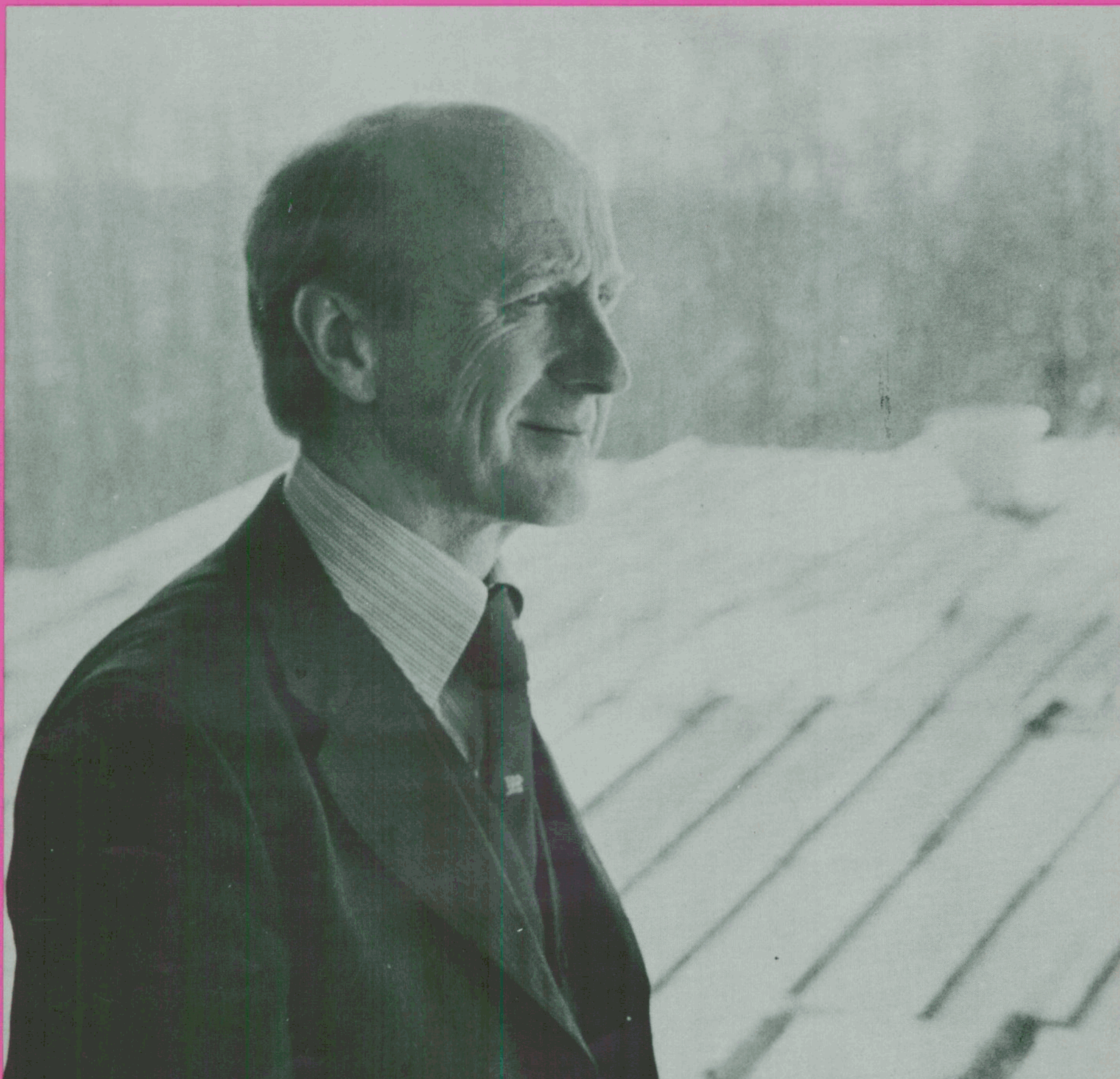
HOSPITAL ENGINEERING

April 1979

The Journal of the Institute of Hospital Engineering



The New President

'Hospital Engineering' is published monthly, except in January and July, by Earlsport Publications

Individual copies cost
£1.95 UK postage paid

The annual subscription is UK: £16.75
Overseas: £20 Americas: $45

Average circulation per issue
(January-December 1978): 2,347

ABC

Editor
Christopher Tanous TD

Art Editor
David Shilling

Advertisement Manager
Janet Rich

All correspondence relating to the Journal should be addressed to:

'Hospital Engineering'
Earlsport Publications
17 St Swithin's Lane
London EC4, England
Telephone: 01-623 2235

UK ISSN 0309-7498

Printed by JB Offset Printers
(Marks Tey) Ltd
Station Approach, North Lane
Marks Tey, Colchester, Essex

The Institute of Hospital Engineering
20 Landport Terrace
Southsea, Hants PO1 2RG, England

Telephone:
Portsmouth 23186 (STD 0705 23186)

Secretary
J. E. Furness VRD*

Hon Librarian
R. G. Smith CEng FInstE MCIBS FIHospE
Dryhill, Cold Slad
Crickley Hill, Witcombe
Gloucestershire

HOSPITAL ENGINEERING

Vol. 33 No. 3

The Journal of the Institute of Hospital Engineering

April 1979

Contents

Front Cover: Mr Lawrence Turner in his office.

Institute News

June One-Day Symposium

Sir Francis Tombs, Chairman of The Electricity Council will be one of the Speakers at the Institute's June One-day Symposium, the full details of which are given below.

The Institute of Hospital Engineering One-Day Symposium 'Electricity and Health Buildings in the 21st Century'

The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London on Wednesday, June 6, 1979

There have been a number of forecasts of the availability of fossil fuels in the 21st century which bring into question the hospital design policy of the future. Will the main source of power be derived from nuclear energy? Will there be more intensive research into solar heating in hospitals and the use of heat-pumps?

As the hospital buildings and engineering services designed in the 1980s will be comparatively new at the beginning of the 21st century, the time is right to seek the answers to some of these questions.

