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Letter from the President

Welcome to Hamburg and the 6th International Congress of Medical Physics. I am sure that this Congress, like its predecessors, will be an outstanding success and I trust that our colleagues from DGMP will feel that a successful outcome is just reward for all the hard work and responsibility they have shouldered in organising this Congress.

The Federation's major contribution to the Congress is the half-day Symposium on The Role, Status and Responsibilities of the Clinical Radiation Physicist. The discussion papers for this Symposium are printed in this edition of European Medical Physics News. Please find time to read them carefully before you come to the Symposium on Friday, 10th September 1982. The Scientific, Professional and Education Committees of EFOMP have worked very hard in the last two years to collate the data and formulate the proposals which are incorporated in these papers. The Symposium therefore marks the culmination of this effort and provides the opportunity for the members of the Federation to express their views and wishes. It is the intention of the Council of the Federation to subsequently produce policy statements concerning the role, status, education and responsibilities of the clinical radiation physicist based on the discussion of these papers at the Symposium. If the Federation is to pursue its commitment to advancing the status of the clinical physicist it must follow an agreed policy. It is intended that the policy will be finalized by Council in the light of the discussion at the Symposium. It is important therefore that you attend and make your views known.

Elsewhere in this Bulletin you will see that the Officers of the Federation have been active on your behalf in a number of different directions. A worthwhile liaison has been established with IEC and contacts with many other organisations who have complementary interests in the field of medical physics are being explored and developed. I think we can say with some measure of confidence that EFOMP is rapidly becoming established as the voice of medical physics in Europe.

As we meet together in Hamburg let us make the most of the opportunity not only to exchange scientific information and ideas but to make new friends and to further develop the spirit of help, collaboration and understanding which have been the outstanding attributes of our Federation since its inception in May 1980.

John S. Clifton

Contents

Welcome to Denmark

On the 25th February 1982 a formal application for membership of EFOMP was received from the Danish Association for Medical Physics. The Officers of the Federation examined the Constitution of the Danish Association and the other papers enclosed with the application and decided unanimously that the Danish Association for Medical Physics should be accepted as a full member of the Federation. As the second Council Meeting in Brussels had given authority to the Officers to admit Denmark if a suitable application was received, the Officers decided that Denmark's membership of EFOMP should date from the 25th February 1982.

Our colleagues from Denmark have always shown an active interest in the Federation and as observers have made an important contribution to our discussion. We welcome them to full membership of the Federation.

Notes from Council

The Officers of Council met in Maidenhead (UK) on the 27th and 28th November 1981. They dealt with a number of matters arising from the Council Meeting held in Brussels in June and considered the need for continuity and to plan a phased change-over of the Officers of Council.

Scientific Committee

Professor Bekkering (Netherlands) was invited to succeed the late Professor Ellis as Chairman of the Committee but declined to take office as he planned to retire in the autumn of 1982. Dr. Poretti (Switzerland) was therefore approached and has accepted this office. He takes up his duties immediately. Dr. A.J. Piron (Belgium) was confirmed as Secretary of this Committee. He undertook to produce the discussion paper for Hamburg on The Scientific Role of the Clinical Radiation Physicist. Professor S. Lillicrap (UK) was appointed to fill the vacancy caused by the death of Professor Ellis.

Publications Committee

Professor Franconi (Italy) had been nominated by EFOMP and elected European Editor of CPPM and in consequence wished to resign as Chairman of this Committee. Dr. E. Claridge (UK) was elected to succeed him. Dr. Claridge is currently responsible for the production and printing of EMPN and will combine this role with that of Chairman of the Publications Committee. Dr. J. Chavaudra (France), nominated by EFOMP, has been elected to succeed Professor A. Kaul (FDR) as European Editor of PMB at the end of 1983. It was agreed that the European Editors of CPPM and PMB should be full members of the Publications Committee.

Professional Committee

Dr. Pele Asärd (Sweden) tabled a first draft of his report on Professional Status. The Officers made various comments and suggestions which will be included in the final version for discussion at Hamburg.

Education Committee

Professor Kaul (FDR) was unable to attend the Officers Meeting but had written to report that a draft of the report on Education and Training would be considered by a further meeting of the Education Committee early in 1982 and completed in time for Hamburg. The report would contain the results of an updated survey on existing education and training arrangements.

Progress report on liaison between EFOMP and other Scientific Organisations

European Physical Society (EPS)

Contact has been established and EPS would welcome support from EFOMP. EPS has seven divisions: astronomy and astrophysics, atomic physics, computational physics, high energy and particle physics, nuclear physics, plasma physics, and quantum electronics. Some of these areas overlap into medical physics but there is no separate division concerned with the application of physics in health care. The main activities of EPS are the organisation of conferences, scientific exchange schemes, and scientific publications. In the first instance collaboration with EPS would take the form of membership of various existing advisory committees and working parties. Any individual members of the Federation who already take an active part in EPS or would be interested to be nominated for membership of an advisory committee of EPS are requested to contact the President of EFOMP.

World Health Organisation (WHO)

Contact was established with the Secretariat of WHO in Geneva who recommended that EFOMP should liaise with the European division of WHO. This seems to be the correct level of contact since it is consistent with EFOMP's European role. This liaison has now been established and EFOMP is taking an active part in supporting WHO in the field of quality assurance. The Secretary General of EFOMP will represent the Federation at the WHO workshop on Quality Assurance to be held in Budapest on the 5th and 6th June 1982.

European Science Foundation (ESF)

This body, which works in association with the European Parliament in Strasbourg, is concerned with the development of science in the European community. It is particularly concerned to establish exchanges and training schemes that will enable all countries in the EEC to reach the scientific standards achieved by the foremost scientific countries of the community. The Foundation has been appraised of the aims and objectives of EFOMP which coincide with the goals of the Foundation and the reaction of the Council of the Foundation to suggestions for collaboration is awaited.

UNESCO

The Federation has sought non governmental affiliate status with UNESCO. Negotiations are proceeding but no definite decision has yet been reached.

International Atomic Energy Agency (IAEA)

The IAEA is particularly interested in education and training of medical physicists and Dr. R.A. Dudley of the IAEA Secretariat has been informed of the activities of EFOMP in this field. IAEA are particularly interested in having up to date information on centres in Europe that can provide training for medical physicists from developing countries.

Liaison established with the International Electrotechnical Commission

The IEC is the international body responsible for the promulgation of manufacturing and safety standards for electrical and electronic equipment. It has numerous committees and working parties which cover all aspects of the construction, installation and use of electrical apparatus. Because members of EFOMP are closely involved in the safety standards and quality assurance for electromedical and radiological equipment a close collaboration has been sought, in particular with IEC committees TC62 on Electrical Equipment in Medical Practice, and SC45B on Radiation Protection Instrumentation.

I am pleased to report that the Officers of the IEC have welcomed this liaison and offer of help from the Federation. The normal procedure of IEC is to deal only with national committees and the decision of the Officers of IEC to set up this collaboration with EFOMP is unique and stems from their belief that medical physicists play an important role in the assessment, selection and performance testing of electrical equipment in medical practice and of instrumentation in radiological protection. This liaison gives EFOMP and individual medical physicists within the Federation an opportunity to use their expertise to assist IEC in drafting regulations which are appropriate to our area of professional endeavour.

Member organisations of EFOMP have been asked to nominate a scientist who will be the point of contact for IEC matters and will receive draft documents and regulations on which IEC seeks an opinion. These individuals will be linked together in a network responding to Dr. A.J. Piron, the Secretary of the EFOMP Scientific Committee. Dr. Piron will be responsible for co-ordinating the response of the Federation to IEC. Each scientist will then make known the viewpoint of EFOMP through the channel of the IEC National Committee in the country in which he resides.

The IEC Central Office in Geneva has already written to the National Committees concerned to inform them of the desirability of associating EFOMP members closely with the work of preparation of IEC Standards.

