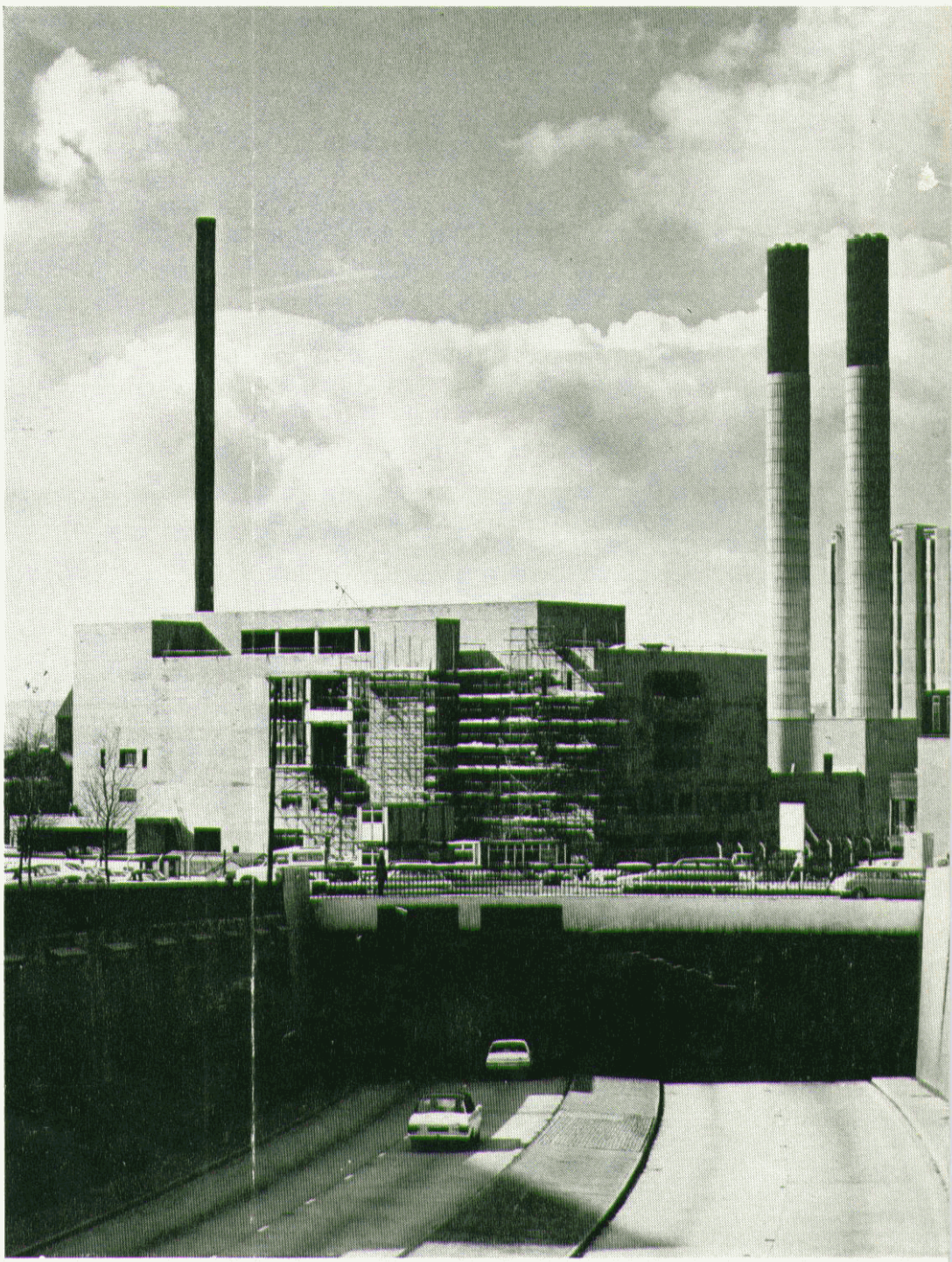
Hospital Engineering

MAY 1976

INTERNATIONAL FEDERATION ISSUE



Institute of Hospital Engineering

'Hospital Engineering' is published ten times a year by Peter Peregrinus Limited (PPL is a member of ESIP)

Individual copies cost £1.50 (postage paid)

The annual subscription is UK: £13. Overseas: £15. Americas: $36.

Application to mail at 2nd-class postage rate is pending in New York, NY.

Average circulation per issue (January-December 1975): 1933 (ABC)

Editor
David Mackin

Deputy Editor
Julian Ryder

Graphics Manager
M. C. Partridge

All correspondence relating to the Journal should be addressed to:
'Hospital Engineering',
Peter Peregrinus Limited,
PO Box 8, Southgate House,
Stevenage, Herts. SG1 1HQ, England
Telephone: Stevenage 3311
(s.t.d. 0438 3311)

Advertisement Manager
Barry Weitz,
Advertisement Department,
Peter Peregrinus Limited,
Station House, Nightingale Road,
Hitchin, Herts. SG5 1RJ
Telephone: Hitchin 53331
(s.t.d. 0462 53331)

Subscription agent for the Americas: International Scholarly Book Services Inc., 10300 South West Allen Boulevard, Beaverton, Oregon 97005
Telephone: (503) 620–0721

UK ISSN 0046-7960

The Institute of Hospital Engineering,
20 Landport Terrace,
Southsea, Hants. PO1 2RG, England
Telephone: Portsmouth 23186
(s.t.d. 0705 23186)

Secretary
J. E. Furness, V.R.D.

The International Federation of Hospital Engineering,
24 Nutford Place,
London W1, England

HE

INTERNATIONAL EDITION

No. 18

Hospital Engineering

Incorporating 'The Hospital Engineer'

Vol. 30
May 1976

The Journal of The Institute of Hospital Engineering

Contents

Special features

News features

Departments

Front cover: Total energy complex for Leeds hospitals and medical schools (photo: Shepherd Construction Ltd.)

INTERNATIONAL FEDERATION ISSUE

No. 18

Hospital Engineering

Vol. 30
May 1976

IFHE Council 1976-78

The International Council for the 1974-76 period held its final meeting at the Exhibition Centre at Porte de Versailles, Paris, on 11th January 1976. The meeting was attended by sixteen representatives from the following thirteen countries: the UK, Italy, France, Greece, Portugal, Holland, USA, New Zealand, Sweden, Barbados, South Africa, Spain, Iran.

Mr. Zissimos Tzartzanos of Greece, President for the period 1974–76, opened the meeting from the chair.

The President, Vice-President, General Secretary and Treasurer were elected to serve for the 1976–78 period. They are as follows:

President—M. Jacques Ponthieux—France
Vice-President—Mr. Eduardo Caetano—Portugal
General Secretary—Mr. Bruno Massara—Italy
Treasurer—Mr. Enrico Milone—Italy.

It was agreed that the 5th International Congress of Hospital Engineering shall be held in Portugal in mid-1978.

The Treasurer was congratulated by Council for controlling the finances of the Federation during a time of inflation and for showing a balance of 627 164 lire corresponding to about 909 dollars, 4046 French francs or £450.

As Nigeria and South Africa have now formed national organisations, known as the Nigerian Association of Hospital Engineering and the South African Federation of Hospital Engineering, respectively, these two countries were transferred from associateship to membership. Mr. Faluyi and Mr. Clinkscales therefore cease to be associates and they were thanked for their service to the IFHE and congratulated for their part in forming national associations.

Ghana has also formed a national institute and was elected a member. This therefore brings the membership of IFHE to 12 members and 11 associates as follows: *Members:* UK, Italy, France, Greece, Portugal, Holland, USA, New Zealand, Australia, Nigeria, South Africa, Ghana.

Associates: Sweden, Hungary, Switzerland, Israel, Syria, Venezuela, India, Barbados, Spain, Brazil, Iran. It was reported that Belgium have a national institute and that India has recently formed one. It was hoped that both these countries would be making an application to join the international federation.

General meeting

Council members were again urged to help to make the international issues of *Hospital Engineering* truly international by sending contributions from their own countries. They were asked particularly to send newsletters describing events which have taken place which would be of interest to fellow hospital engineers in other parts of the world.

The next meeting will be held in Teheran, where it is hoped to discuss a paper which will look into methods by which communications can be shortened and made more effective in a federation which involves 23 nations all over the globe.

The general meeting of the IFHE was held following the council meeting. The meeting was open to all members of the national institutes and associations forming the Federation.

The members accepted all the propositions put by council and adopted the accounts. They heard a speech by the outgoing President, Mr. Zissimos Tzartzanos, and one by the new President, M. Jacques Ponthieux, who promised to do all he could to see that the Federation continued to build on the strength it had gained since it was formed by six countries in Rome in 1970. Mr. Eduardo Caetano promised that he would do everything possible to organise a highly successful international congress in Portugal in 1978.

A vote of thanks was proposed by Mr. Ponthieux for the work done by Mr. Tzartzanos, Sgr. Massara and Sgr. Milone during the last two years.

From the President of the IFHE

On my election as President of the International Federation of Hospital Engineering at the commencement of the IVth Congress, held in Paris from the 11th to the 16th January 1976 as a part of the VIth Assizes of the Public Hospital Service, organized by the Hospital Federation of France, I very sincerely thank all those who have elected me to exercise this function.

I consider it a great honour, and am fully aware of the responsibilities developing upon the holder of this office.

During the next two years I will make every effort to lead our Federation along the path traced out for me by my predecessors and friends, Messrs. Amato (Italy), Rooley (Great Britain) and Tzartzanos (Greece) by publishing and gaining consideration throughout the world for the ideas of the IFHE and the work of its members.

It will not be contested that the work of this IVth Congress has been followed closely by the Hospital Engineers, certainly with great circumspection, but also with much assiduity, sense of responsibility and efficiency.

So Paris, after Rome, London and Athens, has been for one week the international capital of the Hospital Engineer.

I thank all those who contributed to the success of this Congress.

Elu Président de la Fédération Internationale d'Engineering Hospitalier à l'issue du IVème Congrès qui s'est tenu à Paris du 11 au 16 Janvier 1976 dans le cadre des VIèmes Assises de l'Hospitalisation Publique organisées par la Fédération Hospitalière de France, je remercie très sincèrement tous ceux qui m'ont élu à cette fonction.

J'en mesure l'honneur et l'ampleur des responsabilités qui m'incombent.

Je m'efforcerai durant ces deux années de conduire notre Fédération sur la voie que m'ont tracée mes prédécesseurs et amis, Mrs. Amato (Italie), Rooley (Grand-Bretagne) et Tzartzanos (Grèce), en faisant connaître et rayonner à travers le Monde la pensée de l'IFHE et les travaux de ses membres.

Sans conteste les travaux de ce IVème Congrès furent suivis par les Ingénieurs Hospitaliers certes avec une grande discrétion, mais avec beaucoup d'assiduité, de sérieux et d'efficacité.

Ainsi Paris, après Rome, Londres et Athenes, fut pendant une semain la capitale internationale de l'Engineering Hospitalier.

Je remercie tous les artisans de cette réussite.

JACQUES PONTHIEUX

Following the IFHE meeting, the 4th Congress of Hospital Engineering was held at Porte de Versailles, Paris from 12–16 January, together with the 6th National Conference of French Public Hospitals and exhibition of hospital equipment.

The hall was one of the several large buildings on the exhibition complex at Porte de Versailles and it housed both a very large and well laid-out exhibition and the congress hall, equipped with an impressvie dais with the now familiar blue and white banner behind. Simultaneous translation was provided in French and English only.

As this was a combined conference it is perhaps not surprising that there were over 1500 delegates and, whilst the majority of these were from France, about 240 came from 23 other countries from New Zealand to the USA. Italy was represented by 121 delegates and it was a disappointment to them that simultaneous translation in Italian was not provided.

The programme began with an official opening by Mme. Veil, the Health Minister, who stressed the need to improve health care in France and outlined some of the developments which were being considered.

The papers given throughout the week dealt with a review of the French hospital service, management organisation, industrialised buildings, relationships between the medical and engineering professions, equipment maintenance, training and the role of industry in the development of hospital equipment. All the papers were published in the form of reports prepared by multidisciplinary working parties and they were presented to the Congress by rapporteurs drawn from each of the working parties. At the end of the presentation, the subject was open for discussion from delegates. All the sessions were well attended and there was no difficulty in getting contributions from the floor.

A reception was given on the Monday evening at Claridges and a dinner and dance was held on the Thursday at the Pavillon d'Armenonville in Bois de Boulogne. Both these occasions were highly successful and enjoyed by the delegates.

New members

The International Federation is developing rapidly: from the original six founder members of June 1970; The IFHE now comprises twelve national associations and ten associates from countries which do not have recognised national associations.

The following countries have now been admitted as full members of the International Federation of Hospital Engineering by resolution of the Council at its meeting in Paris on 11th January: Australia, New Zealand, Nigeria, Ghana, South Africa.

Application for membership has been received from Belgium, via the Association Nationale des Techniciens Hospitaliers, and is currently being considered by Council.

Representatives of National Associations in the Council:

Members

UK

Institute of Hospital Engineering

Kenneth W. Ashton
3 Fernwood Road
Sutton Coldfield
Warks.

K. I. Murray
33 Ashley Drive
Walton-on-Thames
Surrey.

Italy
Federazione Nazionale Tecnici Ospedalieri
Massimo Ferrando — Largo C. Laxxerini 7 — Roma
Giovanni Zedda — Via Ermini 31 — Roma

France
Association Nationale des Ingenieurs Hospitaliers
Pierre Vanier — c/o SODETEG — Le Plessis Robinson 78000
Pierre Gras — 5 Rue des Ateliers — 34100 Montpellier

Greece
Technikon Epimelitirion tis Ellados
Iordanis Pavlidis — Odòs Vulis 5 — Athinai
Philimon Tzovaris — Odos Patissìon 92 — Athinai

Portugal
Associaçâo Portuguesa de Engineering Hospitalar
José Conceição Mealha
Avenida Miguel Bombarda 133–5 B
Lisboa 1

Holland
Nederlandse Vereiniging Ziekenhuis Technici
Adriaan M. Vertegaal — J.A. de Gravenlaan 9 — Zoederwoude-Dorp
Jan Beijer — Oude Hoeverweg 61 — Alkmaar

USA
American Society for Hospital Engineers
Vern E. Atwater — St. Luke's Hospital — 44th and Wornall Road — Kansas City — Miss. 64111
Vinson R. Oviatt — Public Health Service — Building 13, Room 3K-04 — Bethesda — Md. 20014

New Zealand
New Zealand Hospital Engineers Association
George Parker — Waikato Hospital — Hamilton
J. D. Jones — North Canterbury Hospital — Christchurch

Australia
Institute of Hospital Engineers
Harvey Roberts — Royal Park Hospital — Parkville 3052 Vic.
Leonard Irwin — 73 Edwards Street — Macleod 3058 Vic.

