mbe news

News section of the Journal
of the International Federation for Medical & Biological Engineering
May 1976

Canadian pacemaker pioneers honoured

Canada's first cardiac pacemaker manufacturing plant—the new Canadian head office of Medtronic of Canada—was opened in the Autumn of 1975 at Mississauga. Donald Hurley, President of Medtronic of Canada, stated that the multimillion dollar investment would see Medtronic not only manufacturing for the Canadian market, but for export as well. The company's objective was to equal Medtronic's USA manufacturing costs which historically have averaged 10% lower than in Canada. The long-range plans called for a major investment in research and development in Canada. At the official opening-day ceremonies, three Canadian pioneers in the field of cardiac pacing were honoured: Wilfred Bigelow, senior surgeon and head of the Division of Cardiovascular Surgery at Toronto General Hospital; John Callaghan, clinical professor of surgery and director of cardiovascular and thoracic surgery at the University of Alberta Hospital, Edmonton; and Jack Hopps, head of the medical engineering section of the National Research Council, Ottawa, and a former President of the IFMBE.

The stabilisation and control of cardiac activity was a natural outcome of early experimentation in open-heart surgery during the 1950s and, in Canada, Bigelow and Callaghan were studying the effect of low temperatures on cardiac activity in dogs. A report of their discoveries sointerested the National Research Council that they assigned a senior engineer, Jack Hopps, to work on the project full-time. Jack's job was to advise on a problem of rewarming the patients. He says that at the time he was engaged in a satisfying study of the radio frequency repasteurisation of beer. He felt a little concerned with this medical assignment which threatened to disrupt what he had visualised as a lifetime's project!

Artificial pacemaker

A problem of maintaining a hypothermic patient was the tendency of the heart to lapse into standstill at low temperatures. Using a commercial physiological stimulator, it was found that repetitive pulses applied to the region of the sinoatrial node could control heart action. This finding led to the development of an electric artificial cardiac pacemaker and the pioneering use of endocardial pacing via an intravenous pacing catheter. At the time of these Canadian discoveries, Earl Bakken (now president of the American Medtronic Company) was working in Minneapolis with Dr. Lillehei to develop an external pacemaker to treat a patient suffering from Stokes-Adams attacks. By 1960 the idea of an internal unit became a reality when Dr. William Chardack performed the first human implant of a pacemaker made by Medtronic. The first nuclear powered pacemaker was implanted in a Canadian at the Toronto General Hospital in 1973.

Readers of *MBE* will be delighted to recall the close involvement of an engineer with the evolution of cardiac pacing in Canada and to know that work still continues at the National Research Council in this important area.

WHO budget

The 57th session of the World Health Organisation's Executive Board meeting at Geneva in January 1976 recommended that the assembly should adopt an effective working budget of $146·9 million for 1977. The following were determined as the principal objectives of the 6th General Programme, 1978–1983: development of comprehensive national health services; disease prevention and control; promotion of environmental health; health manpower development; promotion of biomedical and health services research and support of health-promotion activities within the overall socioeconomic development. To help meet the shortage of health workers, the board recommended a new strategy based on integrating manpower development with the health services to ensure the formation of manpower systems that are responsive to specific local health needs.

Artificial elbow joint

Dr. F. C. Ewald, an orthopaedic surgeon at the Robert Breck Brigham Hospital of Boston has developed a prosthetic elbow joint which simulates the free-floating construction of the natural joint and is composed of high-molecular-weight polythene plus a cobalt-chromium alloy. An important feature of the joint is that it allows a sideways action with little danger of snapping or loosening the prosthesis by pressure exerted on the mechanical parts. It is used to restore mobility to arms crippled by advanced degenerative rheumatoid arthritis.

Flow in the small intestine

A team of engineers and physiologists at the University of Iowa is investigating the relationship between contractions and flow in the mammalian small intestine. Long a matter for conjecture, this relationship has never been very clear, largely because of uncertainties about the characteristics of contractions of the two muscle layers of the intestinal wall.

Duodenal study

The team has used both experimental and analytical modelling techniques to investigate the flows produced by stationary contractions of the circular muscle layer of the duodenum. Such contractions, developing transiently as rings, 1 cm or less in width, and spaced irregularly along the bowel, give rise to the contraction pattern commonly called segmentation. Study of the models indicates that segmentation can induce net axial flows, accounting for pumping as well as mixing of chyme.

In another study, a cinematographic study of a duodenal segment *in vitro* indicated that contractions of the longitudinal muscle layer can occur independent of those of the circular muscle layer. Such contractions produce a transient shortening of a segment of intestine, and this contraction migrates or sweeps along the intestine. Study of experimental and analytical models indicates that such contractions induce complex flows in which fluid contents of the bowel are made to move between the core and boundary of the cylindrical conduit. This flow pattern suggests that such contractions may be of importance in facilitating absorption.

Other experiments have been designed to provide more detailed information than heretofore available about the spatial and temporal characteristics of the contractions of both muscle layers in the duodenum. Further details from Joel G. Melville, Iowa University Institute of Hydraulic Research, Iowa City, Iowa 52242, USA.

Engineering-applications course

The Department of Surgery at Baylor College of Medicine, Houston, Texas, offers an elective course for students interested in the applications of engineering to surgery. The course emphasises applied technology, particularly in the areas of cardiovascular disease, including instrumentation (data acquisition/storage, cardiac pacemaker), cardiovascular prostheses (valves, grafts, blood pumps), biomaterials (prosthetics, tissue cultures, relationships between fluid mechanics and fibrin deposition on prosthetic surfaces) and fluid mechanics (heart valves, grafts and blood pumps).

The course is offered by the staff of the Taub Laboratories in mechanical circulatory support and includes 12 lecture hours of teaching, a weekly seminar and the development of a project in the field, its prosecution and presentation under the supervision of a staff member. There is also a 3-week course in physiological monitoring for surgery and surgical intensive care.

New research section at TRIMS

Bernard Saltzberg has joined the staff of the Texas Research Institute of Mental Sciences as chief of the new information-sciences research section. An internationally respected investigator in the application of mathematics to the neural sciences, Dr. Saltzberg has been head of biomathematics and director of the biomedical signal analysis laboratory at Tulane University School of Medicine since 1967. He received his doctorate in biomedical & electrical engineering from Marquette University and has been awarded five patents for his developments in the computer field. His work at TRIMS will be primarily concerned with the analysis of brain electrical activity as it relates to behaviour and mental illness. The new section will work closely with Neil Burch, the head of psychophysiology research. Further details from Dr. Saltzberg at the Texas Institute of Mental Sciences, 1300 Oursund Avenue, Houston 77030, Tex., USA.

HEALTH CARE IN CHINA

The January 1976 *Chinese Medical Journal* contains some interesting news of the development of the medical services in Hsiyang County, Shansi. It is claimed that the shortage of conventionally trained physicians has been made up by the use of 'barefoot doctors'. Prior to the Cultural Revolution, the mean physician/population ratio of the county was 1:1900. Now there are more than 600 'doctors' averaging one to about 340 persons. The barefoot doctors also participate in agricultral collective productive labour with the peasants.

There is now a medical and health network composed of county, commune and brigade treatment and prevention units. Before the Cultural Revolution, the 20 commune hospitals had only 150 beds, but now the number has doubled and there are 18 X-ray sets. 18 of the commune hospitals are equipped for general surgery and 11 have laboratories. Diseases such as measles, dysentry, influenza and enteritis have been brought under control. The journal also carries an intriguing paper on 'Acupuncture anaesthesia for open-heart operation under extracorporeal circulation'.

6-year study

The US National Heart & Lung Institute has announced that enrolment of volunteers has been completed for a major clinical trial to evaluate what effect lowering blood cholesterol, reducing elevated blood pressure and curbing cigarette smoking has in the prevention of first heart attacks and in reducing death rates from coronary artery disease and other cardiovascular disorders. The trial involves 20 centres and more than 12 500 volunteers. The clinical phase of the study will run for 6 years at an estimated cost of approximately $12 million per year. In addition to the 20 clinical centres, the programme also includes a co-ordinating centre, a central laboratory, an e.c.g. centre and support from the National Heart & Lung Institute, the National Centre for Disease Control and the Drug Supply Centre of the US Public Health Service.

Comparative study of electromedical equipment

The Hospital Institute of the Netherlands decided that their purchasing policy would be assisted by a comparative investigation of electromedical equipment, directed particularly to the value the user could obtain from the instruments. Money invested in this type of investigation would have a direct effect in bringing about a saving of expenses by preventing the purchase of unsuitable apparatus. This often occurs in practice, owing to a lack of data and criteria. Also, the results of the investigation would be of benefit to industry. The organisation of the test schedules was carried out by the TNO Institute of Medical Physics, Utrecht, with the help of the Dutch Heart Foundation and the Department of Clinical Physics of the Free University at Amsterdam.