A list of the names and addresses of the scientists who have been nominated to undertake this IEC liaison is given below. Please contact the scientist nominated by your national organisation on all matters relating to IEC and do your best to ensure that IEC and the membership of EFOMP both benefit from this collaboration.

J. Clifton

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HAMBURG SYMPOSIUM

The following papers contain material which forms a basis for the discussion at the forthcoming EFOMP Symposium. The Symposium will be held at the Congress Centre, Hamburg, on Friday 10th September 1982, as part of the World Congress on Medical Physics and Bioengineering.

The Role, Status and Responsibilities of the Clinical Radiation Physicist

Scientific Responsibilities

G.G. Poretti (Chairman), A. Piron (Secretary), D.H. Bekkering, A. Kaul.

Committee for Scientific Activities

1. Introduction

'Medical Physics' can be described as the scientific discipline which is concerned with the application of the concepts and methods of physics in medicine. In what is possibly the first modern book on medical physics, the physiologist A. Frick of the University of Zürich (Switzerland) wrote, as early as 1856: 'For some time a new scientific discipline has been developing, called physiological chemistry, which falls between Chemistry and Physiology. This book is a first attempt to drive a wedge, which we shall call medical physics, between physics and general medicine.' The following table gives an outline of some of the areas of medicine in which the medical physicist can be of great help:

1. IN-VIVO MEASUREMENTS

1.1 Functional Tests

1.1.1 Bioelectric potentials
- electro-cardiography
- electro-encephalography
- electro-myography
- vector-cardiography
- cardiotocography
- patient safety.

1.1.2 Nuclear Medicine
- production of short lived isotopes
- organ tests
- blood flow measurements
- whole body counting
- neutron activation analysis
- compartmental analysis
- radiation protection

1.1.3 Opthalmometry

1.1.4 Audiometry

1.1.5 Other Functional Tests
- blood densitometry
- phono-cardiography
- electo-thermometry

1.2 Topographic Techniques

1.2.1 Radiography
- conventional methods
- special angiographic methods
- X-ray cinematography
- computer assisted tomography
- patient dose reduction
- quality assurance
- radiological proteetion

1.2.2 Nuclear Medicine
- production of short lived isotopes
- conventional and special scintigraphic methods
- positron scintigraphy
- radiation dose to organs
- radiological protection

1.2.3 Ultrasound Imaging

1.2.4 Thermographic Imaging

1.2.5 Nuclear Magnetic Resonance Imaging

2. LABORATORY MEASUREMENTS

2.1 Special Methods
- chromatography
- electrophoresis
- microwave-spectroscopy (ESR and NMR)
- particle counting
- electron microscopy
- radiation sterilisation

2.2 Laboratory Automation and Data Processing

3. THERAPY

3.1 Radiation Therapy
- Cobalt and Caesium Units; Accelerators
- intracavitary and interstitial therapy
- radiation dosimetry
- treatment planning
- quality assurance; protocols
- radiation protection
- special techniques (hyperbaric oxygen, etc.)

3.2 Electrotherapy
- galvanic and Faraday generators
- conventional and microwave diathermy
- electrosurgery

3.3 Laser and Light Therapy

3.4 Special Therapies
- anaesthesia
- oxymetry
- pacemakers
- defibrillators
- ultrasound
- dialysis
- artificial organs

2. Activities and responsibilities of the Medical physicist

The table shows that the physical scientist who works in a hospital must be able to undertake a wide range of complementary responsibilities within a framework encompassing routine and service commitments, original research and development work orientated towards the needs of the patient.

In collaboration with the clinician the physicist can help in establishing physical and technical procedures to formulate a diagnosis or to conceive a treatment. He can also give assistance in the application and safe utilization of new physical techniques and perform physical measurements on patients. The analysis and interpretation, in terms of accuracy, statistical validity etc. of data obtained from the measurements can also be an important responsibility.

From a technical point of view the physicist can be of great help in the choice of new equipment, in establishing the physical and constructional requirements and in controlling their conformity with national or international recommendations. The choice of suitable instruments for the technical inspection of the new equipment and the design of the auxiliary devices necessary for optimal use of the equipment is similarly one of the tasks of the medical physicist.

The most important activity of the medical physicist in a hospital is perhaps scientific research on the physical aspects of some of the disciplines mentioned in the table. From the establishment of models for the simulation of biological processes, to the elaboration of new measurement techniques, to the prevention of deleterious effects of certain physical phenomena, the medical physicist can achieve much for the progress of preventive, diagnostic and therapeutic medicine.

One field of medicine to which the pure sciences and engineering have contributed a very great deal is radiology. Since radiological medical physics still provides substantial employment opportunities for physicists in medicine, the work of the physicist in this field will be looked at in rather more detail, albeit in a simplified form. Medical radiation physics is primarily concerned with the generation, detection and measurement of ionising radiation and the assessment of its direct and indirect effect on biological systems. The clinical radiation physicist applies this knowledge to achieve the safe use of ionising radiation in the following fields:—
- diagnostic radiology
- radiotherapy
- nuclear medicine

2.1 Diagnostic Radiology

The radiation physicist can assist in this field with calculations and measurements to determine and critically evaluate the physical properties of the types of radiation and their absorption in human organs. The determination of organ dose following diagnostic X-ray examinations is of particular importance. Together with doctors the radiation physicist seeks to optimise the use of the latest kinds of diagnostic equipment.

Complex radiographic equipment must be regularly checked to ensure that it continues to function to specification. The design and implementation of quality assurance procedures is also the responsibility of the radiation physicist. In conjunction with the manufacturers he can assist in the improvement of image quality and in the development of new equipment.

2.2 Radiotherapy

The radiation physicist can collaborate in the design and construction of the Teletherapy equipment and the linear and particle accelerators used in the treatment of tumours. Similarly, he can work in a reactor station or in centres where particle accelerators are in use for the generation and calibration of radioactive isotopes for medical purposes, both therapeutic and diagnostic. The main task, however, is the measurement of the dose of ionising radiation used for treating patients. On the basis of measurements and calculations and sometimes with the aid of a computer, he determines as precisely as possible the distribution of radiation intensities in the patient's body and provides doctors with suitable plans for treating tumour tissue whilst minimising damage to the surrounding healthy cells.

In larger hospitals the radiation physicist is responsible for the control and distribution of sealed radioactive sources (e.g. Caesium 137) used primarily in gynaecology for intracavitary treatment. Here, after establishing as precisely as possible the position of the sources applied by the doctor, he has the task of determining the radiation dose in their close vicinity (generally by means of computer calculations).

The physicist can apply his knowledge of mathematics and computer technology to the bio-physical problems which arise in connection with the testing of models of the effect of radiation on normal and tumour-like biological systems. Close cooperation with radiobiologists is particularly important. Further progress in radiotherapy will be made through better understanding of the effect of photons and particles on cancerous and healthy cells and on the sensitivity of organs to radiation.

Working with doctors the physicist can investigate the physical principles of new methods of irradiation or of techniques such as hyperthermia, which can sometimes increase the power of the radiation effect.

A further and considerable part of the physicist's work is devoted to protecting doctors and hospital personnel against excess radiation and to teaching the principles of the discipline both to them and to junior colleagues.

2.3 Nuclear Medicine

In a large nuclear medicine department the radiation physicist is generally responsible for the purchase, measurement and distribution of open radioactive sources used for diagnostic and therapeutic purposes and for the production of radiopharmaceuticals. He must be able to calculate the radiation doses produced in various organs of the patient's body by the radioactive substances which are administered.

The responsibilities of the radiation physicist also include the continuous assessment of the performance of the imaging and counting equipment. This is generally relatively complex from the technical point of view and it is necessary to maintain close contact with the suppliers on maintenance and improvements.