South Africa
South African Federation of Hospital Engineering
W. D. S. Clinkscales — P.O. Box 196 — Port Elizabeth 6000
J. J. Nieuwoudt — P.O. Box 2060 — Cape Town 8000

Nigeria
Nigerian Association of Health Engineering
A. O. Faluyi — 10 Augusto Close — Surulere
H. A. Von der Mosel

Ghana
Ministry of Health Engineering Services Association
M. L. Cruickshank
Regional Hospital
P.O. Box 16
Tamale, N.R.

Associates

Sweden
Jan Thorp — c/o S.p.r.i. Box 1109 — S–11181 Stockholm

Hungary
Ottó Gecser — Bürök u.8 — Budapest XII

Switzerland
Joseph Flury — Chemin de la Chaumière 10 — Lausanne 1010

Israel
Eliecer Rahat — P.O. Box 3486 — 11 Zev-Haklai Street — Jerusalem

Rodolfo Salas Sivoli — Centro Simon Bolivar — Ministerio de Sanidad y Asistencia Social — Edificio Sur — Caracas

Venezuela
Jaghdish Chander Mehta — Post Graduate Institute of Medical Education and Research — Chandigarh 160011

Barbados
L. D. Etheridge — Enmore n°7 — Collymore Rock

Spain
Antionio J. Bonnin Vila — Villarroel 247 — Barcelona 11

Brazil
José Annibal Silva — Rua Pompeu Loureiro 68 — Copacabana ZC 07 — Rio de Janeiro 20000

Iran
Massoud Soheili — 30 Dolfan Avenue — Upper President Roosevelt Avenue, Tehran

Officers

President:
Jacques Ponthieux — 2, Avenue Paul — Marchandeau, 51100 — Reims, France

Vice-President:
Eduardo A. Caetano — Rua Victor Hugo 4,4° — Lisboa 1, Portugal

Past-President:
Osvaldo Amato — Via Martellini 38 — Roma, Italy

Past-President:
George A. Rooley — Clifton House — 83–87 Uxbridge Road — London W5, UK

President
Zissimos Tzartzanos — Odòs Vekiareli 7 — Philothei — Athens, Greece

General Secretary:
Bruno Massara — Via Corazzieri 99 — 00143 Roma, Italy

Treasurer:
Enrico Milone — Via Fagaré 15 — 00195 Roma, Italy

Institute news

Welsh Branch

Mr. J. Smith, chief quantity surveyor, Welsh Office, delivered a talk entitled 'The rôle of the quantity surveyor' to the branch at its meeting on the 13th December. The presentation was informal and, at Mr Smith's request, more in the nature of a discussion.

He described the procedure by which the architect and the engineer collate the requirements of medical and non-medical staff in the design of a new hospital; starting with medical and departmental briefs, required areas, source of money, selection of site, type of building, phasing of work etc.

From these considerations, a development control plan evolves which enables a quantity surveyor to produce a design cost, subdivided into structure, substructure and engineering costs and usually based on known costs of similar buildings. When no such comparison is possible, the cost is obtained by costing out, in detail, the whole of the proposed works. As so often happens, when the calculated cost falls outside available finances, cost reduction exercises have to be undertaken. Cost planning must be effectively carried out. Mr. Smith then dealt with the preparation of bills of quantity and contract procedure, tenders and commissioning.

A period of discussion then followed during which many interesting points were raised by members, it becoming apparent that the subject was one of great interest and available time for discussion too short.

West of Scotland Branch

On the 26th February, in the offices of the Greater Glasgow Health Board, Mr. F. E. Waspe, engineering manager of the Electrical Components Division of Siemens (UK) Ltd., gave a talk on the subject of electrical safety equipment with special emphasis on earth-leakage protection. The talk was exceptionally well supported by visual aids in the form of 35 mm slides, overhead projector and numerous display boards for the demonstration of the operating characteristics of the components and the fault conditions which can exist in electrical installations.

Mr. Waspe began his talk by examining the process of electric shock in the human body, the incidence of death from electric shock, and the conditions leading to electric shock in the standard electrical wiring installation. He then displayed a graphical illustration of the relationship of current flow and shock duration and explained the reasons behind the general acceptance of 30 mA maximum as the standard for earth-leakage tripping in normal installations.

The principles, characteristics and construction of both voltage- and current-operated earth-leakage breakers were described and the additional fire protection advantages were illustrated. Mr. Waspe concluded his talk by stressing the need to consider discrimination between subcircuits when installing protective equipment.

After a short break for coffee, during which the members had the opportunity of operating the various displays, the branch chairman, Mr. Gray, invited Mr. D. C. Nicolson to propose a vote of thanks to Mr. Waspe on the excellent paper which he had presented.

Book news

Fire safety training in health care institutions 1975

The American Hospital Association, 51 pp.

Yet another well produced and illustrated publication from the American Hospital Association; although this time soft backed and pocket sized. Clearly aimed to promote and maintain fire safety in health-care institutions, the focus of the manual is on training of hospital personnel.

One is impressed with the clarification and simplicity of the American approach and ability to instruct and communicate to personnel a technique so well adopted for many years with their military forces.

On p. 1, detailed in large print, one reads 'Appoint a fire marshal'. The first duty of the safety committee is to appoint a fire marshal. How often in the UK would we find the reverse attitude from board or committee. Would we be faced with a decision such as 'How can we prevent appointing a fire marshal?'.

The manual is not, however, without fault. Various tasks illustrated in regard to evacuating patients from one fire area to another, and removing a patient from a bed fire by means of the service of a single nurse needs the closest study. A very strong nurse would be the first priority.

Finally, one questions whether Appendix A, p. 37 to 44, is too extensive. These various detailed inspection duties if undertaken correctly and at regular intervals throughout an area health authority would require full-time staff provision.

Unfortunately, I failed to find the price of the manual stated anywhere. Notwithstanding, this manual will surely appear on various book shelves in our hospitals.

Commissioning hospital buildings by G. Millard

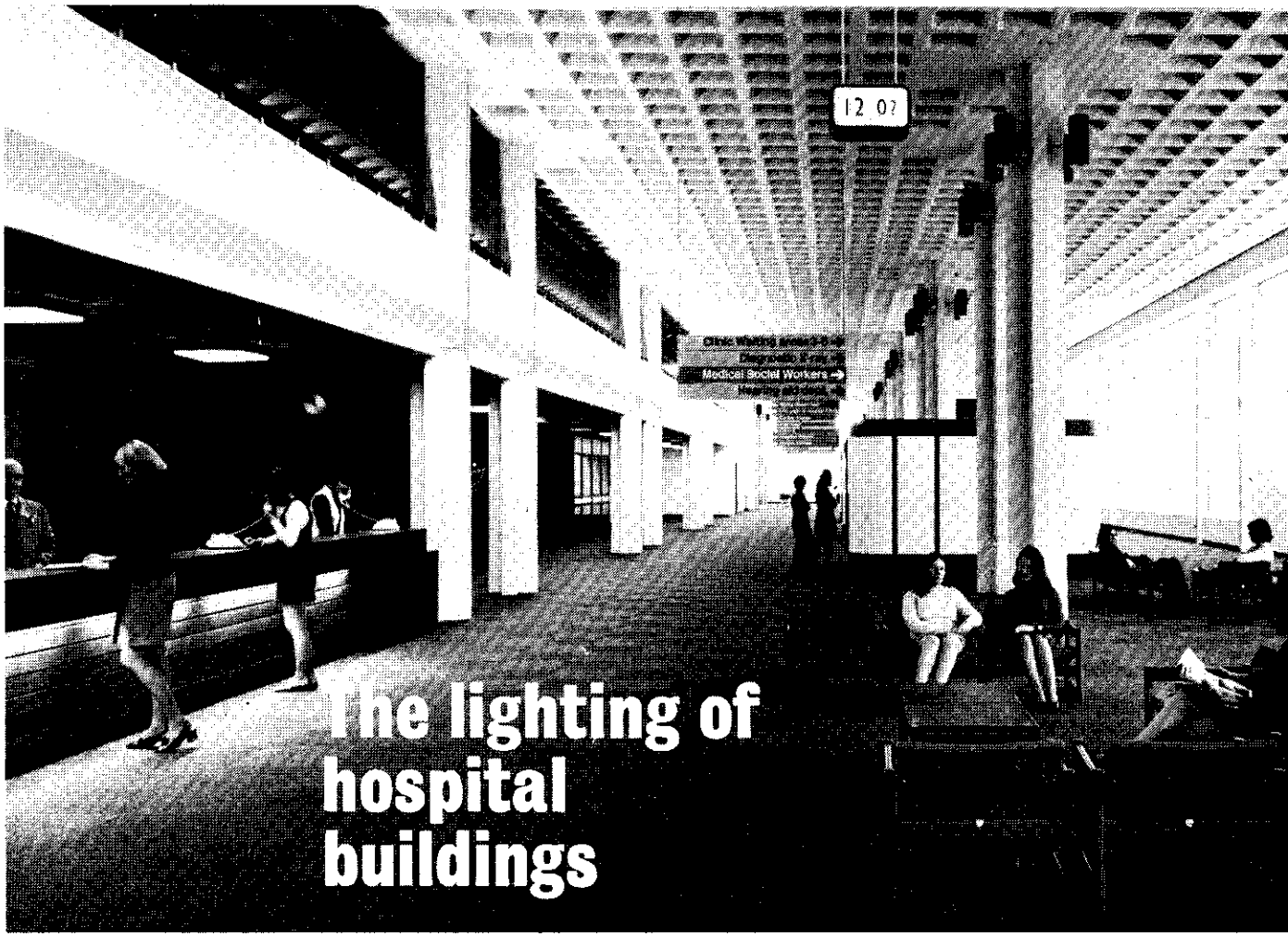
King Edward's Hospital Fund for London, 1975, pp. 143, £4·50.

I found the book well presented, with an abundance of charts, illustrations and check lists to ponder over, and discuss.

The book covers the whole concept of commissioning hospital buildings, from conception through design and onto construction, handover and commissioning for the user. It is aimed at giving an overall picture of commissioning, with practical guidance aimed at the managers and not any one particular profession.

The book does touch on such management techniques as critical-path analysis, linear balance and cascade charts; but, for works officers, further reading is essential to fully understand these techniques if encountered for the first time.

In conclusion, I found the book easy to read and full of essential information for any officer employed in the works department.



The lighting of hospital buildings

photo: Ninewells Hospital & Medical School

by ALAN COCKRAM

Introduction

A modern hospital is comparable with a small town in its complexity and requires the application of most of the known lighting techniques.

These applications range through simple domestic lighting of staff living accommodation, balancing and focusing of lighting required for exacting visual tasks carried out in operating theatres, and to the exterior lighting of access roads and car parks.

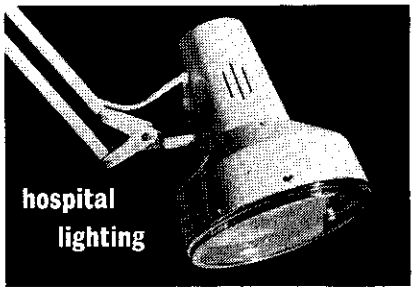
One of the most important factors is the need to consider the whole appearance of the interior of the hospital or health-care building. This means that lighting design should be considered at the planning stage of any new project, and both the type of light sources used and the surfaces on which the light impinges should be co-ordinated. The choice of surface reflectances should also ensure that backgrounds do not conflict with the task or contrast too harshly with the light source, whether it be daylight or artificial light.

During the day, the major lighting component in most areas of a hospital will be natural light. The windows thus assume a dual role of transmitting daylight and providing patients and staff with the view of the exterior environment. Advantage should therefore be taken wherever possible of the varying appearance and direction of natural lighting. This particularly applies to low-rise deep-plan buildings, where consideration can be given to additional natural lighting from roof lights or clerestory windows.

Public areas

In public areas quality can take precedence over quantity of light, although all areas require adequate lighting. This provides a chance for design contrasts and variation of intensities and sources for artificial lighting to be used. Effective variation can be achieved by conventional lighting techniques, an example of which is the use of shielded fluorescent lamps for curtain and wall washing, while compact light sources offer greater flexibility for lighting pictures, displays and route signs. The overall effect of the artificial lighting in these areas should be one of contributing to creating a reassuring atmosphere. The initial impressions gained by prospective patients may possibly influence the rest

Mr. Cockram is with the Building Research Establishment, Building Research Station, Garston, Watford WD2 7JR, England.



of their stay in hospital. The lighting of reception areas should highlight the desk against the other features such as waiting areas which in turn should be adequately lit by the general lighting (150 lux). In these cases tungsten light sources attached to suitable light track provide a flexible system.

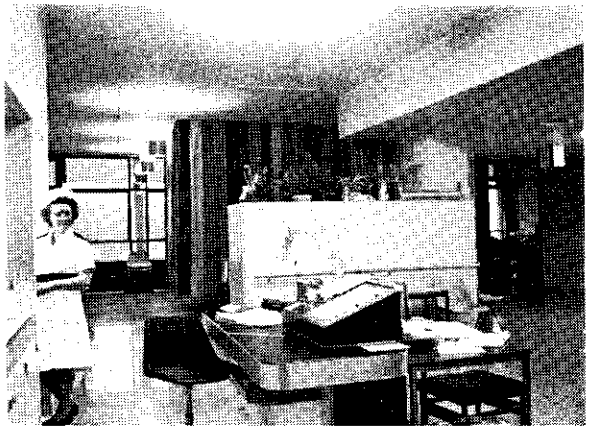


Fig. 1 A nurses' station

A recommended level of 300 lux at the desk should be adequate for clerical work to be carried out. Staircases in public areas need careful attention, where all treads should be clearly defined by the lighting, and the luminaires employed should have low brightness characteristics. In passenger and bed passenger lifts the lighting can be either direct or indirect (i.e. reflected light from a suitable surface) and the luminaires should have low brightness. At least one luminaire or an additional lamp in a multilamp luminaire in each car should be supplied from a standby battery power source in the event of mains failure.

The lighting of changing rooms, cubicles and lavatories should promote hygiene and cleanliness and should not give rise to corners in shadow which might harbour dirt and germs. Showers and rooms with bathing facilities require care in selecting and placing of the luminaires; in changing areas the luminaires should be sited between clothes racks and personal locker units to provide adequate lighting for locker interiors.

Operating-theatre departments

The chief visual requirements in a theatre are the detailed examination of skin and various tissues exposed during surgery and the correct manipulation of instruments during an operation. The luminaires for the general lighting in a theatre should provide a recommended illuminance of 400 lux evenly distributed over most of its area. This illuminance is adequate for ancillary tasks to be performed by the theatre staff. Wherever possible the luminaires should be fully recessed into the ceiling. The walls and ceiling finishes should not show reflections of luminaires, especially where these may occur and coincide with the standing eye heights of theatre staff.

A ceiling reflectance of 0·8 will assist in controlling the luminance (brightness) contrast ratio between the ceiling and the diffusing enclosures of the general lighting luminaires. The wall reflectances should be between 0·4 and 0·8. A light toned floor of 0·35 reflectance is necessary to achieve an adequate reflected light component to compensate for the controlled lateral spread of light from the general lighting luminaires.