The Symposium will provide a forum in which some forecasts will be made and in which the lessons already learned in designing one hospital for the future will be discussed.

10.00 Coffee

10.30 OFFICIAL OPENING BY
JOHN BOLTON Esq LLB(Lond) CEng FICE FIMechE FInstE HonFCIBS HonFIHospE FIArb, Chief Works Officer, Department of Health and Social Security
CHAIRMAN for the day:
PROFESSOR PATRICK O'SULLIVAN BSc PhD FCIBS, Chair of Architectural Science, Welsh School of Architecture, University of Wales Institute of Science and Technology, Chairman of the Building Group of the Advisory Council on Energy Conservation

10.35 'ENERGY DISTRIBUTION IN THE 21st CENTURY — A FORECAST'
Speaker: SIR FRANCIS TOMBS BSc LLD CEng FIMechE FIEE FBIM, Chairman, The Electricity Council
DISCUSSION

11.15 'HOSPITAL DESIGN PHILOSOPHY FOR THE 21st CENTURY'
Speaker: R. MANSER Esq BSc(Eng)(Hons) CEng MIMechE FIEE PPIHospE, Assistant Chief Engineer, Department of Health and Social Security
DISCUSSION

12.00 'OVERSEAS DEVELOPMENTS FOR THE FUTURE'
Speaker: J. R. PLATTS Esq BSc(Eng) CEng FIMechE FIEE, National Energy Sales Manager, The Electricity Council

12.45 LUNCH

14.15 'A CURRENT DESIGN WITH THE FUTURE IN MIND'
Speaker: W. H. STRIPP Esq CEng MIEE, Assistant Regional Engineer, East Anglian Regional Health Authority

15.00 DISCUSSION RANGING OVER THE WHOLE SYMPOSIUM

16.00 CLOSURE

NB *Please note that tickets are available* **only** *from The Institute of Hospital Engineering £13 each, including morning coffee and lunch.*

Report of the Council for 1978

Council has pleasure in submitting a report of activities during the year.

Council and Council Committees met on 23 occasions during 1978.

The membership again showed an increase, 140 new members being elected, whilst the category of a further thirty members was revised.

The most significant event of the year was the election of the Institute to be an Affiliate of the Council of Engineering Institutions. Consequent on this, the Institute acquired representation on the Chartered Engineer Board of the Engineers' Registration Board.

The Institute remained a member of both the Technician Engineer and Technician Sections of the Engineers' Registration Board and thus continued to sponsor members for registration with the appropriate Section of the Board.

The 1978 Annual Conference of the Institute was held in Cardiff and, once again, attendance figures reached a 'new high'. The now customary separate ladies programme was much enjoyed.

Three separate one-day Symposia were held during the year, at the Institution of Electrical Engineers, Imperial College and the Institution of Mechanical Engineers. These now well-established Symposia attracted attendances of 150, 250 and 170 respectively, again showing their popularity and drawing power.

The Institute continued to make certain contributions to the 'Keele' Engineering Management Courses which were moved to the NHS Hospital Engineering Centre in 1976.

The Institute continues to be represented on Council of, and make a major contribution to, the International Federation of Hospital Engineering and each quarterly issue of the Institute Journal, *Hospital Engineering* constitutes the official publication of the Federation. The membership of IFHE continues to grow and now embraces thirty countries. The latest development in the International field is that the Institute, on behalf of the International Federation, has undertaken to organise and stage during 1979 the first International Seminar for senior echelon 'hospital engineers' and this will be held at the NHS Hospital Engineering Centre at Falfield.

1978 was the first year of the new Bursary Competition which is supported by the King Edwards Hospital Fund for London. The Bursary Award went to R. D. Buckley, District Works Officer, Roehampton Health District. Mr. Buckley used the Award to visit special Burns Units in the United States of America and the United Kingdom, to study the engineering implications of these Units. A further Bursary Competition has been announced for 1979.

The Northcroft Silver Medal for 1978 was awarded to T. Wagstaff for his Paper on 'Noise Control in Health Buildings' given at the Annual Conference held in Cardiff. It is planned to present the Silver Medal during the 1979 Annual Conference Dinner.

Once again, the Institute Honorary Librarian reports an active year. As well as dealing with the lending of books, Mr Smith is much engaged in offering advice on reading relative to particular studies. The Honorary Librarian also receives 'fan mail' from various parts of the world (IFHE members and others) relative to the establishing and improving of library services.

The Institute continued to have representation on the Watt Committee on Energy, which Committee has achieved increasing recognition in all quarters for the importance of its contribution.

Representation on various British Standards Institution Committees was maintained and, again, the Institute was invited to give evidence or comment to Government Departments and other bodies.

Finally, members will have commenced to benefit, already, from Council decision that from January 1, 1979, the Journal will be distributed in envelopes rather than in wrappers as hitherto.

The Library's New Cassette Service

Council has recently agreed with the Librarian's report that a modest introduction in the field of cassettes should take place. The library now holds four "Waterlow" cassettes, each with a running time of some fifty minutes. In total they constitute an essential programme pack of particular value for educational group counselling as well as individual use.

A brief resumé of the cassettes' content is as follows:

The Health and Safety at Work Act 1974
A conviction for a breach of this important Act could lead to a fine or even imprisonment. It is vital that members understand how the Act affects them and their employees. Greville Janner, QC, MP, explains in depth how the Act works, and how it affects every business in the country. If you want to stay out of trouble you need this cassette.

The Employment Protection Act — In Action
It does not matter how many people you employ — you still need to know how to cope with the current Employment Protection rules. Did you know that you can get free advice from the Advisory Conciliation and Arbitration Service (ACAS); do you know how maternity rights operate; redundancy warnings; disclosure of information and recognition procedures? If not you will find that Greville Janner and Sir Desmond Heap explain this important and complicated piece of legislation so thoroughly that you will have a positive understanding of its workings. These rules are not affected by the Employment Protection (Consolidation) Act 1978, which consolidates the law, but in no way changes it.

