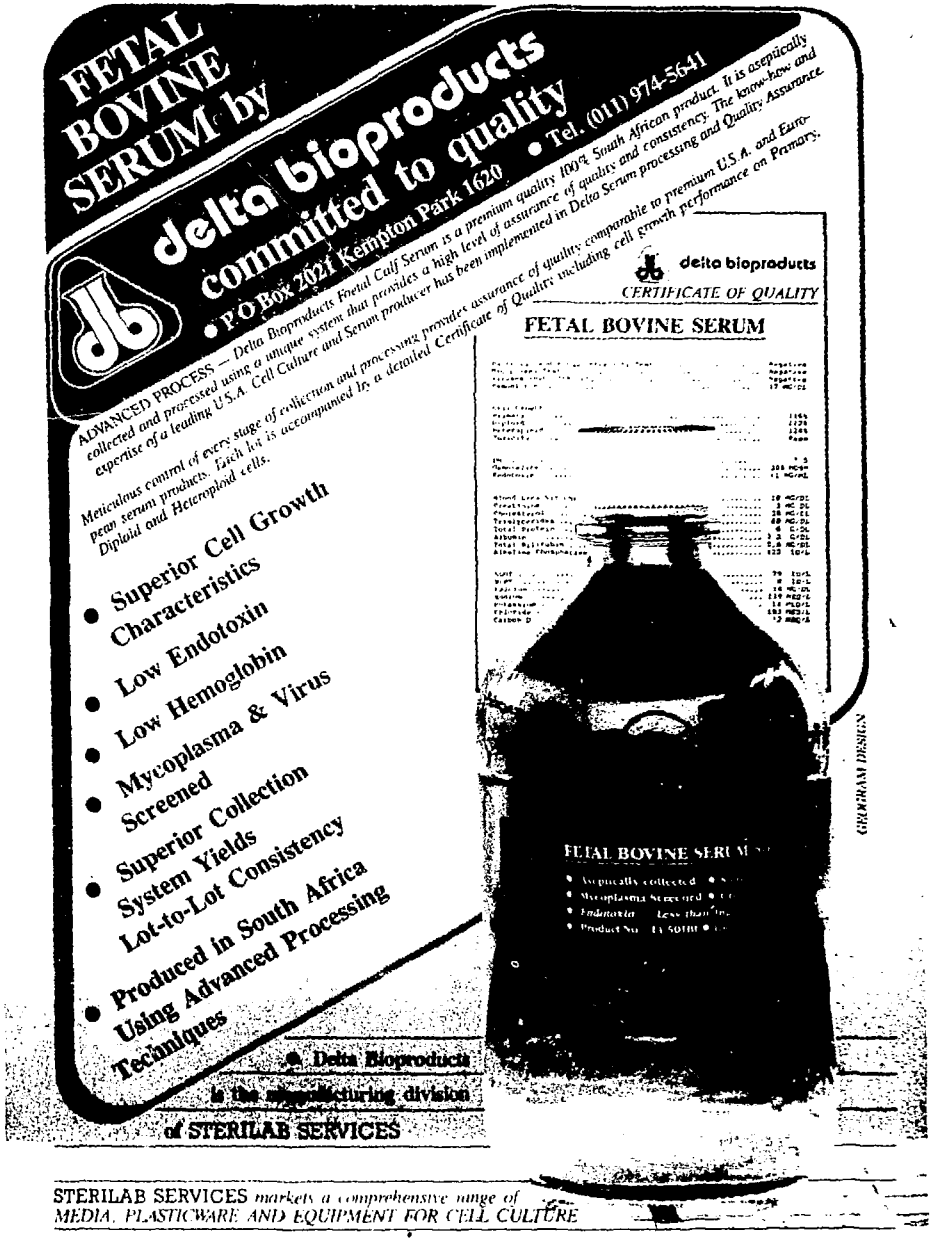

INTERNATIONAL ORGANISATION FOR MEDICAL PHYSICS

Official Representative: M L du Preez

The arrangements for the 9th International Conference on Medical Physics and the 16th International Conference on Medical and Biological Engineering are in full swing. The venue for both meetings is Kyoto, Japan and will run from 7 to 12 July 1991. Papers on 56 topics have been called for by the organizers and members are urged to attend these meetings.

Two IOMP committees, namely the Developing Countries Committee and the Education and Training Committee, have been restructured and both have resumed their duties.

Prof A van Aswegen serves on the Developing Countries Committee and has been in contact with several medical physicists in Africa. In response to a request from the IOMP to donate relevant redundant literature, copies of journals have been sent to medical physicists who have expressed a need.

The Education and Training Committee of the IOMP, of which Prof W J Strydom is a member, has identified the need for a workshop on Quality Control. Attendance by medical physicists throughout Africa is envisaged and a joint SAAPMB/IOMP venture is under consideration.

INTERNASIONALE ORGANISASIE VIR MEDIESE FISIKA

Amptelike Verteenwoordiger: M L du Preez

Die reëlings vir die 9de Internasionale Konferensie oor Mediese Fisika en die 16de Internasionale Konferensie oor Mediese en Biologiese Ingenieurswese is in volle swang. Beide hierdie byeenkomste vind vanaf 7 tot 12 Julie 1991 in Kyoto, Japan plaas. Die organiseerders het 56 onderwerpe genoem en referate word aangevra. Lede word aangemoedig om hierdie byeenkomste by te woon.

Twee IOMF Komitees, naamlik die Ontwikkelende Lande Komitee en die Onderwys en Opleiding–komitee, is nuut saamgestel en albei het hul werksaamhede hervat.

Prof A van Aswegen dien op die Ontwikkelende Lande Komitee en het met verskeie mediese fisici in Afrika kontak gemaak. Na aanleiding van 'n versoek van die IOMF om oorbodige vakliteratuur te skenk, is tydskrifte aan dié mediese fisici gestuur wat 'n behoefte aangedui het.

Die Onderwys en Opleiding–komitee van die IOMF, waarvan prof W J Strydom 'n lid is, het die behoefte aangedui vir 'n werkswinkel oor Kwaliteitsbeheer. Bywoning deur mediese fisici dwarsdeur Afrika word beoog en 'n gesamentlike SAAVGB/IOMF onderneming word ondersoek.

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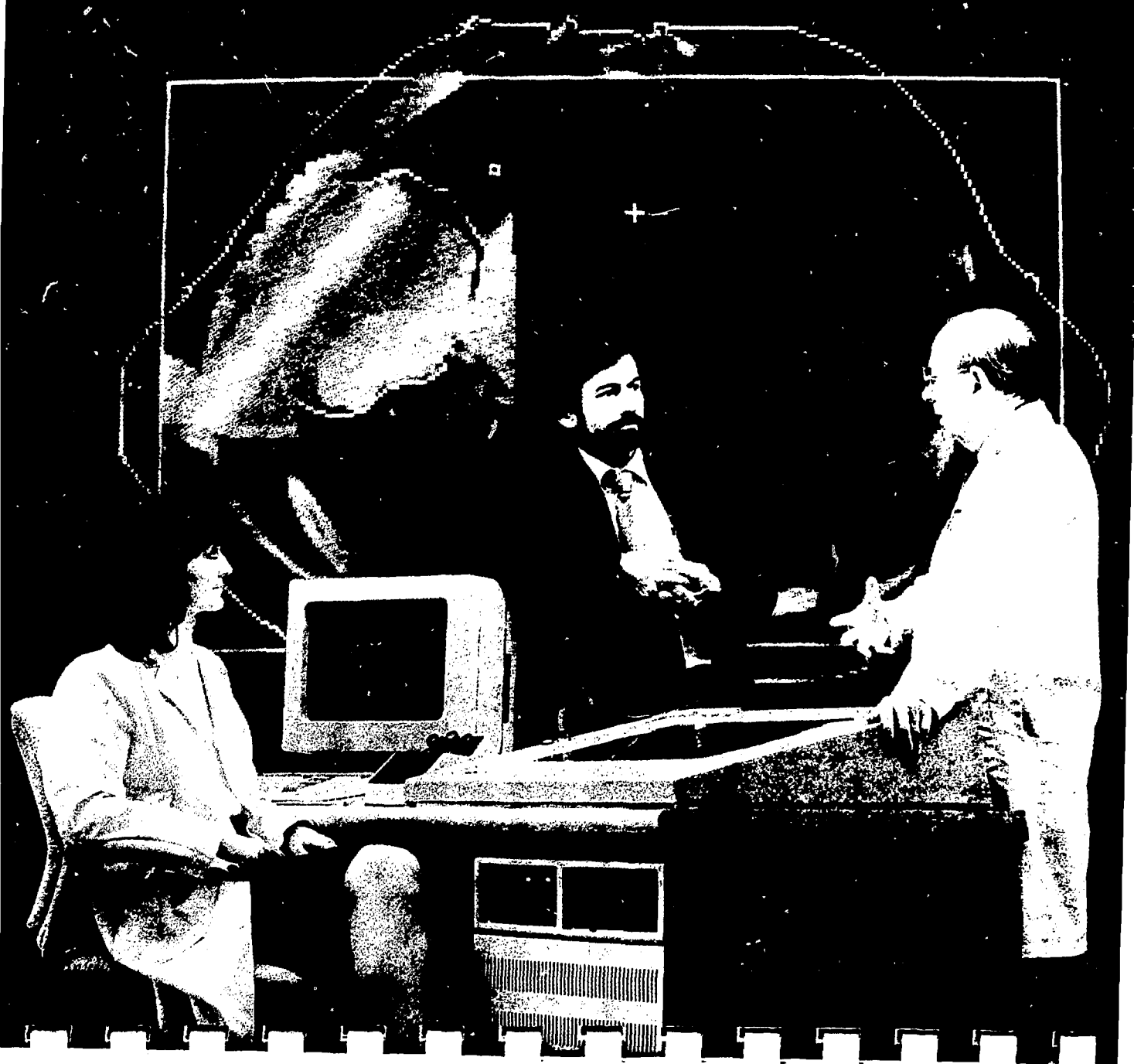

INTERNATIONAL RADIATION PROTECTION ASSOCIATION

Official Representative: A H Leuschner

This year the IRPA will commemorate its thirtieth year of service to the international community. The IRPA has over 15 000 registered members representing 31 associate societies in 36 countries. The Group of Health Physicists of the SAAPMB is the South African Associate Society of the IRPA.

The Executive Council of the IRPA met during June 1990 in Anaheim (USA). It was decided at this meeting that the working group on Education, Training and Certification should focus on certification. The next Executive meeting will be held in Montreal during April 1991.

The quarterly IRPA–Bulletin has improved its presentation regarding print and production quality.

In response to encouragement and support from the IRPA, the International Non–Ionizing Radiation Committee (INIRC) has issued a selection of publications entitled "Guidelines for Protection against Non–Ionizing Radiation".

Following the unification of the two Germanies, two German organizations, namely the Fachverband für Strahlenschutz (West Germany) and the Vereinigung für Strahlenforschung und Strahlenschutz (East Germany), are being restructured to form a single body.

A Regional Congress was organized for December 1990 by the French Society in collaboration with the German, Swiss and Italian Societies.

The 8th International Congress of the IRPA will be held in Montreal during May 1992.

GROUP OF HEALTH PHYSICISTS

The Group of Health Physicists of the SAAPMB aims to provide a medium through which persons engaged in the professional practice of health physics in South Africa may communicate more readily with each other and in so doing advance the science of health physics. Besides promoting its professional interests, the Group organizes scientific meetings and renders advice and assistance in matters pertaining to health physics.

The group has 56 members, 21 associate members and 2 student members, indicating a growth in total membership over the past year of about 10%. Our Publicity Committee has been very active in promoting health physics amongst school children by supporting an award for young scientists at the GEC EXPO.

The Group of Health Physicists is an associate society of the IRPA, through which continued international contact is assured. By interacting with the Association of Societies for Occupational Safety and Health (ASOSH), the group has maintained contact with other related professions in safety and health.

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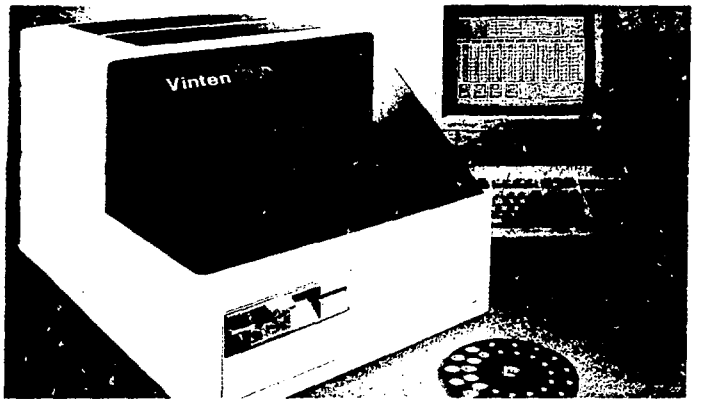

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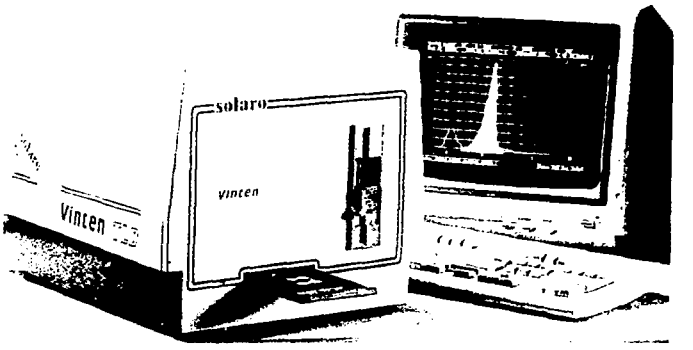

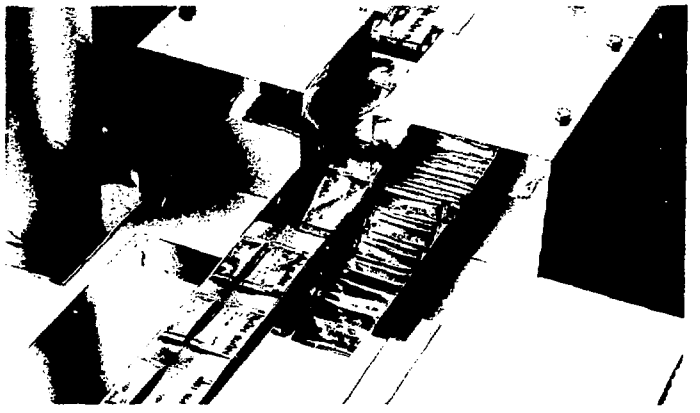

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GROUP OF MEDICAL PHYSICISTS

The first 5–year term of the Professional Board of Medical Sciences expired at the end of 1990. For the new term the composition of the Professional Board has been altered to include two medical physicists. The Medical Physics subcommittee of the Professional Board will consist of these two members plus an additional two members who are elected and one other elected member who represents the Radiation Technologists. During the first term the Professional Board has achieved much in the formulation and publishing of regulations defining the scope of the profession and as regards the training of medical physicists. The inspection of training centers has been initiated, thereby ensuring a high standard of training.

The Professional Committee has been requested to evaluate the minimum personnel requirements necessary to deliver an acceptable service in medical physics.

The Medical Physicists group has 47 members and 10 associated members.

GROEP VAN GENEESKUNDIGE FISICI

Die eerste 5–jaar termyn van die Beroepsraad van Mediese Wetenskappe het aan die einde van 1990 verstryk. Die samestelling van die Beroepsraad vir die nuwe termyn het verander en sluit nou twee geneeskundige fisici in. Die Geneeskundige Fisici subkomitee van die Beroepsraad sal dus uit dié twee lede bestaan plus twee addisionele lede wat as sulks verkies word en een verkose lid wat die Stralingstegnoloë verteenwoordig. Gedurende die eerste termyn het die Beroepsraad baie vermag in soverre dit die formulasie en publikasie van 'n beroepsomskrywing aangaan en wat betref die opleiding van geneeskundige fisici. Daar is ook begin met die inspeksie van opleidingsentra om sodoende te verseker dat die standaard van opleiding op 'n hoë vlak geskied.