The control of the general lighting can be either singly or in diagonal pairs, according to the individual requirements for specific types of operations. Facilities for varying the intensity of the light may also be required, but the possible inherent electrical interference to sensitive recording equipment should be taken into account when the methods of dimming are chosen and installed.

The illuminances at the site of the operation can be between 10 000 and 50 000 lux; higher values will seldom be required but lower values can be an advantage for some kinds of surgery. For maximum visual acuity when the surgical cavity is illuminated to levels within the range quoted, the immediate cavity surrounds, which are usually formed by drapes, should have a luminance of about three times greater than the background luminance.

However the colour appearance of skin and tissues is of great importance throughout the theatre complex and is dependent upon the special qualities of both general lighting sources and room surface finishes and therefore the specification of light sources is very strict and only lamps on the approved list issued by the Department of Health & Social Security should be used in these areas. The colours used in the theatre should not distort the effect of colour-corrected light sources; light yellow/green or pale grey are suitable colours but blues and yellows should be avoided. The control of glare from luminaires and specular reflections from theatre surfaces is a difficult problem and a study is being carried out to try to achieve a satisfactory specification commensurate with present methods of lighting.

The choice of the operating-table luminaire should be governed by a number of considerations, the chief of which are:

- there should be sufficient clearance for the mounting of the specified luminaire, including any satellite lamps, in relation to the operating table
- the positioning of the operating luminaire should be co-ordinated with other fixed equipment to ensure satisfactory functioning in relation to each other
- quick positive lamp replacement should be possible
- the luminaires should be of robust and easily cleanable construction

- structural strengthening may have to be provided for the turning moment of the luminaires.

The head of the luminaire should be fully adjustable both horizontally and vertically and should rotate through 360° without stops and not collide with the theatre walls. The cupola should remain in any required position without further adjustment. To achieve shadow-free illumination at the operating cavity, a multilamp cupola or single-source cupola with suitable optical controls should be used. The more usual type of luminaires use tungsten filament lamps or tungsten

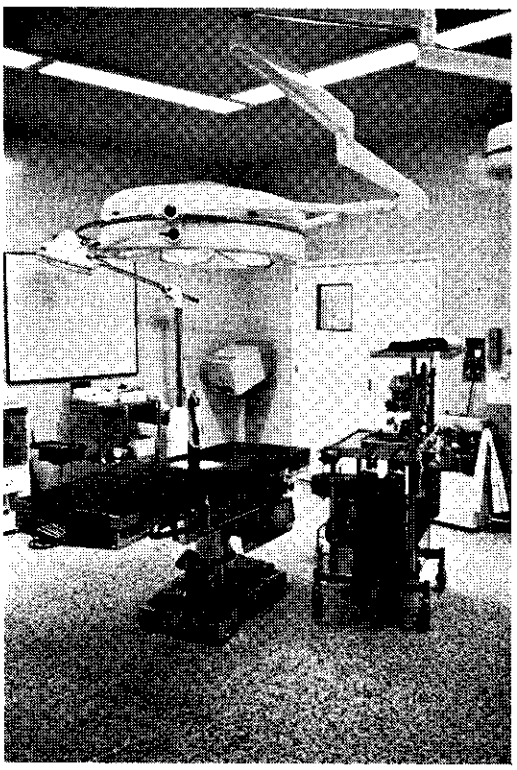
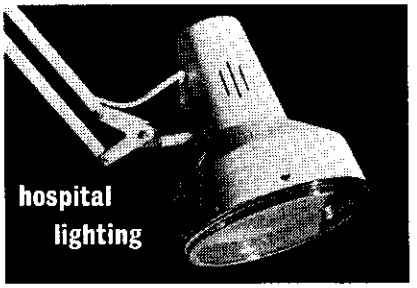


Fig. 2 An operating theatre

halogen lamps. In certain types of surgery, such as orthopaedic, multiheaded luminaires moving independently of each other may be required. All types should be adjustable in both focus and intensity and, to prevent undue drying of tissue in the operating cavity and to ensure low ambient working temperatures for the surgeon and ancillary staff, heat filters should be fitted. Internal wiring and components must be suitable for withstanding the temperatures associated with the compact incandescent sources and the maximum temperatures of outer surfaces of luminaires should not exceed approximately 60°C. to avoid injury to the hands of the surgeon or ancillary staff.

The provision and selection of any 'satellite' luminaire is dependent on the type of surgery undertaken and these are generally mounted on a suspension arm of the main luminaire and vary in type between single-source treatment luminaires, multisource operating lamps or fibre-optic lamps for deep cavity operations. An important feature of planning the operating-theatre layout is to know in advance about the inclusion of other items



of equipment, which could include fixed X-ray units, track-mounted X-ray units, fixed operating-table luminaires, track-mounted operating-table luminaires, air-conditioning supply vents, medical-gas pendants and electrical-supply outlets, ceiling-mounted operating microscopes, and closed-circuit television. All these items can affect the light distribution from luminaires and it cannot be stressed too strongly that co-ordination of all planned services should take place at the planning stage. A line diagram showing a typical layout where space is at a premium is shown (Fig. 3). Apart from the

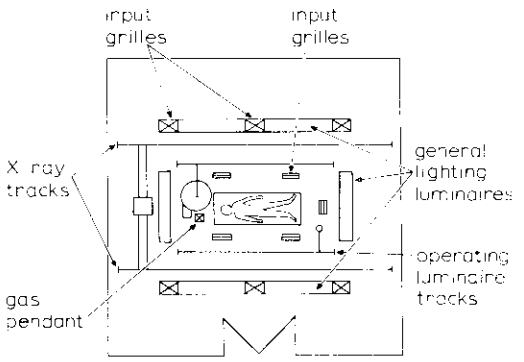


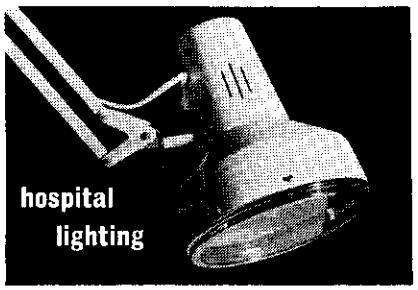
Fig. 3 Operating theatre (with space premium problems)

main types of operating theatres, there are many specialist theatres involving additional features, including theatres with viewing galleries, closed-circuit television, clean-air theatres for open-wound surgery and these require special treatment. Information can be found in appropriate publications from the Illuminating Engineering Society and the Department of Health & Social Security. Ancillary areas including anaesthetic rooms, recovery rooms, scrub-up and plaster rooms, preparation rooms should all be lit with the appropriate colour-corrected light sources and care should be taken to ensure that the lighting is correct for the task being undertaken.

A failure of lighting during an operation may have serious consequences, it is therefore essential to provide reliable emergency lighting arrangements.

Wards and corridors

It has been possible to improve the artificial lighting of the long and narrow Nightingale wards by the introduction of luminaires incorporating linear fluorescent sources. These luminaires can be suspended to the appropriate heights and the lamps shielded from direct view of the patient by suitably designed luminaires, thus overcoming the high degree of discomfort glare



caused by luminaires incorporating incandescent sources in globe diffusers.

However, most modern hospital buildings are now designed on the 'race-track' principle where the bed bays are situated around the periphery of the building with windows in the exterior wall and beds arranged parallel to the windows. Service and other rooms are usually internal and separated from the bed bays by a corridor. Each bedded area can have from four to eight beds according to its depth. The methods of lighting different areas comprising the ward unit need careful design if contrast between daylight and windowless areas are not to be unpleasant or disturbing. Subjective observations have determined the preferred illuminance levels required in the windowless internal rooms during daytime conditions when the rooms were entered from the ward across the corridor.[1] Similarly, the corridor illuminance was studied so that it would be satisfactory in the intermediate zone for optimum visual acuity when coming from the internal room and looking across the corridor into the ward area with the windows in the remote wall.[1] The illuminance requirements for corridors open to bed bays have also been determined.[2] This work contributed towards the present levels of lighting recommended for various areas of the ward unit[3] and these appear in Table 1.

Fig. 4 6-bed ward with tungsten lighting

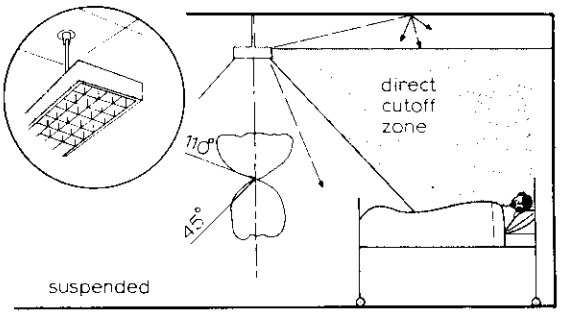


Fig. 5 Light-distribution requirements for a suspended luminaire for ceiling heights in excess of 3 m

The artificial lighting in bed bays must satisfy both the patient and the nursing staff during the day, evening and night. During the day, bed bays are normally illuminated by natural light. Corridors and internal service rooms may not be so lit and thus require illuminating to a standard that will enable staff and patients to move to and from these areas without any marked variations in the quality of lighting.

The most important aspect of bed-bay lighting design is the luminaire providing the general lighting. In bed bays with ceiling heights in excess of 3m it is possible to use a pendant-type fluorescent lamp luminaire to achieve the recommended distribution and levels of lighting (Fig. 5). The brightness of any surface or illuminated surface can be kept within acceptable limits.

However, with the need for economies in building costs and the benefits of having voids between floors to carry services, ceiling heights are currently at 2·75 m and in some instances below this value. These lower ceilings preclude the use of pendant luminaires because

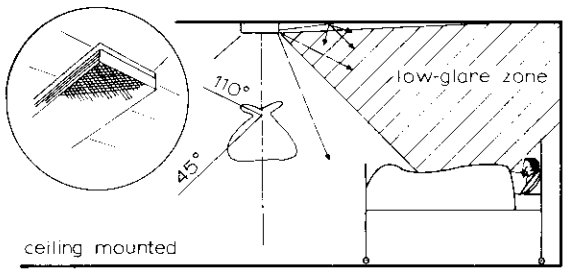


Fig. 6 Light-distribution requirements for a ceiling-mounted luminance for ceiling heights below 3 m

Table 1. Recommended service illuminances for ward units

Location	Day	Morning/Evening	Night
	lux	lux	lux
Bedhead (general lighting)		30/50	0·1/1·0
Patients' reading lights		150 (on task)	5 (watch lighting)
Circulation area (between feet of beds)	not less than 100	100	3/5
Nurses' stations or staff base	300	300	30/50 (well shielded)
Corridors (screened from bed bays)	200	100/150	5/10
Corridors (open to bed bays with natural light)	not less than 200	150	5/10

of the need to maintain sufficient clearance for tall equipment to be wheeled to the bedside. Luminaires for general lighting can then only be mounted directly to the ceiling. To achieve the desired distribution of light a prismatic based and opal reeded side-light controller usually encloses the fluorescent lamps and thus can create a bright object directly in the patient's field of view. This can be very disturbing and the limitation of surface luminance is essential. An acceptable light distribution for a surface-mounted luminaire is shown in Fig. 6. Two other aspects of lighting within the ward areas that again require attention to detail are the night lighting and the lighting at the bedhead for patients' use.

As far as night lighting is concerned, the conflict between the patients endeavouring to sleep and the staff requiring to survey them and noting any changes in the state of a patient can be overcome by restricting the illuminance in the bedded area to 3 5 lux in the circulation area between the beds and 0·1 lux at the bedhead. If additional lighting is required for more detailed surveillance an additional low-wattage lamp to provide 5 lux may be incorporated in the bedhead luminaire or the main lamp may be dimmed. The night lighting of the corridor must not cause a disturbance, nor must the lighting of the nurses' station after normal hours. The lighting in these areas should be well shielded and should not create any bright surfaces that may be visible to patients from their beds. The limiting luminance should be 3 cd/m^2.

The patient's reading light can be a problem as it should not be the source of discomfort to other patients in the bedded areas and considerable measures such as stops on the travel of the bed head lighting should be incorporated in the design, but not sufficiently restricting to prevent the patient from getting the light where it is required (see Fig. 7).

As far as young children are concerned the level at the bedhead should be increased to 1·0 lux and 3–5 lux in the circulation areas between the beds. Some medical opinion suggests that, at night, distress and phantasmagoria are more readily experienced by patients when the ceiling is slightly illuminated; a darkened ceiling appears less disturbing for a feverish patient and to young children. Direct light should, therefore, fall

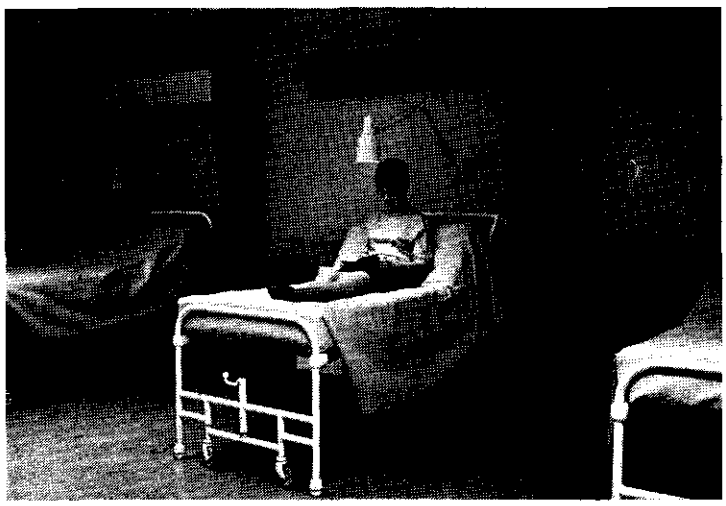
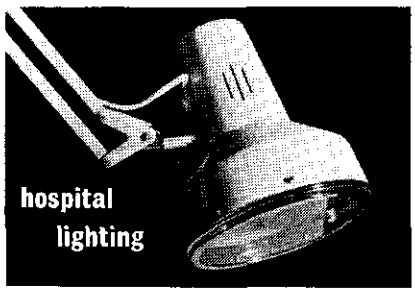


Fig. 7 Reading light



neither on the bedhead nor the ceiling, but should be restricted to the floor or the lower ends of the beds. Shadows of trees cast by car headlamps or road lighting can be particularly disturbing and the visual shock resulting from switching on the patient's reading lights at night can both be disconcerting and painful.

The internal rooms which open off the side of the corridor opposite the bed bay can be classified into two groups: those where specific medical tasks are performed and general utility areas. The recommended illuminances of these areas can be 400 lux and 300 lux, respectively, for the daytime with a reduction to a 150 lux in the general utility areas at night. These levels will help to reduce the apparent brightness contrast when moving to and from these areas and will not conflict with the lighting in the rest of the ward area.