How to Handle Dismissals
An unfair dismissal could cost your organisation £13,400. This cassette will help you keep to a minimum your chance of making this payment, or even any part of it. Everyone you employ has a contract with you that you may wish to terminate. How you do it, and stay on the right side of the law is the heart of this conversation between Greville Janner and Sir Desmond Heap. The tape also includes an exact breakdown of the different kinds of dismissal, the amounts of money an employee can claim, and many hints on how to make the law controlling dismissals work for you and not against you. Conversely, if you are dismissed you need to turn this law to your own good account.

Coping with Tribunals
Industrial Tribunals will hear over 100,000 cases this year. So however much you hope you will keep away from them, the chances are that sooner or later you will be involved. When you have listened to this talk by Greville Janner in conversation with Sir Desmond Heap, you will find that you will be more confident about facing a tribunal or court. You will know the procedures, how to present your case in the best possible way, and how to make sure that you win whenever possible. In addition, Mr Janner offers much valuable advice about how to stay out of the Courts and Tribunals — by far the best way to cope with them. The talk was recorded in July 1977 and lasts for an hour.

These cassettes are now available to Members on loan. Application should be made to the Librarian (R. G. Smith, Dryhill, Cold Slad, Crickley Hill, Witcombe, Gloucestershire) in the normal way as for books.

It is suggested that Branch Secretaries may wish to make use of the four cassettes as a package. This would seem ideally suitable for branch meetings and seminars.

The Northcroft Silver Medal Award for 1978

Council of the Institute has approved that the Northcroft Silver Medal Award for 1978 be made to Mr T. Wagstaff for his Paper on 'Noise Control in Health Buildings' which he gave at the 1978 Annual Conference in Cardiff and which appeared in the October Issue of *Hospital Engineering*.

When communicating their recommendations, the Adjudicators recommended that Mr J. R. Fielding and Mr R. D. Buckley be especially commended also, for their Papers on 'Solar Energy for the Boiler House — Economic Practicabilities' and 'The Development and Training of Health Care Engineers' which appeared in the April and November 1978 issues of Journal respectively and Council endorsed this recommendation.

East Anglian Branch AGM

At the Annual General Meeting of the branch held at St Andrews Hospital, Norwich, on Saturday, March 3, 1979. Mr Kidsley, the chairman, stated that the past year had been a good one for the branch. There had been improvements in the standard of meetings and the chairman thanked those members who had given up their time to present lectures, particularly Mr Freestone, Mr Allison, Mr Le Breton and Mr Banks.

In his report Mr Kidsley gave a resumé of the proceedings of the Cardiff Conference and asked for support at future conferences. He thanked all members of Committee and the Secretary for their support during his term of office and formally handed over the chairmanship to Mr F. D. Blackburn.

Mr Blackburn thanked Mr Kidsley for his efforts and contributions during the past two years and hoped to carry on the good work.

Election of Officers

The branch officers for 1979 are as follows:

Chairman

Mr F. D. Blackburn, District Works Officer, Norwich Health District;

Vice-Chairman

Mr R. G. Freestone, District Engineer, Cambridge Health District;

Hon. Secretary/Treasurer

Mr M. Brooke, District Works Officer, Gt. Yarmouth & Waveney Health District;

Committee Members

Mr C. P. Le Breton, Senior Engineer, Norwich Health District;

Mr J. A. Parker, Area Works Officer, Norfolk Area Health Authority;

Mr R. G. Kidsley, District Works Officer, Bury St Edmunds Health District;

Mr A. Bray, Senior Engineer, Norwich Health District.

Welsh Branch Meetings

On Thursday evening, November 16, 1978, a meeting was held at the University Hospital of Wales, Cardiff, to hear a talk with film/cassette presentation given by Mr Clive Smith of Furmanite International Limited. An informative talk described the Furmanite process of sealing leaks under pressure, leaks from vacuum to 4,500 psi — from below zero to 600°C. Leaks of all types — steam, water, air, natural gas, acids, various gases and many other process leaks — can be sealed without plant shutdown. Statistical evidence was given to indicate the importance of leak sealing in energy conservation measures. The various methods and materials used for sealing leaks in valves, glands, flanges and other locations, were covered in detail.

On Wednesday evening, December 6, 1978, a meeting was held at Nevill Hall Hospital, Abergavenny, to hear a talk with film presentation given by Mr N. Powell of Metalock Ltd. Although attendance was less than normal, those members present thoroughly enjoyed the presentation. The company's process was described in detail and it was indicated that restored pressure vessels will withstand hydraulic pressures of up to 7,000 psi and steam pressures of up to 5,000 psi. Members contributed to a lively question and answer session which was ably dealt with by Mr Powell. An interesting description was given of the commercial development of the process into a worldwide operation.

Unfortunately the January 1979 meeting had to be cancelled due to inclement weather — the venue would have meant a perilous journey through snow. It was even more disappointing when the February meeting had to be postponed because of the effect of of industrial action within the Health Service. The first of these meetings was re-arranged for Tuesday evening, March 27, 1979, at Prince Charles Hospital, Merthyr Tydfil, when Mr R. R. Morgan of WHTSO spoke on the subject of Mobile Radio Communications in the Health Service. It is hoped that the talk previously arranged for February, on the subject 'Heat Recovery from Incineration', can still take place before the end of the present session of meetings.

IME April Meeting

A meeting will be held on April 24 at 5.30 pm for 6.00 pm at the Institution of Mechanical Engineers, Birdcage Walk, London SW1 on 'Medical Gases — a Piping Problem'. The speakers will be Mr L. W. M. Arrowsmith, DHSS and Dr Peter Dinnick. The discussion afterwards will be led by Robin Manser.