Die Professionele komitee is versoek om ondersoek in te stel na die minimum personeelbehoeftes wat benodig word om 'n aanvaarbare diens in geneeskundige fisika te lewer.

Die Groep van Geneeskundige Fisici het 47 lede en 10 medelede.

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For opening the Congress	Dr D Reitmann Director: NAC Direkteur: NVS	Vir die opening van die Kongres
For sponsoring the Summer School and the visits by Prof P M DeLuca Jr and Dr H Blattmann	Medical Research Council Mediese Navorsingsraad	Vir die borg van die Somerskool en die besoeke van Prof P M DeLuca Jr en Dr H Blattmann
For sponsoring the Council's Incentive Award	Siemens	Vir die borg van die Raad se Aansporingstoekenning
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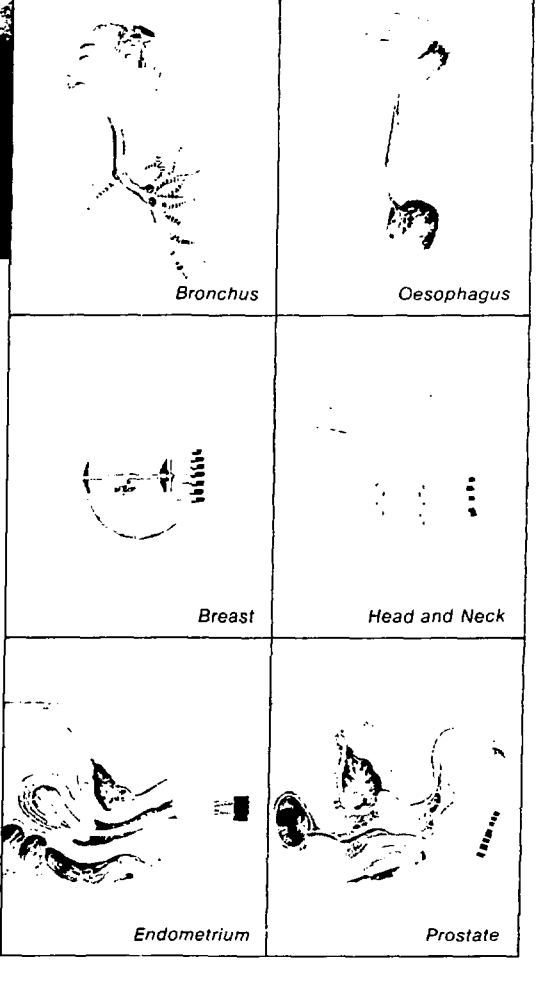

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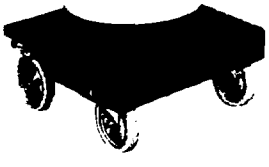

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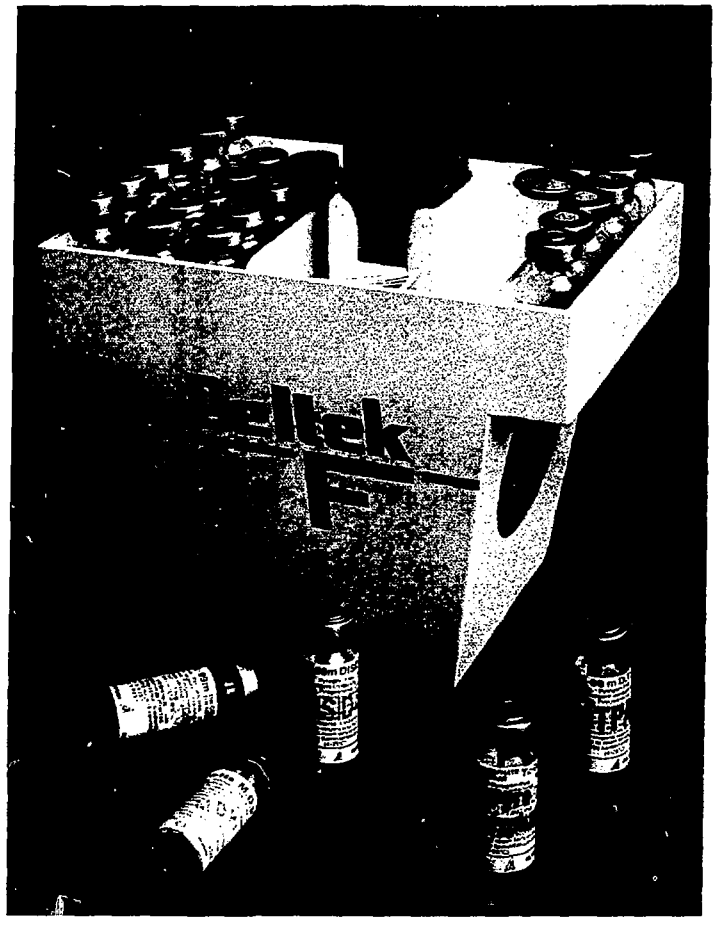

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11-12 MARCH / MAART 1991

BIOPHYSICAL ASPECTS OF THERAPY BEAMS
BIO-FISIESE ASPEKTE VAN TERAPIE-BUNDELS

MNR
MRC

MONDAY, 11 MARCH

09h00–12h00 SAAPMB Council Meeting

11h00–13h00 Registration

13h00–14h00 Lunch

14h00–14h05 Welcome: **Dr J H Hough**
Organizing Committee

14h05–14h20 Opening: **Dr P D R van Heerden**
President, Medical Research Council (MRC)

SESSION A **HEAVY PARTICLE THERAPY**

Chairman: Dr J H Hough

14h20–14h50 **Dr D T L Jones**, *National Accelerator Centre, Faure*

Physical aspects of particle therapy beams.

14h50–15h20 **Dr H Blattmann**, *Paul Scherrer Institute, Villigen, Switzerland*

Charged particle therapy programmes worldwide: treatment techniques.

15h20–15h40 Discussion

15h40–16h10 Tea

SESSION B **BIOMEDICAL PHYSICS**

Chairman: Dr D T L Jones

16h10–16h40 **Prof P M DeLuca Jr**, *University of Wisconsin, Madison, USA*

Neutron production and shielding for a 250 MeV proton synchrotron.

16h40–17h10 **Dr J H Hough**, *National Accelerator Centre, Faure*

Concepts in microdosimetry with applications to neutron therapy.

17h10–17h40 **Mr S Pistorius**, *Tygerberg Hospital/University of Stellenbosch, Tygerberg*

Developments in photon and electron beam dose calculations.

17h40–18h10 Discussion

18h15–20h00 Cocktail Party

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TUESDAY 12 MARCH

SESSION C PROTON/PION THERAPY

Chairman: Dr D Reitmann

09h00–09h30 **Prof P M DeLuca Jr**, *University of Wisconsin, Madison, USA*

Instrumentation for a treatment nozzel for a 250 MeV proton synchrotron.

09h30–10h00 **Dr H Blattmann**, *Paul Scherrer Institute, Villigen, Switzerland*

Three-dimensional conformation therapy with pions: treatment techniques, patient preparation, treatment planning.

10h00–10h20 Discussion

10h20–10h50 Tea

SESSION D RADIOBIOLOGY

Chairman: Dr S Wynchank

10h50–11h20 **Mr J P Slabbert**, *National Accelerator Centre, Faure*

Basic concepts in radiobiology.

11h20–11h50 **Dr G H Blekkenhorst**, *Groote Schuur Hospital/ University of Cape Town, Observatory*

The relevance of radiobiology to radiotherapy with special reference to neutron beams.

11h50–12h20 **Dr L Böhm**, *Tygerberg Hospital/University of Stellenbosch, Tygerberg*

RBE measurements on the p(66)+Be neutron beam at Faure, South Africa.

12h20–12h50 Discussion

13h00–14h00 Lunch

SESSION E RADIATION PROTECTION

Chairman: Mr B C Winkler

14h00–14h30 **Dr G P de Beer**, *Atomic Energy Corporation, Pretoria*

General considerations regarding radiation protection in beam therapy.

14h30–15h00 **Dr T C Kotze**, *Department of National Health and Population Development, Bellville*

Radiation protection regarding medical electron linear accelerators.

15h00–15h20 Discussion

15h20–15h50 Tea

SESSION F CLINICAL ASSESSMENTS

Chairman: Prof B J Smit

15h50–16h20 **Dr E E D Mills**, *Tygerberg Hospital/University of Stellenbosch, Tygerberg*

Clinical aspects of neutron therapy.

16h20–16h50 **Dr C V Levin**, *Groote Schuur Hospital/University of Cape Town, Observatory*

Proton therapy – clinical aspects.

16h50–17h10 Discussion

17h10–17h15 Closure

17h30–17h45 SAAPMB Council Meeting

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13–15 MARCH 1991

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13–15 MAART 1991

PROGRAM

WEDNESDAY 13 WOENSDAG

07h00–08h00 Registration
Registrasie

08h00–08h05 Welcome/Verwelkoming
Dr D T L Jones
Chairman: Organizing Committee
Voorsitter: Reëlingskomitee

08h05–08h20 Opening Address/Openingsrede
Dr D Reitmann
Director: National Accelerator Centre
Direkteur: Nasionale Versnellersentrum

08h20–09h10 SESSION A **RADIATION PHYSICS I**
SESSIE A **STRALINGSFISIKA I**

Chairman/Voorsitter: Prof W J Strydom

08h20–08h40 A1 **P M DeLuca Jr**
Radiation physics and biology of ultrasoft x-rays.

• 08h40–08h55 A2 **S N Surujhlal**
Determination of x-ray spectra from attenuation analysis.

08h55–09h10 A3 **W A Groenewald**
A comparison of electron beams respectively produced by double and single scattering foil systems in medical linear accelerators.

09h10–10h25 SESSION B **COMPUTER APPLICATIONS**
SESSIE B **REKENAARTOEPASSINGS**

Chairman/Voorsitter: Prof M G Lötter

† 09h10–09h25 B1 **D J Savage**
The use of computers at the HF Verwoerd Hospital Radiotherapy Department.

† 09h25–09h40 B2 **C P Herbst**
Die gebruik van 'n persoonlike rekenaar vir vinnige versameling van kardiologiese data oor 'n verlengde versamelperiode.

•† 09h40–09h55 B3 **N J Uys**
Versameling van kardiologiese data met behulp van 'n persoonlike rekenaar: akkuraatheid en stabiliteit.

† 09h55–10h10 B4 **J K Hough**
Cerebral lesion co-ordinates for computer control of a proton beam and for proton therapy planning.

† 10h10–10h25 B5 **A J van Rensburg**
Air dispersion modelling at Rössing Uranium.

10h25–10h55 Tea
Tee

• Council Award / Raadstoekenning
† Computer Prize / Rekenaarprys

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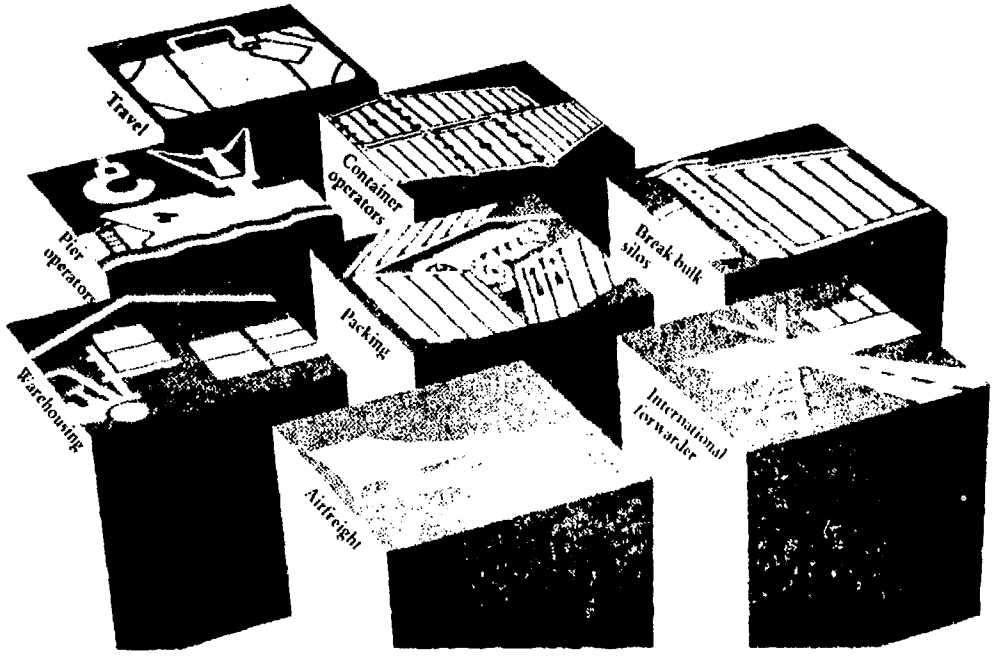

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10h55–11h50 SESSION C **RADIOTHERAPY**
SESSIE C **RADIOTERAPIE**

Chairman/Voorsitter: Dr D T L Jones

10h55–11h15 C1 **H Blattman**
Dose distribution comparisons for various techniques (pions, protons, photons) for a pelvic tumor and a head case.

11h15–11h30 C2 **D G van der Merwe**
Evaluation of the role of computerized treatment planning in electron therapy at Hillbrow Hospital.

11h30–11h50 C3 **H Blattmann**
Dynamic application techniques for protons – a problem of movement.

11h50–12h35 SESSION D **ISOTOPE PRODUCTION I**
SESSIE D **ISOTOOPPRODUKSIE I**

Chairman/Voorsitter: Dr P J Fourie

11h50–12h05 D1 **F J Haasbroek**
Stand van die radioisotoopproduksieprogram van die Nasionale Versnellersentrum.

12h05–12h20 D2 **F M Nortier**
Tegniese aspekte ten opsigte van ^{111}In–produksie via die ^{nat}In(p,xn)^{111}Sn→^{111}In produksieroete.

12h20–12h35 D3 **G F Steyn**
Die ontwikkeling van 'n kripton gasskyf vir die produksie van ^{81}Rb vir gebruik in ^{81}Rb/^{81m}Kr-generators.

12h35–13h20 SESSION E **DOSIMETRY**
SESSIE E **DOSIMETRIE**

Chairman/Voorsitter: Prof R J Keddy

12h35–12h50 E1 **S Pistorius**
A convolution/scatter integration model for photon beam dose calculations in inhomogeneous media.

• 12h50–13h05 E2 **A N Schreuder**
Primary dose component measurements in a p(66)/Be neutron beam.

• 13h05–13h20 E3 **M D du Toit**
Rectal and bladder dose during low dose rate intra-cavitary therapy for carcinoma of the cervix.

13h20–14h05 Lunch
Middagete

14h05–14h50 **POSTER PRESENTATIONS (GROUP A)**
PLAKKAATVOORDRAGTE (GROEP A)

Chairman/Voorsitter: Dr S J Mills

14h50–15h20 Poster Viewing
Plakkaatbesigtiging

15h20–15h45 Tea
Tee

• Council Award / Raadstoekenning

15h45–16h45 **SESSION F GENERAL**
SESSIE F ALGEMEEN

Chairman/Voorsitter: Dr E J van der Merwe

15h45–16h00 F1 **B Gutschow**
A near real time photogrammetric PC based system to study regional body surface motion of humans during respiration.

16h00–16h15 F2 **M Benatar**
A critical comparison of three methods for measuring orthodontic dental records.