Ancillary areas

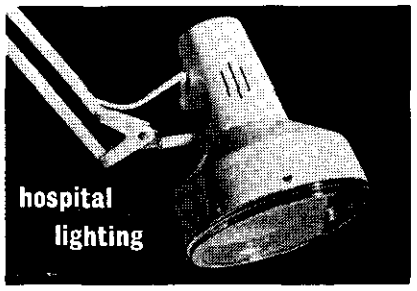
There are many other areas in a hospital that have not been covered by the aforegoing and which require specialised lighting source such as dental suites, ophthalmic departments, hydrotherapy pools, occupational therapy, audiology departments, specialised equipment rooms, cobalt rooms, maternity units, special baby-care units, mortuaries, postmortem rooms, X-ray departments, radio diagnostic rooms, X-ray processing and standard photographic darkrooms, general treatment rooms, pathology laboratories, medical-records departments, intensive therapy units, and animal houses. The list appears inexhaustible, but all these areas require special attention to lighting. The appropriate information can be found in the publications of the IES and DHSS. Anyone undertaking the task of lighting hospital departments is strongly urged to read these documents. Even though they may or may not be exhaustive in their coverage, they at least set out principles on good lighting practice so that lighting can contribute towards patient comfort and an efficient hospital service.

Acknowledgment

This article is based partly on the work of the Revision Panel, revising the Illuminating Engineering Society's Technical Report 12 'Hospital Lighting' and partly on that of Building Research Establishment and permission to use the work is acknowledged.

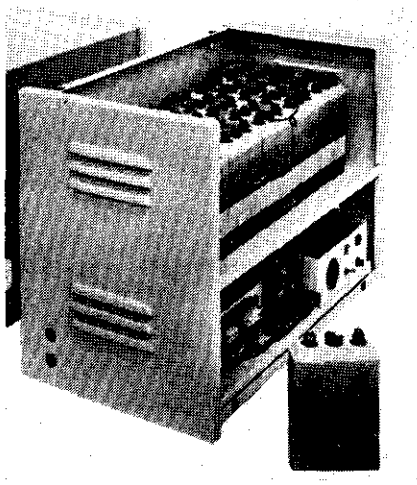
References

1 NE'EMAN, E., and COLLINS, J. B.: 'Lighting of compact plan hospitals', Trans. Illum. Eng., 1966, **31**, pp. 37–58.
2 COCKRAM, A.H., and COLLINS, J.B.: 'Lighting of hospital circulation spaces which are open to bed bays', Lighting Res. & Tech., 1974, **6**, (2)
3 'Hospital lighting'. Technical Report 12, Illuminating Engineering Society, 1968 (currently under revision)



Central battery lighting

There are 124 standard models in this range, with outputs from 12 V d.c. to 110 V d.c. Loadings are from 40 to 9 820 W. Larger nonstandard systems can be built to order, say the company. Wall-mounting cubicles are used for the smaller units in the range, and floor-standing cubicles for the larger systems. For buildings where the emergency lights are



required to be illuminated only when the mains supply fails, there is a complete range of non-maintained systems: for continuous illumination of the emergency fittings during normal and emergency conditions corresponding maintained systems are offered. Vented nickel-cadmium batteries provide the emergency source of power. The cells are housed in a translucent casing that makes visual checking of the electrolyte level simple. Battery maintenance is minimised by the provision of a substantial reserve capacity of electrolyte, and also by automatic constant potential charging, which keeps systems at immediate readiness. Options include the fitting of contactors to BS764, phase fail units for the operation of the emergency circuit if one phase of the supply fails, and the provision of an alarm to signal low electrolyte level. Current prices of the new central battery systems without luminaires are from £165 to £4455.

Security Lighting Ltd., 27 Breakfield, Ullswater Crescent, Coulsdon, Surrey, England

Generating sets

This range of generating sets provides outputs ranging from 770 to 2 600 kVA at 50 Hz; extending the company's range of diesel generators from 22 kVA up to 2 600 kVA. Designed principally for primary baseload operation and conventional standby duties, the 12 new models, designated the *Jumbo range,* are driven by the *SEMT-Pielstick PA4-185* range of six- and eight-cylinder inline engines and also the eight-, 12-, 16-, and 18-cylinder vee-formation water-cooled diesel engines; all operating at 1 500 rev/min to give an output frequency of 50 Hz. Direct inline cylinder air starting is used with the vee-formation engines, while electric starting is normally fitted to the inline models. The new sets can be run simply in parallel with machines of different types of manufacture, assisted by an adjustable quadrature droop circuit and fully interconnected pole face damping windings in the alternator. Where more than one generating set is installed, a completely self-contained system of synchronising equipment with either manual or automatic control is available.

Petbow Ltd., Sandwich, Kent, England

Prismatic luminaire

This new *Trimline* prismatic luminaire has a clear polycarbonate precision-moulded prismatic lens diffuser, which provides efficient controlled downward illumination, even ceiling lighting and reduced brightness from normal viewing angles. Designed for a 100 W GLS incandescent lamp or 22 W Circline fluorescent lamps, and available with either slate black or pearl grey gallery it is suitable for wall or ceiling mounting. This all-purpose unit is ideally suited for either commercial or decorative areas. Complementary to the surface mounted fittings are semirecessed or fully recessed units using the same clear polycarbonate, virtually unbreakable prismatic lens diffusers, and suitable for lamps up to 150 W GLS.

Merchant Adventurers Ltd., Hampton Road West, Feltham, Middx. TW13 6DR, England

Lighting controller

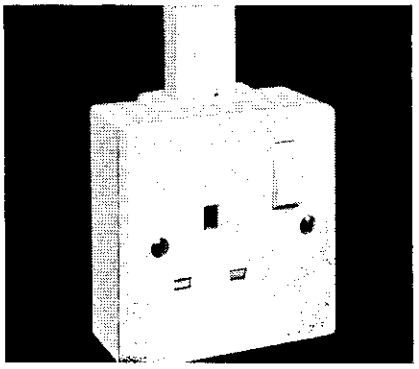
The *Litepak* automatic lighting controller is designed to detect changes in ambient light levels and can thus be used to switch lighting on and off automatically. It can also be used to turn lights on and off automatically at dawn and dusk; and is

a useful security aid. The unit can be set to operate at any desired light level, and, for a relatively low cost, provides a useful saving in electricity costs.

Hird Brown Ltd., Lever Street, Bolton, Lancs., England

Rewire system

Gilflex Conduits Ltd. has introduced the *Easiwire 250* system, which is, they claim, the first complete trunking system for commercial and domestic rewiring schemes. The system, made up of two sections of minitrunking, a multiway box, a



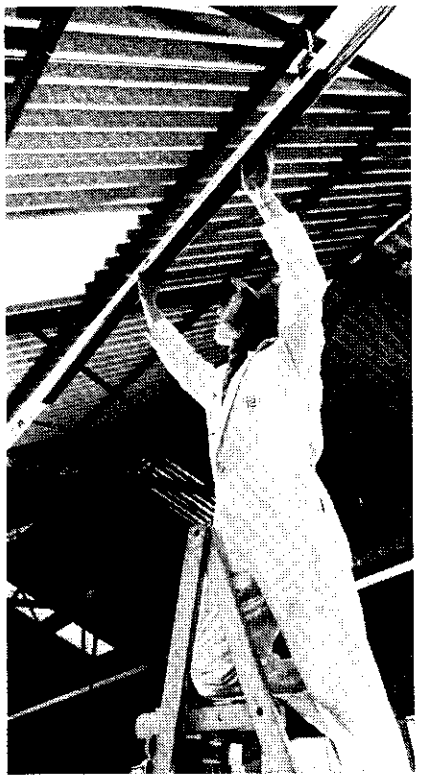
ceiling spur plate, a circular box, an accessory box, a sealing grommet and three types of elbows, was designed in consultation with local-authority engineers to meet all specifications and applications.
Gilflex Conduits Ltd., Weirvale Estate, Denham Way, Rickmansworth, Herts., England

Emergency light

This 3-hour circular emergency-lighting fitting with all-white diffuser, has been tested independently and is certified to meet GLC specification. The 216 mm diameter decorative unit has an opal glass diffuser. The unit is designed for use in all areas where there is a need to combine high standards of interior decor with rugged and reliable emergency lighting. The permanent mains supply operates a solid-state charger to maintain the battery in a fully charged state. In the event of a mains failure, instant emergency lighting is provided automatically. The light is fitted with a single 4 W fluorescent lamp, and the nonmaintained unit's recharge time is 14 h. A 1-hour version of the fitting is also available.
Patrick Roberts Lighting Ltd., 18 Queens Road, Brighton, Sussex, England

Trunking

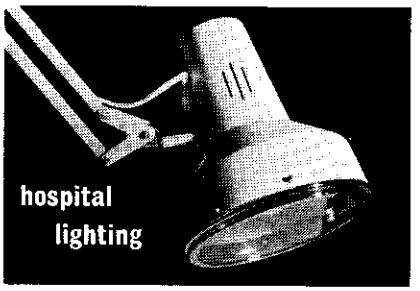
This commercial lighting system from Thorn Lighting Ltd. is based on cold roll-formed trunking as an economical alternative to press bending. The *Clipper* trunking system comprises long lengths of trunking and a clip-on spine that carries electrical fittings and a fluorescent tube. It is claimed to be exceptionally easy to install. Individual 4·5 m trunking lengths—far longer than press bending could produce—are manufactured from galvanised coil strip steel. The section is an open channel, 72 mm wide and 45 mm deep. Lips on the inside edges act as retainers for the spine and its finger latches. They also permit springiness for simple installation. The spine—carrying all the electrical fittings, including the



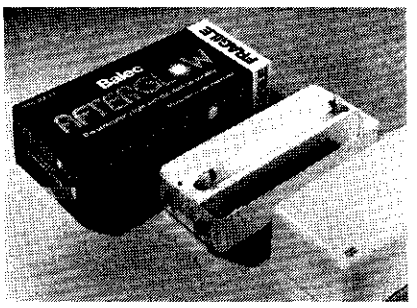
tube—is simply clipped into the trunking. This eliminates labour normally required to fit tee-bolts, washers and nuts holding fittings to trunking. Metsec also produce the couplers that join sections of trunking together. These pierced channels slide into trunking ends and are secured with eight screws.
Metal Sections Ltd., Broadwell Works, Oldbury, Warley, West Midlands, England

Dual-operation unit

Bradley and Lomas (Electrical) Ltd. has launched an 8 W fluorescent unit incorporating new circuitry and a 2-stage transformer—which may be converted from maintained to nonmaintained operation by simply connecting or disconnecting a single lead—giving optimum battery life and eliminating overheating problems. The Balec *Afterglow* has a sealed nickel-cadmium battery, an



emergency duration of 3 h, a recharge time of 14 h and complies with BS764, 1954. A clean invertor sine wave eliminates tube blackening. The 30 cm daylight fluorescent tube, giving illumination equal to four similar size tungsten emergency-lighting fittings, is carried in a white stove-enamelled aluminium case. A self-extinguishing polycarbonate diffuser, with slide-in slot for end entry, may be supplied with the word exit in 12·5 cm lettering or, in the case of fire exit and emergency exit, in 7·5 cm lettering. The unit



has an exterior indicator light to warn of malfunction or failure of battery-charging facility. Fully automatic in operation, the *Afterglow* has a built-in facility for 2-wire maintained lamp switching which supersedes existing complex 4-wire multi-pole switching arrangements. Input voltage is 230/250 V a.c., 50 Hz and the unit incorporates BESA box and four corner screw fixings. Balec designers have devised a circuit with the capability of controlling the switching on or off of the lamp; automatic battery charging through a tap-change transformer and a method of switching the output of the transformer between a first and second output lead. This system allows for optimum control of the nickel-cadmium battery charging rate, thus extending battery life.
Bradley & Lomas (Electrical) Ltd., Kent Road, Sheffield S8 9RN, England

Safety conference

Every 20 s during a working day, somewhere in the world, a person dies as the result of an accident at work. This adds up to a total of 405 000 industrial fatalities a year, according to figures available from the International Labour Office and the Library of Statistics and Market Intelligence.

In a major effort to reduce this figure, the British Safety Council and the Royal Society for the Prevention of Accidents, in conjunction with the Industrial Safety (Protective Equipment) Manufacturers' Association (ISPEMA), are jointly organising World Safe 76, an international occupational-safety conference and exhibition at the new National Exhibition and Conference Centre, Birmingham, on the 17th–21st May 1976.

Speakers at the conference will include Mr. Bill Simpson, Chairman of the British Government's Health & Safety Commission; Mr. Ernest Mastromatteo, of the International Labour Office; Mr. Patrick Hillery, of the Commission of the European Communities; Mr. Greville Janner, a British Member of Parliament and Queen's Counsel and an expert on product safety; Mr. James Tye, Director General of the British Safety Council, and Mr. John Weston, Director General of RoSPA.

Industry will be represented by Mr. Alex Jarrett of Reed International, Sir Campbell Adamson, Director General of the Confederation of British Industries, and Mr. Len Murray, Secretary of the Trades Union Congress. There will also be speakers from the United States and Canada.

Some implications of the Health & Safety at Work etc. Act 1974

by L. MUNRO

The Act places certain responsibilities on both employer and employee, the author explains some of the provisions of the Act and how it may affect hospital engineers and their jobs.

Statistics

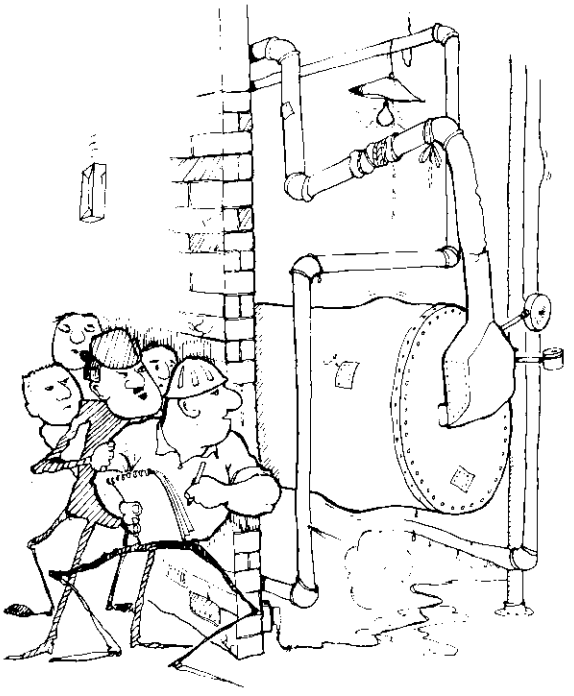
- It is worth repeating that around 700 000 persons are absent from work because of accidents every year. Even after allowing for alleged cases of malingering, which no doubt do occur, a goodly proportion of that 700 000 are absent owing to incapacity caused by machine accidents or generally brought about by working environment.
- Approximately a thousand of these accidents are fatal and a dead man can hardly be accused of malingering.
- 20 000 workpeople will be notified as having contracted an industrial disease, such as pneumoconiosis, silicosis, asbestosis, dermatitis and other industrial diseases.
- Approximately 800 people will die in the course of the year because they have contracted certain of these illnesses in past years.