Report 75·77 on single-channel electrocardiographs covers tests on 14 machines and divided these into three classes depending on their price. Class I, 1800–2700 Florins; Class II, 2700–3500 Florins and Class III, 3500–4200 Florins. In Class I, the Nihon Kohden Cardiofax MC12 was judged to be the best, followed by the Elettronica Trentina Cardioline ETA. In Class II, the best was the Simpliscriptor T20 of Hellige, followed by the Sharp MT22. In Class III, the Cambridge Vs4 and the Simpliscriptor EK100 were the best. When the price is not taken into consideration, the Cambridge Vs4 was the best of the series.

Monitors

The Report on cardiac monitoring systems uses four categories: Class I, 45 000 to 60 000 Florins; Class II, 60 000 to 75 000 Florins; Class III, 75 000 to 90 000 Florins and Class IV, 90 000 to 110 000 Florins. In Class I, SE Labs. was the best followed by Simonsen & Weel. In Class II, Hewlett-Packard and Philips were best, followed by Siemens. In Class III, Mennen Greatbatch was first, followed by General Electric. Further technical developments were found to be necessary, particularly with regard to the effect of eliminating disturbances of the cardiotachometer. 19 systems were tested An important conclusion was that the evaluation results are not always reflected in the price of the instrument.

Defibrillators

23 defibrillators were tested. Of the mains-powered defibrillators without synchronisation or a cardioscope, the Mennen Greatbatch 920 A was the best, followed by the Quinton 610. The best mains-powered synchronised defibrillators were, in alphabetical order, the Hellige Servocard 8707, Hewlett Packard 7802D, Mennen Greatbatch 604A, Philips SD 400 and the Siemens Sirecard S. The best battery-powered defibrillator without synchronisation or cardioscope was the Gould PD 20 and with synchronisation it was the Cambridge 73618. The best battery-powered defibrillator with cardioscope was the Gould PDS 25.

These are well produced reports with excellent documentation of the test methods. Those interested should contact Ir. J. Boter of the TNO Institute for Medical Physics, 45 Da Costakade, Utrecht, The Netherlands.

Prince Philip Award

The Plastics and Rubber Institute has announced that the first Prince Philip Award for 'plastics in the service of man' has been made to Prof. John Charnley, Professor of Orthopaedic Surgery at the University of Manchester and Director, Centre for Hip Surgery, Wrightington Hospital, Wigan. Prof. Charnley has received the award for his pioneering work with plastics materials in the development of an artificial hip joint.

TNO DIRECTOR RESIGNS

It is with regret that we report the resignation of Dick Bekkering, a former President of the IFMBE, from the post of Director of the TNO Institute for Medical Physics in Utrecht. Dick was appointed the first Director in 1956 and has now handed over to Bert Van Eijnsbergen and Fernando Lopes da Silva as joint Directors.

Over the years the Institute has produced some internationally famous research workers and research projects—the Institute's Annual Reports speak for themselves. The Institute staff have also done much to assist the Federation, particularly in supplying the IFMBE with its current Secretary General, Jan Kuiper, and his office facilities. Administering a major institute involves not only being in close contact with the various research projects and their staff and equipment needs, but also a vast amount of committee work to secure the vital financial support for new buildings and people. In addition to all of this, Dr. Bekkering was the first holder of a chair in medical electrical engineering at the University of Eindhoven, which is now occupied by Jan Beneken. Inevitably, this mountain of work took its toll on Dick and influenced his decision to stand down.

For my part, I have enjoyed the privilege of Dick offering statesmanlike advice at many Administrative Council meetings of the Federation and numerous instructive meetings at the Institute. Dick has always been a perfect gentleman and has inspired many good Dutch engineers to turn their talents to the service of biology and medicine. In all of this he has been greatly helped by his wife Elly who has endeared herself to many at IFMBE meetings.

Fortunately, Dick's wide ranging experience has not been lost to biomedical engineering as he now serves as a specialist in Hospital Technology with the Dutch National Health Research Organisation and is starting to build up a new function from nothing, as he did with the Institute. He is also working hard on the series of lectures he is now giving at the Technological University of Twente on medical technology. Most of all, he says, he would like to look into the future, to try to co-ordinate the large investments required in hospital equipment, to introduce youngsters to the marvels of medical technology and last, but not least, to 'contemplate on the philosophical backgrounds of science, the two cultures and the counter culture'. On behalf of the readers of *MBE*, I would like to thank Dick for all the help he has given to our profession and wish him every success in his new ventures.

D. W. HILL

Biomedicine and WHO

Introducing WHO is the title of an 88-page booklet produced in 1976 by the World Health Organisation. Increasingly, biomedical engineers are wondering how their skills can best fit in the aspirations of WHO and those with an interest in this subject will find it worthwhile to read this publication. The contents include: The origin and development of international health co-operation; nature and structure of WHO; scope of activities; prevention and control of specific diseases; basic activities; methods of work; building and budgeting for the programme; administrative support, WHO within the UN system; WHO–the changing emphasis. There is also a list of WHO publications and documents and WHO addresses.

WHO is much concerned with the effects of exposure to ionising radiation and works closely with: IAEA, ILO, the UN scientific committee on the effects of atomic radiation and the International Commission on Radiological Protection and the International Commission on Radiation Units and Measurements. Hopefully, ways will emerge for WHO and the IFMBE to work closely together. The booklet is available from the WHO, Geneva, Switzerland at a cost of 10 Swiss francs.

Baghdad University medical school

Together with Prof. J. P. Payne, director of the Research Department of Anaesthetics at the Royal College of Surgeons of England, Dr. D. W. Hill visited the Medical School of Baghdad University during March to lecture to anaesthetists studying for the University's diploma in anaesthetics. He also lectured to the medical students on various aspects of medical physics at the new medical school of the Al-Mystansiriyah University in Baghdad. The standard of both doctors and students was high and there was some excellent equipment. However, there is a marked shortage of technicians and facilities for equipment maintenance. This is a problem which appears to be common to nearly all developing countries.

World Health Day

Two-thirds of the blindness in the world today is estimated to be preventable or curable and 'Foresight prevents blindness' was the theme of World Health Day on the 7th April 1976. Biomedical engineers have been much concerned with the development of aids for the blind. It is a sobering thought that 50 US cents will treat a case of trachoma, $5 will remove a cataract and 12 cents will buy enough vitamin A to protect a child from xerophthalmia for a year. In the developing countries , the three great health problems related to eyesight are trachoma (about two million sufferers blinded), onchocerciasis (70 000 sightless in the Volta River basin of West Africa alone) and xerophthalmia (not less than 100 000 blind).

Ultrasonic diagnostic imaging reports

The US Alliance for Engineering in Medicine & Biology reports that it has completed two final reports: A 5-year research and development agendum for ultrasonic diagnostic imaging technology, and radiologic and radioisotope imaging techniques. The technology procurement project has a 50-page executive summary on the acquisition of technology by federal hospitals in final draft and the civilian handbook on technology procurement by the Health Care Institution is in the first draft of five of its 12 chapters. The information exchange and problem assessment has five tasks: (i) a directory of federal programmes in medical ultrasound (first issue January 1976); (ii) organising instrumentation conferences at scientific meetings; (iii) alerting institutions teaching technicians to the new career in ultrasound; (iv) international technology transfer; (v) guidelines for setting up and managing a clinical ultrasound laboratory. The international technology transfer task is resulting in a workshop in Cairo, Egypt, from March 6th to 11th 1976 and the setting-up of a National Science Foundation—Cairo University Technology transfer focus.

Two radiation reports from US council

Report no. 45 from the US National Council on Radiation Protection and Measurements ,'Natural background radiation in the United States', is concerned with the assessment of the radiation dose to the population from natural background radiation. Included are the absorbed doses due to radiation from cosmic sources, radionuclides in the earth, inhaled radioactivity, internally deposited radionuclides and fall-out from nuclear weapons tests.

Report no. 46, 'Alpha-emitting particles in lungs', specifically addresses the question of whether the current practice of averaging over the lung the absorbed dose from particulate alpha-emitting radionuclides is a defensible procedure in the practice of radiation protection and whether exposure limits derived on this basis are more or less conservative than those that might result from a precise consideration of the spatial distribution of dose. This report compares the observations in experimental animals and in man with theoretical considerations and concludes that current practice of averaging the absorbed dose over the lung is a defensible procedure.

The cost of Report no 45. is $5 and that of no. 46 $3 from NRCP Publications, PO Box 30175, Washington DC, 20014, USA.

Book information service

International Book Information Services provides a selective book-information service enabling publishers to send information on new books and journals to those likely to be interested. The service already covers higher education, science, the professions, industry, commerce and government throughout the world. It is now planned to cater for those working in medical and biological engineering. Further details from: H. Erdohazi, International Book Information Services, New Building, North Circular Road, Neasden, London NW10 0JG, England.