16h15–16h30 F3 **M O Shackleton**
Quantitative CT image performance using an RMI phantom.

• 16h30–16h45 F4 **M van Zyl**
Die effek van temperatuur en ontwikkelingstyd op die kwaliteit van mammografie films.

16h45–17h45 Annual General Meeting
Health Physics Group

Algemene Jaarvergadering
Gesondheidsfisikagroep

17h45–18h45 Annual General Meeting
Medical Physics Group

Algemene Jaarvergadering
Groep van Mediese Fisici

19h30 SEAFOOD BRAAI/SEEKOSBRAAI
(Suikerbossie Restaurant)

THURSDAY 14 DONDERDAG

08h00–08h45 **SESSION G NUCLEAR MEDICINE**
SESSIE G KERNGENEESKUNDE

Chairman/Voorsitter: Dr C P Herbst

† 08h00–08h15 G1 **A J White**
Restoration of gated cardiac images.

† 08h15–08h30 G2 **M A Sweetlove**
Computer compartmental analysis to identify platelet activation in graft patients.

• 08h30–08h45 G3 **M M Calitz**
Die bepaling van die stralingsdosis gelewer deur Tc-99m gemerkte HMFG-1 monoklonale teenliggame.

08h45–09h30 **POSTER PRESENTATIONS (GROUP B)**
PLAKKAATVOORDRAGTE (GROEP B)

Chairman/Voorsitter: Mr A E Houlder

09h30–10h00 Poster Viewing
Plakkaatbesigtiging

10h00–10h30 Tea
Tee

• Council Award / Raadstoekenning
† Computer Prize / Rekenaarprys

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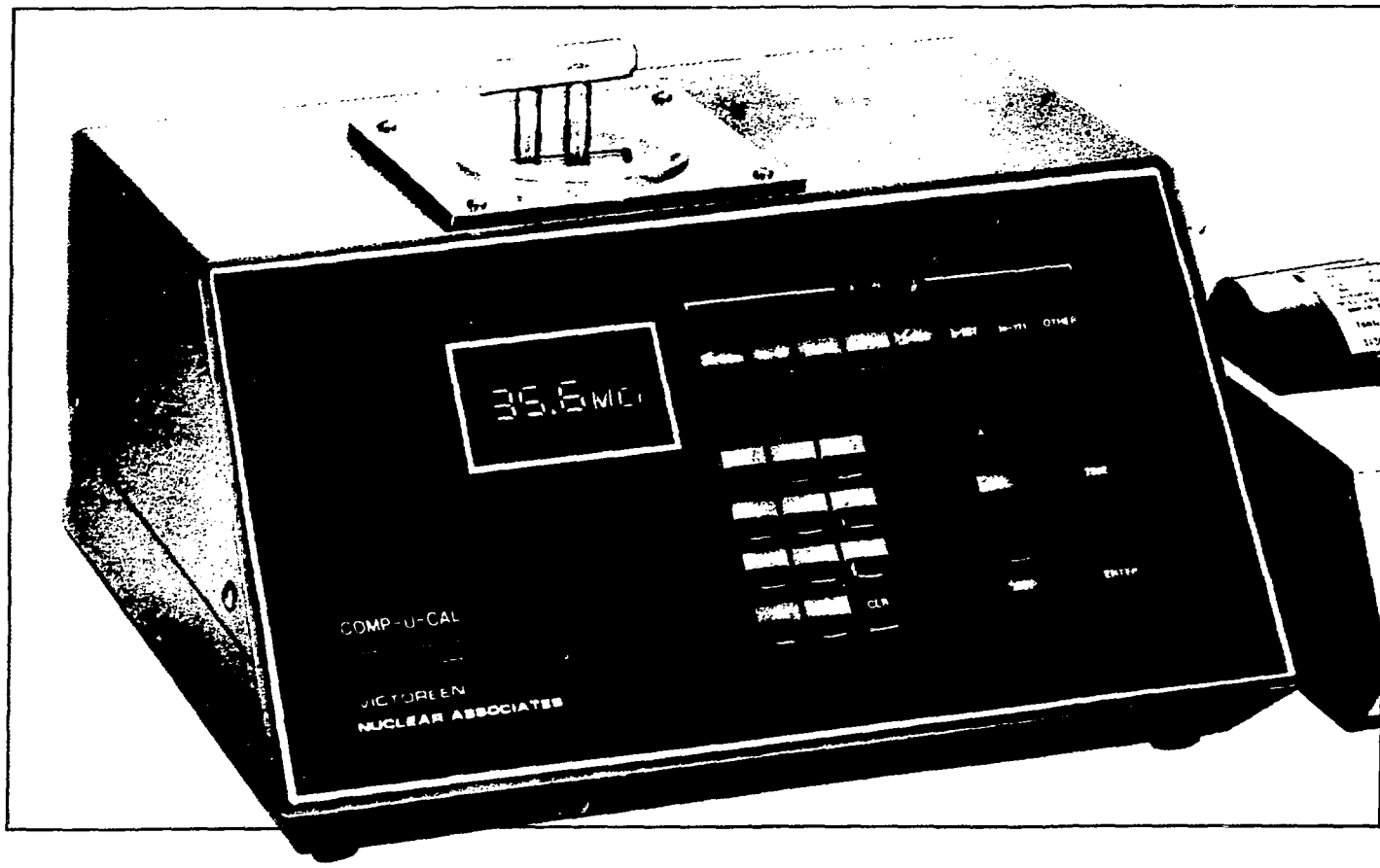

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10h30–11h20 SESSION H **RADIATION PHYSICS II**
SESSIE H **STRALINGSFISIKA II**

Chairman/Voorsitter: Dr J H Hough

10h30–10h50 H1 **P M DeLuca Jr**
Neutron kerma factors for low-Z elements from 15 to 30 MeV.

10h50–11h05 H2 **P J Binns**
Time-of-flight measurements with proportional counters.

11h05–11h20 H3 **R J Keddy**
Electron stopping powers: A study of the density effect correction.

11h20–12h05 SESSION I **RADIOBIOLOGY I**
SESSIE I **RADIOBIOLOGIE I**

Chairman/Voorsitter: Dr S Wynchank

11h20–11h35 I1 **J P Slabbert**
Cellular response to variations in the secondary charged particle spectrum of a p(66)/Be neutron beam.

11h35–13h50 I2 **J Michie**
In vitro colorimetric assay of cell survival predictive of human tumour response to radiation.

11h50–12h05 I3 **L Böhm**
Modulation of the radiosensitivity of cultured cells.

12h05–12h50 SESSION J **RADIATION PROTECTION I**
SESSIE J **STRALINGSBESKERMING I**

Chairman/Voorsitter: Dr G P de Beer

12h05–12h20 J1 **R Edwards**
Evaluation of possible P-32 internal contamination using a NaI detector and a whole-body counter.

12h20–12h35 J2 **C A R Bain**
Radiological dose assessment in the mining industry.

• 12h35–12h50 J3 **A Steyn**
Development of an active integrating technique for measuring radon daughter activity in underground mines.

12h50–13h35 Lunch
Middagete

13h35–15h05 Annual General Meeting: SAAPMB
Algemene Jaarvergadering: SAVFGB

15h05–15h30 Tea
Tee

15h30–18h30 Visit to NAC Faure
Besoek aan NVS Faure

19h30 for 20h00 CONGRESS DINNER/KONGRESDINEE
(Arthur's Seat Hotel)

• Council Award / Raadstoekenning

FRIDAY 15 VRYDAG

08h00–08h45 **SESSION K ISOTOPE PRODUCTION II**
SESSIE K ISOTOOPPRODUKSIE II

Chairman/Voorsitter: Dr F J Haasbroek

08h00–08h15 K1 **P J Fourie**
The chemistry and application of ^{99m}Tc–(V)DMSA for the diagnosis of tumours.

08h15–08h30 K2 **T N van der Walt**
A review of short–lived radionuclide generators.

08h30–08h45 K3 **W K A Louw**
^{99m}Tc–labelling of polyclonal human immunoglobulin for scintigraphic localization of inflammatory sites.

08h45–09h30 **POSTER PRESENTATIONS (GROUP C)**
PLAKKAATVOORDRAGTE (GROEP C)

Chairman/Voorsitter: Dr J H Hough

09h30–10h00 Poster Viewing/Plakkaatbesigtiging

10h00–10h30 Tea/Tee

10h30–11h15 **SESSION L RADIOBIOLOGY II**
SESSIE L RADIOBIOLOGIE II

Chairman/Voorsitter: Dr G H Blekkenhorst

10h30–10h45 L1 **S Wynchank**
Uses of in vivo ^{1}H NMR evaluation of T1 and T2 time relaxation in rodent CaNT tumours.

10h45–11h00 L2 **D Szeinfeld**
Response of normal rodent tissue to neutron radiation: protection by exogenous ATP.

11h00–11h15 L3 **L L du Toit**
The biological effects of microwaves.

11h15–12h15 **SESSION M RADIATION PROTECTION II**
SESSIE M STRALINGSBESKERMING II

Chairman/Voorsitter: Dr A H Leuschner

11h15–11h30 M1 **G Lamparelli**
Benchmark of the 1–D shielding modules of scale–3 by means of a model of the Koeberg reactor.

11h30–11h45 M2 **G P de Beer**
A comparison between personal neutron doses as measured with NTA and CR39 under operational conditions.

11h45–12h00 M3 **H Preston** F 3.
An automatic radon/neutron measuring system based upon track etch detectors.

12h00–12h15 M4 **A Southgate**
A fully integrated system for personal monitoring using TLD.

12h15–12h45 **SESSION N ICRP PANEL DISCUSSION**
SESSIE N ICRP PANEELBESPREKING

Chairman/Voorsitter: Dr J K Basson

12h45–12h50 Closure/Afsluiting.

13h00 Council Meeting/Raadsvergadering

POSTER ALLOCATIONS / PLAKKAATTOEKENNINGS

SESSION A / SESSIE A

	A1	Radiation shield optimization	T J van Rooyen
	A2	Brief report of cobalt–60 radiation incident	W I D Rae
	A3	The radiation monitoring of staff using a whole body burden chair	C Johnson
	A4	Continuous low dose–rate irradiation of the rat brain	J Madhoo
	A5	The effect of cisplatinum and radiation alone or in combination on surfactant in balb/c mice	R Duffett
	A6	Radiation and energy metabolism	A J Hunter
	A7	Studies on the fine specificity of antibodies to the C–terminal end of histone H1 in idiopathic SLE	P C Creemers
	A8	Oxygen uptake in CaNT tumours of different volumes and after neutron beam irradiation	A Burger
*	A9	Modulation of radiation response of normal and tumour cells by pre– or post–irradiation exposure to gamma linolenic acid	J Michie
*	A10	The use of the cardiac glycoside, Ouabain as a radiosensitizer	F Verheye–Dua
	A11	A computer model of human ventilation and oxygen distribution	S Smyl

*Poster Prize/Plakkaatprys

POSTER ALLOCATIONS / PLAKKAATTOEKENNINGS

SESSION B / SESSIE B

	B1	Quantitative x–ray analysis – mobile units	A Botha
	B2	A simple program to compare modulation transfer functions of a scintillation camera	A C Chamberlain
	B3	Evaluation of the South African produced macro–aggregated human serum albumin (MAA)	L B Burger
	B4	Methods for three–dimensional display of SPECT data	S van der Woude
	B5	Avoiding bladder interference in pelvic SPECT	H J Wasserman
*	B6	A new scatter correction technique for radionuclide image quantitation	A J van Rensburg
*†	B7	Die gebruik van 'n persoonlike rekenaar vir die verwerking en vertoon van kerngeneeskundige beelde	W P van Wyk
	B8	A comparison of absolute volume determination on two SPECT imaging systems using a threshold edge detection method	P H Pretorius
	B9	^{131}I–labelling of sunflower seed oil for scintigraphic detection of leakage in the lymphatic system	W K A Louw
*	B10	*In vivo* assessment of regional microvascular albumin leakage during *E. Coli* septic shock in the baboon model	N Hugo
	B11	An evaluation of ^{111}In–labelled platelet uptake in the liver and spleen by means of planar scintillation camera imaging.	M G Lötter

*Poster Prize/Plakkaatprys
† Computer Prize/Rekenaarprys

POSTER ALLOCATIONS / PLAKKAATTOEKENNINGS

SESSION C/SESSIE C

C1	An assessment of the effect of the angular response of dosimeters used in electron therapy	D G v d Merwe
C2	Neutron spectral measurements in the NAC's p(66)/Be therapy beam	D T L Jones
C3	Gamma production measurements in a p(66)/Be neutron beam	A N Schreuder
C4	A microdosimetric evaluation of tissue substitutes	P J Binns
C5	Synthetic diamonds as pulse–counting detectors in electron dosimetry	M Tan
C6	Whole body dose estimates to staff involved in gynaecological radium insertions	S Carswell
C7	Thermoluminescent dosimetry during screening of RANDO pelvis	W I D Rae
C8	3–D planning of a large volume with shaped fields	C P Pienaar
C9	Excimer laser–induced fluorescence in biological tissue	N Bhagwandin
C10	Three–dimensional motion of the human head and stereophotogrammetry.	B Gutschow
C11	Acoustic cavitation and the safety of diagnostic ultrasound	M v d Merwe

PAPER ABSTRACTS / VOORDRAGOPSOMMINGS

PAPER A1

RADIATION PHYSICS AND BIOLOGY OF ULTRASOFT X-RAYS

P M DeLuca Jr. and C M Meger-Wells

Department of Medical Physics, University of Wisconsin-Madison, Madison, WI 53706, USA

As energetic electrons slow in matter, their pattern of energy deposition, particularly near the end of the range, changes significantly. The energy deposition rate increases sharply approximating that at the Bragg peak for energetic heavy charged particles. The biological response of nanometer dimension sensitive sites will also vary. Phenomena related to this effect can be best investigated by beams of ultra soft x-rays. Such quanta exhibit mean free paths of a few micrometers and interact with matter producing almost mono-energetic soft electrons that have an energy deposition pattern similar to the end of range electrons of more energetic quanta. Electron storage rings provide an ideal source of such photons. We report the development of a suitable beam line and irradiation fixture providing intense fields of monochromatic photons of 100 to 2000 eV using a 1 GeV electron storage ring. Multi-layer mirrors are employed to monochromate the broad synchrotron photon spectrum and select the transmitted beam energy. An irradiation fixture was developed to isolate biological experiments from the synchrotron vacuum and to allow precise positioning and scanning of cells and instruments through the beam. Several instruments were developed and tested to measure the absolute photon fluence. Using this facility, a preliminary cellular response experiment was completed at 1480 eV photon energy.

PAPER A2

DETERMINATION OF X-RAY SPECTRA FROM ATTENUATION ANALYSIS

S N Surujhlal and W J Strydom

Medical Physics Department, Medunsa, 0204

The direct spectral determination of diagnostic x-rays requires expensive equipment. An alternative computational method using a Laplace transform pair model and attenuation measurements is available. The purpose of this project is to determine diagnostic x-ray spectra from attenuation measurements using Aluminium attenuating filters; and to compare these to experimentally determined spectra obtained on the same x-ray unit using silicon spectroscopy.

Attenuation data for varying thicknesses of aluminium are fitted into a four parameter analytical function whose inverse Laplace transform generates a data set that approximates the x-ray spectrum. Experimental x-ray spectra are acquired using a high resolution room temperature silicon detector.

Preliminary results indicate that the indirect method of attenuation analysis closely approximates the experimental bremsstrahlung spectra.