Together with the doctor, the physicist must be responsible for proper radiation protection and must be able to take the necessary steps in the case of accident (e.g. the contamination of personnel or rooms by open radioactive substances). Again all these responsibilities bring associated teaching commitments.

3. Conclusions

The medical physicist can only come to terms with his large number of different tasks in close cooperation with doctors and through active contact with colleagues working at the national and international level. It is therefore important for the medical physicist that he joins a national specialist body which has connections at the international level. In the meantime, one of the most urgent tasks of every medical physicist or alternatively of this body would be to convince the medical world that from the scientific and technical point of view medical physics has become an important, if not an essential discipline.

Medical Physics Education and Training: The Present European Level and Recommendations for its Future Development

A. Kaul (Chairman), D.H. Bekkering, A. Benini, J. Chavaudra.
Committee for Education and Training.

Introduction

The European Federation of Organisations for Medical Physics (EFOMP) was founded during the 2nd conference of representatives from European organisations for Medical Physics in London on 7-9 May, 1980. The current membership includes 17 national organisations which represent approximately 2500 physicists and engineers in the field of Medical Physics.

It is one of the objectives of the Federation to formulate recommendations for education and training in Medical Physics that might be suitable for the establishment of comparable European qualifications. This task was assigned to the Committee for Education and Training consisting of the following members: A. Kaul (Chairman), A. Benini, Italy, D.H. Bekkering, Netherlands, J. Chavaudra, France and the late R. Ellis, United Kingdom. For the preparation of such recommendations it is of course necessary to be informed about the current state of development of education and training in Medical Physics in the individual European countries. For this purpose, two fact-finding inquiries were conducted recently, as a result of which 19 national organisations for Medical Physics and/or respective sections of other scientific organisations, described the current level of education and training in the individual countries. The essential questions contained in the inquiry, the results as well as the future work of the European Federation in education and training are summarized in the present study.

1. Inquiry

Ten questions were asked on the following subjects, if applicable:

1. The type of additional education and training (postgraduate courses and/or on-the-job training) and the entry qualification;
2. The length of additional education and training and the nature of the final examination, accreditation and official recognition;
3. Collaboration with other bio-science sections, in particular with biomedical technicians and engineers.

In addition available course prospectuses were requested.

2. Results

Organisations for Medical Physics of the following countries participated in the inquiry: Belgium, Federal Republic of Germany, Denmark, German Democratic Republic, United Kingdom, Finland, France, Greece, Netherlands, Ireland (Republic), Italy, Yugoslavia, Norway, Austria, Poland, Sweden, Switzerland, Spain, Turkey. The results of the inquiry may be summarised as follows (see table 1):

2.1 Type of additional education and training and basic qualification

In 10 countries, i.e. nearly half of those participating in the inquiry, additional education and training in the field of Medical Physics is provided solely within the framework of professional practice and, in some cases, is supplemented by a period of introduction – given by an experienced colleague – to the tasks assigned to a hospital physicist. However, this does not preclude the fact that in some countries, e.g. Belgium and Austria, structured courses in Medical Physics are additionally offered. In the remaining countries, additional education and training programs have been established but can only be put into effect gradually.

Such countries as Finland, France, Greece and Sweden have had several years of experience with regular education and training programs, while the United Kingdom, the German Democratic Republic, the Netherlands and the Federal Republic of Germany have only just begun to profit from this experience.

The Hospital Physicists Association in **England**, the largest national association in Europe with approximately 1500 members, requires professional work at a hospital with simultaneous participation in additional education and training courses and practical work performed under the supervision of an experienced medical physicist as an 'assessor'. Obligatory topics for additional education and training are Anatomy and Physiology, Safety in the field of ionizing and non-ionizing radiation, including the handling of electrical facilities, as well as an individual selection of areas of endeavour, such as Diagnostic Radiology, Radiation Therapy, Nuclear Medicine, Physiological Measurement and Computer Science. The basic qualification is a Bachelor of Science degree

Tab. 1: Postgraduate education and training (on-the-job and courses) in Medical Physics

	Country	formally regulated	individually regulated	Duration on-the-job	Duration courses (h)	Examination	Certification State	Certification Private[4]
1	Austria	–	+	–	–	–	–	–
2	Belgium	–	+	1 a	465	+	–	+
3	Denmark	–	+	–	–	–	–	+
4	England (UK)	+	+	$\leqslant 4$ a[2]		+	(+)	+
5	Federal Republic of Germany	+	+	3 a	360	(+)	(+)	+
6	Finland	+	–	1 + 4 a		+	+	–
7	France	+	–	3 a		+	+	–
8	German Democratic Republic	+	+	2 a	180[6] + 320[5]	+	+	–
9	Greece	+	–	600 h	463	+	+	–
10	Ireland (Republic)	–	+	–	–	–	–	–
11	Italy	+	+	2 a	500	+	+ (?)	+
12	Jugoslavia	–	+	3 – 4 a		+	–	+
13	Netherlands	+	–	2 a		–	–	+
14	Norway	–	+	–	–	–	–	–
15	Poland	–	+	3 a	–	+	+ (?)	– (?)
16	Spain	–	+	–	–	–	–	–
17	Sweden	+	–	3 + 4 a[3]		+	+	–
18	Switzerland	–	+	–	–	–	–	–
19	Turkey	–	+	$\geqslant 1$	120	+ (?)	–	+

(+) approved but not as yet implemented
1 as temporary rule simultaneously possible
2 depending on initial qualification (B.Sc., M.Sc., Ph.D.)
3 if a higher qualification is the objective, e.g. Ph. D. or „Senior Medical Physicist"
4 affiliation, scientific association, University
5 scheduled lectures
6 sit-in lectures
? data incomplete

(B.Sc.). The academic degree of M.Sc. or Ph.D., respectively, may be attained during the process of additional education and training.

The system of additional training in **Finland** is limited to Medical Radiophysics and characterised by postgraduate on-the-job training. A formal study of Physics or Electro-Technology is required, concluded by the academic degree of M.Sc., as well as several years of basic instruction in Physiology, Anatomy, Biophysics, Radiobiology and Clinical Radiobiology, Radiation Protection and Radiation Hygiene, at a university or other research institution.

In **France**, Medical Physics is practised by various specialists who have been educated as engineers, physicists, medical doctors or in other disciplines. Almost no formal education or qualifications are defined, except for the field of Radiology. In this case, hospital physicists' qualifications and an agreement procedure have been regulated by law since 1977. Hospital physicists following this scheme must have a university degree in Physics, Informatics or Techniques as a basis for a specific postgraduate training, both theoretical and practical. This training, dealing with Physics, Radiobiology, Computer Techniques and the medical applications of Physics, includes nine months in the University Paul Sabatier, Toulouse, and eight weeks in the University of Paris-Sud and in the Institut Gustave Roussy (about 350 hours). It leads to an M.Sc. in Medical (Radiological) Physics. Students must present a report on clinical research in one of the radiological subspecialities of Medical Physics or Radiobiology. A written, oral and practical examination is given by a mixed commission of physicists and physicians, leading to an accredited Diploma in Radiological Physics. After this about 90% of the selected students prepare a Ph.D. in Medical Physics before entering the profession. In-service training, the length of which is not specified, follows.

Due to legal requirements in the **Federal Republic of Germany** for specially educated physicists in Radiotherapy, radiopharmaceutical applications and Radiation Protection, the German Association for Medical Physics has recently (March 1980) ratified regulations for postgraduate education and in-service training in Medical Physics. The training takes at least 3 years. As a requirement for professional employment in a speciality of Medical Physics such as Nuclear Medicine, the physicist in the training program will be given additional knowledge in both his speciality and the general field of Medical Physics by lectures, seminars and practicals of at least 360 hours total duration. Accreditation will be granted by an official commission which will check all professional and educational prerequisites. A first university postgraduate course, for a period of 3 years, consisting of 5 hours education per week during the term has been started at the Free University of Berlin (West).