In a random sample of 48 accidents investigated, connected directly with the transport industry, which was concerned with the second half of 1972, only two involved a breach of the law at that time, and by that I mean a breach of the Factories Act and associated legislation. You may remember that the full force of the Health & Safety at Work Act did not come into being until April 1975. At the conclusion of the survey it was stated that in 32 of these cases there was no reasonably practicable precaution that could have been taken and of the remaining nine there were precautions which could have been taken and would have possibly prevented the accidents. Five of these contraventions were caused, by management default, three were the fault of workpeople and one was the joint responsibility of management and workpeople.

A fifth of those accidents could have been prevented.

As those statistics refer to only people coming within the ambit of the Factories Act and associated legislation and codes of Regulations, now that the Health & Safety at Work Act provides similar cover for eight million more people in Scotland, England and Wales, there is no doubt that the number of breaches recorded will increase *pro rata*. Not all of the accidents or industrial diseases arising out of legislation covering these new entrants will be dealt with by HM Factory Inspectorate, indeed the Health & Safety Executive includes the Inspectors of Mines and Quarries, Nuclear Inspectors, Inspectors of Explosives and others. One of the most notable inspectorates not included in the ambit of the Health & Safety Executive is the Agricultural Inspectorate, although I believe there have been some suggestions by the Agricultural Union to have that inspectorate become part of the Health & Safety Executive.

The Factory Inspectorate is by far the largest of all these and, although we have had an increase in staff, the bulk of this increase has been taken up at the headquarters in London. There are more persons involved in administration, planning, re-organisation of the Inspectorate's work, research, and not least those involved in giving technical advice, analysis and sampling, such as we get from the Industrial Hygiene Laboratories at Cricklewood. That means that out in the Divisions, and Scotland is currently a Division, (although it will soon be divided into two areas) inspectorial staff is too thin on the ground to administer



... men on the shop floor should monitor their own safety...

Mr. Munro is HM District Inspector of Factories with the Health & Safety Executive, HM Factory Inspectorate, City Wall House, Eastwood Avenue, Glasgow G41 3NS, Scotland.
This article is based on a paper delivered to the Scottish Branches Conference of the Institute of Hospital Engineering, October 1975.

this Act as I believe Parliament and the trade unions wished it to be administered. However, I believe that the aim of the Robens Committee's recommendations and the aim of the Health & Safety at Work Act is to get management at all levels, and men, as it were, 'on the shop floor' to monitor their own safety and to take safety precautions regarding machinery and processes which could lead to injury from a mechanical source or injury to health from a toxic material.

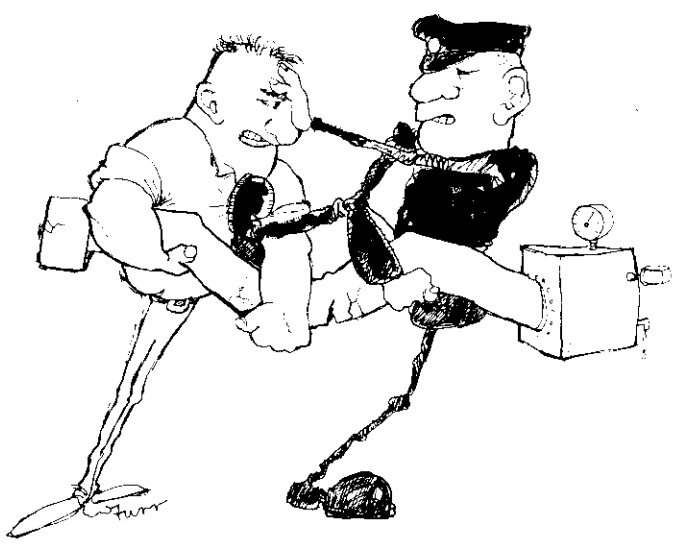
Reduction in the accidents and in the incidence of of industrial disease can only be brought about by greater effort on the part of management and men to evolve, among other things, safe systems of work, safe methods of work and developing a critical mind when dealing with any safety aspect of their work.

Teeth of the act

In the final analysis, where a firm, its management or its employees fails to comply with the requirements of existing legislation concerned with safety, health and welfare, there are several lines of action which can be taken (albeit reluctantly) by an Inspector. These include the issue of an improvement notice under Section 21 of the Act, a prohibition notice under Section 22, to seize any article or substance etc. that could cause imminent danger or personal injury by virtue of Section 25 of the Act and where a person is convicted of an offence under any of the relevant statutory provisions in respect of any matters which a court thinks are within its power to remedy, the court may, in addition, or instead of imposing any punishment, issue an order for remedying the particular matters concerned (Section 42).

Improvement notice

An inspector will, as a general rule, not issue improvement or prohibition notices as if they were confetti; indeed, an improvement notice can only be issued if there is a breach of any statutory requirements whether these be under the Factories Act or Health & Safety at Work Act, or any of the associated Regulations.



... inspector would not seize any article without giving it serious consideration...

If an improvement notice is issued, the person or firm receiving it can appeal to an industrial tribunal and can, if he wishes present his own facts or he can obtain the services of a lawyer. Immediately an appeal is laid—and a form for the appeal should be attached to any notice (form IT 19)—the effect of this appeal is to suspend the requirements of the notice until the appeal has been heard and a decision has been made by the tribunal. The appeal can be withdrawn by the appellant or in the event of his dissatisfaction with the decision arrived at by the tribunal he can take this to a higher court. In England this would be to the High Court and in Scotland the Court of Session.

Prohibition notices

There are two kinds of prohibition notices, immediate and deferred. In the case of a deferred notice, this would come into effect sometime in the future where, in the opinion of the inspector, there would be imminent risk of injury to a person or persons. An immediate prohibition notice, which is also issued when an inspector considers there is an imminent risk of serious personal injury, comes into effect the moment the notice is issued. An appeal against such notices does not have the effect of suspending the requirements set out by the inspector. It should be noted that a prohibition notice can be issued even though there is no breach of any statutory duty. Because an immediate prohibition notice stops any specified activity forthwith, it is usual for the hearing by the industrial tribunal to take place as early as possible and such a hearing can be arranged, I understand, within a matter of a day or two. In the event of a firm being dissatisfied with the conclusions drawn by the tribunal, an appeal can be made to the High Court, or in Scotland to the Court of Session.

Powers of seizure

An inspector would not, I suggest, use his power to seize any article or substance which is a cause of imminent danger without giving it serious consideration, and most probably not without discussing it with a senior colleague. In any event, if such a seizure is authorised, the inspector has to prepare and sign a written report giving particulars of the circumstances in which the article or substance was seized and so dealt with by him, and he has to give a signed copy of the report to a responsible person at the premises where the article or substance was found by him and, unless that person is the owner of the article or substance, he has also to serve a signed copy of the report to the owner. You may wish to note here certain of the words in Section 26 of the Act: 'Where an Action has been brought against an inspector in respect of an act done in the execution or purported execution of any of the relevant statutory provisions and the circumstances are such that he is not legally entitled to require the enforcing authority which appointed him to indemnify him, that authority may, [*and I emphasise the word may*] nevertheless indemnify him against the whole or part of any damages, cost or expenses which he may have been ordered to pay or may have incurred if the authority is satisfied that they honestly believed that the act complained of was within his powers and that his duty as an inspector required or entitled him to do it'. The inference is that the Health & Safety Executive could

decide that an inspector exceeded his duty, did not do this honestly and that inspector will be liable for damages at common law.

Section 42 of the Act, which allows a court to make an order, would, I think, be rarely used and circumstances under which it would be used I suggest could be similar to those pertaining at Flixborough, or perhaps where an inspector had issued a prohibition notice, a firm had failed to comply with the requirements of that notice and had been convicted of so failing and the danger was so imminent that a court order was the final remedy. It would be a brave man or firm who failed to comply with such a court order, because, in effect, they would be in contempt and as such I do not think I need elaborate on the action that would be taken by a court in such a case.

Penalties

The penalties imposed for breaches of the Act can be up to £400 in certain circumstances, or in certain indictable offences an unlimited fine and/or a term of imprisonment not exceeding two years. I understand that the first indictable offence is being taken in the near future in the South of England.

How then, will the provisions of this Act affect hospital staffs, and more particularly hospital engineers? This can perhaps be best illustrated by considering circumstances either real or imagined whereby a hospital staff or members of the public or employees of subcontractors are involved in a dangerous situation while at work.

Example 1

A hospital engineer instructs his general foreman to have certain slates or tiles of the roof of one of the hospital buildings replaced because they are broken. The slater or tiler goes onto the roof and fails:

(*a*) to have a ladder of adequate length

(*b*) to tie that ladder so that it cannot slip

(*c*) to use a roof ladder because the roof has a pitch of more than 30° and, as a consequence, while the man is replacing a tile he slips and falls to ground level and in so falling either he or some of the debris which falls with him strikes a visitor to the hospital.

First, we have to consider what breaches there have been and, secondly, who was responsible for those breaches. The Construction (Working Places) Regulations 1966 would apply and in particular Regulation 32; which, among other things, requires ladders to be securely fixed so as to prevent them slipping at their top and bottom points of rest and for them to extend 105 cm above the landing place. Regulation 35 which requires among other things that where work is done on a sloping roof with a pitch of more than 30° there shall be provided sufficient and suitable crawling boards, and further that where the work is extensive, a barrier at the lower edge of the sloping roof or, alternatively, that the work is done from a suitable working platform not less than 42·5 cm wide. So here we have, without looking too deeply into the matter, at least two breaches of statutory legislation. We have now to look at what steps the hospital authority had taken to instruct the hospital engineer as to his duties concerning compliance with the Factories Act 1961, the associated legislation and the Health & Safety at Work etc. Act 1974:

(i) They should have evolved and established in writing what their safety policy is.

(ii) The engineer either himself or by delegating the job to a competent assistant should have ensured that all construction employees were made aware of the principal requirements of the four codes of construction regulations, and in particular those regulations which required the employees to use certain equipment.

(iii) Suitable ladders, crawling boards etc. must have been provided by the hospital authority.

I suggest that one way of achieving this is to establish a set of rules for particular kinds of jobs. In this particular case perhaps rule 1 could be that on the job sheet there be specific instructions as to the type of job to be done, including whether the roof work was extensive or not. Rule 2 could be a list of the equipment required, i.e. two ladders, two crawling boards, a receptacle or method for securing the tools and material that he was to use, warning notices to be placed at ground level and possibly tape or barrier to keep persons not involved in the work out of harm's way.

Under Section 2 of the Health & Safety at Work Etc. Act, the employer, in addition to having the duty to provide and maintain plant and systems of work and to make arrangements for ensuring, so far as is reasonably practicable, safety and absence of risk to health in connection with the use, handling, storage and transport of articles and substances, he has also to provide such information, instruction, training and supervision as is necessary to ensure so far as is reasonably practicable the health and safety at work of his employees. This provision might be met by arranging for building workers or construction workers to attend lectures dealing with their specialist type of work.

If the hospital authorities or the engineer, his general foreman, foreman, or the man himself, had failed to carry out their duties they could find themselves in breach of either Section 2, Section 3 or Section 7 of the Health & Safety at Work Etc. Act. Section 3 requires that 'it shall be the duty of every employer to conduct his undertaking in such a way as to ensure so far as is reasonably practicable the persons **not** in his employment who may be affected thereby, are not thereby exposed to risks to their health and safety' and Section 7 requires, 'it shall be the duty of every employee while at work:

(*a*) to take reasonable care for the health and safety of himself and of other persons who may be affected by his acts or omissions at work; and

(*b*) as regards any duty or requirement imposed on his employer or any other person by or under any of the relevant statutory provisions, to co-operate with him so far as is necessary to enable that duty or requirement to be performed or complied with'.

Section 8 requires that 'no person shall intentionally or recklessly interfere with or misuse anything provided in the interests of health, safety or welfare in pursuance of any of the relevant statutory provisions'. I suggest that, in this instance, had the necessary equipment been provided and another person had come along and removed it quite deliberately and without thought to safety he could very well be in breach of Section 8.

Had this job, however, not been undertaken by members of the hospital staff but had been given to a self-employed contractor, to whom the Construction

Regulations would not necessarily have applied, that self-employed person would have been in breach because, under Section 3(2) of the Health & Safety at Work Etc. Act 1974, 'It is the duty of every self-employed person to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that he and other persons (not being his employees), who may be affected thereby, are not thereby exposed to risks to their health and safety'. I would also, were I a hospital engineer, ensure that any contract entered into with any subcontractor contained clauses that they (the contractors) should comply fully with the requirements of the Factories Act, associated legislation and the Health & Safety at Work Etc. Act while they were on the hosptial or other premises for which I was responsible. I would also make a point of checking, at least when the contract was initially commenced, that there was suitable equipment on the jcb and that this was being correctly used. If I found that the firm concerned were in breach I would make a point of writing to the management of the contracting firm concerned asking them to remedy the matters forthwith. Depending on the severity of the breach and the danger involved I might even stop the job.

Example 2

A nurse under training is instructed to get from stores two winchester quarts containing highly flammable solvent which are to be used for surgical purposes. She draws two winchester quarts from stores and while holding them by their necks one slips and smashes on the concrete floor. A nearby source of ignition causes the vapour to ignite resulting in serious injuries to the nurse and other people in the vicinity. In this case, I would have expected the nurse to have been provided with a suitable carrier with which the bottles could be transported more safely. I would have expected her to have been told of the dangers in the event of spillage of the liquid and of the immediate steps she should have taken to remedy a potentially dangerous situation. An incident similar to this, I understand, did occur in a hospital several years ago resulting in serious injuries to two nurses.

One could go one giving instances of possible dangers, but I would suggest that some of the problems which should receive attention are the use and stripping of old asbestos lagging, various fire provisions, including ensuring that exit doors are readily available, stairs and passages are not obstructed so as to prevent easy escape, the regular testing of fire warning and instructions as to the action to be taken in the event of fire. Repair of certain radiological plant, X-ray sets etc., could involve maintenance engineers or mechanics in possible danger where sets have to be energised in order to test their efficiency and possibly the safety measures which most, if not all, radiologists take, are not taken by the engineering staff carrying out the repairs.

One thing that is pertinent to hospitals is that they may be deemed to be Crown premises. (This matter is currently being considered by the solicitor of the Health & Safety Executive.) As you know, in the past, Crown employees have been immune from legal proceedings or rather from criminal proceedings under the Factories Act. Section 48(2), however, requires that although the provisions of this Act do not apply to the Crown, Sections 33-42 *shall apply to persons in public service of the Crown as they apply to other persons and Sections* 32–46 *are the offence sections and other matters relating to legal proceedings.*

Consultation with workpeople

Under Section 28 of the new Act, inspectors are now required to divulge certain information to employees. This is a quite new course of action and such information could include reference to dangerous condition of machinery, dangerous or obnoxious fumes given off from a process, or the failure by a firm to provide certain welfare facilities such as suitable washing facilities etc. To this end, the inspector can either discuss these matters with a trade-union representative and (or) confirm, by sending a copy of the letter he sends to the firm regarding matters requiring attention. I usually send two copies of such a letter to the firm and they pass one of the copies to the trade-union convenor or shop steward. If there is no trade-union representative I ask the firm to pin a copy of the letter in a conspicuous place in the factory where it can be read by employed persons.