ZA9200124

PAPER A3

A COMPARISON OF ELECTRON BEAMS RESPECTIVELY PRODUCED BY DOUBLE AND SINGLE SCATTERING FOIL SYSTEMS IN MEDICAL LINEAR ACCELERATORS

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In this study the electron beams produced in the double scattering foil system of the Philips SL15 linear accelerator were compared to the beams from a single foil Philips SL75-20 accelerator. The beams were analysed with respect to the energy loss and energy spread in the foil system. The parameters used in the analysis included the therapeutic range and 50% range, the dose gradient, the percentage photon contamination and the first derivative of the depth dose curves. The results indicated a 3% decrease in the energy spread parameters and a 2% decrease in the photon contamination for the SL15 beams. A remarkably close agreement however was found in the range parameters for the two accelerators. It may be concluded that the electron beam characteristics of these two accelerators are clinically well matched.

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PAPER B1

THE USE OF COMPUTERS AT THE H F VERWOERD HOSPITAL RADIOTHERAPY DEPARTMENT

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Examples are shown of the advance of calculating methods since early 1950.

The slide rule gave way to the mechanical calculator followed by the pocket calculator, the early dedicated planning computer of the mid 70's and the current Mevaplan planning computer where direct input of digital patient data from a CT scan and beam data from a computerised water phantom are done routinely. A personal computer is also used routinely for various tasks such as dose – output calibration of the various treatment machines. The formulae containing the constants and variables involved in machine calibration are embodied in a spread–sheet program and the results are printed out in the required format e.g. a treatment time chart. Possible errors resulting from hand calculation are thus avoided. A program written in BASIC for simpler types of planning such as parallel opposed fields, single electron fields and compensating filters is described together with the formulae used in the calculations.

LESING B2

DIE GEBRUIK VAN 'N PERSOONLIKE REKENAAR VIR VINNIGE VERSAMELING VAN KARDIOLOGIESE DATA OOR 'N VERLENGDE VERSAMELPERIODE

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Die vinnige veranderinge in kardiologiese parameters vereis vinnige dataversameling om te voorkom dat inligting verlore raak. Die maksimum adresseerbare rekenaargeheue beperk die dataversamelingstyd egter in die algemeen tot ongeveer 6 sekondes.

Die doel van hierdie studie was om 'n dataversameling- en analisestelsel te skep waardeur kardiologiese data teen 4000 Hz vir meer as 6s versamel kan word.

'n Program is in BASIC geskryf om versyfering van 8 analoë seine teen 4000 Hz te bewerkstellig. Die verlengde dataversamelings-periode van 40s (160 000 datapunte) word verkry deur die data in die agtergrond in opeenvolgende geheueblokke te versamel. Prosessering van die data sluit outomatiese kalibrasie, vergladding van die datapunte en die berekening van die dP/dt in. Die analiseprogram stel die navorser in staat om die kontraktiliteit van die hartspier te bereken, eind-diastolie en eind-sistolie automaties te bepaal, asook spesifieke seine te integreer.

Die stelsel word reeds met sukses gebruik in die ondersoek na die effek van kombinasies van medikasie en narkosemiddels asook om die effek van koronêre afsluitings te ondersoek.

LESING B3

VERSAMELING VAN KARDIOLOGIESE DATA MET BEHULP VAN 'N PERSOONLIKE REKENAAR: AKKURAATHEID EN STABILITEIT

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Voordat data, wat m.b.v. 'n plaaslik ontwikkelde rekenaarprogram versamel word, as korrek aanvaar kon word, moes die akkuraatheid daarvan eers vasgestel word.

In die ondersoek is die akkuraatheid en stabiliteit van digitale waardes van spiervesellengtes, linkerventrikel- en aorta drukke bepaal.

Analoë waardes wat op 'n 8 kanaal analoog papier registreerder geskryf word, word terselfdertyd in 'n rekenaar digitaal versamel. Die analoë data is as verwysingsbron gebruik nadat dit teen bekende toegepaste drukwaardes geverifieer is. Die stabiliteit van die digitale waardes is bepaal deur die verandering in 'n bekende drukwaarde as 'n funksie van tyd te monitor. Spiervesellengtes is m.b.v. 'n ultraklank mikrometer gemeet.

Die verskil (0,14 ±1,42 mmHg) tussen die digitale en analoë drukwaardes is kleiner as die verskil tussen die analoë en die bekende toegepaste drukwaardes (0,45 ±1,29 mmHg). 'n Gelykmatige dryf (10,73 mmHg) het in beide drukwaardes gedurende die eerste uur na aanskakeling voorgekom, waarna dit stabiliseer het. Die stabiliteit van die digitale lengtesein (0,01 mm) is van dieselfde ordegrootte as die oplosvermoë (0,02 mm). Die verskil tussen die digitale en analoë lengtewaardes is 0,4 ±0,2mm.

Die akkuraatheid van die digitale drukwaardes word bepaal deur die akkuraatheid waarmee die drukwaardes, vir kalibrasie doeleindes, van die manometer afgelees kan word. Aangesien dit tegnies baie maklik is om die digitale waardes vinnig en korrek te kalibreer, word 'n hoë mate van presisie in die druk sowel as die lengtemetings verkry.

ZA9200126

PAPER B4

CEREBRAL LESION CO-ORDINATES FOR COMPUTER CONTROL OF A PROTON BEAM AND FOR PROTON THERAPY PLANNING

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Because of their charged nature, proton beams can be focussed and deviated, so allowing precise irradiation of well defined, small volumes. For a proton therapy beam to be under computer control both its direction and the lesion's location must be known in the computer's co-ordinate system (CCS). A novel method to site the lesion in the CCS has been derived using either CT or MRI images.

Fixed retroreflective markers on the patient's head are located in the CCS by a unique stereophotogrammetric procedure using 6 fixed video cameras under computer control. With appropriate CT images the lesion and markers are visualised, the latter using steel spheres of diameter 1mm attached to the skin. Thus co-ordinates of lesion and markers are readily obtainable in the CT co-ordinate system. A co-ordinate transformation then locates lesion and markers in the CCS. A similar procedure is followed with MRI (if MRI delineates the lesion better) with oil filled spheres used in place of the steel balls. Measurements using a head phantom, which has been precisely surveyed with a reflex metrograph, have shown accuracy of the lesions' positions is within 1,0mm in the CCS using the CT images (and similar results for MRI).

The resulting implications for proton radiotherapy of cerebral lesions will be discussed.

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PAPER B5

AIR DISPERSION MODELLING AT RÖSSING URANIUM

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As part of our ongoing program of monitoring potential health, safety and environmental hazards, we do dispersion modelling of airborne pollutants emanating from the mine.

Meteorological data collected by a network of three weather stations is used for the modelling.

To evaluate our emergency drill as well as the possible impact an accidental spill of ammonia might have, various continuous and instantaneous release scenario's were modelled. Both spatial and temporal variations were taken into account to assess danger areas and possible fatalities.

Sulfur dioxide (SO_2) invariably escapes into the atmosphere from our pyrite burning acid plant. Modelling was done to assess the occupational and environmental impact of this. The sensitivity of the model to topography and mixing layer depth were determined. Monthly average concentrations were correlated with measured levels. Short term averages, indicative of maximum levels, were also determined.

The results supported our existing ammonia emergency drill and showed that there is room for improvement as far as SO_2 emissions are concerned.

ZA9200128

PAPER C1

DOSE DISTRIBUTION COMPARISONS FOR VARIOUS TECHNIQUES (PIONS, PROTONS, PHOTONS) FOR A PELVIC TUMOR AND A HEAD CASE

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To evaluate the possible advantage of proton radiotherapy for various indications, three dimensional dose distributions have been calculated for selected cases and dose volume histograms for tissues at risk have been compared for different radiation sources and application techniques. For proton therapy conformation treatment was assumed and the dose distributions compared with dose distributions from pion therapy by spot scanning and from photon therapy by standard application techniques as well as conformation treatment. The comparison for a retroperitoneal liposarcoma, nestled against the spinal cord, with a target volume of 823 ml, has demonstrated a drastically reduced dose to the spinal cord compared to photon application techniques and also to pion spot scanning technique. Corresponding observations could be made for the radiation burden to the pituitary for the treatment of an osteosarcoma in the region of the left upper jaw. Dose volume histograms have been calculated for the critical normal tissues for each treatment technique, but the calculation of uncomplicated control is not yet possible, lacking especially appropriate radiobiological data for inhomogeneously irradiated normal tissues.

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PAPER C2

EVALUATION OF THE ROLE OF COMPUTERIZED TREATMENT PLANNING IN ELECTRON THERAPY AT HILLBROW HOSPITAL

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The computerized treatment planner at HH uses a modified pencil beam algorithm for electron beam calculations, based on the algorithm developed by Hogstrom, et.al.(1). With the recent commissioning of a new dual modality linear accelerator, an investigation into the capabilities short-comings and accuracy of the algorithm was required.

Calculation of open fields, blocked fields, tissue inhomogeneities, patient contour corrections, extended SSD calculations and bolussing were studied. Although the algorithm certainly highlights the importance of the lateral scattering properties of electrons, the investigation demonstrated many of the practical problems associated with current electron therapy dosimetry protocols and emphasized the need for the active involvement of Medical Physicists in electron treatment planning.

(1) K.R. Hogstrom, M.D. Mills and P.R. Almond. Electron beam dose calculations. Phys. Med. Biol. 26(3), 1981, p445-459

ZA9200130

PAPER C3

DYNAMIC APPLICATION TECHNIQUES FOR PROTONS – A PROBLEM OF MOVEMENT

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Three dimensional conformation therapy with protons could yield advantageous dose distributions compared to other radiation sources or treatment techniques for well delineated solid processes. Independent from the radiation source or treatment technique a localized treatment needs a precise, **reproducible positioning** of the patient to guarantee reliable match of the dose fall-off to the target contour. For dynamic application techniques as spot scanning any movement of the patient or an organ becomes in addition highly relevant for achieving homogeneous dose distributions inside the target volume, an important condition for achieving reliable therapeutic results. An analysis of a computer simulations of **movements of organs** due to respiration has demonstrated that over the entire treatment deviations of dose from the described dose can be kept smaller than 5% inside the target volume if the dose spot is large enough, i.e. has a FWHM of at least the size of the movement in each scan direction. The number of fractions and rescannings of the target volume reduce the deviations of the dose from the desired dose roughly by the square root of the number of scans, but other means as synchronization of the irradiation with the movement have to be also taken in consideration.

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LESING D1

STAND VAN DIE RADIOISOTOOPPRODUKSIEPROGRAM VAN DIE NASIONALE VERSNELLERSENTRUM

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Die eerste twee jaar van voltydse roetine vervaardiging van radioisotope en radiofarmaseutiese middels by die Nasionale Versnellersentrum te Faure is pas agter die rug. Die huidige stand van hierdie program sal bespreek word met spesiale verwysing na die vordering wat gemaak is met die ontwikkeling van produksiefasiliteite en produksieprosedures, die beskikbaarheid van die siklotronbundel en die invloed daarvan op produksieskedules, die radiosiotope en radiofarmaseutiese middels wat reeds beskikbaar is asook toekomstige uitbreidings wat voorsien word.

ZA9200132

LESING D2

TEGNIESE ASPEKTE TEN OPSIGTE VAN ^{111}In-PRODUKSIE VIA DIE ^{nat}In(p,xn)^{111}Sn→^{111}In PRODUKSIEROETE

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Die produksie van ^{111}In via die ^{nat}In(p,xn)^{111}Sn——→^{111}In produksieroete het 'n definiteiwe voordeel bo ander welbekende produksiemetodes waarin kadmium skyfmateriaal gebruik word. 'n Eindproduk wat totaal vry is van ^{114m}In kontaminasie word verkry en die totale stralingsdosis wat die pasiënt opdoen is dus noemenswaardig kleiner.

Aan die ander kant lê die gebruik van eersgenoemde produksieroete sekere randvoorwaardes vas wat uiteindelik hoë tegniese eise aan die daarstelling van 'n betroubare, roetine–produksieproses stel. Sommige van die probleme wat hieruit voortspruit en die hantering daarvan word uitgelig. Voorlopige resultate dui daarop dat die tegnieke wat in die produksieproses aangewend word, doeltreffend is en dat 'n eindproduk van 'n hoë gehalte haalbaar is.

ZA9200133

LESING D3

DIE ONTWIKKELING VAN 'N KRIPTON GASSKYF VIR DIE PRODUKSIE VAN ^{81}Rb VIR GEBRUIK IN ^{81}Rb/^{81m}Kr-GENERATORS

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Die spreiding van 'n protonbundel as gevolg van veelvuldige Coulombverstrooiing in die intreevenster en gasvolume van 'n hoëdruk Kr–gasskyf is eksperimenteel gemeet en vergelyk met berekeninge gebaseer op die teorie van Veelvuldige Coulombverstrooiing van Molliére. Hierdie informasie, tesame met opwekkromme–metings van protongeïnduseerde reaksies op natuurlike Kripton, is gebruik om 'n optimale gasskyf te ontwikkel vir die produksie van ^{81}Rb met 'n 66 MeV protonbundel.

ZA9200192

PAPER E1

A CONVOLUTION / SCATTER INTEGRATION MODEL FOR PHOTON BEAM DOSE CALCULATIONS IN INHOMOGENEOUS MEDIA

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The present radiotherapy dose calculation algorithms are not sufficiently accurate to meet the demands of modern radiotherapy. Improved, physically sound algorithms that can be implemented in a clinically acceptable time are essential if we wish to carry out radiotherapy to within the ±5% accuracy proposed by the ICRU.

In this paper we describe the development of a convolution based algorithm which considers the transport of photons and secondary electrons in inhomogeneous media. Analytic (model based) and numeric deconvolution of measured beam data is used to extract the convolution kernels. A combination of lateral scatter integration and azimuthal FFT based convolution, together with the application of O'Connors scaling theorem is used to calculate the dose in 3D inhomogeneous volumes.

The model has been tested against data generated using the EGS4 Monte Carlo code and published experiments. The results show that for inhomogeneous regions (with and without TCPE) a significant improvement relative to the Batho and ETAR methods is obtained.

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PAPER E2

PRIMARY DOSE COMPONENT MEASUREMENTS IN A p(66)/Be NEUTRON BEAM

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The concept of primary and scattered dose components of a radiotherapy beam is commonly used in radiotherapy planning. The primary dose can be defined as the dose delivered by charged particles liberated by uncharged radiation interacting with a medium for the first time, while the scattered dose is due to uncharged radiation that has interacted with the medium more than once. Four different methods that were initially proposed for photon beams were applied to determine the primary dose component and also the primary attenuation coefficient for p(66)/Be neutrons. They were (a) The extrapolation of measured tissue maximum ratio's (TMR's) to zero field size, (b) Narrow beam attenuation measurements in water, (c) Fitting a convolution model to the percentage depth dose data and (d) a method proposed by Nizin et al which comprises of in phantom measurements with and without a central axis attenuator. The results from these methods are compared and discussed with more emphasis placed on the fourth method which is believed to be more suitable for neutron beams.

PAPER E3

RECTAL AND BLADDER DOSE DURING LOW DOSE RATE INTRA-CAVITARY THERAPY FOR CARCINOMA OF THE CERVIX

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A low dose rate Selectron afterloading device enabling two patients to be treated simultaneously with 1,48 GBq C2-137 sources was installed during March 1990 at H F Verwoerd Hospital. An average of 25-30 patients are treated per month.

It was decided to treat carcinoma of the cervix with 50-60 Gy Co-60 external beam therapy followed by 20 Gy intra-cavitary with Selectron using the stem applicator only. For bulky tumors it seemed necessary to use not only the stem but ovoid applicators as well. However concern was expressed as to the extra dose that the bladder and the rectum would receive.

It was found in case studies where ovoids were used that the bladder received a dose of up to 30% more than if the ovoids were omitted. These values were obtained using the Van Kleffens formula in the Nucletron planning system.

To verify the dosage that the bladder and the rectum would receive with and without ovoids, measurements were made with an ionization chamber (I-10) in a Wellhöfer waterbath. Isodose curves for bladder and rectum will be presented.