The **German Democratic Republic** (GDR) usually requires postgraduate on-the-job training by so-called "Natural Science and Technology Cadres" for certified psychologists and sociologists of the Public Health Service as well as physicists. For physicists in the medical field courses are organized by the Section for Clinical Radiation Physics of the Association for Medical Radiology. The study program includes practical professional experience, autonomous study, lectures and courses with emphasis not only on the fundamental physics of ionizing radiation but also on Dosimetry, Radiobiology and Radiation Protection, Health Politics, Health Service and its organisation. The basic qualification for entering a postgraduate on-the-job training program is a completed university study as a certified physicist or engineer and additional work for a minimum of 1 year in the Public Health Service.

The current system of additional training in **Greece** is also characterized by a combination of courses emphasizing Physiology, Anatomy, Radiobiology, Clinical Radiphysics and Physics of non-ionizing radiation and Electronics as well as by additional practical on-the-job training. Participation in the additional training program requires a completed university training in Physics (M.Sc. or equivalent academic degree).

In the **Netherlands**, education and training of clinical physicists follow a postgraduate on-the-job program, as established by the Dutch Society of Clinical Physics, at a hospital under the supervision of a 'mentor' with simultaneous course participation. Basic qualification is an academic degree of M.Sc. The courses are set-up in blocs and their subjects correspond with the respective field of Clinical Physics, e.g. Physics in Radiation Therapy, Nuclear Medicine, Physiological Measurement and Technology.

In **Sweden** a differentiation is made between hospital physicists who work as assistants and 'Qualified Hospital Physicists'. Assistants are either required to have a B.Sc. degree ('fil. kand.') after a 3 years study of Physics and Mathematics or hold an M.Sc. degree after 4 years of study at a Technological University. In addition, for a period of one and a half years, theoretical work – part of which must be performed during the main study period – is required in the fields of Radiation Physics (Radiation Measurement Technology), Radiobiology, Dosimetry and Radiation Protection, and 3 years of on-the-job training, including a minimum tenure of half a year at a hospital. Furthermore, the participation in a 10 weeks course of medically oriented subjects is mandatory.

2.2 Length of additional education and training, final examination, accreditation and official recognition

The length of postgraduate on-the-job training extends from a minimum of 1 year to a maximum of 4 years but may require 7 years if an advanced qualification in Medical Physics is desired, e.g. 'Qualified Hospital Physicist' in Sweden, and if combined with an academically advanced study awarding a doctorate (Ph.D.). An average of 3 years of postgraduate on-the-job training is generally required. The course hours, in as far as they are not specified and are scheduled during the postgraduate on-the-job training period, amount from 120 to 500 hours, with a mean of 400 hours.

In nearly two thirds of the 19 countries participating in the fact-finding inquiry, a final examination after completion of the education and training program is required or will be in future. Examinations are given in written and/or oral form and, in some cases, are connected with the award of a special title, e.g. 'Fachanerkennung für Med. Physik' (Federal Republic of Germany), 'Fachphysiker, – Ingenieur für Strahlenphysik' (GDR), 'Senior Hospital Physicist' (Finland, Turkey) or 'Diplome Etude Approfondies Specialite Physique Radiologique' (France).

An official recognition of this qualification over and above the regular study of Physics or Engineering Sciences is presently awarded in only 4 countries. The same seems to apply to two more countries (information incomplete), and in an additional two countries (United Kingdom and Federal Republic of Germany) it is deemed as desirable.

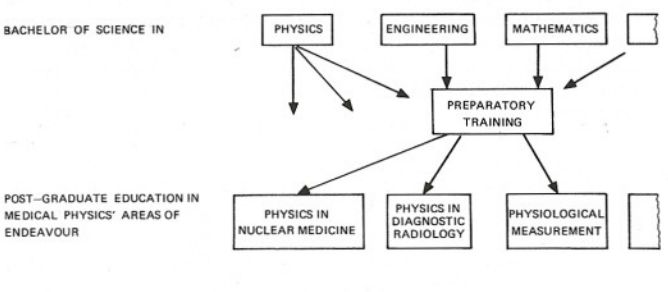

Fig. 1: Entry requirements for the training scheme of postgraduate education

2.3 Collaboration with other biomedical sections

The results of the fact-finding inquiry clearly demonstrate that with the exception of the GDR there is a lack of collaboration with other scientific biomedical associations in the area of additonal education and training for medical physicists, apart from the fact that in 5 countries postgraduate training in Biomedical Technology is available, as comparable to Medical Physics. However, even in these instances, the mailing address of the national organization responsible was not known, indicating the absence of an exchange of information.

3. Summary of results of the inquiry

According to the results of the fact-finding inquiry, a formally regulated additional education and training program for physicists and university graduates in the engineering sciences with emphasis on Technological Physics exists in nearly half of all the European countries (9 from 19) that participated in the general inquiry. In the remaining countries, the postgraduate on-the-job training in hospitals or Nuclear Physics sections is managed on an individual basis, i.e. not following a generally recognized nation-wide concept. This approximately applies also to final examinations, whereby such examinations may actually be given, even though a nation-wide formally regulated additional training program does not exist in the respective country. To qualify for postgraduate training usually calls for a completed university study in Physics or the engineering sciences with a certification comparable to a diploma. The length of postgraduate on-the-job training amounts from a minimum of 1 to a maximum of 4 years. However, in cases where a higher qualification in Medical Physics is desired (e.g. 'Qualified Hospital Physicist') combined with the achievement of a doctorate (Ph.D.), this period may be extended to 7 years. On the average, 3 years are usually required for postgraduate on-the-job training, mostly with an average of 400 course hours. Only in 4, or perhaps 6 of 9 countries with formal postgraduate training programs, an official recognition of the added qualification is awarded as comparable to that of a medical specialist. Two additional countries are planning the same recognition.

The individually responsible work of a physicist in the therapeutic application of ionizing radiation to man is legally required in only countries (Federal Republic of Germany, German Democratic Republic, France and Greece). The close cooperation with other biomedical sections is a rare occurrence!

4. Objectives of the European Federation

Based on the results of the fact-finding inquiries, the objectives of EFOMP considering postgraduate education and training may be summarized as follows:

- Development of a scheme for postgraduate education and training and recommendation of a time period required for a postgraduate education and training program;
- Support of an exchange of physicists between countries where a regular postgraduate training program is already in effect.

4.1 Scheme for postgraduate education and training

4.1.1 The entry requirements for the training scheme

A primary need in planning a basic training scheme for medical physicists is to agree upon for whom the scheme should be designed. Medical Physics has evolved in different ways in different countries and, in the past, significant contributions to this field of work have come from individuals whose first degree was *not* in Physics. Thus, graduates in Mathematics, Engineering, Chemistry, Medicine and other disciplines have entered the field and become accepted as members of the profession of Medical Physics.

The application of Physics to Medicine requires first and foremost a high standard of education and training in the ideas, principles and techniques of Physics. Thus, today, it is now almost universally recognized that an entrant to Medical Physics training should hold a first degree with Physics as a major subject. The Committee on Education and Training agreed that entrants to Medical Physics training should have, as a minimum requirement, the Bachelor's degree (B.Sc.), or its equivalent, in Physics. Individuals with degrees in Mathematics, Engineering, Chemistry, Biology or medical sciences could also be considered but would need preparatory training to ensure that their knowledge of Mathematics and Physics is up to the required standard (fig. 1). In addition the Committee discussed the question because, if a model basic training scheme has to cater for entrants with degrees in major subjects *other* than Physics, it should include provision for optional courses in Physics subjects normally taken by a Physics student when reading for his first degree. It was decided by the Committee that it would be inadvisable to extend a training scheme in Medical Physics to make provision for such preparatory courses.