Scanner and ultrasound aid tumour diagnosis

The January/February 1976 issue of the *Massachusetts General Hospital News* contains an interesting article on the use of a combination of ultrasonic B-scanning and the EMI X-ray scanner to delineate the extent of a teratoma (a developmental tumour formed before birth from two or more types of misplaced tissue). The infant was full term and was born with a tumour behind his right eye, the tumour being larger than a lemon. The growth led to a severe proptosis, a forward protrusion of the eyeball from its socket. Ultrasonographic investigations at the Massachusetts Eye & Ear Infirmary confirmed that the mass within the orbit was a tumour and disclosed that it was cystic in nature. The outlook was death within a year unless the tumour was removed. A subsequent EMI scan corroborated the earlier findings that a cystic mass was behind the baby's right eye and pushing the eye forward and that the growth was confined to the socket area.

Surgery

When the child was seven days old, the growth was surgically removed in about 90 min without complications or evident injury to the eye structures. Dr. Dallow, Director of the infirmary's ultrasound laboratory, said that the ultrasound and EMI scanner techniques have revolutionised the diagnosis of tumours such as this. The combination provides much more information than could ever be obtained from other sources.

Bioengineering at Milan

Roberto Fumero has written to say that there is a flourishing bioengineering teaching course at the Milan Polytechnic. The interests of the bioengineering section are divided into two main sections: the study of the cardiovascular system and of the machines and prosthetics connected with it; and the applications of computing to thermography, isotope scintigraphy and the study of cardiovascular system parameters.

Dr. Fumero's own research embraces the design and evaluation of cardiac valvular prostheses, the study of membrane oxygenators and the energy problems of the artificial heart. Further information from Dr. Roberto Fumero, Politecnico di Milano, Instituto di Macchine, Piazza Leonardo da Vinci 32, 20133-Milano, Italy.

EUROCON '77

The 3rd Eurocon meeting will be held at Venice, Italy, from the 3rd-6th May 1977. There will be a session on 'Communications and signal processing in medicine' covering: communication in health services; telemedicine; signal processing in medicine and communication in the living system. Further details from Eurocon '77, c/o AEI, Viale Monza, 259, Milan 20126, Italy.

Computerised X-ray interpretation

An automated X-ray-interpretation system is under development by a team of radiologists, electrical engineers and clinical scientists at the University of California College of Medicine at Irvine. A single X-ray film is translated into a mosaic of a million squares and the density of each square in relation to the surrounding squares is analysed. Contrasts between particular structural areas are compared with patterns stored in memory to provide a preliminary machine judgement on the presence of abnormal patterns and as to whether further manual viewing is needed. Large-scale screening programmes can require that radiologists screen 200 to 300 films per day, and it is hoped that computer analysis will relieve this burden.

SYSTEMS FAILURES OF TECHNOLOGY IN MEDICINE

PAMELA ROGERS

A building on fire is in the same class for expeditious treatment as a patient suffering coronary thrombosis or cardiac arrest. Here, in Edinburgh, it was the young James Braidwood who, in 1830, at the age of 24, organised the Fire Service. Later, he founded the London Fire Brigade. It was a case of new ideas with old technology. At the scene of action, the firemen had to dig up the road to find the main and call in bystanders to pump the water. Sailors made the best firemen as they were used to climbing rigging, and so managed the ladders well.

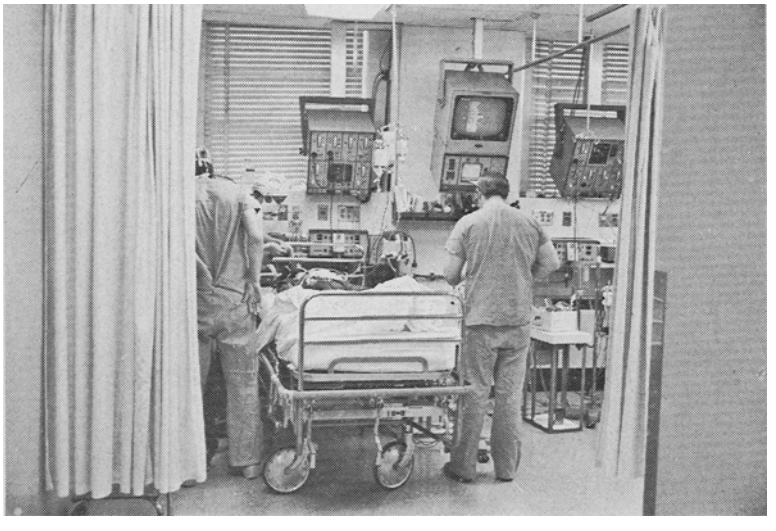

Fig. 1 A patient submerged by machines in an intensive therapy unit

(Photo. Geoffrey Rivett)

In coronary care and intensive therapy units, nurses make good operators because they are used to handling and comforting patients, encouraging them to be receptive to their medical treatment, and monitoring their privacy. They are already used to making frequent small manipulations of the patient's personal external environment to his advantage.

Technology has failed in medicine when it has been concerned too much with machines and not enough with people. A patient cannot be in harmony with either his internal or external environment when he is submerged by machines, and perhaps hardly visible (see Fig. 1).

New technology does not come without its ramifications, including problems of human factors and work-station layout for patients and staff, as well as equipment design, maintenance and replacement. Expectations are likely to be high and, when things go wrong, disappointment results.

Human factors and work-station layout

I saw recently, in a coronary care unit, that a nurse had considerable difficulty in moving the heavy crash trolley to the scene of action, in the case of cardiac arrest. Furthermore, the drawers were low and the contents required simultaneously, so that it was more practical to remove them altogether (see Fig. 2). Staff said that several small, light, standard trolleys, as used in the rest of the hospital, could be placed more strategically among the members of the emergency team and would have been a better and cheaper solution. Some special trolleys for such equipment may cost up to £900 each. In this case, the medical staff alone had selected all the high-technology equipment, although the nurses, who handled the equipment more frequently and knew it well, would have had suggestions to make.

A further problem was that the time taken in removing the bedhead to allow access for intubation of the patient, during cardiac-arrest treatment, was too long with the type of bed which had been chosen. Once a new hospital is opened, it may be a considerable time before further

Paper presented to the controversy session, *Technology in medicine—success or failure*, of the 15th InternationalConference of the Biological Engineering Society, Edinburgh, August 1975.

money is available and equipment can be replaced. Mistakes in equipment have to be managed.

There was a 2-monthly meeting of all staff concerned with coronary care, but it could not include the technical staff because there were none. The doctors were good at minor adjustments of equipment and the electricians at repair jobs, in competition with the rest of the hospital. Every thoughtful nurse of course has her own oil can. Alternatively, in this unit, if fixed equipment failed in one bedspace, the patient was moved to another; but it does not take much imagination to realise that this might not always be possible. The lack of proper technical staff and a program of planned maintenance of equipment worried the nurses. If a nurse is anxious, this is quickly conveyed to her patient.

Intensive-therapy-unit technical staff recently showed me some of their workstation problems. Equipment repairs were done in a cupboard and patient ventilators were cleaned in the disposal room intended for dealing with bedpans. The problems had occurred as a result of accommodating a new, and expanding unit in an old building. When staff feel hampered in doing their best, and perhaps dissatisfied, the problems should be taken quickly to a mixed professions unit meeting and considered jointly.

Technology in planning

Equipment storage is another source of concern for medical and nursing staff. Expensive items do not look comfortable huddled together in a corner, or sharing a cupboard with domestic cleaning items. My main reason for describing these problems is that opportunities for involvement in planning, should be seized by biological engineers and technical staff. New hospitals and modifications to existing buildings do not come about every day. The opportunity to take part may come only once in a working lifetime.

In the NHS, health-care planning has been effected on a joint professional basis since 1959, when a team was set up, sponsored by the Nuffield Foundation, to investigate the functions and design of hospitals. Basic teams comprise a doctor, nurse, architect, administrator and engineer, but the information net is widely spread. In good planning, the proposed operational policies are fully explained to the potential users and, in addition, specialists of various disciplines, including the fire services, are drawn in. If the draft guidelines for corporate planning, outlined in 1974 by the DHSS, are to be effective, the voice of scientific and technical staff should be included at both policy formation and practical levels. Standard policies for planning have to be updated in the light of new information and agreed procedures.

During a project, drawings which may reveal the semantic differences between team members, should be carefully watched to prevent errors, particularly if there are changes of plan. It is possible for a new coronary-care unit to open with inconvenient pressure for piped air, doors which barely take the larger machines and no windows. Even when systems are standardised, planning is always a watchful process.