I could do worse, in conclusion, than to say that if the Health & Safety at Work Act means anything, it means complete, honest co-operation between men and management regarding safety, health and welfare, irrespective of any dissensions concerning wages or other problems. Training courses are available for management and details of these can be obtained from your local, and I hope friendly, factory inspector.

Le Décret met certaines responsabilités sur l'employeur et l'employé; l'auter explique quelques dispositions du Décret et comment ce Décret pourrait affecter les techniciens des hôpitaux et leurs situations.

La Legge attribuisce certe responsabilità al datore lavoro ed al dipendente. L'autore spiega alcune disposizioni della Legge e come sees possano interessare i tecnici ospedalieri ed il loro lavoro.

Das Gesetz legt sowohl dem Arbeitgeber als auch dem Arbeitnehmer gewisse Pflichten auf. Der Autor erklärt einige der Bestimmungen des Gestzes und fürht aus, wie es sich auf Krankenhausingenieure und ihre Arbeit auswirken kann.

Pollution of the atmosphere of operating theatres

The Council of the Association of Anaesthetists of Great Britain and Ireland* set up a working party in November 1974 to review the available evidence and make recommendations concerning the pollution of the operating-theatre environment and other areas by anaesthetic gases and vapours. The working party has now completed its report and the council is issuing the following statement of advice to its members, and to others who may be concerned. The working party has been advised by representatives from several divisions of the Department of Health & Social Security and from the Medical Research Council who have assisted with the preparation of this statement.

1. Council's Working Party is satisfied that significant quanties of anaesthetic vapours are inhaled by anaesthetists even in well ventilated theatres, and that measurable, though lesser, quantities are inhaled by other persons in the operating department. The quantities inhaled vary considerably from location to location.

2. Although numerous effects on the mortality and morbidity patterns of theatre personnel have been suggested and are being investigated, one which seems reasonably probable is a statistically significant increase in the spontaneous abortion rate of females working in operating theatres. There are many factors which influence spontaneous abortion, and the observed rate depends on the criteria employed. It is generally accepted that under normal conditions the spontaneous abortion rate lies between 9 and 15 per 100 live births. Various surveys indicate that the rate for women employed in operating theatres lies between 17 and 27 per 100 live births. It should be stressed that there is no direct evidence that this observation, even if validated, is causally related to the inhalation of anaesthetic agents.

3. However, it is a sound principle of hygiene to take steps to reduce atmospheric pollution as far as possible. Apart from mitigating any effects on their own performance, health and subjective well-being anaesthetists have a responsibility to consider the welfare of others working in operating theatres.

4. Attempts to reduce pollution need not wait for the development of adequate monitoring programmes nor for an agreed standard on the maximum limits which should be permitted. The aim should be to reduce atmospheric contamination to the lowest practicable levels.

5. Action should be taken as soon as possible to provide facilities for venting residual anaesthetic gases away from the theatre environment. The DHSS will be issuing guidance on appropriate engineering facilities and procedures for their installation.

6. Anaesthetists are advised to take the appropriate steps to institute measures to lower the atmospheric concentration of anaesthetic agents in operating departments. This should be done in consultation with the engineering and other relevant interests. There are two methods of removing exhaust gases—passive exhaustion and active scavenging.

(i) *Passive exhaustion to the exterior.* It is necessary either to replace the normal expiratory valve with a special valve or to fit a suitable gas-tight hood to existing valves. The expired gases can then be channelled to a suitable exterior discharge point. The patient will be exposed to an additional expiratory resistance but existing prototype systems suggest that 25 mm diameter smooth-bore metal piping is satisfactory in most circumstances. This has a resistance of 0·01 cmH_2O per metre at a flow of 30 l/min (Corrugated anaesthetic hose has a resistance approximately eight times as great as this.) We recommend that the resistance of a passive system should not exceed 0·5 cmH_2O at a flow rate of 30 l/min. This resistance would be produced by 50 m of *unbent* pipe. The resistance of piping with bends should be measured to ensure that it is acceptable. External discharge points may be subject to significant fluctuations in atmospheric pressure and the siting may be critical. It may be advantageous to use a short T-piece as a terminal. The exhaust duct of the operating-theatre ventilation system may be more accessible than a suitable exterior exhaust point and in certain circumstances may be used. The ventilation system must be nonrecirculating at the relevant point and not subject to pressure fluctuations. Not all types of theatre ventilation systems are suitable and the district engineer should be consulted.

(ii) *Active scavenging.* An appropriate device must be fitted which prevents either negative or positive pressure being applied to the respiratory circuit. It is also convenient to include a reservoir. This allows mean extraction flow rates to be reduced from about 100 l/min. to about 25 l/min. An open T-piece of adequate internal volume (greater than the tidal volume) can be used for this purpose, but care must be taken to see that the intake cannot be obstructed, and cannot entrain contaminated or dirty air. A 1 litre canister can also be used. If the canister is open to the atmosphere, the inlet and suction points must be arranged so that expired gases are removed preferentially before room air is entrained. An enclosed reservoir must allow for free overflow in the event of suction failure, and free ingress of room air to prevent negative pressure being applied to the expiratory valve. The working party recommends that systems should ensure that negative pressure greater than 1 cm H_2O cannot be applied to the airway. The source of suction can be either a diaphragm pump, a fan, or a venturi. The use of piped medical vacuum systems is considered in paragraph 9.

---

†This feature was first published in the journal *Anaesthesia* and is reproduced here by kind permission of the editor.

*This statement was prepared by Dr. M. D. Vickers (Birmingham) Secretary of the Association at the request of the President and Council.

7. To avoid introducing any additional hazard from possible misconnection, all expiratory exhaust ports on ventilators or anaesthetic apparatus should be fitted either with nonstandard* fittings, or a 30 mm male cone. This latter is recommended in the draft International Standard for spirometer outlets and is likely to be the British Standard. Likewise any fixed installation points to which an exhaust tube is to be connected should be fitted with a 30 mm female socket or a matching nonstandard fitting. The working party hopes that manufacturers will adopt the 30 mm fitting. This cannot so easily be defeated by amateur adaption and will enable devices to be fitted to spirometer outlets of ventilators.

8. Termination points should be clearly marked: DANGER ANAESTHETIC GASES. Since flammable gases may be involved, equipment should also take account of Hospital Technical Memorandum 1. The siting of the exterior discharge point should be such that other areas are not contaminated. When overhead pipe runs are used, the possibility of condensation must be considered, and water traps incorporated. Periodic sterilisation of such lines may be necessary.

9. The use of hospital piped medical vacuum systems though feasible, introduces several special problems and they should only be used with the approval of the hospital engineer. They should not be used with flammable anaesthetic agents; since anaesthetic agents are soluble in pump oils, routine maintenance of the pumps may need adjustment. The exhaust point for hospital suction may be unsuitable. It must be established that the pumps can handle the additional flow without significant loss of vacuum and a metering orifice or flowmeter should be included in the line. Such systems cannot therefore be regarded as a preferred method.

10. While partial or complete rebreathing techniques, associated with low input gas flows will obviously reduce contamination, partially closed systems will still require the use of scavenging devices. Activated charcoal will absorb anaesthetic vapours but is not able to deal with nitrous oxide.

11. There are circumstances in which vapours cannot be reliably scavenged by the above methods, for example, outpatients dentistry and oral surgery with a Boyle–Davies gag. Continuous removal of large volumes of (contaminated) air as close as possible to the site of loss will minimise the level of general pollution, in proportion to the flow rate. The flow necessary to reliably remove exhaust gases depends on many factors, and it is not possible to specify the optimum scavenging flow rate. Systems unable to handle 250 l/min. are likely to be ineffective in many circumstances.

12. Anaesthetists should consult with theatre nursing staff to ensure that anaesthetics are not used for cleaning or for disinfecting surfaces. The importance of avoiding spillage should be included in the inservice training of theatre staff and improved methods of filling vaporisers may be desirable. It is good technique to arrange for vaporisers to be filled at the end of the day, or if necessary, at the end of an operating session, and *not* at the start of a session.

13. Many of the causes of spontaneous abortion are not well understood. Nevertheless, women with a history of previous spontaneous abortions and those who become pregnant may seek advice as to their environment. The association is unable to give general advice since statistical factors cannot be applied to the individual case. If there is no apparent cause for repeated abortions counselling should be sought by individuals from their obstetric adviser.

14. Council has advised the DHSS that there is a need for further research into methods of controlling atmospheric contamination, from the point of view of effectiveness, safety and acceptability in various situations. They have also suggested that there is a need for a continuous programme of monitoring of the health of operating-department staff.

* i.e. not 15 mm or 22 mm conical connections as specified in BS3849.

Correspondence

Dear Sir,

After reading G. C. Bushill's article in the March 1976 issue of *Hospital Engineering*, I feel I must take him up on his paragraph on lighting, and in particular his mention of 'limit stops on adjustable reading lamps'.

When these stops are put on to restrict the shade movement it is because a reading lamp is precisely what its name implies.

Fittings required to double as examination lamps—which is more often than not the case—can be constructed with completely free movement of the shade. So much can be done to avoid costly and inconvenient maintenance caused by broken 'stops' if the manufacturer is consulted and given the facts before the installation.

Yours faithfully,

G. E. Rowse (Mrs.)

Sales Office Manager
Thousand & One Lamps Ltd.
108, Bromley Road
London SE6 2UX

16th March, 1976

The author replies

Dear Sir,

It would seem that Mrs. Rouse and I are really on the same wavelength.

My statement was that items 'must be in both function and position suitable for the use to which they are put'. The requirement for a bedhead lamp is, in the majority of cases, not for a reading lamp at all, but for 'a source of illumination useable by both patient and clinician', yet often reading lamps with their associated limit stops are specified.

For this reason adjustable lamps for Multequip Bedhead Services System are normally supplied without stops thus avoiding the 'costly and inconvenient maintenance' Mrs. Rouse so rightly refers to, irrespective of the incoming specification!

Yours faithfully,

G. C. Bushill

Marketing Planning Manager
Hospital Engineering Systems
Medishield (Harlow) Limited
Elizabeth Way
Harlow
Essex CM19 5AB

26th March 1976

The road from Wigan pier

by J. E. BURTON

Mr. Burton was the winner of a competition arranged by the IHE as a result of which he was sponsored to attend the International Congress in Paris. Here, he presents his personal view of the congress. He is a hospital engineer with the Wigan Area Health Authority.

The Paris Congress was an event which I had looked forward to with eager anticipation. I did not know quite what to expect, but with a passport and a 'fist full of francs' I travelled from Wigan to Paris—perhaps not the most well trodden route in Europe.

The congress meetings and exhibition were all held in a single building at the Parc des Expositions de la Ville de Paris. The building was one of six similar exhibition halls, all on one site, and which provide France with an enormous exhibition centre covering some fifty acres, which is in continuous use.

The opening speeches and subsequent papers impressed upon me that health care in France, as in Britain, is taken very seriously. France is continually striving to improve health-care facilities and at present is engaged in hospital construction on 200 sites.

Standardisation

Of course, mention of finance, economy and inflation seemed to crop up in every other sentence; showing that Britain is not alone, but suffers from an international problem. One method of reducing the effects of inflation and improving facilities as rapidly as possible is by standardisation in the design of wards, departments and structures. This policy has been adopted in France and is claimed to have reduced building costs and construction time. For example, a complete 500-bed unit can be built in significantly less than the previously accepted eight years, from initial planning to final handover.

Despite the fact that units were claimed to be standard designs, to be repeated at different sites, the designers claimed to alter each design to suit local needs, a policy which I feel defeats the main objective if not strictly controlled. Also, standardised buildings were not without critics, notably a French administrator who claimed that his hospital had roofs which leaked, basements which flooded and wards which were either too hot or too cold. However, the administrator did not explain whether the problems were design, construction or maintenance faults, and was unable to offer a technical explanation as to the exact causes.

The exhibition contained displays of all items of hospital equipment, from surgeon's tools, to diesel generators, to coffee dispensers. Certainly the financial tones of the delegates did not seem to be reflected in the glossy displays of the exhibitors. However, for an international event, I was disappointed with the notable absence of British exhibitors and with a few exceptions, the majority were French.

International

My attention was drawn, in particular, to the fact that British and continental countries seem to have different standards in respect of some equipment. The most apparent differences were French and German autoclaves, without safety interlocks on the doors, and fire-alarm systems incapable of distinguishing between an open-circuit fault and a fire call.

The Congress was, I felt, French orientated, mainly French delegates speaking about the French health service. This is not necessarily a criticism, but detracted from the appeal of a truly international meeting. The delegates themselves, represented most parts of the world including Greece, Germany, Portugal, Italy, Belgium, South Africa, Nigeria, Israel, USA, Spain, New Zealand, Yugoslavia, Brasil, Switzerland and the UK.

It was a valuable experience being able to meet people from such a variety of countries, yet who were employed in the same sphere of work as myself. While language difficulties did arise, I found it surprisingly easy to make myself understood when talking about a subject with which both parties were familiar. This was one of the few occasions when national barriers disappeared and were replaced with a bond of common interest.

I am pleased to have had the opportunity to attend this Congress and Exhibition which, together with Paris itself, made a deep impression on me. It will only be in future months as new events present new problems that I will recall many of the details of these impressions and obtain the full benefit of the visit. I am most grateful to the Institute and the King Edward's Hospital Fund of London for enabling me to attend the Congress.

Nottingham's second phase

Taylor Woodrow Construction (Midlands) Ltd. has received a contract valued at approximately £18·5 million from the Trent Regional Health Authority for phase II of the University Hospital & Medical School, Nottingham.

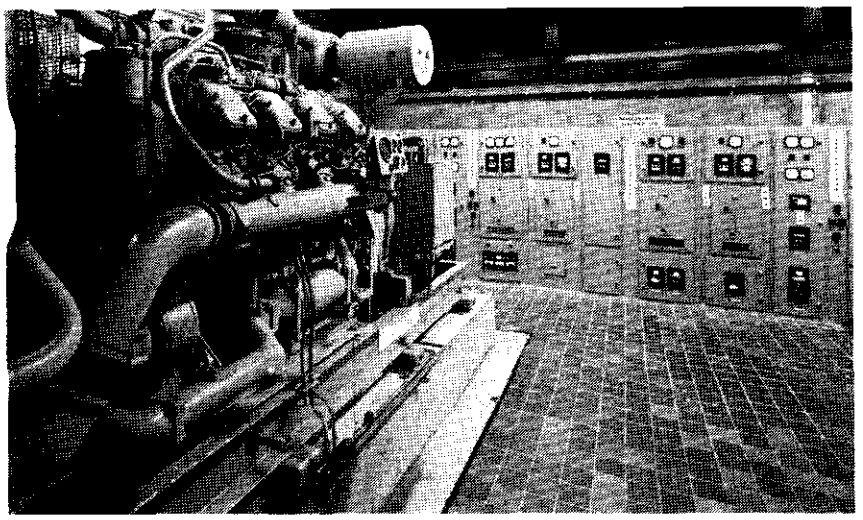
The architects, quantity surveyors and structural engineers are Building Design Partnership (Preston Group), the electrical and mechanical engineers, E. G. Phillips Son & Partners, and Revall Hayward & Partners.