4.1.2 The length of the education and training period and its subjects

According to the Committee's opinion the education of medical physicists can be divided into three stages. After a first step of bringing the physicist up to a basic standard (B.Sc.) in Physics, Mathematics and other relevant topics in Natural Sciences, the second step is to introduce Medical Physics in postgraduate education. The third step is in-service training in hospitals. After finishing this the physicist can be recognized as a junior medical physicist. It should also be possible to reach a senior level by further education and training, and to get a higher academic degree i.e. M.Sc., PhD or equivalent in Medical Physics.

Postgraduate education in Medical Physics should follow as a formal course of lectures, seminars, practicals, tutorial work by means of on-the-job training and professional work (see fig. 2). A minimum of 2 years for professional work including on-the-job training is required. It should be possible from the beginning at this stage to concentrate on a Medical Physics speciality as an area of endeavour but the courses should also include other aspects of Physics applied to Medicine (see tab. 2) and mandatory subjects irrespective of the individual area of endeavour (see tab. 3). On-the-job training should be done under the supervision of a medical physicist at senior level. It is an advantage if during on-the-job training the physicist gets opportunities to do individual work on projects. The on-the-job training period can be included in the second stage of postgraduate education by formal courses if this is more practical. The total length of the postgraduate education and training period by lectures, seminars or practicals included in professional work, or in addition to, shall be not less than 300 to 400 hours and will comprise mandatory subjects, subjects of the individual area of endeavour (Medical Physics speciality or sub-speciality) and optional subjects of Medical Physics (see fig. 3).

The agreed wording of the recommendations of the 1972 Kiel WHO Seminar on these matters was: 'The minimum period of training should normally correspond to two years of full-time work, including a formal course and an introduction to in-service training whether as a paid hospital employee or not. The in-service training should not begin before the start of the formal course and both should preferably be taken in the same institution. Where this desirable situation cannot be met and the formal course is given by an educational establishment separated from a hospital, the in-service training should either be closely supervised by this educational establishment or be in an established Medical Physics department headed by a senior medical physicist.'

4.1.3 Examination and certification

It was realized by the Committee that examination systems vary from one country to another and that the Committee should not prescribe a universal, detailed system. Assessment of the training can be done on an individual basis by written examination, report and oral examination of the candidate of by checking all relevant submitted documents indicating whether or not the candidate fulfils the presupposition to be accredited as a junior medical physicist (see fig. 4). If both the corresponding national training scheme and the level of postgraduate education by lectures, seminars, practicals and on-the-job training are recognized by EFOMP to be in accordance to its recommendations the accreditation can be extended by means of a European certificate.

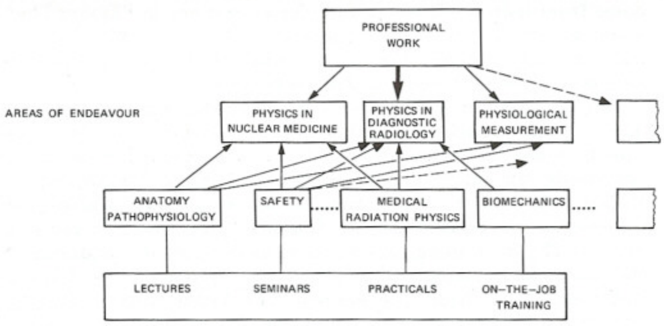

Fig. 2: Training scheme postgraduate education

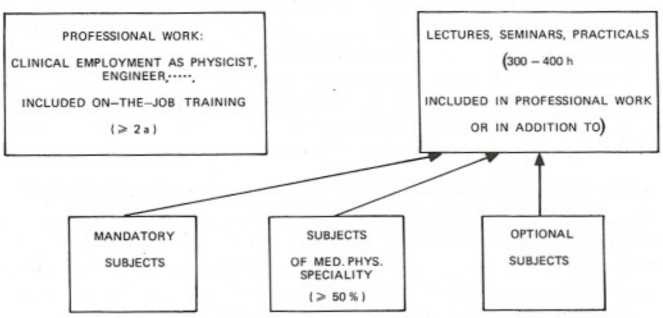

Fig. 3: Total length and subjects of the postgraduate education and training period

Tab. 2: Medical Physics specialities and subspecialities

MEDICAL PHYSICS SPECIALITIES
RADIOLOGICAL PHYSICS IN:
– DIAGNOSTIC RADIOLOGY
– NUCLEAR MEDICINE
– RADIATION THERAPY
PHYSIOLOGICAL MEASUREMENT IN:
– CARDIOLOGY
– OPHTHALMOLOGY
– AUDIOLOGY
– NEUROLOGY
....
....
EACH OF THESE SUBSPECIALITIES CONTAIN
– APPLIED ELECTRONICS
– INSTRUMENTATION
– DATA PROCESSING

4.2 National training centres, exchange of medical physicists and support from international organisations

EFOMP will as a further step to fostering education and training on a European level encourage the establishment of national training centres providing both formal courses and in-service training for their own medical physicists but also for physicists from other European countries. International organisations such as IAEA, WHO and the European Community may contribute to this aim in various ways: They may award fellowships for training of students on an individual or group basis; they may organize national, regional, inter-regional or international training projects; they may support such projects by providing visiting lecturers and other experts, equipment and supplies; they may promote the publication of manuals and other teaching aids.

IAEA has from time to time given assistance to national projects by providing visiting lecturers. It has also supported a number of short-term training courses at more advanced levels either intended for, or of interest to, medical physicists.

WHO's activities in this area have been directed more towards the promotion of basic training projects.

Particular emphasis is given by the European Community to the promotion of cooperation in higher education within the EC by the development of 'Joint Programmes of Study' between institutions of higher education in the Member States and by the support of 'Short Study Visits' to other Member States by teaching of administrative staff and researchers from higher education institutions. At the present time, 217 'Joint Programmes', in a wide range of academic disciplines at both the first degree and further degree levels, and involving same 320 higher education institutions in the Community, have been or are being supported under the joint programmes of study grant scheme. The grants are intended to foster the development of cooperation between institutions of higher education from different Member States, with a view to the joint development of courses of study or parts of such courses. The aim of the "Short Study Visits" is to enable those professionally engaged in higher education to extend their knowledge and experience of higher education in other Member States, and to increase in the longer term the opportunities for collaboration between institutions of higher education in the European Community.

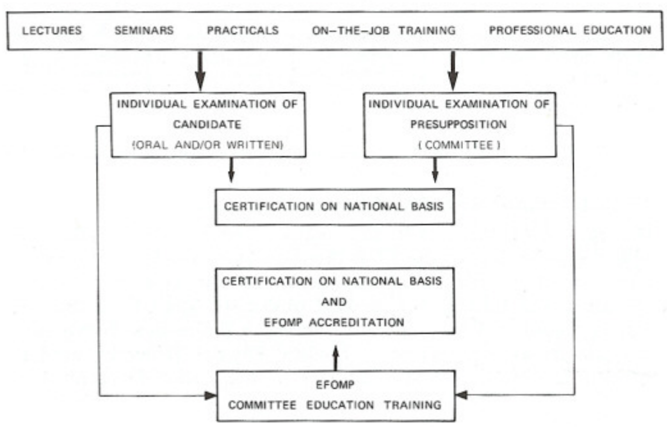

Fig. 4: Examination and certification

Tab. 3: Mandatory subjects

MANDATORY SUBJECTS
ANATOMY / PATHOPHYSIOLOGY
SAFETY
– IONISING RADIATION
– ULTRASOUND
– ELECTRICAL
– LASER
– MICROWAVE
– ULTRAVIOLET
– CHEMICAL
– BIOLOGICAL
– MECHANICAL WORKSHOP
GENERAL HEALTH CARE AND HOSPITAL MANAGEMENT
MEDICAL STATISTICS
INFORMATICS
PRINCIPLES OF QUALITY CONTROL AND ASSURANCE

Professional Status

P.-E. Åsard (Chairman), H. Aget, M.M. Black, A. Piron, M. Tautz.
Committee for Professional Matters.