PAPER F1

A NEAR REAL TIME PHOTOGRAMMETRIC PC BASED SYSTEM TO STUDY REGIONAL BODY SURFACE MOTION OF HUMANS DURING RESPIRATION

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By using a PC computer based system (TAG) to measure human torso motions, it is possible to evaluate the respiratory muscle functions and underlying pathology in near real time. For young paediatric patients this is especially valuable for their thorax movements are too fast to observe by any other method. The system captures dynamic pictures of the human breathing cycle. It uses two video cameras, a vision mixer and a video recorder, all mounted on a hospital bed. TAG, the computer system, is designed for non-photogrammetrists. It guides the user through (1) the transfer of images to PC with image processing hardware, (2) the measurement of reference points on the images and (3) the processing of the data to give co-ordinates of targeted points (x,y,z) in each image.
When viewed in the stereoscopic mode, vectors, plotted on the image of maximum expiration, show the movement of the torso between the extremes of inspiration and expiration. The value of the system is not limited to quantification of motion in near real time, but it also permits the viewer to review the video images in the stereoscopic mode and so recognise certain forms of underlying pathology.

PAPER F2

A CRITICAL COMPARISON OF THREE METHODS FOR MEASURING ORTHODONTIC DENTAL RECORDS

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Dental plaster casts are permanent records. If used by orthodontists it is essential that small differences in distances between fiducial points on them can be measured accurately. A critical comparison of three methods of varying complexity to measure these distances has been completed. Eight casts and their holograms were studied with 13 fiducial points on each cast. The first method used Vernier calipers. Also the reflex metrograph was employed for direct observation of the plaster casts and measurements on holograms of the casts. Every measurement of the coordinates of the fiducial marks was repeated at least 10 times.

There are no significant differences ($p < 0,1$) between measurements from the three techniques as indicated by the Wilcoxon sign rank test. The means of equivalent distances differed by less than 0,5mm for measurements compared with those obtained with the calipers. However when those obtained using the reflex metrograph on the casts were compared with those from the hologram, the resulting means differed by less than 0,2mm.

Thus holograms can be used as orthodontic case records and so they may solve the perennial problem of the storage of orthodontic plaster casts. Also each of the methods used for measurement proved satisfactory.

PAPER F3

QUANTITATIVE CT IMAGE PERFORMANCE USING A RMI PHANTOM

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A quality control program was implemented at Groote Schuur Hospital using the RMI Head/Body phantom. Quantitative analysis could be performed on data obtained during measurements. (Methods) Body and Head measurements were done on a monthly basis on a Siemens Somatom DRH and Elscint 2400 CT scanner. Properties such as CT scale factor, mechanical alignment, slice thickness, low contrast detectability and high contrast spatial resolution were measured using appropriate inserts. Typical body and head pre–defined settings were used during tests. (Results) During a period of 18 months slight variations in low contrast detectability could be observed (8 mm – 2.8 mm). The difference in contrast was 0.6%. Slice widths (2 mm – 10 mm) were very reliable (within 10%). High contrast spatial resolution measurements were between 2 mm and 1.25 mm. Hounsfield numbers and uniformity had to be adjusted from time to time. No significant artifacts could be seen during mechanical alignment or beam hardening tests. The effects of room and detector temperature on image quality will also be discussed. (Conclusion) This program has enabled us to detect gradual changes in scanner performance and to become aware of image degradation before diagnostic performance was significantly affected.

LESING F4

DIE EFFEK VAN TEMPERATUUR EN ONTWIKKELINGSTYD OP DIE KWALITEIT VAN MAMMOGRAFIE FILMS

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Tydens mammografiese ondersoeke is dit noodsaaklik dat die stralingsdosis aan die pasiënt so laag as moontlik moet wees. Die kontras en spoed van die mammografie film moet dus optimaal benut word. Die doel van hierdie studie was om te bepaal wat die invloed van (i) temperatuurverhoging van ontwikkelingschemikalieë en (ii) verlenging van ontwikkelingstyd op bogenoemde filmparameters sal wees.
Sensitometrie is op mammografie x-straalfilms uitgevoer en direk daarna deur 'n prosesseerder gestuur. Die temperatuur van die ontwikkelingschemikalieë is gewissel van 35 ^{o}C tot 40 ^{o}C in stappe van 1 ^{o}C. Die deurgangstyd van die films deur die ontwikkelingschemikalieë is gewissel van 20 tot 50 sekondes in stappe van 10 s. Volledige densitometrie is gedoen en karakteristieke krommes (KK) gekonstrueer deur optiese digtheid teen die logaritme van die relatiewe blootstelling te stip. Die spoedindeks, kontrasindeks en basisneweldigtheid is hieruit verkry. Die helling van die KK is ook teen optiese digtheid gestip.
Uit laasgenoemde krommes blyk dit dat die verlenging in ontwikkelingstyd geen noemenswaardige verbetering van kontras tot gevolg het indien hoë ontwikkelingstemperature gebruik word nie. By kort ontwikkelingstye het 'n verhoging in temperatuur 'n groot positiewe invloed op die spoedindeks. Hierdie effek verminder met verlenging van ontwikkelingstyd tot 'n minimum effek by 50 s. Die neweldigtheid was nooit onaanvaarbaar hoog nie.
Indien die kontras- en spoedindeks in aanmerking geneem word blyk dit dat 'n beeld met die beste kontras teen die laagste blootstelling by ontwikkelingsparameters gekry word wat wissel van 37 °C en 50 s tot 40 °C en 30 s.

ZA9200137

PAPER G1

RESTORATION OF GATED CARDIAC IMAGES

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The restoration of a digital image is the process of using computer techniques to remodel the image to more accurately represent the original object. The proceedure requires some a priori knowledge of the degradation phenomenon which occurred during image acquisition.

Nuclear medicine gamma camera images in particular suffer from poor spatial resolution due to the large point spread inherent in the camera performance. We have attempted to restore clinical images by deconvolving the point spread function from them.

Gated tomographic cardiac left ventricle short axis images of the baboon model using Tc-99m CARDIOLITE were acquired and restored by deconvolving from them the tomographic image of a point source. These are compared with the same position slices of the ventricle of the sacrificed baboon.

ZA9200138

PAPER G2

COMPUTER COMPARTMENTAL ANALYSIS TO IDENTIFY PLATELET ACTIVATION IN GRAFT PATIENTS

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Multicompartmental analysis of In^{111}- labelled platelet data lead to the finding that in vitro activated platelets have a longer transit time through the organs of the reticular endothelial system than unactivated or normal platelets. It was thus proposed that platelets activated in vivo will also have an increased transit time. We therefore utilized the multicompartmental model in an attempt to quantify in vivo platelet activation in patients with atherosclerosis.

The data of the in vivo distribution of In^{111}- labelled platelets in 10 patients (age 55-75 years) who had undergone vascular reconstructive surgery was utilized and compared to that of 5 normal subjects.

RESULTS

	TRANSIT TIME (min)		FLOW (min^{-1})	
	SPLEEN	LIVER	SPLEEN	LIVER
NORMALS	6.4 ± 1.1	0.35 ± 0.11	0.05 ± 0.02	0.38 ± 0.11
PATIENTS	11.9 ± 2.3*	0.48 ± 0.22	0.04 ± 0.02*	0.28 ± 0.11*

(* significant difference from normal subjects, p = 0.05)

The mean platelet life span of the patients was normal. The mean left ventricular ejection fraction of the patients was 58.8 ± 20 %.

The transit time and the flow of the platelets deviated from normal in these patients, yet from this data it is not possible to distinguish between a haemodynamic effect and activated platelet behaviour.

ZA9200139

LESING G3

DIE BEPALING VAN DIE STRALINGSDOSIS GELEWER DEUR Tc-99m GEMERKTE HMFG-1 MONOKLONALE TEENLIGGAME

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Menslike melkvet globulien (HMFG-1) monoklonale teenliggame (MTL) gemerk met I-123 word gebruik vir die opsporing en diagnose van ovariële kanker. Metodes is ontwikkel om HMFG-1 nou met Tc-99m te merk en hierdie studie is gedoen om die stralingsdosis van laasgenoemde merking te bepaal.

Tc-99m HMFG-1 is aan 5 wyfie bobbejane toegedien en heelliggaamflikkergrafie met die sintillasiekamera uitgevoer 1, 3, 6, 24, 48 en 72 uur na toediening in die anterior en posterior posisies. Volgens die verspreidingspatroon van die MTL is die lewer, niere, blaas en heelliggaam as bronorgane geïdentifiseer en gebiede van belang hierom getrek. Die geometriese gemiddelde tellings vanaf dié gebiede is gebruik om dosisberekeninge volgens die MIRD sisteem te doen.

Die gemiddelde kumulatiewe aktiwiteit van die bronorgane was 0,58; 0,67; 1,43 en 5,01 MBq/h onderskeidelik en die totale geabsorbeerde dosis in mGy/MBq van die teikenorgane as volg: 0,043 (niere), 0,013 (lewer), 0,078 (blaas), 0,008 (ovarium), 0,003 (tiroïed), 0,005 (hartwand), 0,012 (uterus) en 0,005 (heelliggam).

Die hoogste stralingsdosis word aan die blaas gelewer hoofsaaklik deur die blaas se eie aktiwiteit. Indien blaasleding gou plaasvind is die stralingsdosis laag genoeg om optimale beelding te verseker.

PAPER H1

NEUTRON KERMA FACTORS FOR LOW-Z ELEMENTS FROM 15 TO 30 MEV

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Neutron kerma factors, the initial energy transferred to charged particles per unit mass and fluence by neutrons, are essential to accurate dosimetry. Such information is particularly important for the elements carbon and oxygen, the major contributors to absorbed dose besides hydrogen in tissue and detector components. Microscopic cross sections can be employed to calculate kerma factors, but data are unfortunately sparse above 15 MeV neutron energy. Integral measurements of kerma factors by means of small, low pressure proportional counters and microdosimetric interpretation of the data techniques can provide these important values. Our recent measurements extended to 30 MeV neutron energy kerma factor values for carbon, oxygen, magnesium, aluminum, silicon, and iron. These measurements and results are discussed and compared to microscopic cross section derived values as well as nuclear model estimates.

PAPER H2

TIME-OF-FLIGHT MEASUREMENTS WITH PROPORTIONAL COUNTERS

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Of prime interest to physicists and clinicians at neutron therapy facilities is the neutron kerma associated with a particular beam. Under conditions of charge particle equilibrium, the measured absorbed dose is equivalent to the kerma. When the kerma is expressed per unit neutron fluence, it is called the kerma factor. The kerma factor is a function of neutron energy and since most neutron therapy beams are polyenergetic, kerma factors must be known for the whole range of energies encompassed in the therapy beam.

Commercial tissue equivalent proportional counters (TEPCs) have been used successfully to measure kerma factors in true monoenergetic beams for $E_n < 20$ MeV. At higher energies, however, only quasi-monoenergetic fields can be generated and counters exhibiting good timing characteristics are needed so that the time-of-flight (TOF) technique can be used to select the required neutron energy.

Measurements with two different TEPCs were performed in a pulsed beam of quasi-monoenergetic neutrons ($E_n = 63.3$ MeV). TOF data obtained from these observations will be presented.

ZA9200172

PAPER H3

ELECTRON STOPPING POWERS: A STUDY OF THE DENSITY EFFECT CORRECTION

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Following the theoretical derivation of Bethe and then Rohrlich and Carlsson, the mass collision stopping power for electrons interacting with matter can be calculated from :

$$(S/\rho)_{col} = \frac{2\pi r_e^2 m_0 c^2 N_A Z}{\beta^2 M_A} \left\{ ln\left[\frac{\tau^2(\tau+2)}{2(I/m_0c^2)^2}\right] + F(\tau) - \delta \right\}$$

where the parameters are defined in the original papers but, particularly, δ is the density effect correction term. The influence of δ on the overall total mass stopping power $(S/\rho)_{tot}$ as it relates specifically to carbon is investigated in detail. Trends can be inferred for other materials however.

ZA9200173

PAPER I1

CELLULAR RESPONSE TO VARIATIONS IN THE SECONDARY CHARGED PARTICLE SPECTRUM OF A p(66)/Be NEUTRON BEAM

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In the build–up region of a fast neutron beam there is a continuous change in the spectral character of secondary charged particles set in motion by incident neutrons. These conditions determine the relative biological effectiveness (RBE) of the beam at different depths and consequently the skin sparing characteristics of the beam.

In this work the RBE at different build–up positions was quantified using cells in culture (V–79 fibroblasts and CHO–K1 cells). Survival curves were constructed for irradiations at the surface and with 1.0 mm, 2.5 mm and 17 mm (D_{max}) of build–up. The fractional biological effective doses (physical dose × RBE) were found to be 68, 83 and 93% of that at D_{max}. The corresponding fractional physical doses were 40, 67 and 80%.

The reparable component of radiation damage was assessed by exposing the cells to a priming neutron dose followed by a series of photon top–up doses. The induction of reparable damage, as expressed by synergistic interaction between the different radiation modalities, is most pronounced at the surface. The response to mixed–field exposures at different depths can adequately be predicted using the lesion additivity model.

ZA9200174

PAPER I2

IN VITRO COLORIMETRIC ASSAY OF CELL SURVIVAL PREDICTIVE OF HUMAN TUMOUR RESPONSE TO RADIATION

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Following a visit to the M.D. Anderson Hospital in Houston, we have established the Adhesive Tumour Cell Culture System (ATCCS) in our laboratory. Tumour biopsies are mechanically and enzymatically treated to yield single cell suspensions. The cells are plated out, as an inoculum titration for each column of wells, into Cell-Adhesive-Coated (CAM) multiwell plates in attachment medium containing methyl cellulose. When the cells have attached, individual columns of wells are irradiated with doses from 0 to 5 Gy. A ^{3}H-thymidine "suicide" culture in one column provides a background of non-proliferating cells. The cells are incubated in hormone- and growth factor-supplemented medium for a period dependent on individual cell culture growth rates. The cells are fixed and stained (crystal violet), destained with SDS and the absorbances measured spectrophotometrically. After subtraction of the background, graphs of absorbance versus cell inoculum are generated for each radiation dose, using a linear curve fit with zero intercept. Surviving fractions are calculated as a fraction of the control (0 Gy), and survival curves fitted according to the linear quadratic equation.
To date, we have generated survival curves for 6 out of 9 biopsies received, the failures being due to bacterial contamination of the specimens. The SF_{2Gy} values calculated from the fitted curves range from 0.16 to 0.70, reflecting a wide range in radiosensitivity between the biopsies.

ZA9200175

PAPER I3

MODULATION OF THE RADIOSENSITIVITY OF CULTURED CELLS

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From the survival at 2 Gy the radiosensitivity of cells against photons and neutrons was found to be V79 < B16 < Hela < fib/T with V79 cells emerging as radioresistant and mouse fib/T cells as radiosensitive. n-Sodium butyrate (NSB) alters the radiosensitivity. The effect of NSB was found to be restricted to the low dose region (< 4 Gy) and was most pronounced against photons. NSB rendered the radioresistant V79 cells but also Hela cells more radiosensitive whereas the radiosensitive fib/T cells and B16 cells showed no further enhancement of their radiosensitivity. Dq - measurements indicated that sublethal damage repair (SLDR) was decreased in V79 and in Hela cells. In B16 cells SLDR was unaffected and in fib/T cells it was slightly elevated after exposure to NSB. All effects were less pronounced when measured against p(66)+Be(40) neutrons. The differential effect of NSB on radiosensitive and radioresistant cell lines may reflect differences in the accessibility of the target to which NSB emerges as an important modulator.