Environmental domestic touches

I learned recently that the bystanders, that is the patients' visitors, in one intensive-therapy unit were not always a help to staff in raising the morale of patients, as they fainted fairly regularly, from alarm at seeing their loved ones surrounded by machines. I suggest that there is a strong case for the careful briefing of visitors before they enter the working zones, for improving the appearance of equipment and for achieving some domestic touches in the decor, wherever this is practical, not as an extravagance but as a necessity. Some units in the USA have wallpaper and carpets. Perhaps fabric or disposable curtains at the windows and wall and ceiling pictures could be considered. I noticed that an extremely ill patient whose visual range was determined by his attachment to machines busy measuring, regulating and replacing his body functions, could see part of the ceiling when he occasionally opened his eyes. I felt that he might have been refreshed in his ordeal, by a ceiling painting. This is not a new concept. Charles I hit on the idea in 1629 and Rubens carried it out at Whitehall Palace in London. Cave dwellers in France tried it 25 000 years ago. Artists, as well as designers, should be involved in building the patient's environment.

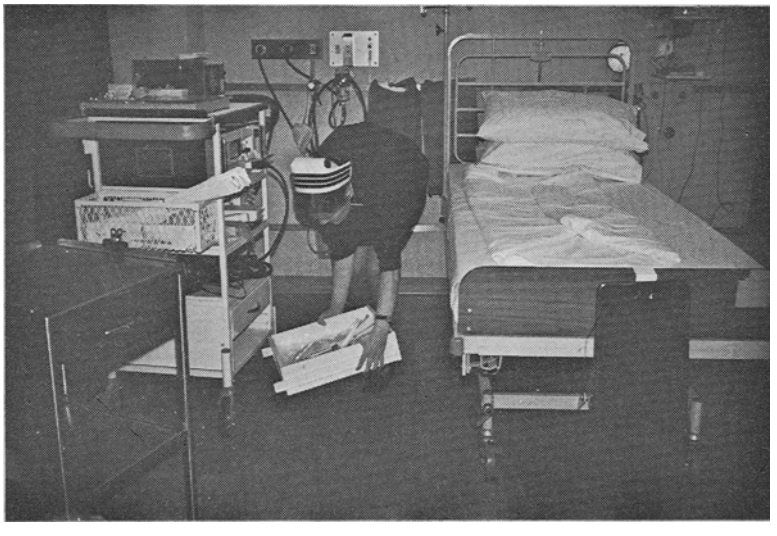

Fig. 2 Expensive crash trolley with inconvenient drawers in a coronary care unit

(Photo. Pamela Rogers)

Education

Some anxiety and human error may be overcome by education. It has been found that fewer drugs were required to maintain a patient's synchronisation with a respirator when he felt confident through having an experienced nurse with him, than when he did not feel secure in his nurse's knowledge of the equipment. Such a situation may arise if staff have to be replaced from elsewhere in the hospital or by outside agency staff, perhaps owing to sickness. Apart from special teaching on the job, and the post-registration courses which are available for nurses, perhaps there should be an introduction to technology in the basic curriculum. For example, student nurses nowadays may come in contact with patients with cardiac pacemakers in any part of the hospital, including the geriatric unit, whereas this would have been unlikely only a few years ago.

All relevant hospital staff in a high-technology area should know the equipment. This includes X-ray departments, where it is unlikely that another doctor would be quickly available if, for example, the doctor operating a complicated machine suddenly became ill. The nearest person undoubtedly would be a radiographer. This education does not always take place and a more positive approach is required, particularly in view of health and safety factors.

Doctors themselves have told me how unfamiliar the symbols on some X-ray diagnostic equipment are. Such equipment has to be positively learned and before many more symbols arrive, the effects of stressful situations on their interpretation, should be considered seriously. Symbols appear in everyday life. However, Ames has shown us with his distorted room experiments that the perception and judgement of the individual are open to error and go wrong when the truth seems unlikely. The symbol source book by Henry Dreyfuss, the industrial designer, has an index in 18 languages. A planning doctor, would need to know at least 480 symbols from the book, 254 for medicine and 226 for architecture. Currently an International Electrical Commission is considering the problem, as are four working groups of the Electrical Equipment British Standards Institution Committee.

The gap between high and low technology

In the NHS of the UK, few patients are reached by technology. One in ten of acute admissions, that is 250 000 patients, experiences treatment in the field of high technology. Even there it is often frustrated because of lack of thought about the impact on nurse, patient and relatives.

The NHS was reorganised in April 1974, by Act of Parliament, and the consequential integration of hospital and community services will inevitably swing some of the emphasis and some of the technology away from hospitals. A recent study of mortality rates for patients with coronary thrombosis has shown a figure for home care of 10%, which is the same as in a coronary-case unit.

For disabled persons, optimum mobility is the keynote and an important way of raising morale and reducing dependence on relatives or neighbours and on health and social services. Frequently, items of low technology, such as a height-adjustable or profiling bed, may allow a patient to get up by himself, or at least to change his position, when he is alone.

The caring person also may need help. I met an elderly patient recently who suffered from rheumatoid arthritis and was helped by her husband at home. However, the situation was more complicated than it appeared. Although 15 years younger than his wife, her husband had a cardiac pacemaker, high blood pressure and also had undergone recent prostatectomy. His treatment at one of the most famous graduate medical centres, would have been greatly helped by better arrangements for his wife, whom he assisted with difficulty, every day, to and from a settee which was far too low. There should be proper ongoing data concerning each disabled person's range of daily living activities, so that opportunity to extend the range, may be taken early. Furthermore, the surgeon may wish to read it, when his patient has a heavy caring role in the family.

Bridging the gap

Spin-off from high technology may be applicable to medicine. The National Aeronautics and Space Administration in the USA has set up a technology-utilisation office. Factors relating to reliability, quality and system safety (known as R, Q and S), are translated for non-aerospace industries. The office has also worked with the Veterans Administration, which has now developed preventive-maintenance programs for about 56 classes of medical instrumentation. Currently, NASA's jet-propulsion laboratory is working with the Hospital Council of Southern California to develop an R, Q and S management plan for their 243 hospital systems. The Systems Reliability Service of the United Kingdom Atomic Energy Authority, has a close working relationship with the DHSS, a number of RHA's and some manufacturers of medical-engineering equipment. A number of studies involving systems in the NHS have been carried out, in areas both personal to the patient, and in overall relation to the major hospital complex.

It is essential to the useful function of all equipment for use in health care, that consideration is given to its full context. This includes other related equipment and the total impact on operators, users and the relatives of users. The context also must include the organisation in order that feedback and exchange of information may occur and that maintenance may be programmed. Biological engineers undoubtedly discover factors which could improve patient care, and they cannot be by-standers. Sometimes it is necessary to tread new ground in communications, particularly if one's appointment is an academic one, alongside the NHS. This is not always a comfortable process, but there should not be too much hestitation when the common denominator is the patient.

Attempts should be made to bridge the widening gap between spectacular high technology in some hospital units and the low technology of general medical practice and, even more conspicuously, of the average home.

There is not much wrong with technology, except that too much of it is applied for the gratification of the innovator, with little regard for the basic needs of patients, who are the long-suffering silent majority.

Reference

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new developments

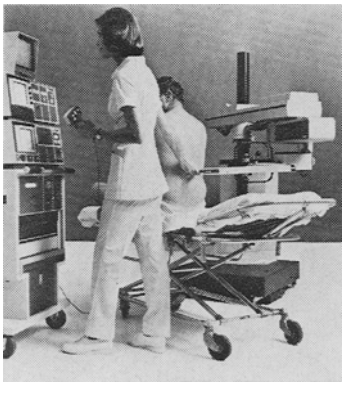
VENTILATION MONITOR

The model LS75 is a solid-state medical calculator which automatically measures flowrate through a patented ultrasonic vortex generating sensor. The unit displays consecutive or cumulative tidal volumes, minute volumes and respiratory rate over a 60 s period. The unit is powered by a Ni–Cd battery pack which is sufficient for 100 complete measurements. It can be fully recharged in 3–4 h.

Cardio Vascular Instruments Ltd., 37 Hydeway, Welwyn Garden City, Herts., England

LAMINOGRAPH

Known as the Echoview TM System 80L Laminograph, this ultrasonic-laminography unit developed by the Picker Corporation of America, allows noninvasive and painless examination of most abdominal organs. The unit produces the clinical images in eight shades, ranging from black to white, or it can be operated as a straight bistable system. It also allows the operator to intensify echoes from selected points along

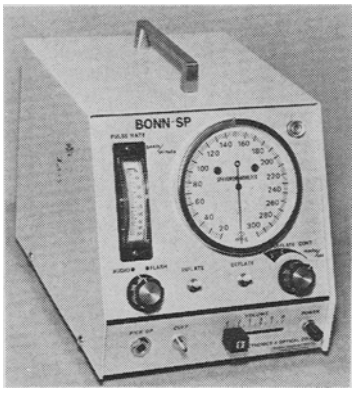


the sound beam. This technique is called depth-selective amplification (d.s.a.). A scanning arm reduces operator fatigue to a minimum and offers the advantage of scanning patients in any position; prone or supine, sitting or standing. Echoview system 80L has a complete range of image recording equipment options which include 70 mm cameras, multi-format camera, patient identification keyboard, grey-scale video hard-copy recorder and videotape cassette recorder. A full range of scanning transducers is also available enabling maximum performance for each application.