Introduction

The aims and purposes of the Federation include the task of 'making recommendations on the appropriate general responsibilities, organisational relationships and roles of workers in the field of medical physics'.

At the inaugural meeting of the Federation in London in May, 1980, Dr. Åsard presented a report on replies to a questionnaire on professional matters, including grading structure, organisation, and salaries. A working group was elected, consisting of Dr. Åsard (Sweden, Chairman), Dr. Aget (France), Professor Black (U.K.), Dr. Tautz (G.D.R.) and Mr. Piron (Belgium), to work towards policy statements on these matters. This working group became the Federation's Committee on Professional Matters and at a meeting of officers in Berlin in November, 1980, it was proposed that a symposium in Hamburg could be used to gather information and opinions.

The outline of this discussion document of recommendations was debated at the meeting of EFOMP Council in Brussels in June, 1981, and final comments made at the Officers' Meeting in London in November, 1981.

1. Medical Physics – Past, Present and Future

It is generally agreed that the important effects of scientific thought on medicine first occurred during the Renaissance. From that time (1600 AD) and during the three following centuries the association of physics and medicine and the development of physics applied to medicine advanced. During this phase it was possible for an educated person to have sufficient knowledge of both physics and medicine to make important and fundamental contributions in both fields.

From around 1900 after the discovery of X-rays and radioactivity, atomic and nuclear physics developed. It was clear that no person could as a rule have sufficient knowledge in both fields. Thus some physicists in the 1920s began to appear in medical work mainly to solve problems involved in medical applications of ionizing radiations. These problems lay particularly in radiotherapy and radiation protection including radiation biology. Later on, in the 1940s, the use of radionuclides was introduced for both diagnostic purposes and for therapy and increasingly physicists were employed by hospitals as hospital physicists. These physicists contributed to the improvement of radiotherapeutic equipment, technique and dosimetry and the use of radionuclides in medical care and research. With the introduction of the ^{60}Co-therapy machine, accelerators, and more advanced nuclear medicine techniques, the number of hospital physicists increased in some countries very rapidly during the 1950s, the 1960s and the 1970s.

During this development of medical physics the working fields of the medical physicists increased. They cover today in almost all countries the whole field of radiology and also non-ionizing radiation such as ultrasound, ultraviolet, radiofrequency and laser radiation. In many countries they also cover extensive areas in computer science and electronics that have been introduced at an increasing rate into medical care by physicists, mathematicians, electronic engineers and computer specialists working in hospitals. In some countries the working field includes applications of electrical measurements, physics of gases, and mechanics.

In the past the physicists' contribution to the initial progress of some applications of physics in medical science was made from outside direct clinical involvement. During the last 20 years however the situation has developed where physicists are main collaborators with the clinicians in almost all fields of medicine, although perhaps especially in the radiological field. Medical electronics and clinical or bioengineering have commonly developed from the activities of physicists. In some countries these are today regarded as part of the medical physics service, and in other countries as separate from it, although closely related. In the future, physics will be of even more importance both in clinical medicine and in medical science. Medicine can be expected to become more scientific and quantitative. Scientific data will be of more significance in the diagnosis and treatment of diseases. Medical physics will play an increasingly important part in this development. High standards in medical physics services must be maintained and sufficient resources directed towards this.

2. Definition of the Medical Physicist

The preamble to the Constitution of EFOMP states that 'In most European countries there are National Organisations in which the principal defined category of members are persons . . . qualified with a University degree or equivalent in physics, mathematics, computing sciences, physical chemistry, mechanical, electrical or electronic engineering, etc., and . . . working in alliance with medical staff in hospitals, universities or research institutes'. These individuals are medical physicists. In addition to their university degree or equivalent they will have training in the concepts and techniques of applying physics in medicine and they will also have practical training in the field.

Two categories of medical physicists can be identified according to their employment situation and working fields. One category consists of medical physicists working as teachers and scientists in universities, as researchers in industrial laboratories and so on. For these physicists the employment itself defines their role, responsibilities and status. The Committee has no intention of including this category in these recommendations. These recommendations are intended to be applied only in the situation where these physicists are also involved in clinical work or research work involving patients.

The second category to which these recommendations are intended to apply concerns medical physicists working in a clinical environment either employed in hospitals or as a consultant to hospitals. These physicists have or might have an influence on the diagnosis and/or treatment and safety of patients, or their decisions might have consequences for the performance of diagnostic, treatment and safety procedures in hospital care. The name of this category of medical physicists varies from country to country. For example "medical physicist", "clinical physicist", "hospital physicist" are used to categorize these physicists.

The Committee has used the words clinical medical physicist in the following to stress that these recommendations do not, except for the distinction above, include medical physicists not working in a clinical environment. They also do not include a category of medical doctors who in some countries get training in medical physics in the faculty of medicine.

3. Professional Aspects of Education and Training

Education and training of medical physicists is of great importance when defining roles, responsibilities and status. The evolution of medical physics in each country depends to a large extent on the existence and standard of education. In general it can be said that medical physics is most advanced in countries where there exists a more formal organization for education and training of medical physicists. It is therefore of importance that chairs of medical physics and/or in medical radiation physics at universities should be established in every country. These chairs should have dual responsibilities in the faculty of science and the faculty of medicine.

The education of medical physicists can be divided into three stages. The first step is to bring the physicist up to a basic standard during an initial period of training at the university in physics, mathematics and other relevant topics in natural science. The second step is to introduce medical physics in the education and the third step is in-service training hospitals. After finishing this the physicist can be recognized as a junior medical physicist. It should also be possible to reach a senior level by further education, training and experience, and to get a higher academic degree, i.e. Ph.D. or equivalent in medical physics. The Committee will not in these recommendations go into details about education and training but will only give a view of the levels.

First stage: An entrant to medical physics training should have at least a Bachelors degree in physics or equivalent and entrants with basic training in mathematics, engineering, etc., should also be accepted. There should be a preparatory training for categories which have not the knowledge in mathematics and physics equivalent to a Bachelors degree.

Second stage: Education in medical physics should follow as a formal course of lectures, seminars, tutorial work and practical work. A minimum of 1-2 years is required. It should be possible from the beginning at this stage to concentrate on, for instance, medical radiation physics but the courses should in such cases also include other aspects of physics applied to medicine. This second stage can run simultaneously with the third stage.

Third stage: In-service training should be done under the supervision of a medical physicist at senior level.

It is an advantage if during in-service training the physicist gets opportunities to do individual work on projects. The length of the in-service training period should be 2 years or longer.

It is most important that in every country not only formal courses in medical physics are arranged but also that possibilities are created to help those physicists who want to make a career in clinical medical physics to get opportunities to do in-service training in an efficient and economical way in hospitals.

From the junior level it should be possible for the physicist to attend additional courses which give opportunities for obtaining deeper understanding and knowledge in special branches of medical physics. This is necessary as even in the field of medical radiation physics a high degree of specialisation among medical physicists in different types of applications of radiation physics to medicine has occurred. A further training to the senior level should be arranged and the universities or some of them should have the capacity to arrange training leading to a Ph.D. or equivalent in medical physics.

4. Responsibilities of the Clinical Medical Physicist

In countries where the clinical medical physics service is well developed it plays an essential part in medical care and health services. The main responsibility of the clinical medical physicist is to provide a high standard of service in the hospital. Two functions can be distinguished. One function is the professional one fulfilled by the medical physicist through his competence in the field of clinical medical physics, a competence not as a rule found among any other medical, paramedical or technical specialities. Thus the clinical medical physicist should be responsible within this area of competence for the standardisation and calibration of medical physical equipment and for the accuracy and safety of physical methods used in routine clinical applications in close co-operation with medical doctors and other personnel. He has also a responsibility in research and in the development of new techniques and physical methods and equipment. Further he has a responsibility for providing education and training in applied physics for doctors, nurses, medical technical assistants, etc., and student physicists and technical staff.