The work will comprise the erection of the north-east block, containing five floors of wards for geriatric, obstetric and paediatric patients, together with the south-east block, containing four floors of wards for psychiatric and medical patients. A total of some 1 000 out of 1 450 beds for the complete hospital will be provided. These included 168 obstetric beds, 84 geriatric beds and 140 children's beds. Also included is the completion of the outpatients' department and finishings of buildings erected as shell only in the phase-1 contract, which was let at some £15·6 million in 1971 to Taylor Woodrow.

The buildings are of steel-framed girder construction on a 9·6 m grid. Double-T precast concrete units spanning 9·6 m form user floors, which alternate with service floors throughout the buildings. The service floors are of pot-and-plank construction, spanning 4·8 m with a centre support from mid-span of the double-T units above.

Incorporated in the buildings are 10 *in-situ* reinforced-concrete service towers, containing stairwells and lifts, toilets and service ducts, making a total of 31 such towers in the whole project.

Completion of work is scheduled for September 1979.



HE News

TOPPING OUT AT LEEDS

The topping-out ceremony at the new Leeds General Infirmary was performed by Mr. Arnold Tunstall, area administrator, Leeds Area Health Authority, on the 27th February.

The £22 million complex is the first British hospital to be based on the total-energy principle. The complex will supply, from One self-contained building, all electrical power, steam, hot-water, and air-conditioning refrigeration requirements for the new Leeds General Infirmary and University Medical and Dental Schools.

Ultimately, the station will have six 2 mW generators with dual-fuel engines, complete with waste-heat boilers plus heat-recovery systems; six 7 110 kW steam boilers with dual-fuel burners; 17·58 mW of refrigeration plant; and six 450 l/s air compressors and driers.

Eastbourne standby

Two fully automatic mains-failure generators and one manually switched set with a combined output of 1290 kVA have recently been installed at the new Eastbourne District General Hospital by Dawson-Keith of Havant. The new 600-bed hospital is scheduled to come into operation in May this year.

The two automatic generating sets are on standby to four substations supplying vital hospital services. Each unit provides 392 kVA and they are linked by Dawson-Keith designed and built switching and control gear, giving full paralleling with automatic synchronisation. The system will reach full rated output within 10 s of failure of mains supply, and is designed to provide complete flexibility in supplying any permutation of substations. Both units have Dorman engines driving Stamford alternators, and automatic shutdown facilities, in the event of low oil pressure, overheating or excess engine speed, are included.

The third set, also with a Stamford alternator but with a Rolls-Royce engine, produces 506 kVA. It is employed as a direct standby via a single substation to the hospital laundry.

Safety and medical equipment

by JAN THORP

A general view is presented on how to avoid hazards due to medical devices. As the most common cause of mistakes and accidents lies in the interaction between man (patient/staff) and machine, the necessity of information (instructions) and training is stressed. The component parts of the 'safety-tower': design; manufacture, installation, usage, maintenance, prepared measures and procurement, as a link between producer and user, are discussed.

The aim of this article is to present a general view on how to avoid unreasonable hazards from medical devices. Many well known facts are quoted—but have we drawn the right conclusions from them? Are we tackling each problem separately without taking the whole safety picture into consideration?

The consequences of the malfunction of medical devices vary from inconvenience to death. Probably the most common unwanted effects of hazardous and unreliable medical devices are caused by:

- oxygen-supply failure
- electrical failures
- abnormal heat supply

Often the consequences, seen retrospectively, could have been avoided. Mostly, it is difficult to blame one person; in some cases the equipment was deficient; now and then you can trace the trouble to inadequate maintenance.

Generally, technical defects in medical apparatus are, rare compared with the most common causes of mistakes and accidents, which are found in the interaction between man (patient, staff) and machine.

There is always a risk when a medical device is used by inadequately trained staff and when clear instructions are lacking.

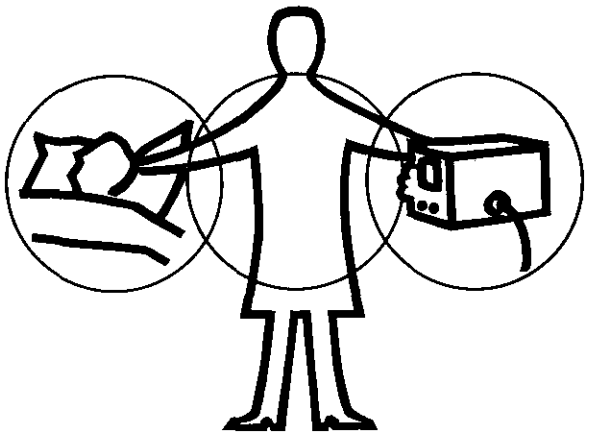


Fig. 1 Mistakes happen here

Mr. Thorp is head of the Equipment Department, Swedish Planning & Rationalization Institute of the Health and Social Services, Fack, S-10250 Stockholm, Sweden.

The Swedish Supreme Court laid the responsibility on the County Council (the hospital owner) in a case where an intravenous catheter had been cut off in a vein. The staff could not be accused as the instruction for use was in a foreign language.

When using the term 'unreasonable risk', written instruction should be regarded as an integral part of the equipment. Too often the staff do not have enough information and training on how to behave, medically and technically, in stress situations.

'Unreasonable risks from hazardous medical devices' is a rather vague term, and it is still more elusive as the risks may arise from any part of the chain: design, manufacture, installation, usage, maintenance.

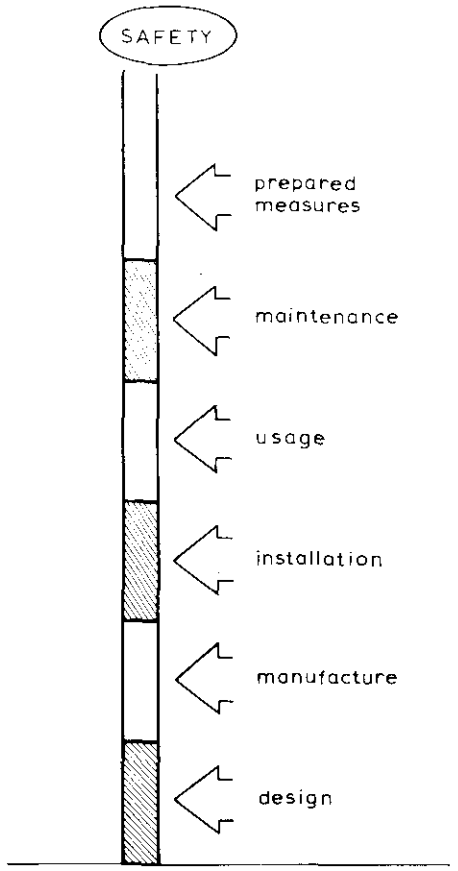


Fig. 2 The safety tower

We never reach total safety. Even if we do, whatever can be done in the stages from design to maintenance, there will still remain a gap between the safety level achieved and absolute safety. This gap can be diminished by forward planning (e.g. of available alternate equipment to serve the same role, planned alternative methods etc.).

A perfectly safe construction might require less caution in use. A prototype for clinical evaluation may require more skilled users.

Design

The designer's skill, his experience and his knowledge of requirements on different levels (medical, technical, legal etc.) are of great importance. The designer is also dependent on a feedback procedure to get continuous information on risks, complications etc. from the user and technical staff.

The development of safe, effective medical devices must be based on well-defined medical and technical requirements. It is, however, year-long processes to obtain a 'safe' device. Well established co-operation between clinical researchers, hospital staff and manufacturers is necessary.

It is easy to to fall into the trap of including too many functions, refinements or gadgets in the equipment. Too little time is then used for ergonomic considerations, simplifications and essentials. Simplicity in design and use of devices is highly desirable in clinical work. It is said that an apparatus with more than one knob is a bad design!

Manufacture

We can design and manufacture 'safe' products, sometimes at very high cost, and it is quite clear that where the limit for safety is concerned there are conflicting choices.

The safety requirements for electrical apparatus in medical use concentrate upon obtaining conducting connections to the patient which will allow only low leakage currents to flow. Connections isolated from earth are preferred and when it comes to cardiac application the principle of floating connection must be applied. The general safety precautions advocated by IEC as laid out in SCGZA (Secretariat) 10 for electromedical apparatus result in a marginal rise in production costs, say a few percent, if included from the beginning. Floating connections for cardiac application are more costly and will result in a cost increase of about 15%.

An adoption of all the extreme requirements that have been discussed would result in complexity and higher costs. IEC's proposal can be looked upon as a good compromise giving a reasonable safe equipment at a moderately increased price.

The manufacturer (seller) can be forced to guarantee that his product is safe for the intended use. Unfortunately, the definitions of 'safe' and 'use' are often rather vague. This implies that the manufacturer should actually warn the user, so that he is quite aware of the dangers he faces when using the products.

The manufacturer (the seller) of factory-sterilised disposables must register with the National Board of Health & Welfare. He must take the precautions needed to ensure that these products are sterile when they are used and to prevent their causing harm.

Representatives of the Board are entitled to inspect the manufacturing of factory-sterilised disposables. (Swedish Law SFS 1975: 187).

It is as important to control the manufacture of complicated medical equipment as well as mass-produced disposables. Quality control must be undertaken by the producer and can be supplemented by checking by an approved inspecting authority or by the buyer.

When a purchaser requests visual proof of compliance with the test requirements, his representative shall be permitted to witness the carrying out of the specified tests at the manufacturers' works. (Dept. of Health & Social Security, London. Hospital technical memorandum 8. Safety code for electro-medical apparatus.)

Installation

Installation has to be safe; and this can be guaranteed only if special requirements are complied with. Such requirements are laid down by different authorities, standardising bodies etc., and are valid for medically used rooms and other places where dangerous situations may arise.

The work within the IEC concerning electrical installations in hospital buildings is well advanced. The basic philosophy is to obtain an electrically stable and quiet electrical supply. A 5-conductor distribution system gives a common zero potential on all conducting surfaces. A reliable emergency system supplies electric power to operating lamps and other critical apparatus during breaks, and precautions in lay-out and screening assist in obtaining interference-free operation.

Procurement

Procurement is an important administrative function to obtain a strong 'safety tower' (Fig. 2).

The basis for a good product in the end (meaning correct function, effectiveness, safety, maintenance system and staff education) is laid when specifying the functional and technical requirements of the equipment. The requirements must be as clear as possible and should be prepared as a teamwork between all parties

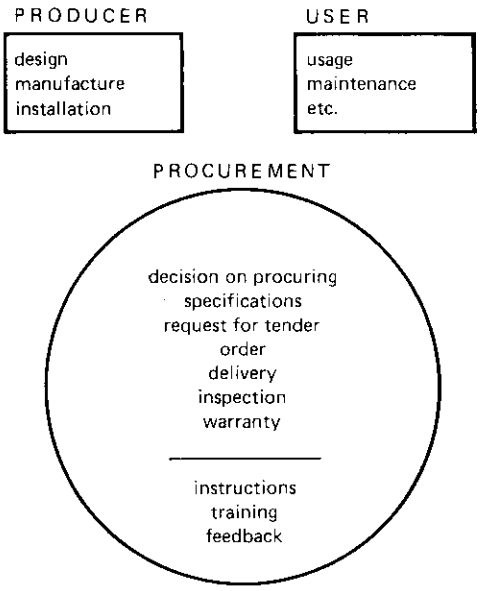


Fig. 3 To procure is not just to buy

concerned (user, technical staff etc. in co-operation). Reference should be made to standard specifications and test specifications (if any).

To avoid a vicious circle, it would be appreciated if the buyer stated his willingness to pay for safety, i.e. a higher priced but safer product.

When the product is delivered, it should be inspected to see if it fulfils the buyer's purpose and gives safety for staff and patients. It is the responsibility of the buyer to arrange such an inspection using a qualified inspector either at the hospital or from an outside company, whichever is agreed upon between the buyer and the producer. Detailed safety requirements are often lacking and the inspector must therefore be well aware of the safety philosophy of the authorities.

Usage

In some cases it would be advisable to reduce the amount of equipment to minimise some of the hazards. Too many technical devices can stand in the way of proper contact between the patient and the staff.

The safe use of electricity has long since been regulated by rather similar general laws around the world. Generally, the owner of electrical equipment and installations—and thus also the hospital owner—bears the responsibility

- to ensure that applicable safety standards are followed
- to perform adequate maintenance of the installations and devices
- to issue supplementary safety directions if necessary
- to ensure that the staff in question get relevant instruction.

For non-electrical equipment, laws for the protection of the worker (i.e. the staff) are applicable. Very little, however, is stipulated regarding the patient's right to be protected against the use of hazardous devices and methods. Here, personal responsibility comes into the picture.

The physician, who is the head of the clinic (or department) is responsible for the activities within the clinic. (*Swedish Health Care decrees* 15 and 31).

Thus the physician—also as a representative of the hospital owner—must see that directions and instructions regarding the medical devices are available to the staff. The staff must also be instructed regarding the use and the care of the equipment (including continuous control of the operation). The head of the clinic must also check that the maintenance of the equipment is properly performed—typically technical work!

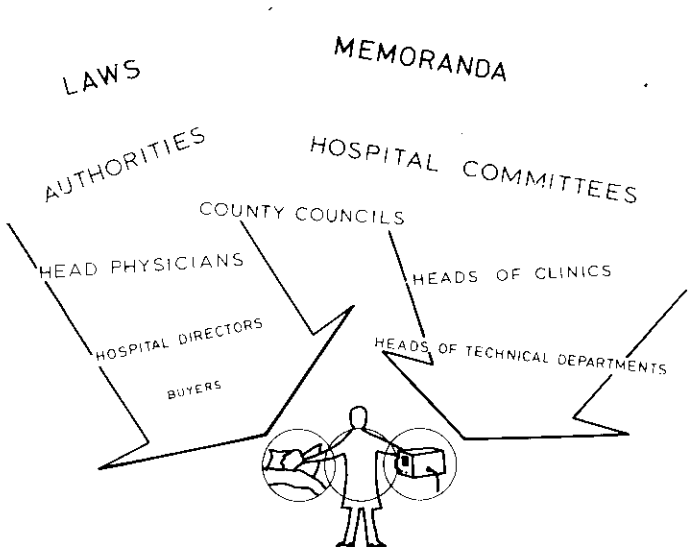


Fig. 4 The impact of responsibilities

These generally defined responsibilities of the physician (head of the clinic) constitute a problem, owing to the fact that the developments in the medical and technical fields have made it practically impossible to demand from the physician—and other users—recognition of all the intricate technical hazards. It is therefore desirable to separate the medical and the technical responsibilities. Consequently, the head of a clinic should formally delegate his technical responsibility to a competent technician within his staff or to a technical department with sufficient competence.

Maintenance

Many hospitals have no systematic procedures for maintenance of equipment and installations. Apparatus is not sent to the technical staff until failures have already occurred. In some cases, the technical staff have insufficient knowledge of the apparatus and have not been asked to take part in the procurement of the apparatus. Furthermore, maintenance instructions are often missing.