GEC Medical Equipment Ltd., Nuclear Therapy and Ultrasound Division, PO Box 2, East Lane, Wembley, Middx. HA9 7PR, England

SPHYGMOMANOMETER

For fast routine use, i.c.u., mass screening, clinical research etc., this unit offers fully automatic inflate/deflate, with simultaneous indication



of pulse-rate frequency. Additionally, there is an optional operation of switch-in to a built-in speaker, which gives several thousand times amplification of the actual Korotkoff sounds, from pre-systolic to first 'thud' to last 'blowing sound'; this feature has a volume switch, doubling as a sensitivity control. The instrument will pick-up a diastolic as low as 20/30 mmHg. No stethoscope is required; as the cuff is deflated, systolic through to diastolic is determined by flashing light on the 10 cm aneroid dial. At systolic, the pulse-rate monitor commences to indicate beat per minute and will hold the reading until the instrument is switched-off. Dimensions are $177 \times 198 \times 205$ mm, weight is 7·5 kg.

Andrew Stephens (1974) Co., Medical Electronics, 41 Dickson Road, Blackpool, Lancs., England

PERFUSION INDICATOR

This instrument can optically inspect the upper part of the ear (pinna) and indicate the level of a patient's blood flow there. Since blood flow needs to be high to make accurate measurement with an ear oximeter, the

perfusion indicator is designed to detect patients with sufficient peripheral vasoconstriction to limit oximeter application. To measure flow, an earprobe is placed over the pinna. With a light source and a

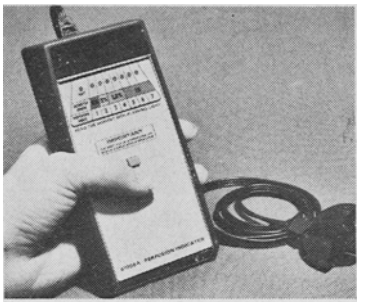


photo cell located on either side, light is transmitted through the ear and is measured. In less than ten seconds, after pressing the key of the battery-operated instrument, a row of l.e.d.s gives a reading which is a measure of blood flow. With adequate perfusion, the last of the lamps normally flashes at the subject's heart rate.

Hewlett–Packard Ltd., King Street Lane, Winnersh, Wokingham, Berks., England

MONITOR-DEFIBRILLATOR

The BD400 monitor-defibrillator has a low-power consumption 'monitoring' mode and an automatic disarming circuit which discharges the high-voltage capacitor in monitoring and off positions. It also has automatic switchover from internal to

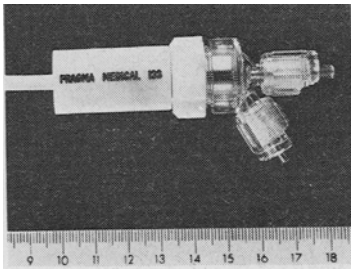
external supply and a 1 mV differential e.c.g. output. An operator's handbook for the BD 400 has been produced in English, French, German, Spanish and Dutch, it has been written in such a way that in those countries where the Red Cross, ambulance, fire brigade, police and first-aid personnel are empowered to use a defibrillator, the booklet provides vital information using a minimum of technical jargon.

The booklet has been compiled under the direction of a Dutch heart surgeon and so is also technically correct in content. It defines fibrillation and its consequences as regards the victim, and explains remedial action to be undertaken under these circumstances.

Philips Medical Systems, Eindhoven, The Netherlands

BLOOD-PRESSURE TRANSDUCER

The model AV300 blood-pressure transducer is for use in intensive care and post-operative monitoring environments. The transducer features electrical isolation to 10 000 V d.c., a typical leakage current of 2 μA at 250 V, overpressure without damage



of up to 10 000 mm Hg, a frequency response from d.c. to 80 Hz, and a pressure range to 300 mm Hg. Excitation required is 1 to 10 V, a.c. or d.c. and output is 50 mV or optional 15 mV. The device uses a patented silicon beam and diaphragm construction. This technique permits patient isolation up to 10 000 Volts d.c. and offers a positive mechanical stop to prevent damage at pressures up to 10 000 mm Hg. Either arterial or venous pressures can be measured.

Pragma Medical Systems Ltd., Middlesex House, 29 High Street, Edgware, Middx. HA8 7UU, England

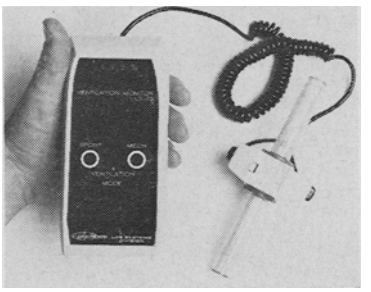
PORTABLE PRINTING CALCULATOR

Operated by rechargeable battery or mains, the HP91 weighs 1·13 kg and measures 220 × 203 × 64 mm. The calculator is a more powerful version of the HP45 pocket calculator but with 16 addressable memory registers instead of 9. It performs regression and linear estimates, has three 'percent' functions and keyboard buffering seven keystrokes deep for high-speed data entry. The built-in silent printer will print and display in fixed decimal, scientific and engineering notation. The HP91 costs £310 including v.a.t.

Hewlett–Packard Ltd., King Street Lane, Winnersh, Wokingham, Berks. RG11 5AR, England

INFANT PRESSURE VENTILATOR

The BP200 infant pressure ventilator is an electronically controlled and pneumatically operated time-cycled



device. It is a constant or continuous flow generator which functions as a controller. The ventilator can provide zero end expiratory pressure, positive and expiratory pressure and continuous positive airway pressure. a combination of techniques termed intermittent mandatory ventilation or an inspiratory plateau. During all modes of operation the clinician can limit the amount of pressure delivered by adjusting the pressure-limit control. The respiratory rate is 1–60 breaths/min and the flow is 0–20 l/min.

Bourns Life Systems, 9335 Douglas Drive, Riverside, Calif 92503, USA. UK distributor: *Cardio Vascular Instruments Ltd., 37 Hydeway, Welwyn Garden City, Herts. England*

OUTPUT MODULE

The 4001 output module from Gould Advance Ltd. provides a 'hard-copy' output from the recently introduced OS4000 digital storage oscilloscope by producing a permanent record of a stored trace on any X–Y, T–Y or strip-chart recorder. Digital outputs are also provided. The unit is housed in a 3·75 cm-high module which fits underneath the OS4000.

Gould Advance Ltd., Roebuck Road, Hainault, Essex, England

book reviews

Biomedical sciences instrumentation Vol. II Ed.: K. C. Rock, *Instrument Society of America* (*Wiley*), 1975, 616 pp., £7·35

This book is a collection of the papers presented at the 12th Rocky Mountain Bioengineering symposium and the Twelfth International ISA Biomedical Sciences Instrumentation Symposium.

The 36 papers included cover instrumentation and measurement, systems analysis, telemetry, computer applications, health care, clinical instruments, prosthetic devices and the behavioural sciences. The overall scope of the papers is wide and the subjects chosen are pertinent to the problems being encountered in biomedical engineering. The presentation is good for a book which is produced by copying the original manuscripts presented by the authors and the editor, K. C. Rock, is to be congratulated for insisting and getting a well produced book.

This record of the 12th proceedings maintains the high standard of its predecessors and as I wrote after reading the 11th proceedings, I wish I had been there.

J. A. BUSHMAN

Operational amplifiers: theory and practice by James K. Roberge. *Wiley*, 1975, 659 pp., £11·95

This text book treats an operational amplifier not only as a versatile circuit element but also as any other dynamic system. Most of the materials used in this book are evolved from two courses on operational amplifiers and feedback systems that were started by the author at Massachusetts Institute of Technology seven years ago.

In this volume Dr. Roberge has clearly shown how valuable the feedback concept can be regarding the design and application of an operational amplifier. He maintains his philosophy throughout the book by not providing details of any ready-made circuit for particular cases but by using an operational amplifier as an 'instructional vehicle' to illustrate concepts valuable for imaginative and original design effort in the general area of electronic circuit and system design. As he puts it, 'the successful design almost always involves combining bits and pieces, a concept here, a topology there, to ultimately arrive at the optimum solution'.

The book can be divided into three main sections. One deals with the application of classical feedback concepts to operational amplifiers, the other covers the circuit techniques needed to realise an operational amplifier and the rest is the various applications of operational amplifier as a data-processing element.