The other function is a managerial one exercised at a senior level where the clinical medical physicist is an administrator for the clinical medical physics service. He will also have a responsibility for the financial control of the medical physics service and responsibilities in the general organization and financial control of the hospital and/or the region. He will be answerable to the highest level of central administration.

The clinical medical physicist is a member of a team of personnel responsible for diagnosis and treatment of patients. The clinical medical physicist will have an influence on the diagnosis, treatment and safety procedures for the patient and thus his decisions will have consequences for the patient. As his decisions are based on his competence, a competence not found elsewhere, he should be fully responsible for his work.

The Committee recommends that the responsibility of the clinical medical physicist should be recognized by the national health authorities in every country. The Committee feels that state recognition of clinical medical physicists, perhaps by a structure comparable to that used for medical doctors, might be appropriate in establishing a base for competence and responsibility. Therefore the question of recognition or certification or state licensing should be taken up by the national health authorities.

5. Status and Organization of the Clinical Medical Physics Service

The status of clinical medical physicists and the clinical medical physics service varies largely throughout Europe. This depends on several factors but in general it is related to the existence and standard of the education and training in medical physics and to the standard of service provided. In some countries this standard is high and the ultimate goal in other countries must be to reach the same level. In general and especially for these latter countries it is of vital importance that the profession of clinical medical physics has a recognized high status, that good working conditions and facilities are provided and that the organization of the medical physics service is attractive for skilled physicists. A good career structure for medical physicists is of importance.

The organization for the clinical medical service also varies widely. In countries where the clinical medical physics service is of a highest standard the service is organized with independent departments of clinical medical physics. That means that the head of the department is a clinical medical physicist at senior level responsible for the clinical medical physics service within a hospital or within a region. Clinical involvement will be broad and flexible with a strong supporting organization. It is of importance that the clinical medical physics service is not directed only to a few particular hospitals, for example, university hospitals. Other hospitals in a region should also achieve the same standard of service, which means that the departments of clinical medical physics should serve a whole region of a part of a region.

6. The Need for Clinical Medical Physics Service

The need for clinical medical physics service in each country depends primarily on the standard and scope of medical care. Generally speaking it can be said that in the radiological field (X-ray diagnostics, radiotherapy, nuclear medicine and radiation protection) there is an obvious need for a clinical medical physics service. This has been proven by the development in countries where the service has a long tradition. It is also obvious that the introduction of a medical physics service in general depends a great deal on the appreciation by the medical profession of the ways in which physicists may assist in solving problems of medical diagnosis and treatment.

Figures of the number of physicists per million inhabitants in different European countries show a wide variation. Figures can be used in comparisons between countries only if they have about the same standard of medical care. Countries which do not have this standard but strive to reach it should in their planning take into account the medical physics service needed to obtain this standard. The number of physicists needed in diagnostic radiology, radiotherapy, nuclear medicine and radiation protection is correlated to the number of institutions and the number of, for instance, radiotherapy units. As a rule countries at an early stage of development of medical physics are in fact developing medical radiation physics first as this is still the largest single part of the medical physics service. The Committee considers this strategy suitable and that it will form a basis for further development of physics service in other applications of physics in medical care.

The Committee recommends that the national health authorities examine the manpower need in clinical medical physics service based on local circumstances and future planning of the standard of medical care. This has been done already in some European countries.

'Physics in Medicine & Biology' — Abstracts Service

Members of EFOMP who read the Federation's official journal will know that at the back of each issue are to be found abstracts of articles published in a wide variety of journals. From its establishment in 1956 'Physics in Medicine & Biology' has contained this Abstracts Section, contributed by voluntary workers in several countries, with the idea of providing readers with an up-to-date and concise account of the progress of physics as applied in the fields of medicine and biology.

At present about 100 journals are being monitored by the team of abstractors, who write a brief summary giving the outline and main conclusions of any relevant paper in their alloted journal. Although there is no financial reward, the recompense is that by producing abstracts each physicist is helping his colleagues to gain a wider appreciation of the latest developments in medical physics. Those who already contribute to the abstracts section find the discipline of regularly reading a particular journal and writing concisely on any relevant publication is valuable to themselves as well as useful to their readers.

If you would like to contribute a little of your time in assisting your EFOMP colleagues to gain a rapid appreciation of some of the latest advances in medical physics, please offer your services to Mr. R.G. Wood, at the address below. Mr. Wood will then provide you with full details of the Abstracts Service and how it operates, together with the appropriate stationery. By this means a good coverage of journals published in many different countries and languages will become available in abstract form to all readers of the journal.

The address for all communications is: –

Mr. R.G. Wood,
Abstracts Editor, P.M.B.,
33 Mill Road,
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U.K.

Roving Reports

British Nuclear Medicine Society, London. April 1982

This important Nuclear Medicine meeting was again held in the Imperial College of London University. It provided three days of good quality papers of both scientific and clinical interest covering gastrointestinal, vascular, pulmonary, skeletal, renal and cardiac sessions. Technology sessions with emphasis on computer applications provided the physics interest. There seems to be an upsurge in 3-D imaging techniques which seem an extravagent application for nuclear medicine as the image definition, which is inherently poor in the original 2-D images, is certainly not enhanced by adding a further dimension. Single photon emission tomography, using rotating gamma cameras, featured in a number of papers; the effect of camera non-uniformity on image quality was a serious problem.

This year the Annual Lecture was given by an outstanding pioneer in Medical Physics – Professor John Mallard. (It is significant that physicists have given the annual lecture for two years running). The subject was nuclear magnetic resonance, an exciting topic with great potential for diagnostic imaging. The fundamental principles, future developments and recent clinical applications were beautifully covered by Professor Mallard in a clear and entertaining manner – the hallmark of a gifted scientist. The nuclear medicine clinicians vainly hoped that NMR would be maintained as a nuclear medicine speciality: unlikely, in spite of the same prefix 'nuclear'!

A symposium on bone scintigraphy was held the following week in the Orthopaedic Hospital in Oswestry (Northern England). The guest lecturer was Professor Gopal Subramanian from New York, who gave an outstanding series of papers on the radiopharmacology on recent bone scanning and cell labelling agents. The labelling of blood cells certainly promises to extend the value of nuclear medicine in the near future.

This year has been exceptional in the number of important European meetings – London, Paris and Hamburg. The Hamburg meeting will serve an important function, allowing medical physicists and engineers to discuss the general conclusions drawn from these three meetings and perhaps decide on future directions; the beerhalls will be alive with wild predictions!

D.J. Dowsett

Review of the International Conference on Applications of Physics to Medicine and Biology.

Organized by the International Centre for Theoretical Physics, Trieste 30 March – 3rd April 1982

This meeting had the aim of inviting a number of physicists working in medicine or having some contact with medicine, and attempting to define and clarify those areas where physics (but not necessarily theoretical physics) was having an impact on medicine. The meeting being sponsored by the IAEA and UNESCO, a number of participants from developing countries had been invited.

The first day of the meeting was devoted to therapeutic techniques, some of which were clearly beyond the capacity of many developed nations, let alone developing nations. C.F. von Essen and E. Pedroni presented the results obtained with pi-meson beams from the Swiss Institute of Nuclear Research while the progress of using proton beams at the Massachusets General Hospital was presented by M. Goitein. J.R. Greening discussed the use of neutrons, and M. Bianchi the use of heavy particles. While it was clear that much better distribution of the deposition of energy could be achieved, the clinical value was perhaps less evident. This session was concluded by a presentation by B. Fava on the use of lasers. On the following day W. Kruger completed the subject of therapy with a presentation of his results using heat, either localized or general, in the treatment of cancer.