Visit to RAF Odiham, Hampshire, by Southern Branch

On January 16, 1979, a party of members of the Southern Branch of the Institute of Hospital Engineering visited RAF Odiham, Odiham, Hampshire. The party reported to the Guard Room and were duly assembled in the station HQ Conference Room, where with the assistance of colour slides an introduction to the role of RAF Odiham was given by the station adjutant WO.

The first visit was to the Flight Servicing Bay where the aircraft are inspected and serviced. The party was allowed to wander freely amongst the aircraft which, for maintenance purposes, were in various stages of disembodiment. Both types of operational aircraft, based at RAF Odiham, the Wessex and the Puma Helicopter, were present and the party were able to compare each in close-up.

Having spent some time amongst these elegant machines, which are used for search and rescue operations, flying crane duties, operations over difficult terrain and assault craft operations, the party moved on to the life-saving section where they were entertained by an NCO, Air Sea Rescue, to a fascinating briefing on safety and survival equipment with especially dinghies and life-saving waistcoats.

As time was running out the final venue selected was the Air Traffic Control Tower. On the way to the control tower the party were introduced to Flt Lt Roger Kinszet, Publicity Officer.

At the Air Traffic Control Tower the party were taken to the glass control cabin built on top of the tower and introduced to Flt Lt Doran, Aerodrome and Approach Controller. The party was treated to a fascinating briefing, 'Air Traffic Control', and were able to observe Flt Lt Doran in action.

Fire, Security and Safety Exhibition

Some 40,000 visitors and delegates from all over the world are expected to attend the sixth annual International Fire, Security and Safety Exhibition and Conference (IFFSEC '79) at Olympia, London, on April 23-27, 1979.

Examples of the latest products, materials and services will be displayed by some 350 leading companies in this field and speakers will present papers on a wide range of safety topics. Full details are available from Victor Green Publications Ltd, 106 Hampstead Road, London NW1 2LS. Tel: 01-388 7661.

Reservation of Work to the Registered Engineer

At the Annual Dinner of the Institution of Electrical Engineers (IEE) on February 22, 1979, Sir James Redmond, the President, requested the Government, through the Finniston Committee, to think constructively about the future for engineers in Britain, their status, education and training, to meet the country's economic needs.

In advocating a statutory registering authority for professional engineers, Sir James emphasised that such a authority would be severely restricted in its value if engineering functions of national importance were not reserved to the fully qualified registered engineer. He also emphasised the need to encourage the best young people into engineering and that, to do this, we need to accredit university courses to meet the needs of these would-be registered engineers.

Sir James also said that to encourage people into such an important profession requires that functions be reserved to them in the same way as special functions are reserved to the lawyers, doctors and accountants.

In conclusion he said, "the aim of the IEE's proposals is simple but vital: to provide the nation with engineers of the highest attainable quality, capable of tackling with confidence, the most challenging problems of industry".

Mid Scotland Branch

Mr R. W. Veitch takes a well-earned retirement in March. Mr Veitch was Chairman of the Mid Scotland Branch of the Institute for three years and his term of office embraced the period when the Joint Scottish Branches Conference was held in Inverness.

Our good wishes go with him in his retirement.

Salaries of Chartered Engineers up 13-17%

Salary surveys conducted last month among a random sample of members of the three major engineering institutions — the Institutions of Civil Engineers, Mechanical Engineers and Electrical Engineers — show that since January 1978 the median salaries of all grades of members of the Civils, irrespective of age, have risen by 13%; those of the Mechanicals by 15%; and those of the Electricals by 17%.

This brings the median salaries of the Civils from £6,070 in January 1978 to £6,860 in January 1979; the Mechanicals from £6,500 to £7,460; and the Electricals from £6,210 to £7,240.

As at January 1, 1979 the median salary for corporate members only (ie fellows and members) of the Civils was £7,250 in the public sector and £7,500 in the private sector. The equivalent figures for the Mechanicals were £7,800, public sector, and £8,150, private sector; and for the Electrical £8,410 public and £7,860 private.

US Fire Safety Exhibition

'Fire and the Home Environment' is the theme of the National Fire Protection Association's (NFPA) 83rd Annual Meeting and Fire Safety Exhibition which will be held at the Cervantes Convention Center, St. Louis, Mo, USA, May 14-17, 1979. An estimated 7,000 fire protection specialists from all over the US will be attending and discussing: —

The residential fire problem; Home fire safety for the elderly; Suppressing fires in homes; Home fires and handicapped children; and Training for life safety in home fires.

Mr Lawrence Turner, BSc CEng FIEE FIHospE FRSA, as been elected President of the Institute, in succession to Mr Richard Harrison, CBE CEng (Fellow) and will take over from him after the Annual General Meeting of the Institute to be held on May 11, 1979, at the end of the Institute's Annual Conference. Mr Turner is Chairman of the Static Systems Group, of Wombourne, Wolverhampton.

The New President

In his office Lawrence Turner keeps two framed photographs. One shows an ex-RAF concrete hut on a disused airfield, the other himself and one of his two staff, both wearing white coats, and sitting in a very small clear space inside. The pictures date back 14 years — to the very early days of Mr Turner's first company, Static Switching Limited — now part of the Static Systems Group of four companies, with a turnover around £2½ million and more than 200 staff. The pictures on the wall are significant — Mr Turner is too modest a man to be in any way complacent about his own considerable success, and must feel the need of a reminder of his early struggles which have now built the Group from such

Mr Turner in his factory.

small beginnings.

The Group now consists of four companies: Static Switching Limited; Statiscan Limited; Static Installations Limited and Static Systems International Limited. The company makes a wide range of electronic equipment, much, but not all of it, for hospitals. Static Switching still makes a great deal of the Group's first product, conventional nurse-call systems. The Group also manufactures sophisticated Time Division Multiplex fire alarm and security monitoring systems, the System 770 bedhead service rail to contain all hospital bed services within a neat trunking, sound distribution systems, emergency lighting installations and much else besides.