There are 13 chapters, including an introductory chapter on closed-loop gain. The remaining chapter headings are: properties and modelling of feedback systems; linear system α-response; stability; basic and advanced compensation; nonlinear systems; direct-coupled amplifiers; operational-amplifier design techniques; integrated-circuit operational amplifiers; basic applications and advanced applications. Each chapter again is adequately subdivided and presented in careful sequence. An average of 13 problems and 31 illustrations are provided with each chapter which also encourages reading! However, very few references indeed are given, which may disappoint research workers and advanced students.

Although written for a 1- or 2-semester course for senior undergraduate and graduate electrical engineers, this is a volume that deserves to be studied by all those concerned with operational amplifiers in any way. The presentation is clear and detailed. However, a basic knowledge in active electronic devices and some familiarity with s-plane concepts are the necessary background required.

S. N. MOHAPATRA

IEE medical electronics monographs 13–17, Eds.: D. W. Hill and D. W. Watson, *Peter Peregrinus Ltd.*, 1975, 182 pp., UK £8·50, Overseas (excluding the Americas) £9·95

This set of fine monographs is the third in the series under the editorship of Dennis Hill and Bernard Watson. The monographs published previously have been characterised by thorough coverage of specific topics and extensive bibliographies. The present monographs perpetuate this tradition.

The first monograph, by Anthony Furness, entitled 'Implantable cardiac pacemakers and the post-operative requirements for assessing pacemaker performance', is exceptionally complete, ranging from a statement of the basic physiological considerations to a comparison of features incorporated in the pacemakers marketed by 13 different manufacturers. A partial sampling of the topics discussed include indications for pacing, stimulation phenomena, interface effects, pacing techniques, asynchronous pacemaker, audiovisual synchronous pacemakers, ventricular triggered pacemakers, ventricular-inhibited pacemakers, audiovisual sequential pacemakers, paired and coupled pacemakers, electrode lead assembly, unipolar and bipolar stimulation, techniques of electrode insertion, pulse generators, pulse characteristic, electrical interference, power supplies (mercury-zinc, nuclear, lithium-iodine), complications of cardiac pacing, and assessment of pacemaker performance. This excellent coverage also includes a current bibliography containing 163 references.

The second monograph, entitled 'His bundle electrocardiography' is also by Anthony Furness. His coverage of this important subject is also exceptionally complete and includes 155 references. Both of these monographs are exceptionally well done and easy to read.

The third monograph 'Electrical aspects of orthotics' is by A. Kralj. The emphasis is on functional electrical stimulation (f.e.s.) and the use of feedback to control orthotic devices. The introduction presents definitions and a block diagram of a universal orthosis. The discussion then proceeds to an examination of control information sources and signal pickups, artificial sensory feedback-information selection and transmission, electrodes for f.e.s., both for surface application and implantation, and the presentation is

concluded with specific applications of f.e.s. to the upper extremities, the lower extremities, and for paraplegic patients. A comprehensive bibliography of 85 references is included.

The fourth monograph, by David Rowan, is addressed to the assessment and treatment of impaired bladder function by electronic means.

The physiology of the bladder is discussed first, followed by a description of methods and devices in assessing the type and degree of impairment. Attention is then turned to the treatment of incontinence by electrical means in which specific details of implantable stimulators are given including circuit diagrams, stimulus parameters, and surgical techniques. The problems that can arise with the implant (technical faults, extrusion and infection, and electrolysis) are outlined. Clinical results are also reported. The presentation concludes by considering the problem of urine retention, which is not nearly as simple to solve as one might at first suspect. There are 106 references.

The final monograph, by Max Valentinuzzi, is somewhat shorter than the others (23 pages and 63 references) but contains a concentration of information expressed, in large measure, mathematically. The subject is systemic blood pressure: control parameters. After a historical introduction, the variables of the cardiovascular system are identified and defined. The dependence of blood pressure on five physiological variables (heart rate, stroke volume, peripheral resistance, relative blood volume, and compliance of vessels) is elaborated. The mechanisms that maintain blood pressure, either directly or indirectly, by acting through the physiological variables, are divided into four groups (neural, endocrine, renal, and local). Each of these groups is further subdivided. A quasilinear model of blood pressure control is presented in which values for parameters are assessed and tested in anaesthetised dogs.

Each of these monographs provides the reader with a good background and up-to-the-minute assessment of developments in each of the special fields. The editors are to be commended for bringing together this group of authors. This small volume contains a great amount of readable information and is a bargain.

L. E. BAKER

Principles of applied biomedical instrumentation (2nd Ed.) by L. A. Geddes and L. E. Baker, *Wiley Interscience*, 1975, 600 pp., £13·30

This is a great book. My only complaint is that it does not include enough. This is perhaps an unfair criticism as the book would grow to several times its 600 pages if it were fully comprehensive. For example, the first chapters are devoted in detail to the different types of transducers that are available, including those which can be used for measuring pressure, but nowhere in these chapters are there any details of the effects of the catheter which may be used to connect the transducer to the system being measured. The omission was obviously deliberate since the book is clinically orientated and it treats the instrumentation in a rather abstract way and does not relate to the actual systems under investigation.

The eight chapters on transducers are followed by chapters on electrodes, impedance and bioelectric events, in increasing order of length.

All the subjects in the book are dealt with very thoroughly and in this respect it would be difficult to think that these could be done better. Perhaps the third edition will contain a chapter on gas analysis.

This well produced book is strongly recommended.

J. A. BUSHMAN

Advances in pacemaker technology Eds.: M. Schaldach and S. Furman in collaboration with F. Hein and R. Thull. *Springer* 1975, 515 pp., US $25

This is the first of a series under the general title 'Engineering in medicine'. The series is intended to promote interfaculty exchanges of ideas and is aimed at both clinicians and scientists concerned with biomedical engineering. Later volumes in the series will deal with the problems of knee and hip-joint replacements and artificial heart valves.

The book contains 34 papers based on lectures given at the International Symposium on Advances in Pacemaker Technology held in Erlangen, Germany on the 26th and 27th September 1974, under the auspices of the Societas Physica Medica, Erlangensis. 29 of the 34 papers in the book were presented by West German and American authors and five of the papers are associated with the Betacel pacemaker. The book is not a complete conference report in that two papers appear to have been omitted and none of the discussions at the conference have been included.

There are six chapters and parts of each chapter will be of interest to scientists and bioengineers who are associated in any way with cardiac pacing.

A number of papers deal with the more fundamental aspects of pacemaker electrodes: the electrophysiological aspects of cardiac stimulation; electrochemical aspects of electrodes; tissue reaction at electrodes; changes at the tissue/electrode interface following implantation; and endocardial pacemaker sensing signals. A review paper with a more practical bias discusses materials and designs in current use and outlines the methods used for optimising the designs of the electrodes.

Pulse generators are considered by many authors. There is an excellent review paper on electronic circuits used in pacemakers, but nothing is included on the technology of pacemaker circuitry. Similarly, no paper has been included on the methods of encapsulating circuitry and batteries, or on the problems which arise in interconnecting these parts. Instead the main emphasis has been placed on the pulse generator power sources. Another review paper considers briefly the different forms of power sources. Another paper discusses the design criteria for the β-voltaic nuclear battery whilst another discusses the different thermoelectric conversion systems which are used with plutonium powered generators.

One chapter is devoted to clinical experience with longer-life pacemakers. In a paper dealing with lithium iodide generators, strange terminology is used to refer to the different parts of an implant lift-time.

Little new data is given on clinical experience with plutonium powered pacemakers, but three papers refer to experience with promethium powered pacemakers.

There is an excellent review paper on the 'Interpretation and implementations of internal radiation protection standards for cardiac pacemakers'. The author concludes that nuclear pacemakers which are designed and used in accordance with NEA standards appear to provide adequate safety for the protection of the public.

More than a decade of implantable

pacemakers ought to have produced a mass of statistics, both medical and nonmedical, on all aspects of cardiac pacemaking. Pacemaker patient survival curves and such data appear (as is usual) in abundance in several papers, but there is little data on pulse generator implant lifetimes. Only one paper gives new data in this respect. Another paper shows how implant lifetimes have been marginally improved in clinical practice by reducing the current drain on the mercury cells. A much less satisfactory paper gives results on 'pacemaker longevity' and 'function lifetimes' which have been calculated using a biomedical computer program. These terms have not been defined and can therefore only lead to further confusion in an already generally confused situation.

Several papers discuss the more medical aspects of cardiac pacing: indications for pacing, methods of pacing, techniques of implantation, electrocardiograms of pacemaker patients etc.