PAPER J1

EVALUATION OF POSSIBLE P-32 INTERNAL CONTAMINATION USING A NAI DETECTOR AND A WHOLE-BODY COUNTER

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An incident occurred in October 1989 involving the violent release of approximately 120 MBq (3 mCi) of P-32 in the form of magnesium phosphate in a biochemistry laboratory at the University of Cape Town. The person handling the radioactive solution was badly contaminated on her face, hair and hands, and 2 other persons were residually contaminated in the subsequent clean-up procedure.

Dry smear samples from the wall and ceiling of the laboratory (the floor was successfully decontaminated) showed up to 5 kBq P-32 per sample. Measurements of the samples were performed easily using the beta-induced bremsstrählung on a 50 mm NaI detector. As a follow-up, the three most seriously contaminated individuals were counted on a whole-body counter at Koeberg N.P.S., 8 days after the incident. Measurements showed the maximum internal contamination was less than 28 kBq at the time of counting.

PAPER J2

RADIOLOGICAL DOSE ASSESSMENT IN THE MINING INDUSTRY

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Due to the ubiquitous occurrence of natural radioisotopes with various ore bodies, the mining cycle may result in radiological hazards to the worker and the public in general. This fact has led to the need to license mines according to the Nuclear Energy Act as implemented by the Council for Nuclear Safety.

A study of licensing requirements and case studies of representative gold, uranium and other mines show that, inter alia, the following aspects require attention during the licensing procedure: monitoring of gamma radiation, surface contamination surveys, assessment of radon gas and radioactive dust concentrations, environmental impact pathways (aquatic and atmospheric). These lead to a radiological dose assessment that quantifies the potential dose to the worker and public.

Findings indicate the most likely radiological hazards to be radon exposures to underground workers and gamma and dust exposures to surface workers inside the uranium concentration plants.

ZA9200182

PAPER J3

DEVELOPMENT OF AN ACTIVE INTEGRATING TECHNIQUE FOR MEASURING RADON DAUGHTER ACTIVITY IN UNDERGROUND MINES

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In early 1990 the Aerosols and Air Quality Group of the AEC was approached by COMRO (Chamber of Mines Research Organization) to assist in the development of a radon daughter measuring technique that could be incorporated into the gravimetric respirable dust samplers used in South Africa.

After consideration it was decided to use the track etching technique that has already been used for radon gas measurements in over 2000 South African houses to date. The technique had to be modified for energy discrimination so that only the activity from RaC′ collected on the sampler filter is detected.

To attain energy discrimination it was first attempted to modify the chemical etch parameters, but with poor results. Using absorbers of different thicknesses gave the best results. The next step was to reduce the high number of tracks registered per square centimetre at 1 WL (F–value of ± 0.5). This was successfully done by reducing the duration of the electro chemical etching step. An experimental etch cell is being developed.

Thus far the results look very promising.

ZA9200183

PAPER K1

THE CHEMISTRY AND APPLICATION OF ^{99m}Tc-(V)DMSA FOR THE DIAGNOSIS OF TUMOURS

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^{99m}Tc(V) dimercaptosuccinic acid (DMSA) has been succesfully used in imaging head and neck tumours, medullary thyroid carcinomas and soft tissue tumours.
Consistent correlation between scans and clinical results indicates a wide potential use.
A pilot study is under way to use a locally developed product in treating esophageal carcinoma, which is one of the commonest cancers in South Africa.
Initial studies were performed by adding 0,2 cm^3 of sterile 3,5% sodium bicarbonate solution to a commercial DMSA kidney ^{99m}Tc labelling kit. Labelling was performed by adding 2-3 cm^3 sodium pertechnetate (^{99m}Tc) with the desired activity, followed by incubation for 30 min at room temperature. Upon IV administration of 400-750 MBq ^{99m}Tc(V)DMSA scintigrams were taken after 60-120 minutes.
At present a new DMSA(V) formulation is being developed from commercially available reagents for direct one-step ^{99m}Tc-labelling.
Thin-layer chromatography and biodistribution studies on mice showed the local formulation to be safe and ready for clinical evaluation.

ZA9200184

PAPER K2

A REVIEW OF SHORT-LIVED RADIONUCLIDE GENERATORS

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The development of generator-produced radionuclides have played a major role during the last two decades in expanding the range and scope of the applications of radionuclides in medicine, research and industry. Some of the reactor and cyclotron produced radionuclides which may also be used for the preparation of, and the production of short-lived radionuclide generators for bio-medical applications are briefly discussed. The aim is to provide information on generators which may be suitable in the light of their physical characteristics and medical usefulness e.g. ^{191}Os - ^{191m}Ir and ^{195m}Hg - ^{195m}Au generators. A brief review of the common production routes involving high-current targetry and chemical procedures will be given.

ZA9200185

PAPER K3

^{99m}Tc-LABELLING OF POLYCLONAL HUMAN IMMUNOGLOBULIN FOR SCINTIGRAPHIC LOCALISATION OF INFLAMMATORY SITES

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Radiolabelled IgG scintigraphy has been recognised as a reliable modality for localisation of pyogenic infections. ^{99m}Tc-labelled non-specific polyclonal human IgG accumulates sufficiently in inflammatory lesions (as the result of a non specific process, for which an intact Fc portion of IgG is necessary),to yield external images. IgG (Sandoglobulin, Sandoz Inc) was subjected to mild thiol reduction (for preservation of the intactness of the Fc moiety) to form free sulfhydryl groups which can selectively bind Tc ions. The reduced IgG was subsequently incorporated into a lyophilized kit containing i.a. 1,omg IgG, 20ug $SnCl_2.2H_2O$ and 0,5 mg ascorbic acid. After incubation with up to 37 x 10^2MBq TcO_4^- (30min, room temp) labelling efficiencies > 95% (ITLC 0,9% NaCl and acetone) and > 93% (Sephadex G-50 column chromatography) were achieved. Stability of the labelled product was evaluated by incubation with 37 x 10^2MBq TcO_4^- (24h, room temp) after which > 95% of the radioactivity was retained, while transchelation studies with 3mM EDTA (30min, room temp) yielded radiochemical purities of > 95% (paper chromatography and Sephadex G-50 column chromatography). The results obtained indicate that a useful IgG labelling kit can be produced locally.

ZA9200186

PAPER L1

USES OF IN VIVO ^{1}H NMR EVALUATION OF T1 AND T2 TIME RELAXATION IN RODENT CaNT TUMOURS

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T1 (spin lattice) and T2 (spin spin) relaxation times were determined at 0.5 Tesla for CaNT tumours in CBA mice using an Elscint Gyrex 5000 MRI. Tumours of different sizes were studied and also the effects of irradiations of 3.8 Gy in the NAC neutron therapy beam (p(66MeV)/Be). Irradiated tumours were of volume 550-850 mm^3. The T1 and T2 values, determined from regions of interest which excluded normal tissue, can reflect degrees of heterogeneity of tumour tissue and molecular levels of organisation. Male CBA mice aged 6-10 weeks with sternal tumours were used.

A decreasing trend of both T1 and T2 values with tumour size was seen. T1 and T2 decreased significantly in irradiated tumours.

Hypoxia, a typical solid tumour feature, is rare in normal tissues and arises from solid tumour blood vessels being more disorganised than those of normal tissue. Depletion of O_2 and other nutrients therefore occurs and in larger tumours circulation may cease in whole sections. Cells furthest from capillaries are hypoxic and anoxic. Hence averaged T1 and T2 can reflect the fraction of hypoxic and anoxic tissue. These values are also influenced by the tumour growth rate and ratio of free to bound water in the tissue.

So this non invasive study may allow greater understanding of the degree of tumour hypoxia and hence radioresistance, with practical consequences for more effective radiotherapy.

ZA9200187

PAPER L2

RESPONSE OF NORMAL RODENT TISSUE TO NEUTRON RADIATION: PROTECTION BY EXOGENOUS ATP

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It is well-known that the success or failure of tumour radiotherapy is dependent on the balance between two factors. Firstly, the possibility of tumour recurrence following the use of inadequate doses of radiation, secondly the damage to normal tissues, which might occur with tumour curative doses of radiation.

The enzymatic activities of acid phosphatase and hexokinase in the testes following whole body irradiation and survival after lethal doses in irradiated BALBc mice were investigated. Irradiations were carried out using the NAC's p(66MeV)/Be neutron therapy beam with doses of 6 and 7 Gy. Adenosine-5'-triphosphate (ATP) was administered by intraperitoneal injection before irradiation (Group 1, n = 48). Other mice received only neutron irradiation without ATP (Group 2, n = 39).

The results show that the mice's survival fractions following neutron irradiation were more than twofold those of Group 1 compared to Group 2. The activity of acid phosphatase showed an overall increase (up to 40%), at all times after irradiation. But there was a lesser augmentation in Group 1 than in Group 2. The activity of hexokinase after irradiation shows a pronounced decrease. But after administration of ATP prior to the neutron irradiation a smaller decrease is clearly seen. The glucoregulatory effect of exogenous ATP may stimulate glycogenolysis as reflected in the relative enhancement of hexokinase activity in Group 1. These results suggest a radioprotective effect of exogenous ATP in physiological regulatory processes to maintain homeostasis after disruptive effects of neutron beam irradiation.

PAPER L3

THE BIOLOGICAL EFFECTS OF MICROWAVES

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This is a review of the current state of research on the biological effects of microwaves. Studies in this field have been concerned mainly with the biological responses elicited by thermal interactions. Significant localized energy absorption "hot spots" can occur in the range 400 MHz to 3 GHz when power densities exceed 10 mW/cm^2. Energy absorption decreases as the frequency increases. However, it is important to note that, due to the excellent thermoregulatory response we as humans possess, cutaneous perception of the microwave energy (e.g. warmth) is not a reliable indicator of harmful levels of microwave radiation.

The lens of the eye is particularly sensitive to microwaves because it lacks a blood supply and as a result has a very limited capacity for heat dissipation. Notwithstanding this, no study involving chronic whole body exposures has produced any lens opacities at low power densities. A host of other physiological effects has also been shown to be closely associated with an increase in temperature - either localized or whole body. However, cancer studies have on the whole been rather inconclusive.

Athermal - Direct stimulation of muscle and nerve.
Dominant only below 100 kHz.
Thermal - Heat dissipation

PAPER M1

BENCHMARK OF THE 1-D SHIELDING MODULES OF SCALE-3 BY MEANS OF A MODEL OF THE KOEBERG REACTOR

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The 1-D shielding modules of the SCALE-3 system of codes were benchmarked by means of a model of the Koeberg reactor. The codes benchmarked comprise the cross section manipulation code NITAWL-S, the 1-D discrete ordinates transport code XSDRNPM-S and the 27n - 18g groups SCALE-3 shielding library, 218n groups SCALE-3 criticality safety library and the general purpose shielding library BUGLE-80. The model used for the study is a cylindrical representation of the reactor and its surrounding structures up to and including the biological concrete shield.

This study ascertains that, although SCALE-3 was designed as a tool for the analysis of spent fuel casks, its 1-D shielding modules are also applicable to general purpose (i.e. not necessarily cask related) shielding problems. The level of accuracy obtained using the SCALE-3 modules was shown to be comparable to that obtained using alternative technologies such as the code ANISN. The effect of using different cross section libraries on the calculated spectra and dose rates is also demonstrated by the results obtained.

ZA9200189

PAPER M2

A COMPARISON BETWEEN PERSONAL NEUTRON DOSES AS MEASURED WITH NTA AND CR39 UNDER OPERATIONAL CONDITIONS

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The SABS is at present looking into alternative personal neutron dosimetry systems. To assist in this a comparative study of normal NTA and CR39 operational results has been conducted in collaboration with the AEC.

The main problems encountered with the CR39 technique were:

(i) High and inconsistent background on CR39 films
(ii) Electrical instabilities in equipment due to the high tension and high frequency used during etching.

These were partially resolved through literature studies and experimentation.

The CR39 registered systematically higher doses than the NTA films which could be explained in terms of background uncertainties and the use of different calibration factors.

It is concluded that CR39 is a suitable and improved alternative to NTA film but that the following problems still need attention:

(i) The applicable energy range should be extended from the present 200 keV - 15 MeV range
(ii) The quality of the CR39 regarding consistency in background and sensitivity should be improved.

ZA9200190

PAPER M3

AN AUTOMATIC RADON/NEUTRON MEASURING SYSTEM BASED UPON TRACK ETCH DETECTORS

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A fully automated system for the measurement of radon and neutron doses is described. The requirements for the operation of a total system are presented together with the solutions provided by the system. High throughput, ease of operation and integrity of dose measurement are addressed.

The dosemeters used for the measurement of radon and neutron doses will be described in the results obtained when performing international intercomparisons and/or standard laboratory exposures will be discussed.

PAPER M4

A FULLY INTEGRATED SYSTEM FOR PERSONAL MONITORING USING TLD

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The ability of a system to operate a Personal Monitoring programme efficiently requires that all functions within the system are addressed with equal emphasis. A TL service is not just a TL reader, but involves many other parameters. Viz.

Issue
Return
Anneal
Calibration
Quality assurance
Processing
The Dosemeter

Presented is a description of a total system which addresses each function and provides a solution which is flexible and totally integrated, i.e. based upon a computer network.

The dosemeter is also described and its perforamance relative to international requirements.

The extension of the system to enable neutron and extremity doses to be integrated into the system is explained. The various configurations which are possible will also be discussed.

ZA9200141

POSTER ABSTRACTS / PLAKKAATOPSOMMINGS

POSTER A1

RADIATION SHIELD OPTIMISATION

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This work describes recent progress in the design of optimal radiation shields.

The kinematics and dynamics of the interactions of neutrons and photons are analysed from the perspective of a shield designer. The characteristic shielding capabilities of steel and polyethylene are analysed, with the emphasis on the role of inelastic scattering in the slowing down of neutrons. It is shown that no single shielding material presents optimal attenuation properties throughout the energy range of neutrons and photons encountered in practical shield design problems. As a result, the concept of complementary shielding materials is defined. Sensitivity analysis is used to provide a quantitative criterion for the selection of complementary shielding materials. Next, the optimal spatial arrangement of complementary shielding materials is considered. From an analysis of the Boltzmann transport equation and a generalised form of shield optimisation problems, it is shown that an optim ' radiation shield is characterised by optimal nuclide number-density distribution functions, which may be obtained by rigorous radiation transport calculations, coupled to techniques of sensitivity analysis.

The above principles and calculational methods are used in the design of three radiation shields for a fission reactor, respectively optimised with regard to weight, ;t and thickness.

*The research described here had been conducted while the author was employed by Eskom, P O Box 1091, Johannesburg.

ZA9200142

POSTER A2

BRIEF REPORT OF COBALT-60 RADIATION INCIDENT

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Following a failure of the Cobalt-60 source to return to the safe position after patient treatment, due to a faulty detent pin, a radiographer, not noticing the warning lights which indicated the failure, entered the treatment room and was exposed to radiation. When the source was noticed to be in the out position both patient and radiographer left the room immediately. Her radiation dose monitor showed a reading of 29.60 mSv. Chromosome studies were done which showed no significant whole body dose (Insensitive below 19mGy).

ZA9200143

POSTER A3

THE RADIATION MONITORING OF STAFF USING A WHOLE BODY BURDEN CHAIR

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A Whole body burden chair system is being used at Groote Schuur Hospital since 1989 to monitor the radiation levels of staff working with radioisotopes. The system is specially designed to detect I-125 in the thyroid. 1500 staff members (at UCT Medical School and Groote Schuur Hospital) are counted every 3 months. Radiation levels are recorded in the thyroid and whole body by means of the thyroid and body detectors. Profiles are analysed by using an Abacos software package. A VAX computer is used to run the software.
Since the installation of this health related program, radiation levels especially in the departments of Nuclear Medicine and the Radiotherapy Mould Room have decreased. Radiation levels decreased to approximately one half of those previously measured. Overall people are more aware of the hazards of working with radioisotopes A definite decrease in the I-125 levels could also be detected.