Mr Turner is a man of great energy, with an abundant, rather nervous enthusiasm, which fires those around him with his own bustle and activity. He clearly enjoys being around and about in his factory, his eyes lighting up as he demonstrates the intricacies of printed circuits, microprocessors, and all the other miracles of modern electronics which are to be found in the equipment made by his Group. His management style is consultative, within limits — indeed he says that he believes in the concept of management by consensus, but that he cannot spare the time to allow it to work, and that a firm must, after all, have a boss!

Mr Turner was born 50 years ago near Birmingham, and has lived in the West Midlands all his life. He went to Moseley Grammar School, and developed an interest in electricity and chemistry which became his hobbies, and led to his first job, as an analytical chemist. National Service in the RAF followed, where his skills led him to be employed as a wireless fitter working on radar and other signals equipment. After National Service he took an intensive course at what is now Aston University, taking a BSc degree in Engineering. Subsequently, he also became a Fellow of the Institute of Electrical Engineers, a qualification in which he takes a particular pride, and a Chartered Engineer. He is clearly a gifted innovator, although he claims that modern technical advances are "well beyond" him, and that he relies entirely on his qualified staff. Many are young graduates, some having been sponsored at University by the Group.

His first job after University was with GEC as a graduate trainee. From that beginning he rose through the company until, at 32, he was Divisional Manager in charge of the Installation Equipment Division. He then spent two years as a Director of a much smaller company, but found the experience a frustrating one, so he was persuaded and helped by his wife Jean to start his own business. The memory of those two years remains with him, and he says that he tries terribly hard to remove frustration for those in his own Group.

Mr Turner is married, with two sons, of 21 and 19, both at University, and a 13-year-old daughter. The family has moved recently to a superb Elizabethan Manor House, Harborough Hall, near Kidderminster. The house, set in beautiful grounds, is large enough to provide each of the children with his or her own small "flat", but the family, unusually enough these days, manages to find enough in common to wish to spend quite a lot of time together. The particular bond is music, and everyone plays at least one instrument, so that there is actually a Turner Quintet. Whether they will all appear together in public is perhaps open to doubt, but the two boys both play in amateur orchestras. Mr Turner is also a keen off-shore sailor, with his own 35 ft Nicholson six-berth yacht, with which he and his family cruise overseas. He is an enthusiastic navigator, having passed virtually all the stages to qualify as a yacht master, which he says he will do if he can "pluck up courage" to take the final oral exam. The yacht is at present moored at Picklecombe, near Plymouth, where the family have a holiday flat in the old fortress.

Looking forward to his term as President, Mr Turner considers it is too much of a cliché to say that it is a "great honour", but that he is "terribly pleased" to have been asked. He has been involved with the Health Service for many years, and finds it almost like a club. He says it is full of interesting people, and that he very much enjoys knowing them. He already has a sense of belonging within the Institute, and is prepared to devote the necessary time to making a thorough contribution. The one thing, he says, that he does not relish is the prospect of all the speech-making!

Mr Turner at his beautiful new home, Harborough Hall.

The author, who is District Works Officer of the Roehampton Health District, in South-West London, won the Institute of Hospital Engineering Bursary Award in 1978 for his article The Development and Training of Health Care Engineers *published in the November 1978 issue of* Hospital Engineering. *As a result of this bursary, Mr Buckley was able to travel to the USA and has written this article based on his experiences there and in the UK.*

Health Care Engineering for Burns Hospitals

ROBERT DAVID BUCKLEY DMS FIHospE MBIM

This paper has been written to give Health Care Engineers an up-to-date and wider insight into the design, operation and maintenance of this type of specialised intensive care facility.

In the wider context the burns patient may be seen as a model for the treatment of all trauma. Many of the medical and surgical techniques and methods that have been developed for this type of injury have many other applications in related branches of medicine.

From the engineer's viewpoint, the engineering applications that have been applied to certain aspects of patient care and treatment, particularly infection control and patient comfort, are at an interesting stage of development. Each burns centre has traditionally pursued its own preferred method of treatment which is unique to itself in some respects. This paper has not set out to suggest that a standard or optimum solution should be applied from an engineering standpoint, but rather reviews current practice and examines future trends, in order to emphasise that any new burns unit should be designed to reflect the flexibility needed in this type of patient care. From a brief review of the current methods of treatments in use, it is apparent that what may be the optimum solution today may be considerably out-dated within five years.

The Purpose of the Burn Care Facility

Although it may appear presumptuous to state the purpose of this type of specialist intensive care facility, it is important that the reader fully understands the very serious nature of this type of injury. In general the following main objectives lie behind the distribution of this type of unit on a Regional basis in the United Kingdom:

to provide a single location for **optimum** care of **all** patients;

to permit isolation of the burn patient from probable sources of infection (particularly the general hospital population);

to provide a suitable environment both for progressive patient care and long term care;

to provide a body of knowledge and expertise where teaching and research may be carried out.

The First Objective

To provide a single location of all burn patients, may be seen at first sight as an essential feature for the treatment of this critical injury. This country has led the way in providing special units as a result of the specialised plastic surgery units developed during World War Two. These units treated burned patients from the armed forces as well as civilian air raid casualties, and were absorbed into the National Health Service at its inauguration in 1948.

Although at first the burned patients were treated in general plastic surgery wards, the policy soon developed of segregating them in a ward set aside for the purpose, and the layout of such wards soon became adapted to provide the necessary special facilities. A Ministry of Health circular in 1952 emphasised the need for providing these special burns units in every Region of the National Health Service.

During the 1960s many other countries followed this lead, and the design of Burns Units became a regular programme feature at Burns Congresses.

The World Health Organisation's 'Action Committee' on the organisation of burn care reported in September 1973[1] and emphasised the urgent need to provide this specialised type of unit on an international basis, as there still remain many areas of Europe, North America and particularly of Third World countries without such units. In giving its recommendations, it divided the size of the basic burns unit into five sizes. The largest of these units was in the category size of 16 to 26 beds. In the United Kingdom many of the Regional burns centres fit into this category.