In summary, the book is a useful, though incomplete, record of the pacemaker meeting held in Erlangen. As such it is a valuable contribution to the pacemaker literature and is recommended as a reference book for all those who are seriously involved with cardiac pacing. It certainly contains much that will be of interest to clinical scientists and bioengineers. G. D. GREEN

Handy matrices of unit conversion factors for biology and medicine by C. J. Pennycuick. *Edward Arnold*, 1974. 47 pp., £0·95

This is an excellent little soft-covered book which gives a generous selection of conversion factors. Parsecs to thousandths of an inch, morgens to circular mils, cubic miles to US gallons, factors converting time, speed, mass, density, inertia, force, weight, pressure, work, power, temperature and more, are all here to five significant figures and an exponent. There is a brief introduction and a good index. Future generations will look at this book and marvel at the mess of mensuration that made its use mandatory. Meanwhile this book represents the best solution there is.

I do not know what Dr. Pennycuick's royalty will be, but for my money his name deserves to be a good omen.

JOHN A. BUSHMAN

Holography in medicine, Ed.: Pal Greguss, *IPC Science & Technology Press*, 1976, 149 pp., 165 illustrations, £9

This is the proceedings of an international symposium on holography in biomedical sciences held in New York in 1973 to commemorate the 25th anniversary of the discovery of holography by Dennis Gabor. It forms a very readable introduction to the field, suitable for a wide range of readers. Not the least advantage of the book is its well bound A4-size format, which reduces the need to refer to diagrams over the page and permits clear comparisons of illustrations side by side. This is particularly important, since the number of illustrations exceeds the total number of pages. The style is generally good and the presentation clear though frequently brief. Where the results are of limited use these are presented openly, e.g. the neat but unconvincing exercise in filtering a rabbit out of an image full of hats (p. 39 *et seq.*).

The book is in four distinct sections. The first, on the basic principle, includes appropriately a paper by Dr. Gabor himself in the form of a masterly summary of progress to date, and there are papers covering the fundamentals of acoustic, microwave, microscopy, computer and image-processing applications of holography. The second section, on diagnostic uses of holography, deals with particular systems as in radiology and nuclear medicine, including dynamic radiography and interferometry. There are also comparisons between holographic and other types of 3-dimensional display. In this book details of proper exposure and processing are rightly excluded and would-be holographers will have to look elsewhere for the necessary experience to produce clinically useful results. A small section follows devoted to ophthalmology holography including the use of a fundus camera, an ingenious application of moving speckle patterns to detect aberrations, and an attempt to deblur the image seen through an *in vitro* cataract.

Perhaps the most striking section of the book is that on so called 'biohologrаphy' where holographic principles are applied to the analysis and modelling of the sensory processes. The neurological, auditory, and visual pathways are treated in this fashion, as are brain functions such as memory, information processing and retrieval. This represents a significant contribution towards quantification of these elusive functions.

One does not gain the impression from this book that there are still so many solutions chasing a problem as was the case in the 1960s, or that it will be 25 years before the next such symposium is held, hopefully of the same high standard. These proceedings are of interest to the biomedical scientist and advanced clinical student alike and in view of their topicality should enjoy considerable success.

B. E. KEANE

An introduction to biomedical instrumentation by D. J. Dewhurst, *Pergamon*, 2nd ed., 1976, 263 pp

The first edition of this well known book by a former President of the International Federation for Medical & Biological Engineering was published in 1966 under the title of *Physical instrumentation in medicine and biology* and the 1976 version appears as a low-priced Student Edition with a durable cover. Those who have had the privilege of knowing David Dewhurst over the years will recognise in this book the style of an experienced teacher and biomedical engineer. The first chapter starts off in a down-to earth fashion with a concise exposition of instrument construction. This is followed by chapters on: current, voltage and resistance; meters; the potentiometer and Wheatstone bridge, alternating currents; capacitance; inductance; diodes and transistors; field-effect transistors; power supplies; operational amplifiers; frequency response and filters; the cathode-ray tube; oscilloscope amplifiers; time-base generation; pulse generation—the astable multivibrator; the monostable multivibrator and Schmitt trigger; optoelectronics; binary logic; measurement of radioactivity; recording from living tissue; electrical safety; regulated systems; transducers; some biological analytical methods; storage and processing of data.

It is obvious that much has had to be telescoped to get all of this into 263 pages and as with many 'introductory' books it is hard to draw up a list of contents suitable for both life scientists and clinicians. However, the style and the wealth of practical information between the

covers of this book make it eminently suitable for reading by research students and clinicians confronted with the need to make an initial systematic study of instrumentation techniques. Each chapter concludes with a valuable set of practical exercises. Bostonians will be intrigued to see that Longfellow's celebrated account of Paul Revere's midnight ride is included as a question on digital signalling!

On previous occasions I have stated that it is an excellent thing to see senior biomedical engineers producing books which plough some of their experiences back into the training of new entrants to the profession. David Dewhurst is certainly adding to this tradition.

D. W. HILL

Physiology—a clinical approach, by G. R. Kelman, *Churchill Livingstone,* 1975. 215 pp., £2·25

The appearance of the second edition of this excellent little book only three years after the first edition, is proof of the popularity it has already acquired. Nowadays much lip service is paid to relevance and to integrated teaching in medical education and it is rarely that one finds these precepts put into practice as they are in this book. Prof. Kelman has wisely not attempted to produce a text book of human physiology in health and disease but rather, by selecting a series of common clinical system failures, he has demonstrated the relationship between the normal physiology and path physiology concerned and the importance of a sound knowledge of both to the logical treatment of patients. In 14 chapters, a wide range of topics is covered, encompassing all the major body systems with the exception of reproduction, and an equally broad spectrum of common clinical conditions. The latter range from the common medical problems such as cardiac failure and diabetes, through the surgical topics of shock and water and electrolyte balance to the psychiatric growing point of the neuropharmacological basis of psychoses and their management. A short but useful list of suggested further reading is given at the end of each chapter.

The book will be of interest and of use to many more than the middle stage and early postgraduate students at whom it is primarily aimed. Nonmedical bioengineers will find in it a wealth of information not available elsewhere on the normal control mechanisms of the body and their derangement in disease. Many of the concepts of control theory familiar to bioengineers are exemplified in the text, and although it cannot be read without some knowledge of, or reference to, standard text books on physiology and clinical medicine it fulfils an almost unique linking function. As such it is a book well worth the modest cost for a place in any bioengineer's bookcase.

D. E. M. TAYLOR

Principles of comparative respiratory physiology by Pierre Djours. *North–Holland Pub. Co.,* 1975. xvi+253 pp. US$24·9/Dfl60 paperback: US $14·75/Dfl35.

This book is not for those whose reading is confined to a casual glance at a copy of the latest journal. Pierre Dejours has written about a complex subject with great clarity and insight and succeeds in communicating his interest in the subject to the reader. As the word 'principles' in the title suggests, the book deals rather more with methods and formulas than with results. Readers that are sufficiently interested in respiratory physiology to read authors such as West will find the book very stimulating.

The book begins with a general consideration of energy expenditure and sources and the environmental factors that affect respiration. The middle section of the book is taken up with a discussion of the movement of oxygen and carbon dioxide through the body and how exchange with the environment is effected by different species. This is followed by chapters on the ontogeny of respiration and the characteristics of respiration related to animal size. The book ends with a chapter on the control of respiration.

Those who take more than a passing interest in respiratory physiology will find the book makes fascinating reading, and it must be regarded as an essential volume to any library having a section on this subject.

J. A. BUSHMAN

Understanding e.e.g. by Donald Scott, *Duckworth,* 1976, 248 pp., £3·95 (paperback)

Dr. Scott is the consultant-in-charge of the e.e.g. department at the London Hospital. Over a period of years, whenever the reviewer has had a query to do with e.e.g.s or the organisation of an e.e.g. department he has always been able to obtain an honest, middle-of-the-road opinion from Donald Scott. For this reason he was particularly interested to read *Understanding e.e.g.* The book is stated to be intended for a wide variety of people encountering e.e.g. for the first time, from senior medical students to postgraduates in different fields, both medical and nonmedical.

Because the e.e.g. recorded from electrodes placed on the scalp is an indirect indication of brain activity, it follows that the interpretation of e.e.g. tracings has a substantial empirical content and electroencephalographers require a great deal of experience. Dr. Scott feels that they have perhaps made too little effort to explain the difficulties of the technique and their findings to the 'users'. He claims to have adopted a 'simple and forthright approach to the subject, removing as far as possible any mysteries that surround it'. In this he has certainly succeeded.

The chapter headings are: what happens in the e.e.g. department; the normal and abnormal e.e.g.; cerebral lesions (1) cerebral tumours; epilepsy; cerebral lesions (2) cerebrovascular accidents; cerebral lesions (3) head injury; neonates and children; psychiatric disorder; sleep; brain 'death'; anaesthetics and the e.e.g.; the use of evoked response techniques; the e.e.g. report; the problems and future of e.e.g. In addition there is a useful glossary of terms, and an adequate bibliography. Both the typeface and the illustrations are clear.