ZA9200144

POSTER A4

CONTINUOUS LOW DOSE-RATE IRRADIATION OF THE RAT BRAIN

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Once diagnosed, patients conventionally treated for malignant brain glioma have approximately 10 months (40 weeks) to live. Treatment lasts for 6 weeks. This implies that one sixth of their expected life-span is spent in hospital.

The idea that initiated this research project was that if radiation could be given to these patients overnight with one or two eight-to-twelve hour treatment periods, instead of over six weeks we would achieve a better quality of life for these patients.

However, before this therapy can be applied to humans, an estimate must be made of the limits of tolerance of the brain to continuous low dose-rate irradiation. Equivalence for fractionated and continuous low dose-rate irradiation has been determined for skin. No such equivalent relationship has been determined for brain, nor is there any reason to assume that it will approximate the skin

ZA9200145

POSTER A5

THE EFFECT OF CISPLATINUM AND RADIATION ALONE OR IN COMBINATION ON SURFACTANT IN BALB/C MICE

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Cisplatinum is a cytotoxic drug currently used in the clinic. It has been shown to act as a radiation sensitiser in some systems. The lung is one of the most important dose limiting organs in radiation therapy involving the thoracic region. The above study thus aims to determine and quantify any interaction occurring between cisplatinum and radiation in the lung.

The relative amount of surfactant in bronchoalveolar lavage fluid from female Balb/C mice was determined using HPLC techniques and a colorimetric assay of total phospholipid.

Measuring at 28 days we have shown an increase of 2.5 times that of controls at doses of 9 to 13 Gy rising to 5 times that of controls at 16 Gy in surfactant after radiation alone. Cisplatinum ($8mgkg^{-1}$) alone provoked an earlier release of surfactant with a maximum occurring 1 to 2 days after treatment.

Cisplatinum ($8mgkg^{-1}$) given immediately before radiation (13 Gy) caused an early release of surfactant greater than either single agent. This may contribute to a more severe late reaction and work is in progress to confirm this.

ZA9200146

POSTER A6

RADIATION AND ENERGY METABOLISM

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It has been proposed that adenosine triphosphate (ATP), the major energy carrier of the cell, is necessary for the repair of radiation induced damage. It is important to discover how the energy status of cells after irradiation may be modified.

Substances such as 2-deoxy-D-glucose (2DG) which inhibits glycolysis and amino oxyacetic acid which inhibits glutaminolysis are thought to inhibit ATP production.

Radiation cell-survival in the presence of the above mentioned substances was determined. No major change in cell survival from controls was found.

Because dose levels of substances may be inadequate to modify cellular fuel usage, it was decided that a modification in radiation response should first be determined using culture medium with reduced amounts of cellular fuels. Preliminary results suggest that reduced glucose and glutamine modify radiation response in vitro.

POSTER A7

STUDIES ON THE FINE SPECIFICITY OF ANTIBODIES TO THE C-TERMINAL END OF HISTONE H1 IN IDIOPATHIC SYSTEMIC LUPUS ERYTHEMATOSIS

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Histone H1-DNA complexes were prepared using peptides from the N- and C-domain of H1 and the synthetic oligonucleotide 5'-$(AT)_6$-3'. Circular dichroism (CD) spectroscopy indicated that the free peptides H1(1-16), H1(204-218) and C-H1(121-210) in 1 mM phosphate buffer pH 7.4 assume a random structure but become helical when bound to the oligonucleotide. The structured and unstructured H1 fragments were then analyzed by enzyme linked immuno absorbent assay (ELISA) with anti-H1 antibodies in sera from patients with systemic lupus erythematosis (SLE) and with the monoclonal anti-H1 antibody MRA 12 derived from MLR/lpr lpr autoimmune mice. It was found that binding of these antibodies to H1(204-218) and C-H1 was inhibited to a level of 50% when the H1 peptides were complexed with equimolar amounts of 5'-$(AT)_6$-3'. When the same antibodies were reacted with H1 fragments from the N- and G-domain, i.e. H1(1-16) and complete NG-H1(1-120), complete G-H1(34-120) and complete GC-H1(34-210) attachment to oligonucleotide 5'-$(AT)_6$-3' did not influence antibody binding. Competition studies using various concentrations of liquid phase GC-H1 and C-H1 antigen against solid phase GC-H1 and C-H1 indicated that liquid phase GC-H1 was more efficient in displacing antibody binding reactivity than liquid phase C-H1. The displacement effect of both liquid phase antigens was greatest against solid phase C-H1. It is therefore concluded that auto-H1 antibodies are induced against an epitope located near the junction of the G- and C-domain which is exposed and not bound to DNA. This antibody cross-reacts with lower affinity to sequential determinants in C-H1. The results strongly suggest that the stimulating antigen is native chromatin rather than free H1.

ZA9200147

POSTER A8

OXYGEN UPTAKE IN CaNT TUMOURS OF DIFFERENT VOLUMES AND AFTER NEUTRON BEAM IRRADIATION

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The variation of oxygen uptake with tumour volume and after neutron irradiation was measured in CaNT tumours in CBA mice. The tumour was maintained by serial passage with inoculation of 0.1 ml of a tumour cell suspension in McCoy's 5A medium, containing approximately $2x10^6$ cells, subcutaneously into the sternum area of the mice.

The neutron beam irradiation used neutrons of the NAC cycloton radiotherapy beam, produced by the reaction p(66MeV)/Be, with a dose of 3.8 Gy. Oxygen uptake was measured at 37°C with a Gilson differential respirometer and was expressed as $\mu l\ O_2/g$ tumour tissue for 60 min.

The O_2 consumption per unit mass of tumour falls with increasing total tumour volumes. Endogenous cellular respiration was found to decrease about 20% after 3.8 Gy neutron irradiation.

As tumours increase in volume they derive greater amounts of energy from anaerobic glycolysis. They tend to outgrow their blood supply and higher proportions of cells become hypoxic. Rapidly growing tumours, almost without exception, have a drastic reduction (50% or more) in mitochondrial numbers with tumour growth. This results in lower respiratory activity and high levels of glycolytic transphosphorylating enzymes.

The reduced rate of cellular respiration following 3.8 Gy neutron irradiation may be correlated with the extent of cellular damage which leads to a gradual progression and amplification of metabolic imbalance in the tumour.

ZA9200148

POSTER A9

MODULATION OF RADIATION RESPONSE OF NORMAL AND TUMOUR CELLS BY PRE- OR POST-IRRADIATION EXPOSURE TO GAMMA LINOLENIC ACID

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Polyunsaturated fatty acids (PUFAs) can reduce genetic damage induced by gamma radiation, both in vitro and in vivo. Pigs fed a PUFA-rich diet before and after irradiation show significantly reduced erythema. Clinical trials are in progress to investigate this phenomenon. PUFAs have also been shown to exhibit a selective toxicity towards certain types of tumour cell lines.
We have investigated the effect of gamma linolenic acid (GLA), added 30 min after photon irradiation of fibroblasts (V79) in vitro, on the shape of the survival curve. Calculation of the alpha- and beta-effects at 2 Gy show that the beta ("repair") component contributes little (5%) to cell kill, for both gamma radiation alone, and for radiation followed by GLA exposure. However, the alpha ("intrinsic radiosensitivity") component contributes 20% to V79 cell kill by gamma radiation, and this is increased to 45% when radiation insult is followed by GLA exposure. The effects observed could be due to incorporation of GLA into the nuclear envelope, with resultant disorganization of matrix-associated-regions (MARs), which are sites of DNA replication. This topological disruption may make the "targets" of radiation more vulnerable. Further studies are in progress to examine the effects of GLA in other normal and tumour cell lines, prior-to or following photon or neutron irradiation.

ZA9200149

POSTER A10

THE USE OF THE CARDIAC GLYCOSIDE, OUABAIN AS A RADIOSENSITIZER

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The ability of cells to repair and re-establish normal functions, including those of DNA, after therapy, is a complex process dependent on the effectiveness of the cell's defence systems during therapy. Chemical modifiers that preferentially improve the cell kill of tumour cells compared to normal cells during therapy, would have potential clinical use. One such potential agent is the cardiac glycoside Ouabain. Ouabain is a specific and rapid inhibitor of the Na/K-pump and since the activity of the pump is known to be elevated in tumour and transformed cells compared to normal cells, it seems possible that an agent that influences the working of this pump could also affect the radiosensitivity of tumour cells. So, if we could exploit the differences in physiology of the Na/K-pumps of normal cells and tumour cells, Ouabain could prove to be an important agent in radiation therapy.
In the present study we studied the influence of Ouabain on 3 animal cell lines and one human tumour cell line. We have shown that, independent of the concentration used, growth of V79 and B16 remained unaffected by addition of Ouabain to the medium. On the other hand, Ouabain showed a drastic effect on the growth and plating efficiency of the human carcinoma, Hela. Results of the differential effect of Ouabain on the different cell lines in combination with cell kill due to radiation has been analysed and will be discussed.

POSTER A11

A COMPUTER MODEL OF HUMAN VENTILATION AND OXYGEN DISTRIBUTION

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This model uses both compartment and non compartment techniques to simulate the flow of oxygen through the human organism. It can simulate two different situations:

1) natural breathing
2) artificial respiration

INPUT

The model needs many physiological parameters and some of them may change in time like body consumption of oxygen or concentration of O_2 and CO_2 in the inhaled air.

OUTPUT

The output consist of variations with time of partial pressures (or concentrations) of O_2 and CO_2 in blood and in lungs.

Heart output (vol./minute), and in the case of natural breathing, minute volume of breathing are also calculated.

RESULTS

Tests showed that it is possible to simulate most normal and many pathological conditions.

ZA9200150

POSTER B1

QUANTITATIVE X-RAY ANALYSIS - MOBILE UNITS

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Quality assurance tests were done on mobile X-ray units to keep an accurate record of quantitative image performance. RMI test equipment was used during measurements. The measurements done include kV, mAs, focal spot size, collimator beam alignment and radiation dose levels. By using a step wedge, it was found that below 50 kV, the RMI kV meter is unreliable. Low kV values are used in mammography, neonate cases and hand and feet radiographs. Most results were within specification. By performing regular tests, we can ensure radiographs of a high quality low radiation doses and minimum maintenance costs.

ZA9200151

POSTER B2

A SIMPLE PROGRAM TO COMPARE MODULATION TRANSFER FUNCTIONS OF A SCINTILLATION CAMERA

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To provide a reliable and repeatable means of checking the resolution of a scintillation camera, a simple program to compute and compare the modulation transfer functions of scintillation cameras was developed. The program is user friendly and runs under MS–DOS on an IBM compatible. For demonstration purposes data was acquired from a General Electric GE 400 camera with three different collimators namely: low energy high resolution, low energy general purpose and low energy high sensitivity.

ZA9200152

POSTER B3

EVALUATION OF THE SOUTH AFRICAN PRODUCED MACROAGGREGATED HUMAN SERUM ALBUMIN (MAA)

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Lung scanning using ^{131}I–labelled macroaggregated human serum albumin (I–131–MAA) was introduced during the 1960's. Due to the high patient radiation dose and its relatively high gamma ray energy, a search for a more suitable radiopharmaceutical led to the successful development of Tc–99m–MAA.

The AEC (Atomic Energy Corporation) has recently developed a local macroaggregated human serum albumin radiopharmaceutical.

The necessary preliminary tests like pH, toxicity, etc., have been performed on rats, mice and rabbits by the AEC.

The aim of this study is to evaluate the biokinetics and biodistribution patterns of the locally produced MAA kit in baboons in comparison with a known Belgium MAA agent.

Two female baboons were used for the purpose of this study. A dynamic study of 1 hour was performed, whereafter static images were recorded at 2 hours and 4 hours post injection.

Both the biokinetics and biodistribution of the AEC MAA agent compare well with those of the Belgium MAA agent.

ZA9200153

POSTER B4

METHODS FOR THREE-DIMENSIONAL DISPLAY OF SPECT DATA

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The threshold and transparent methods as well as the three-dimensional bulls-eye are examples of the three-dimensional representation of reconstructed SPECT images. The principles underlying these methods will be briefly described. Examples of studies in nuclear medicine for which the different methods were found to be suitable, will be shown.

We found that the threshold method with 50% threshold was suitable for myocardial imaging with MIBI while the transparent method was more suitable for pyrophosphate imaging of myocardial infarcts.

ZA9200154

POSTER B5

AVOIDING BLADDER INTERFERENCE IN PELVIC SPECT

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Filling of the bladder during acquisition of SPECT images of the pelvis can create artifacts in the reconstructed images which may invalidate the study. By adapting the Thallium background subtraction method of Goris, bladder activity may be replaced in the raw projection images by interpolated background. Subsequent reconstruction of the study yields artifact-free tomographic images. The sinogram of a slice through the bladder may be used to automate drawing of the required regions-of-interest around the bladder on each raw projection image.

Algorithms for executing this procedure using Elscint's CLIP programming only, as well as CLIP combined with FORTRAN were developed and will be described. Programs based on these algorithms have been used routinely in our department for 18 months, enabling interpretation of many studies which would otherwise have to be discarded. Examples will be shown.

ZA9200155

POSTER B6

A NEW SCATTER CORRECTION TECHNIQUE FOR RADIONUCLIDE IMAGE QUANTITATION

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Absolute quantitation of radionuclide distribution in man with the scintillation camera, is hampered by attenuation and scatter of photons. Proper scatter correction can simplify attenuation to narrow beam geometry. In this paper a new scatter correction technique is introduced. In the absence of scatter the photopeak can be considered as a gaussian distribution and is divided in two identical energy windows A and B. With scattering material present, the scatter contribution C and D is added to the non-scattered counts. If E=A+C, F=B+D, G=A/B and H=C/D, the total unscattered photopeak counts can be obtained as A+B={(G+1)(E-HF)}/(G-H). Ideally, G equals 1 and H equals 3. The validity of the equation for A+B was established by determining G and H empirically and using these values to determine the linear attenuation coefficient for an attenuated source.

[Methods] The intrinsic value of G was determined on a pixel-by-pixel basis for Tc-99m and also with a low energy collimator mounted. Sources filled with 10MBq Tc-99m were imaged in varying depths of water and H calculated from the resulting attenuation curve. The effect of the scatter correction method on resolution was furthermore determined by imaging line sources in varying depths of water and calculating the full width at half and tenth maximum (FWHM, FWTM).

[Results] The mean intrinsic G value was 1.07 (±0.12) and varied between 0.76 and 1.51 over the total image. The optimum fit to the attenuation curves was found with H=3.08. This resulted in an average linear attenuation coefficient of 0.155 cm^{-1}. The scatter correction technique resulted in a 52% improvement of FWTM at a depth of 100 mm water.

[Discussion] A simple, accurate method to correct for scatter is described. This method can be applied to improve quantitation of radionuclide distribution on planar and SPECT images.

ZA9200156

PLAKKAAT B7

DIE GEBRUIK VAN 'N PERSOONLIKE REKENAAR VIR DIE VERWERKING EN VERTOON VAN KERNGENEES-KUNDIGE BEELDE

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Die beskikbaarheid van hoë spoed persoonlike rekenaars met gevorderde kleurskerms maak die vertoon en verwerking van kerngeneeskundige beelde moontlik. Hoewel kommersiële stelsels beskikbaar is, is dit egter oor die algemeen duur.

DOEL: Die doel van die projek was om 'n goedkoop beeldvertoonstelsel te skep wat in beide navorsing en opleiding gebruik kan word.