There is, therefore, a continual and increasing recognition that, if high standards of patient care and treatment coupled with low mortality rates are to be achieved, then such units are absolutely essential. There will be a trend to provide more of these centres or facilities and to upgrade existing ones in the coming decade.

The Second Objective

To permit isolation of the burn patient from probable sources of infection is very important indeed, and can considerably affect the overall design and operational policies of these units. Although the burns patient team themselves contribute most significantly in pursuit of this goal, there is no doubt that a well-designed burns care facility can assist substantially in achieving it. The burn patient, due to the very nature of the injury, is extremely susceptible to many complications, the most serious of which is infection. Despite many important advances in treatment generally, infection remains the leading cause of death in patients with 50% or more of their total body surface (TBS)[2] burnt.

The Third Objective

Of the facility is 'to provide a suitable environment for

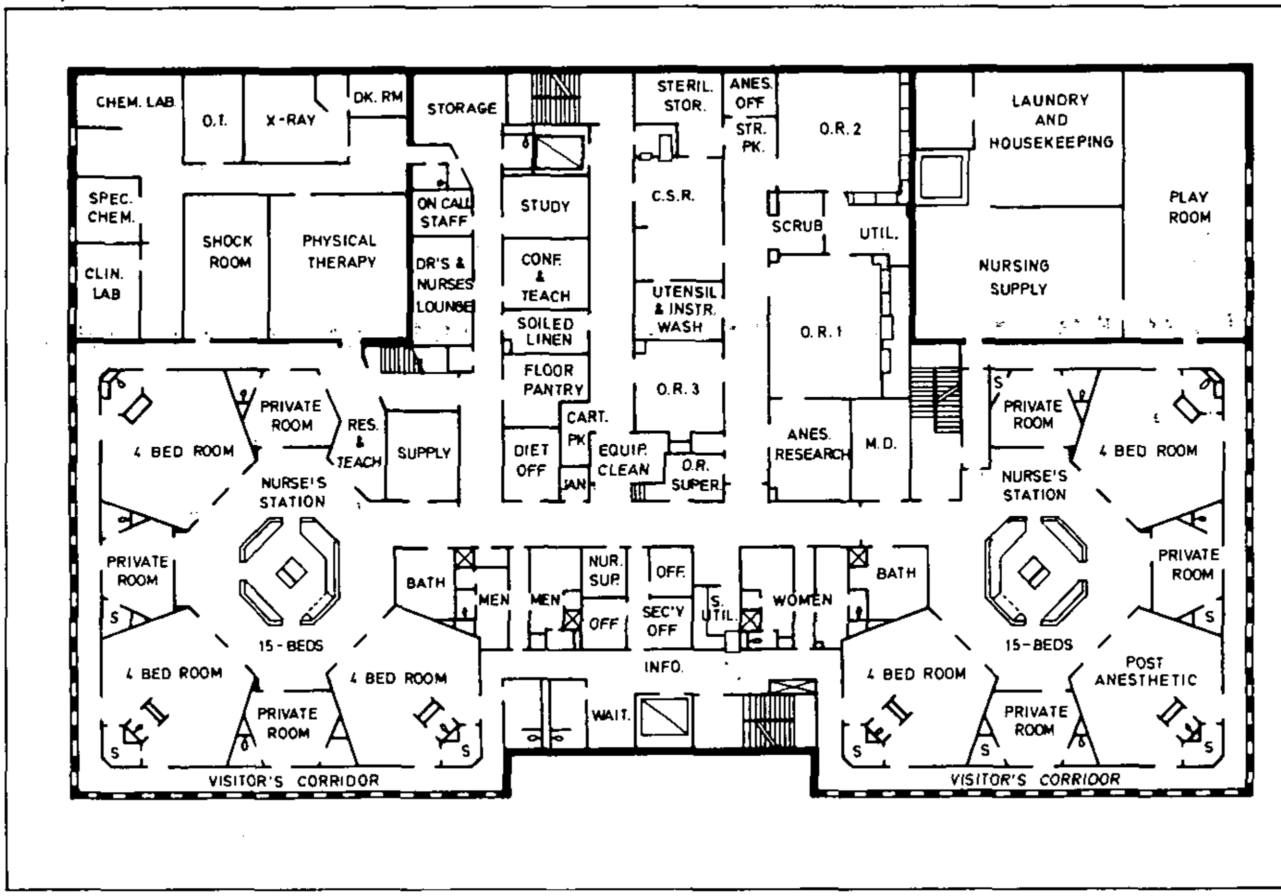


Figure 1. Shriners Burns Institute Unit, Galveston.

progressive patient care' in the acute stages of treatment. In most forms of treatment patients progress through at least three main stages:

Intensive Care Stage

This stage is for the most critically injured (sometimes referred to as the shock stage) where patients may have a TBS burn in excess of 20-30% with other complications that require intensive care and supervision. In the experience of the writer, the work load on the burns team as a whole and the nursing staff in particular is the highest that is normally experienced in acute patient care, both technically and physically.

The full range of intensive care engineering services are required, and are normally provided in single room accommodation. Although the air condition will later be discussed in detail, special consideration should be given to providing an adequate number of socket outlets around the room to cater for all the life support equipment that may be required. Special attention to lighting should be given and, although it is normal to provide an overbed tungsten examination light, colour correction fluorescent tubes should be used. X-ray socket outlets will also be required. Piped medical oxygen and vacuum should additionally be provided for each bed.

During this early phase of treatment which can range from 24 to 72+ hours, it is normal nursing practice to attend the patient on a 24-hour basis. However it is essential to provide a nurse call system for the use of staff, using two-way speech if possible for emergency situations.

Comprehensive Care Stage

This stage is used mainly for admissions that are non-critical, and for patients who have survived the critical phase. Again the full range of intensive care engineering services are required and may be provided by single, two- or four-bedded units of accommodation. Where possible separate toilet accommodation should be installed with wash hand-basins for single side rooms and adjacent for multi-bedded accommodation. In the single side room situation this will be an important way of reducing cross-infection.