Running an active clinical department is a demanding job for any physician, and especial thanks are due to those who make the effort to write down-to-earth text books for others who wish to follow in their footsteps or to work alongside them. This, by today's standards, modestly priced book will be appreciated by e.e.g. technicians, biomedical engineers and signal-analysis staff concerned with neurophysiology. The description of cerebral function monitoring in intensive-care situations which has been a specialty of the London is of particular value. The rear cover imparts a sense of light relief where the publisher's address is shown as The Old Piano Factory!

D. W. HILL

11th AAMI meeting

The AAMI's 11th annual meeting in Atlanta in March 1976 included a number of papers on the subjects of clinical engineers and technicians. The following selection is given for those readers of *MBE* who would like to make further contacts in this expanding field: 'Clinical engineering involvement in the design. contruction and utilisation of a 21-bed intensive care unit', by D. Lubin *et al.* of the Sinai Hospital of Baltimore, 2401 West Belvedere Avenue, Baltimore, Md. 21215, USA. 'Clinical engineering time-cycle responsibilities', by R. L. Trimble, MIS-Hospital Shared Engineering Services, 15133 Kercheval Avenue, Grosse Pointe Park, Mich. 48230, USA. 'Legal requirements of clinical engineering' by W. B. Jarzembski, Texas Technical University, Health Sciences Centre, PO Box 4569, Lubbock, Texas 79409, USA. 'Interaction between a regional shared medical physics service and clinical engineering departments in member hospitals', by T. J. O'Dea, Evanston Hospital Medical Physics Department. 2650 Ridge Avenue, Evanston, Ill. 60201, USA. 'Cost-effective clinical engineering: one engineer's role in a shared service organisation', by H. C. Alder, North Suburban Association for Health Resources, 1500 Shermer Road, Northbrook, Ill. 60062, USA. 'Preliminary results from a shared engineering data base', by M. Shepherd, University of California Office of Environmental Health & Safety, 1344 Third Avenue, San Francisco 94143, USA. 'Unified medical sciences for biomedical engineers', by J. Kline, University of Miami, PO Box 248294, Coral Gables, Fl. 33124, USA. 'Organisational structure for clinical engineering performance', by J. B. Oakes, Johns Hopkins Hospital, 601 North Broadway, Baltimore, Md. 21205, USA. 'BMET training programme at the Massachusetts General Hospital', by P. DeSalvo *et al.*, MGH Medical Engineering, Boston, Mass. 02114, USA. 'A specialty education programme for BMETs', by F. A. Walker, US Army Medical Equipment & Optical School, Denver, Colo. 80240, USA.

Second biomaterials conference to be held at Brunel University

The conference on materials for use in medicine and biology to be held at Brunel University, London, is the second conference on this subject to be organised by the biomaterials group of the UK's Biological Engineering Society. The purpose of the meeting (to be held from the 20th–22nd September 1976) is to review knowledge concerning the biological reactions induced by surgical implants in orthopaedics, dentistry and other reconstructive surgery.

Biological view of metals

Among the questions to be examined are: what metals are available and what properties are required of them from a biological viewpoint; how may biocompatibility be assessed; and do the reactions of tissues to implanted materials cause significant clinical problems? A special topic session relevant to the use of total joint endoprostheses will be concerned with the identity of metal and plastic, wear and corrosion products, the tissue reactions they cause, the problems of hypersensitivity and the clinical significance of these reactions. The Conference is arranged to follow the 6th Combined Meeting of the Orthopaedic Associations of the English Speaking World, which is to be held in London from the 13th–18th of September 1976. Further information from G. D. Winter, Department of Biomedical Engineering, Institute of Orthopaedics, Brockley Hill, Stanmore, Middx. HA7 4LP, England.

THE ROLE OF THE ENGINEER

The position of the engineer in medicine had undergone a dramatic change during the last 25 years, from that of an outsider used only as a manufacturing facility, to that of a professional medical scientist capable of playing an important role in the fight against disease, said Dr. J. Edwards, reader in medical engineering at the University of Surrey, at a meeting of the Society of Engineers in London on April 5.

Analytical approach

The engineer's wealth of experience in design had provided equipment of greater sophistication to satisfy medical needs of ever-increasing complexity. However, probably of more significance than this has been the contributions arising from the analytical approach of engineering towards the solution of problems by means of numerical, mathematical and laboratory testing techniques.

Building on traditional methods

This approach had added a new dimension to the methods traditionally adopted by medicine in which decisions were based on descriptive accounts of past clinical experience. Apart from providing useful hardware, such as implants and devices for heart-lung machines, the engineer's analytical way of working had also enhanced our knowledge of biological systems and what goes wrong with those systems in disease.

Unfortunately, not all bioengineering endeavours had achieved a satisfactory end result and the time had come to take stock of what has been achieved and what will have a lasting place in medical endeavour.

conferences

Artificial organs seminar

The seminar on artficial organs at Glasgow, from the 18th–20th August 1976 will be the second seminar in the Strathclyde University bioengineering seminar series. It will comprise three sessions: Membrane artificial lung—membrane choice; vortex operation; animal model selection for device evaluation; platelet function surface interaction with oxygenator membranes; prolonged cardiopulmonary bypass systems; Taylor-vortex membrane oxygenator. The international state-of-the-art in organ function replacement—membrane artificial lung; adsorbents in therapeutic medicine; biocompatibility at the blood-material interface. Adsorbents in therapeutic medicine —future role of haemoperfusion; acute poisoning; artificial kidney support; artificial liver support; haemostatic changes induced by adsorbent haemoperfusion; oral ingestion; dialysate regeneration; design of haemoadsorption systems; animal models for adsorbent evaluation; selection and use of activated carbons in haemoadsorption; standards for safety.

Oxygenators

There will also be workshops on: The clinical role of the membrane oxygenator; the clinical role of adsorbents in (*a*) acute and (*b*) chronic therapeutic medicine; Thrombogenesis in membrane oxygenators and adsorption devices. The registration fee covering a set of preprints and a volume of the complete proceedings, morning coffee and afternoon tea is £48. Lunch is £2·50 per day. A limited number of rooms will be available in university residences at approximately £3 for bed and breakfast. Further details from Prof. R. M. Kenedi, University of Strathclyde Bioengineering Unit, Wolfson Centre, 106 Rottenrow, Glasgow G4 0NW, Scotland.

Instrumentation at Wisconsin

Hands on Medical Instrumenation was the intriguing title of a 1-week engineering course to be held in June 1976 on the University of Wisconsin's Madison campus. It is an integrated lecture-laboratory course with 18 hours of laboratory work.

The lecture topics include: a discussion of basic biomedical problems; a description of present instruments; and the design of new instruments. Colour videotape presentations were used to provide an insight into the clinical applications of various instruments and 18 experiments will be available during the nine laboratory sessions.

A new text *Medical instrumentation: application and design* edited by John Webster, Professor of Electrical & Computer Engineering at the University of Wisconsin has been developed for use by the course. Further details from R. C. Lutton, Department of Engineering, University of Wisconsin Extension, 432 North Lake Street, Madison, Wisconsin 53706, USA.

Technicians' society

The 1st Annual Meeting of the US Society of Biomedical Equipment Technicians was held in Atlanta, Georgia, from the 22nd–24th March 1976, in conjuction with the 11th Annual Meeting of the Association for the Advancement of Medical Instrumentation. The society's meeting was concerned with the ratification of its byelaws and election of officers and directors proposed by an *ad hoc* committee of technicians. This committee consisted of 13 technicians chosen by those attending the AAMI's annual meeting in Boston in 1975. During the summer of 1975, byelaws were formulated by the committee, circulated to regional groups of technicians and published in the *BMET News* for comment.

Certificates

Certificates were presented in March 1976 to those clinical engineers selected by the US Clinical Engineering Certification Commission in recognition of their 'competence and accomplishments in clinical engineering' immediately following the Beall Lecture at the 11th Annual Meeting in Atlanta of the Association for the Advancement of Medical Instrumentation. The first such certificates were presented at the 10th AAMI Annual Meeting in 1975. This certification programme was initiated in July 1974 in recognition that a new health-care profession had evolved from the increasing use of medical devices in health-care delivery. The objective of the programme is to provide for a better definition and recognition of clinical engineers and their importance to the health-care community.

MBE News is the news section of *Medical & Biological Engineering*, which is published for the International Federation for Medical & Biological Engineering by Peter Peregrinus Ltd. (member of ESIP) bimonthly

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Advertisement and Subscription Offices: Medical & Biological Engineering, Peter Peregrinus Ltd ., Station House Nightingale Road, Hitchin, Herts. SG5 1RJ, England Telephone: Hitchin 53331 (s.t.d. 0462 53331)