Diagnostic applications depend on the detection of a suitable signal. One of the first of such signals considered (by G.L. Romani) was that of biomagnetism. Using a superconducting loop (SQUID), fields of down to 10^{-10} Gauss can be measured providing an alternative method to the ECG of studying the heart. J. Clifton presented a review of the various blood gas measurements in neonates either using catheters or transcutanuously, and also mentioned the important neonatal applications of ultrasound and NMR. Such techniques do seem to have improved not just survival, but the quality of survival. Several papers on the use of models followed covering both established and new techniques in this basic tool of the physicist working in medicine. This session was concluded with potentially the most interesting and certainly the most difficult paper to follow of the whole meeting. R.K. Mishra offered a system based on lyotropnic liquid crystal structures which could possibly explain, from a biophysical point of view, life itself!

On the following day, two papers by A.P. Jeavons and A. Del Guerra showed current progress using proportional wire chamber detectors in nuclear medicine. Dr. Jeavons stated that he had just received a message that at CERN they had at last achieved 1mm resolution, 99% efficiency and 1nsec resolving time, (unfortunately dated 1st April). Alan Cormack, one of the two Nobel prize winners at the meeting, then presented a history of the Radon 'problem' (of which the first solution seems to have been obtained by H.A. Lorenz in 1905) having been rediscovered by many authors throughout its history. He presented a description based on the method of inversion which suggested that the Radon transform could be applied to other than straight line integrals. R. Guzzardi then presented current research at Piza using the Compton camera, and the proposed new positron ring detector. R.A. Kruger followed with a very clear and interesting paper on some of the filtering techniques applicable in digital subtraction radiography, a relatively new technique likely to have very considerable impact in medicine. This was followed by a paper on the use of the scattering of protons for producing high quality tomograms, a technique less likely to be of general value owing to the difficulty of obtaining suitable high energy protons.

Probably the high point of the meeting was the series of presentations on NMR. P. Mansfield impressed us with his real time cardiac images where a 32x32 slice could be generated in a few milliseconds, as did L. Kaufman with the high quality of his present NMR system, and in particular, with the possibility of flow measurements in carotids. J. Orr likewise demonstrated the high image quality and exciting potential applications of current cryogenic NMR systems. J. Mallard showed that, even with a conventional magnet and working at much lower fields it was still possible to obtain interpretable images, and stressed the value of T1 as a diagnostic indicator.

A number of other papers of interest were given, for example C.R. Hill on the use of ultrasound for tissue characterisation, a pair of papers on image processing and the extraction of dynamic data in nuclear medicine, and notably, a survey of Radioimmunassay given by R.S. Yalow (the other Nobel prize winner present). Leon Kaufman summarized the meeting discussing the various competing diagnostic techniques and suggesting that (especially in view of limited financial resources) the potential success of NMR and digital radiography should result in some decrease in the use of X-ray, C.T. and Nuclear Medicine. It should be noted that this survey of papers is not complete, and, in particular, a number of excellent poster presentations were also made. The complete proceedings are in the process of publication.

A. Todd – Pokropek

Book Review

Proceedings of SPIE, Vol. 314: Conference on Digital Radiography
Edited by William R. Brody, Sept. 1981 Stanford California.
ISBN 0-89252-348-4

This book is the proceedings of an international conference on digital radiography held at Stanford in 1981, and contains a total of 62 papers, of average length 6 pages. While it does contain (unusually) a subject index, and although the papers are grouped in 'sessions' e.g. Digital X-ray systems, Imagine subtraction methods etc. there is very little continuity in the book. The grouping of papers seems almost random, and as such, it would be of little value as an introduction to the subject. In addition, and for the same reasons, there is very considerable overlap between many of the papers. Others are so brief and written in resume form so that they hardly merit publication. Nevertheless, this set of papers, the first such collection on this subject, must be considered as essential reading for any scientist or clinician (although there is not much clinical content as such) working in this field, although the clinical content is limited.

Throughout the book, several themes occur and reoccur. There is much investigation of appropriate phantoms, although the use of evaluation procedures appropriate for clinical results (e.g. ROC curves) is sadly lacking, with the exception of the paper by W.D. Foley. Secondly image processing techniques are presented. There is a general appreciation of the problems of signal, noise, image enhacement techniques, and of course, and central to the whole subject, the development of image subtraction techniques, either by temporal subtraction (masking) or by multiple energy techniques, or variants. Robert Kruger, for example, discusses the use of recursive temporal filtering as an aid to improved temporal subtraction, and in particular, elimination of movement artefacts.

A. Macovski (the author or co-author of 11 papers!) has a very brief paper of the use of three energy spectra for iodine imaging, whereas L.A. Lehmann presents a helpful discussion of the noise considerations in dual energy subtraction. The session entitled Storage, Retrieval and Transmission of Digital Images is very disappointing. However, almost all current problems in digital radiography are covered to some extent by one or several papers. It should be noted that many of the participants and authors were from manufacturers research laboratories and presumably reflect opinions which give indications of the form of future equipment that they are in the process of developing.

In summary, for a reader interested in current technology and image processing techniques in digital radiography from a scientific point of view, this book will provide excellent browsing. For the general reader interest in image processing, this book is far too specialized (as indeed it was intended to be) and incoherent.

A. Todd – Pokropek

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Further information can be obtained from UNESCO, 7 Place de Fontenoy, 75700 Paris.

Meetings Diary

1982

7-8th October, Cannes, France
The Impact of Lasers on Medical Science
Secretariat, Cannes Congress of the European Laser Association, Centre Hospitalier de Rueil-Malmaison, 1, rue Charles-Drot, F-92501 Rueil-Malmaison, France.

18-23 October, Avignon, France
Comparison of Risk Resulting from Major Human Activities
Secretariat General SFRP, BP No. 72, F-92260 Fontenay-aux-Roses, France.

19-22 October, Munich
6th International Conference on Pattern Recognition
Prof. H. Marko, Lehrstuhl für Nachrichtentechnik, Technische Universität München, Arcistrasse 21, 8 Munich 2, Federal Republic of Germany.

26-28 October, Berlin
First International Symposium on Medical Imaging and Image Interpretation
IEEE Computer Society, 1109, Silver Street, Silver Spring, MD 20910, U.S.A.

2-7 November, Vienna
First World Congress on Environmental and Radiation Protection
Dr. S.S. Arpad, Institut für Umweltschutz und Strahlendaten-Sammlung, Kirchengasse 32, A-1070 Vienna, Austria.

1983

27-30 March, Elsinore, Denmark
First European Symposium on Radiopharmacy and Radiopharmaceuticals
Symposium Secretariat, The Isotope Pharmacy, Frederikssundsvej 378, DK-2700 Bronshoj, Denmark.

24-28 May, Brussels
Annual Meeting of the European Nuclear Medicine Society
Mr. P. Blocks, Akademisch Ziekenhuis Antwerpen, Dienst Nucleaire Geneeskunde, Wilrijkstraat 10, B-2520, Edegem, Belgium.

18-22 July, Glasgow, Scotland
11th L.H. Gray Conference on Cellular Repair of Radiation Damage.
Prof. J.S. Orr, (L.H. Gray Memorial Trust), Department of Medical Physics, Hammersmith Hospital, Ducane Road, London, W12 0HS, England.

5-10 September, Bordeaux
Fifth European Congress on Radiology
Mme. N. Hargous, Hôpital Pellegrin, Service de Radiologie, Place Amélie Raba-Léon, F-33076 Bordeaux, France.

E.M.P. News — next issue

Please send material for the December 1982 issue of E.M.P. News to Mr. D.J. Dowsett, Honorary Secretary of EFOMP Publications Committee, Radiological Department, Mater Misericordiae Hospital, Dublin 7, Ireland, by 1st October.

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