Convalescent Care Stage

This stage is for patients who have completed their skin-grafting and for those who have relatively minor injuries. The normal acute ward engineering services are required but accommodation is generally provided on a multi-bedded basis.

In summary it will be seen that the degree to which engineering services are provided in each of these phases progressively decreases. During the acute stage the current Hospital Building Note[3] for Intensive Care wards is a good basis to commence design, but it must be supplemented to meet with the special accommodation required and discussed in this paper. Likewise the Hospital Building Note[3] for Operating Departments should be supplemented as discussed in this paper. There are certain aspects in the treatment of the burn patient that require special consideration from an engineering viewpoint. These will be discussed later. In order to assist the reader *Figures 1* and 2 show typical ward designs. The first provides the

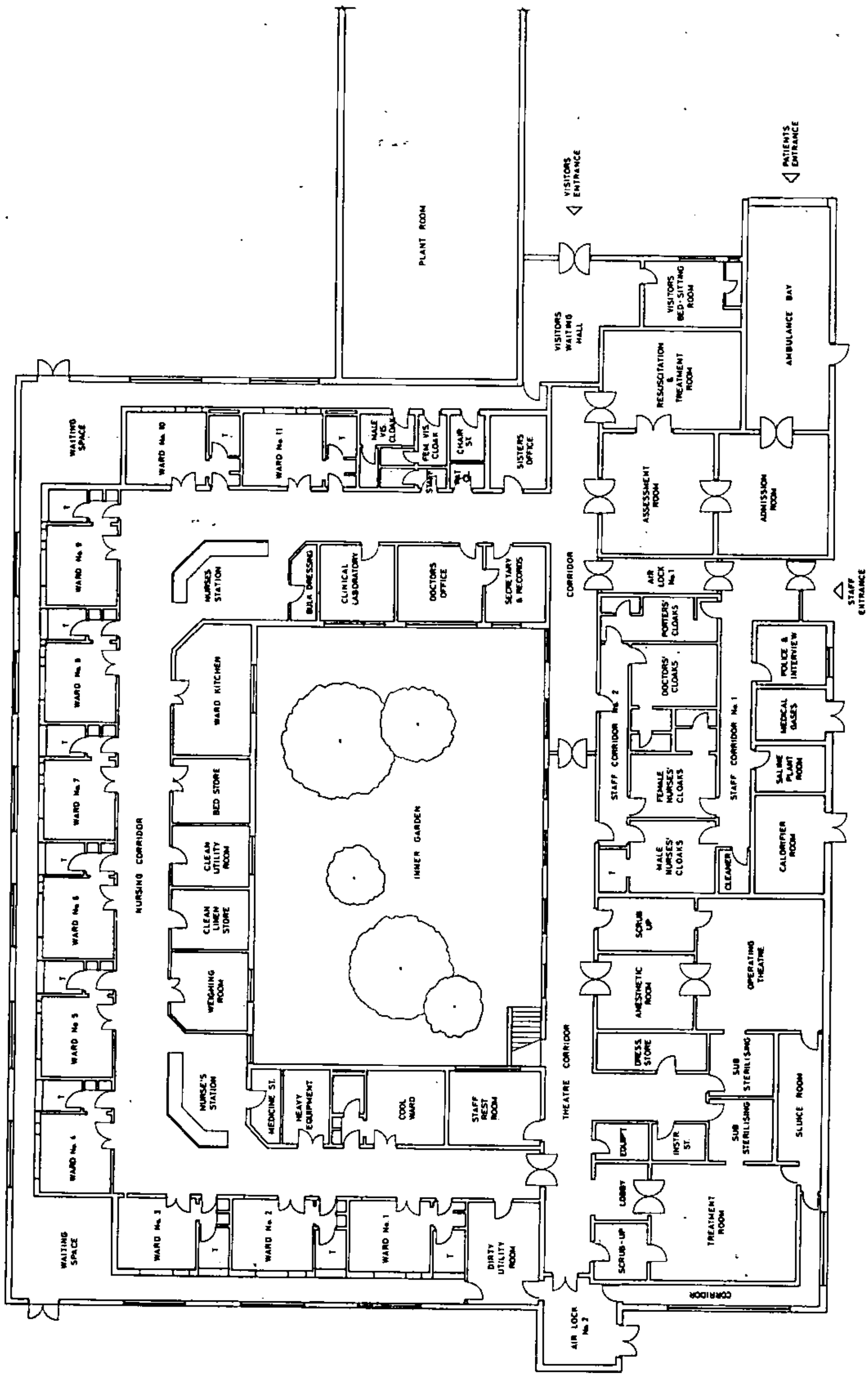


Figure 2. McIndoe Burns Centre, East Grinstead.

best mix of each phase of treatment and is very flexible in approach. The second built in the mid-sixties reflects the move towards total isolation using single room accommodation.

Infection Prevention and Design

Until the early 1960s a 30% total body surface burn carried a 50% mortality rate. Today the survival rate has increased, so that a burn of 60-70% (TBS) has a 50% mortality rate. There are today reports that some centres have successfully treated patients with over 80% plus (TBS) burns.

There have been many factors that have contributed towards this improvement. One of interest to Health Care Engineers is the trend towards patient isolation in order to prevent infection.

The extent to which this affects the design of these units revolves around the way in which treatment is carried out; there have been two distinct schools of medical opinion as to how the burn wound should be treated. The exposure method of treating the burned surface has gradually gained ground and increased in popularity since it was first introduced in Edinburgh in 1948. It is probably the most widely used treatment at present. The alternative method of treatment is to apply closed dressings to the burned wound, but this produces warm moist conditions which can be ideal for bacterial growth and infection. Since the recognition of this problem, this method of treatment has steadily lost ground. It must be noted, however, that exposure is only used in the early period of treatment and dressings will usually be required once skin grafting has been commenced.