When setting up a maintenance system, it is advisable to make an inventory of the equipment available. In short this means collection of equipment data, e.g. producer, date of procurement, price, user, location, utilisation etc. These data should be noted on record cards or other documents. At the same time the condition of the equipment should be inspected and the users' knowledge and operating capabilities checked; resulting, if necessary, in equipment repair or getting rid of obsolete equipment and personnel training. Furthermore, the type of preventive maintenance used on each type or individual piece of equipment should be stated, e.g. periodic maintenance or based on 'condition monitoring' maintenance.

Special attention has to be given to equipment used for vitally important treatment and care. The need for making spare units available in case of malfunctions should be observed. More and better educated technicians in hospitals are wanted, especially for safety reasons. The value of using the technician in the role of a hospital representative to meet the bargaining power of the manufacturer or seller cannot be overemphasised. Reporting of device-related deaths and injuries is important and should be directed to specific committees or staff members with good medical and technical knowledge.

The economically responsible management or authorties play a key role in patient safety. Perhaps the investments in the maintenance of safe equipment is too sparse? The elimination of device-related hazards is a political responsibility.

A British memorandum advises hospital authorities of the procedure to be followed to ensure that information is rapidly made available about serious defects in medicinal products and other medical supplies and equipment, and places the responsibility for the immediate reporting of incidents to the appropriate

Department upon Area Administrators (*HSC* (15) 41). Common international lines of safety recommendations for medical/technical work are highly desirable.

Regulations and safety requirements

As the hospital is a society in miniature, most of the general technical regulations also apply to the hospital. Thus, there is a jungle of clauses and paragraphs behind the technical activities in a hospital.

The state authorities can act in many ways. As is well-known, there is a proposed amendment of the US Federal Food, Drug & Cosmetic Act to assure the safety, reliability and effectiveness of medical devices.

International work on the effectiveness and safety of medical equipment is going on in the International Electrical Commission (IEC) and the International Organization for Standardization (ISO). In the IEC, extensive work has been done on requirements for electrical installation and safety requirements for different types of electrical apparatus. Among the ISO technical committees, number 126 for anaesthetic equipment and breathing machines has reached an advanced stage in its standardisation work.

The possibility of a patient obtaining compensation for injuries caused by hazardous and unreliable medical devices is often strongly connected to judical responsibility and its legal solution. The conditions in Sweden have changed completely since 1975, as the general authorities (the County Councils) have accepted liability for what is called 'treatment injuries' practically independently of possible statements of responsibility. This law is expected to lighten the pressure on the medical staff and thus also to provide increased safety for the patient.

Un aperçu général des moyens d'éviter les risques présentés par les dispositifs médicaux est reporté. La cause la plus fréquente d'erreurs et d'accidents résidant dans l'action conjugée de la personne (patient/personnel) et de la machine, la nécessité d'informer (instruire) et de former est soulignée. Il est discuté des éléments entrant dans le principe de sécurité inhérente (fabrication, installation, emploi, entretien, préparatifs et acquisition) en tant que liaison entre le producteur et l'utilisateur.

Es werden allgemeine Überlegungen angestellt, wie man durch medizinische Geräte hervorgerufene Zwischenfälle vermeiden kann. Da die am häufigsten vorkommende Ursache von Fehlern und Unfällen in der Weshcelbeziehung von Mensch (Patient/Personal) und Maschine liegt, wird die Notwendigkeit der Information (Unterweisung) und Ausbildung betont. Die Bestandteille des Sicherheitsaufbaus (Herstellung, Installation, Gebrauch, Unterhaltung, Vorbereitungsnassnahmen und Beschaffung) als Bindeglied zwischen Herstellet und Benutzer werden ebenfalls diskutiert.

Presentazione dei criteri generali per evitare i pericoli causati da congegni medici. Poichè la causa più comune degli errori ed incidenti è l'azione reciproca tra uomo (paziente/personale) e la macchina, si sottolinea la necessita di informazioni (addestramento) e tirocinio. Si discutono gli elementi che costituiscono la torre di sicurezza (manifattura, installazione, uso, manutenzione, misure predisposte ed approvvigionamento) come anello di unione tra il produttore ed il consumatore.

Nigerian Association of Health Engineering

The Nigerian Association of Health Engineering was formed in 1975 and now has a membership approaching 100, composed of professional and technical engineering personnel associated with hospitals and health services. The Association enjoys government patronage, but does not enter into negotiations for salary and conditions of employment of its members.

In Nigeria, hospitals and health services are generally controlled by the Federal and State Governments, although there are some hospitals run by private interests.

The principal aims and objects of the NAHE are as follows:

- to promote, develop and disseminate health-engineering technology
- to compare national and international experience.
- to promote the principle of integrated design by improved collaboration between the professions
- to promote more efficient management of operation, maintenance and safety of hospital buildings and equipment
- to offer collaboration with other international organisations.

The officers of the Association are:

President: A. O. Faluyi (Engineer), Lagos University Teaching Hospital.

Vice President: J. B. Aje (Architect), Ministry of Works, Ilorin, Kwara State.

Treasurer: Dr. G. O. Ogunmekan, Adeoyo Hospital, Ibadan, Western State.

Secretary: D. O. Imoisi (Engineer), Lagos University Teaching Hospital.

Classified Advertisements

APPOINTMENTS AND SITUATIONS VACANT

UNITED ARAB EMIRATES

GOVERNMENT OF DUBAI

DEPARTMENT OF HEALTH AND MEDICAL SERVICES

ELECTROMEDICAL EQUIPMENT ENGINEER

Dubai is a rapidly growing port and commercial centre (population 210,000) at the southern end of the Arabian Gulf.

The Department of Health and Medical Services is an important part of the development. In addition to existing facilities, a £25 million building programme is in progress and plans are being drawn up for a new 600 bed hospital.

Present facilities include the 400 bed Rashid Hospital, which is the leading Medical Centre in the area, a 150 bed hospital, and several clinics. The Rashid Hospital is being expanded to 500 beds, a Central Services Complex is being built to include a Laundry, C.S.S.D./T.S.S.U., Manufacturing Pharmacy, Stores, Workshop and Vehicle Maintenance Sections. A new 600 bed hospital is in the planning stage. The Engineering Services of the existing hospitals and the designs for the future are comparable with the best world standards.

The Engineering Services are being expanded to meet the new needs and there are a number of engineering posts now vacant including that of an Electromedical Equipment Engineer. This Engineer will be responsible for the maintenance of all the Electromedical and Biomedical Equipment in the Department including theatre, laboratory, E.C.G. etc. He must already have extensive experience of electronic equipment for hospitals and a technical background with management experience in order to run a fully staffed department and to organise any specialist sub-contracts. He will be responsible to the Chief Engineer and will be expected to implement a fully planned preventative maintenance system.

SALARY: Grade A3(A) DH 4460 per month × 220 to DH 6000 per month (present exchange rate: DH 7·4 = £1·00)
Placing in scale according to qualifications and experience.
POST VACANT: Immediately.

Other conditions: Free accommodation with free water, air conditioning, electricity and hard furnishings. Two year contract renewable. Economy air passages for officer, wife and up to 3 children under the age of 18 years. Removal allowance DH 3000. Car allowance DH 250 per month. No other allowances.

Applications should be sent in the first instance in an envelope marked "Electromedical Equipment Engineer" to:

W. Upton,
Upton Associates,
276 High Street,
Langley,
Berks.

SULTANATE OF OMAN

Ministry of Health

HOSPITAL ENGINEER

Applications are invited for the post of Hospital Engineer in the Ministry of Health, Sultanate of Oman, Arabian Gulf. Applicants must be experienced maintenance engineers with a thorough practical knowledge of Central Air Conditioning Plant, H.V. Autoclaves, Steam Boiler Plant, Laundry Plant and all associated hospital equipment. They must also be experienced in the control of Maintenance Staff and Maintenance Programming. Applicants must hold a higher National Certificate in Electrical or Mechanical Engineering (or equivalent) and preferably be Members of the Institute of Hospital Engineers. Appointment is for one year in the first instance Salary Rials Omani 5400 per annum (approximately £7700). There is no income tax at present in Oman. Other benefits include free accommodation, free medical treatment and generous leave.

Applications giving details of educational qualifications and experience together with photo-copies of certificates and testimonials should be sent to:—

J. H. Taylor, O.B.E., M.S.E.
Student Supervisory Services
59 Lower Street
Merriott
Somerset TA16 5NW

NORTH TEES HEALTH DISTRICT

Top Flight Hospital Engineering Opportunity

North Tees . . . a progressive Health District containing one of the largest and most modern hospitals in Europe, need a **Hospital Engineer** (male or female) preferably with hospital experience to use flair and initiative in an important and responsible post.

You should possess a qualification at HNC level or equivalent in mechanical or electrical engineering, plus the ability to organise the work of a skilled maintenance team.

Main responsibilities include maintaining high standards of technical servicing to medical departments and units. And ensuring that technical manpower resources are deployed effectively throughout the District.

In addition you will carry out surveys and prepare plans with a view to improving the engineering services, assist in the design specification and execution of minor capital works, and represent the Works Department at meetings.

In the more important aspects of the job, the Hospital Engineer, is accountable to the District Engineer.

Salary is £3615–£4140 plus £183 special responsibility allowance. Benefits include payment of removal and settling in expenses in approved cases, a car user allowance and a superannuation scheme.

Application form and job description quoting ref. HE/6 available from The Personnel Manager, North Tees General Hospital, Hardwick, Stockton-on-Tees, Cleveland. Telephone Stockton 62122 Ext. 745. Completed applications must be returned by 28th May, 1976.

LAUNDRY INSTALLATIONS LIMITED

Applications are invited for the post of

INSTALLATION ENGINEER

(Electrical)

to join our existing team on global, plant installation work.

This is stimulating but demanding work which needs a first class person. Applications in strict confidence to:

L. A. Edwards, Chairman,
Laundry Installations Ltd.,
Beech House, Cropredy,
Banbury, Oxon.

MISCELLANEOUS

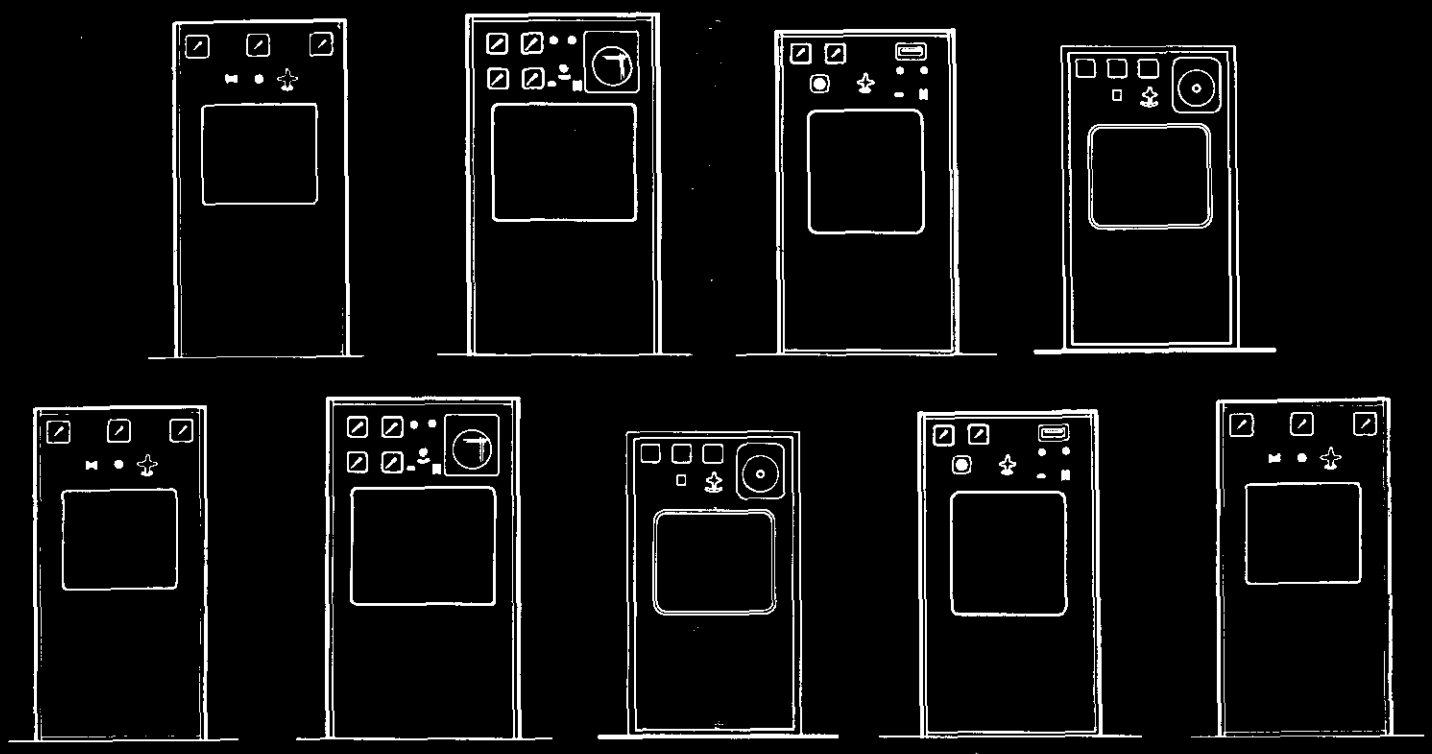
CIRCULATING PUMPS and Steam Turbines, Complete units, electric and steam, spares and service. TURNEY TURBINES Ltd., 67 Station Road, Harrow. Tel.: 01–427 1355 and 01–427 3449

Index to Advertisers

Please mention 'Hospital Engineering' when replying to advertisers

Printed in England by C. F. Hodgson & Son Limited, 50 Holloway Road, London N7 8JL

THACKRAY



All autoclaves look very much the same but...

The latest range of Thackray automatic high speed autoclaves including Porous Load, Downward Displacement, Rapid Cooling Fluids and Laboratory Units incorporate many unique features and user benefits.

All models incorporate the Autoclam steam sealed sliding door which can only be opened when the chamber is at atmospheric pressure. This is an inherant safety feature which eliminates the necessity for complex pressure locking devices and thus reduces maintenance requirements.

The Porous Load autoclave incorporates a highly efficient air removal stage, with a unique partial pressure air detection system. This system will automatically cancel the cycle and interlock the door controls should residual air produce adverse sterilizing conditions.

Thackray autoclaves, all of which conform to BS 3970 and HTM 10, are available in a range of standard chamber sizes. These are designed to take full 10, 15, 21 and 28 cu. ft. loads even taking into account the space usually lost due to loading arrangements.

In order to ensure that your Thackray autoclave will always give you the best results, we operate an after sales service that is second to none. This includes standard service calls, planned preventive maintenance contracts, and a 24 hour emergency service which operates 365 days a year.

For further information, please contact:
Chas. F. Thackray Limited. Head Office: P.O. Box 171, Park Street, Leeds LS1 1RQ. England.