METODE: Kerngeneeskundige beelde is met behulp van 'n GE gammakamera versamel en d.m.v. die RS-232 poort na 'n persoonlike rekenaar, toegerus met 'n 386 prosesseerder, oorgedra. Hierdie beelde kan d.m.v. 'n BASIC program volgens verskillende kleurtabelle vertoon word. Beeldvergladding kan uitgevoer word deur van 'n plaaslik ontwikkelde PASCAL program gebruik te maak. Enige filter kan in die program ingevoer word.

RESULTATE: Data oordrag vind plaas teen 8kb per minuut, terwyl dit 25,5 sek. neem om 'n 2 dimensionele Fourier transform uit te voer. Honderd en tagtig kleurskale is vir beeldvertoon beskikbaar en beeldkwaliteit is van diagnostiese gehalte. 'n Beeld word binne 1 sekonde op die skerm vertoon.

Hoewel die beeldkwaliteit goed genoeg vir diagnostiese en argiveringsdoeleindes is, is die data-oordragtempo nog te stadig vir roetine gebruik. Die stelsel kan egter reeds as opleidingshulpmiddel gebruik word.

ZA9200157

POSTER B8

A COMPARISON OF ABSOLUTE VOLUME DETERMINATION ON TWO SPECT IMAGING SYSTEMS USING A THRESHOLD EDGE DETECTION METHOD

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The introduction of single photon emission computerized tomography (SPECT) facilitated quantitation of organ volume with radionuclide techniques. In this study a comparison is made between volume threshold values using two SPECT imaging systems. A thorax phantom containing different volumes was used for acquisition. Data processing was performed by filtered backprojection and different correction methods were applied, including attenuation correction and scatter subtraction. Transaxial slices were generated and a threshold value for each individual volume determined using an edge detection algorithm. Furthermore, threshold values were determined on reconstructed images without any correction applied and this was also done incorporating the energy weighted acquisition (EWA) capability on the Siemens Orbiter camera. Similar trends were observed when the two imaging systems were compared. Threshold values on the GE Starcam varied between 40.8% and 26.5%, while a variation of between 45.3% and 42.5% were obtained comparing EWA data with those acquired without EWA. In this study it was shown that the actual volume has a definite effect on the threshold. Furthermore, the imaging system used plays an important role and threshold/volume size calibration is imperative for quantitation.

ZA9200158

POSTER B9

^{131}I-LABELLING OF SUNFLOWER SEED OIL FOR SCINTIGRAPHIC DETECTION OF LEAKAGE IN THE LYMPHATIC SYSTEM

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The glycerides in sunflower (Helianthus annuus) seed oil consist essentially of mixed triglycerides with fatty acid moieties such as oleic acid (21,3%) and linoleic acid (66,2%). These can be radiolabelled by addition of ^{131}I to their double bonds to form a stable product which can be used in an oral solution for the scintigraphic detection of leakage in the lymphatic system. A modified oxidative iodine monochloride method was used to radioiodinate sunflower oil. The reaction products (containing small quantities of the aqeous reaction phase), were purified by a single passage through a Sephadex G-25 dehydrating column to remove all water soluble contaminants (including free $^{131}I^-$). No inorganic radioiodides could be detected by means of thin layer chromatography on silica gel impregnated glass fibre sheets (I,ONHCl as mobile phase). Yields of up to 65% were obtained and the final products were adjusted to activities of 37MBq/3ml. Good clinical correlation was obtained with an abdominal lymphatic leak and a right thoracic leak.

ZA9200159

POSTER B10

IN VIVO ASSESSMENT OF REGIONAL MICROVASCULAR ALBUMIN LEAKAGE DURING *E COLI* SEPTIC SHOCK IN THE BABOON MODEL

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Changes in regional microvascular albumin flux during septic shock were studied noninvasively by scintigraphy in the baboon model. Use was made of an i.v. injection of ^{99m}Tc-labelled baboon serum albumin. Count ratios of lung to cardiac, liver to cardiac and abdominal to Cardiac regions were measured two-hourly for six hours in control and septic shock baboons, and compared. Increased ratios obtained during shock pointed to an increase in extravascular albumin. Linear regression lines fitted to these count ratios provided regional albumin leak indices. These indices (Table 1) demonstrated statistically significant increases ($P<0.05$) during septic shock for the abdominal region during the six-hour study, and for all regions, but especially the abdomen, when data were calculated over four hours. Increasing ratios and leak indices correlated with post mortem data and changes in neutrophil and platelet behaviour previously established during shock.

Table 1

Organ	Mean albumin leak index ± SD ($\times 10^{-3} \times min^{-1}$ (n=6)) Controls	*E.coli* shock
Lungs	-0.27±0.10 (-0.56±0.45)	0.56±0.89 (0.99±0.39)
Liver	-0.09±1.98 (0.46±0.42)	1.76±0.39 (2.30±0.60)
Abdomen	0.34±0.17 (0.42±0.38)	3.17±0.80 (3.70±0.23)

Values in parentheses obtained from analyses over 4 hours only.

ZA9200160

POSTER B11

AN EVALUATION OF ^{111}In LABELLED PLATELET UPTAKE IN THE LIVER AND SPLEEN BY MEANS OF PLANAR SCINTILLATION CAMERA IMAGING.

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In this study 3 methods were investigated to quantify the distribution of In-111 labelled blood platelets in the liver and the spleen. The methods investigated were (1) the conventional geometrical mean with attenuation correction (GM-AT) (2) the whole body geometrical mean (WB-GM) and (3) the depth independent built-up factor (DIBF). Quantification with the GM-AT method does not take scattered radiation into account. The accuracy of quantification with the WB-GM method is influenced by redistribution and whole body loss of radioactivity. The DIBF method overcomes the disadvantages of the GM-AT and WB-GM methods.

The purpose of this investigation was to determine if redistribution of activity and organ size influence the accuracy of the WB-GM and GM-AT methods in comparison to the DIBF method.

Blood platelet studies were performed with a 2 week interval in 9 patients with vascular disease. Image quantification using the three methods was performed in each patient daily for 6 days following reinjection of In-111 labelled blood platelets.

The liver and spleen uptake for the WB-GM method increased with time in relation to the DIBF method. The difference increased at 3,2 ± 0,4 % per day for the liver and 2,3 ± 0,2 % per day for the spleen. The difference in uptake between the GM-AT and DIBF methods was constant at 15 ± 1 % for the liver and 10 ± 1 % for the spleen.

The results indicated that redistribution or loss of radioactivity does influence the accuracy of the WB-GM method and that organ quantification obtained with the GM-AT method without scatter correction overestimated the values obtained from the DIBF method with scatter correction.

ZA9200161

POSTER C1

AN ASSESSMENT OF THE EFFECT OF THE ANGULAR RESPONSE OF DOSIMETERS USED IN ELECTRON THERAPY

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It is important to study the effect of the angular response of any dosimeter used when intending to implement an electron arc therapy protocol, or measure obliquity factors, for instance. One requires a combination of a replacement correction factor of unity (P_{repl} = 1.000) as well as an independent angular response. A study was made using common dosimetric devices which displayed one or both of these characteristics viz. a 0.3cc cylindrical chamber, a Markus parallel plate chamber and synthetic diamond TLD's

Preliminary results showed that there are notable differences in the measurements obtained depending on the apparatus used. This is believed to have some important repercussions even in fixed electron beam therapy dosimetry.

ZA9200162

POSTER C2

NEUTRON SPECTRAL MEASUREMENTS IN THE NAC p(66)/Be THERAPY BEAM

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Knowledge of the neutron therapy beam spectra is of interest as it provides important information on beam quality. In principle this information can also be used to determine neutron kerma values in tissue and in A150 plastic which are used in the calculation of dose. Spectral measurements have been made in the NAC's p(66)/Be neutron therapy beam using standard time-of-flight techniques. A pulse shape discriminator was used to identify the different particles produced by the primary beam interactions in the scintillator. The time spectra were converted to energy spectra using the well-known Stanton code. In order to obtain a qualitative assessment of the effects of field size, filtration and off-axis position on spectral shape both the average energy and the "softness factor" were calculated for each spectrum (the latter is defined as the ratio of integral counts below 16 MeV to integral counts above 16 MeV). Both these numbers show that the spectra harden with filtration and soften with increasing field size and off-axis distances. Particularly marked is the significant beam hardening with increasing thicknesses of hydrogeneous filtration (CH_2) which preferentially filters low-energy neutrons while hardening is also observed with metallic flattening and wedge filters. The beam becomes softer with increasing field size due to increased scatter and with off-axis distance. The tissue/A150 kerma ratio was found to be 0.98 for this beam.

ZA9200163

POSTER C3

GAMMA PRODUCTION MEASUREMENTS IN A p(66)/Be NEUTRON BEAM

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Narrow beam attenuation measurements were undertaken in the p(66)/Be neutron beam using a 2 cm diameter steel collimator, inserted into the main collimator of the isocentric neutron therapy unit. Attenuation curves for water and lead were measured in air with Geiger–Müller (GM) counters as well as with tissue equivalent (TE) ionization chambers. Using the modified lead attenuation method, proposed by Hough, it was possible to calculate the neutron sensitivities of the GM counters. Out of beam measurements revealed that the average gamma ray energy in the neutron beam is about 1.0 MeV which is in good agreement with recent data from Moyers et al. The indications are that the production of gammas can principally be attributed to neutron interactions with the iron in the collimator. The Fe–56 (n,γ) spectrum has major gamma peaks at 0.85 MeV and 1.25 MeV. The neutron and gamma dose components in the narrow beam were calculated using the twin detector method. The narrow beam gamma component in air at an SSD of 203 cm was found to be 1.8%.

ZA9200164

POSTER C4

A MICRODOSIMETRIC EVALUATION OF TISSUE SUBSTITUTES

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Accurate radiation dosimetry requires conditions that will ensure secondary charged particle equilibrium. In neutron dosimetry this is normally achieved by using build-up caps manufactured from Shonka A-150 plastic, usually referred to as tissue-equivalent (TE) plastic.

For the p(66)+Be neutron therapy beam at the NAC, full build-up is established with a thickness of 17 mm of TE plastic. Since A-150 plastic is expensive and not always readily available, other more commonly found hydrocarbons were assessed as possible alternatives.

Measurements were performed with a ½-inch Rossi type TE proportional counter and build-up caps fabricated from A-150 plastic, polyethylene and type 6 nylon. Single event spectra obtained with the different build-up materials were used to quantify anomalies in the evaluated absorbed dose and to demonstrate distinct quality differences.

ZA9200165

POSTER C5

SYNTHETIC DIAMONDS AS PULSE-COUNTING DETECTORS IN ELECTRON DOSIMETRY

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It has been demonstrated that diamonds which are custom synthesized for the task, exhibit very attractive pulse generating characteristics and performances in gamma-ray and alpha-particle detection. The same applies also to the detection of electrons and, particularly for electron beams in therapy, the small size of the detector (~ 10mm^3), besides the tissue-equivalence, makes them additionally attractive.

Several such specifically synthesized diamonds have been tested using electron sources and some have shown very suitable responses. The transport of electrons in the bulk diamond is addressed and a Monte Carlo simulation of the responses of diamond in a therapy electron beam will be illustrated.

ZA9200166

POSTER C6

WHOLE BODY DOSE ESTIMATES TO STAFF INVOLVED IN GYNAECOLOGICAL RADIUM INSERTIONS

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The doses as meassured by the SABS monitor badges worn by staff involved in Gynaecological Radium insertions during a 5 year period at two institutions doing on averge 95 insertions per annum, were analysed according to staff duties during insertions. The results were compared to finger ring exposures over a 3 year period and daily measurements performed on staff wearing Xetex dosimeters over a 15 month period.

All staff involved in this form of Radiotherapy received doses within the current maximum limits as specified by the SABS. Non compliance with regulations regarding the wearing of the dosimeter, the partially incomplete records of staff activities in theatre and the rendering of nil dose for readings below a minimum value present problems and probably underestimate the actual doses experienced by staff during Gynaecological Radium insertions.

ZA9200167

POSTER C7

THERMOLUMINESCENT DOSIMETRY DURING SCREENING OF RANDO PELVIS

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Radiological screening done during gastroenterological studies may be carried out unintentionally on pregnant female patients. An estimate of the doses received in the region of the uterus was obtained by the simulated exposure of a Rando Phantom pelvis in which thermoluminescent dosimeters (TLDs) were placed appropriately. These were calibrated at the energies used for the screening. Isodose curves were drawn from the data measured and an estimate of 0.68mGy/s to the pregnant uterus was obtained for gastroenterologic screening. This agrees with other similar published data.

ZA9200168

POSTER C8

3-D PLANNING OF A LARGE VOLUME WITH SHAPED FIELDS

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A patient on the RTOG 88-08 protocol had a broncial tumour behind the heart in the lower lung region. The mediastinal glands were also involved. The protocol prescribed 60 Gy in 30 fractions to the tumour, medias tinal and supra clavical glands. Trimmers or blocks were to be used and there were limitations on the dosage to the normal lung tissue and the spinal cord. Because of the tumours closiness to the spinal cord, extensive 3-D plannings on 5 different planes was used to get a good dose distribution. A shaped volume was treated with a) two AP opposing fields, b) a volume with 3 fields and c) a single field on the supra clavical glands. All was done with shaped blocks which were cast using radiographs taken on a simulator.

POSTER C9

EXCIMER LASER-INDUCED FLUORESCENCE IN BIOLOGICAL TISSUE

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Laser-induced fluorescence spectroscopy is a potentially powerful and minimally invasive technique for *in situ* diagnosis of arterial disease. In this paper, laser-induced fluorescent spectra of atheromatous plaque and normal artery tissue are presented.

A XeCl excimer laser (wavelength: 308 nm) is used to illuminate the tissue, exciting fluorescence in the tissue, which is then collected and spectrally analysed with a spectrometer. The results show that the fluorescent spectra of different tissue differs and demonstrates that fluorescence spectroscopy can be used to distinguish between them.

This study will be used for the detection of atheromatous plaque to achieve safer conditions for laser angioplasty. The next step of this study will be the verification of the results by using an optical fibre to deliver the excimer laser radiation and to collect the fluorescence through the same optical fibre.

POSTER C10

THREE DIMENSIONAL MOTION OF THE HUMAN HEAD AND STEREO-PHOTOGRAMMETRY

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A study of the movement of the head during transitions between sitting and standing may provide information concerning slight brain damage expressed through imperfect fine motor control. Using a PC based near real time photogrammetric system the path of a reference point in the head has been quantitated in terms of Cartesian co-ordinates. This novel method uses digital cameras, a vision mixer and a video recorder to record the head movements. The computer system, designed to analyse the movements, guides the inexpert user through the transferring of video images to the computer (equipped with image processing hardware), the digitising of images and processing the data to obtain spatial co-ordinates for the targets on the subject's head. The path of the subject's head can then be accurately mapped. This stereophotogrammetric system has been developed to replace the slower more traditional photogrammetric method. It permits near real time analysis and comparison with a normalised path obtained from measurements on normals. Results will be presented and they allow a quantitative assessment of relevant minimum brain damage.

POSTER C11

ACOUSTIC CAVITATION AND THE SAFETY OF DIAGNOSTIC ULTRASOUND

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When considering the health risks resulting from human exposure to ultrasound, an important criterion to consider is the physical and biological mechanisms that play a role in the interaction of ultrasound with matter. These mechanisms can mainly be classified in 3 groups namely, thermal mechanisms, stress mechanisms, and the mechanism of acoustic cavitation.

Cavitation can be described as the physical process that creates, enlarges and implodes gaseous cavities in liquids. The implosion of these cavities creates an environment for various reactions, i.e., the generation of intense heat, excited molecules, shock waves, and various chemical reactions. These reactions can cause harmful biological effects in tissue.

In this paper the process of cavitation formation, ways to detect cavitation in a medium, and the threshold levels where cavitation can cause harmful biological effects in living tissue will be discussed.

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