From a bacteriological viewpoint, microbiologists have developed methods of dealing with the predominant bacteria colonising the burns wound which have fallen into four periods in the fight against septicæmia.[4] The introduction of penicillin in the early 1940s proved a most significant advance, together with the use of other broad spectrum antibiotics particularly, where gram positive organisms were dominant. In more recent years gram negative infections have dominated the scene, and many topical anti-infective agents have been introduced, either as an adjunct to exposure or with closed dressings to curtail infections by organisms such as *pseudomonus* aeruginosa. At the present time microbiologists are finding due to the increased use of these agents, the appearance of different strains of these gram negative organisms that are proving resistant to known anti-bacterial agents.

It will be of interest to engineers to note that these particular organisms are not usually transmitted by the air route. In studies that have been carried out[5] it has been found, that when environmental contamination risks were ranked from high to low the transmission by the air route was bottom of the low risk table. By comparison, transmission by personal contact was highest on the high risk table.

Although each burns centre differs due to its original site conditions or the method of preferred treatment, the factors that are relevant to the design from the engineering viewpoint, fall into two main categories:

those which affect the unit overall and involve cross-infection prevention;

those which are used in combination with the above and combine other aspects of patient care and treatment.

Under the first category, the overall design of all burns units should be such that they are fully air-conditioned with 100% filtered fresh air to all patient areas. The number of air changes required are 15-20 per hour in patient areas and must be pressure graded to ensure that cross-contamination cannot take place between one patient area and another, and between patient areas and treatment areas within the unit. The parameters that are required for dry bulb (DB) and relative humidity (RH) will vary depending on the exact area and the method of treatment being used, particularly in the acute stage.

Figure 3. Typical single side room.

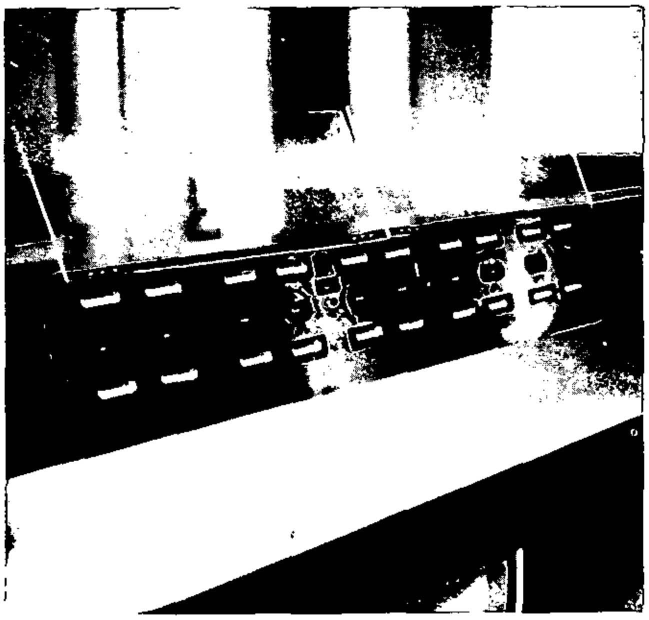


Figure 4. Temperate and humidity remote control panel.

The level of filtration in all areas should be provided to ensure that there is a 99.9% filtration level down to 5 μm particle size. This is because, although in nature bacteria have diameters as low as 0.5 μm, they rarely exist in the air alone. They generally travel attached to dust and skin particles with diameters of between 5 μm to 14 μm.[6]

Single Side-Room Accommodation

The air conditioning design and operating parameters for this type of accommodation depend largely on the preferred method of treatment. Although in all types of treatment during the acute stage, the room will be used to isolate the patient from sources of infection (see *Figures 3* and *4*). If it is intended that the patient's wound should be dressed, then the air conditioning should be designed within the temperature range 21°C-24°C DB and 50% RH.

However, if the exposure method is to be used (and this relates to other special design solutions ie hoverbeds, fluidised beds, etc), **then very special consideration is needed.** The patient in this situation will have an exposed wound that is wet with his or her own body serum. Thus for all practical purposes the patient can be considered to be at **a wet bulb temperature (WB).** In this condition the patient will have a large heat loss. In order to provide a suitable air condition in this situation, it has been found that the air supplied to the room must be in the adjustable range 34°C-42°C DB with a relative humidity of between 60-70%. This combination discovered during the hoverbed research gives a wet bulb temperature that is within 5°C of the patient's own wet bulb body temperature. It has been found that to exceed the patient (WB) temperature by more than the plus or minus 5°C the patient's metabolic rate alters, causing discomfort and undesirable side effects medically. In terms of staff it will be seen that these conditions are unsuitable to work in.

In practice a compromise has to be made. Usually this is achieved by providing either additional radiant heaters or by using a covered frame to prevent radiant heat loss. It will be seen that the use of a side room, where large volumes of hot air are used, as a method of isolation and to provide a suitable environment is costly. Wherever possible the design of the air pattern in the single side room should be uni-directional from ceiling to floor with individual DB and RH control. If correctly designed, mechanical extract should not be necessary to achieve this[6] although in certain circumstances it must be used. Turbulent air patterns must be avoided at all cost because this will encourage bacteria on the floor of the room to be swept into the air current and contaminate the patient. The use and development of other smaller isolation units have also been tried and they will be discussed later.

Operating Theatres and Treatment Areas

Both these areas in the unit should be considered the same from an air conditioning viewpoint. The use of radiant heaters may be required where treatment is extended or is being carried out on children.

The design parameters for air should be within the range 21°C-25°C (DB) and 50-55% (RH) with the air flow pattern from clean to dirty zones, using a ceiling to floor lamina flow pattern in the operating rooms.[6] The air flow from these areas must not be allowed to enter other areas of the unit after its exhaust. Although aseptic conditions are required before a patient enters and during treatment, the very nature of the burn injury is such that it can be heavily infected, and thus will give off bacteria which can be transmitted by particles in the air.

So far consideration has been given to the type of accommodation which has been the basis of the design of many burns units in recent years, the use of single room accommodation being the basis for isolation in the acute

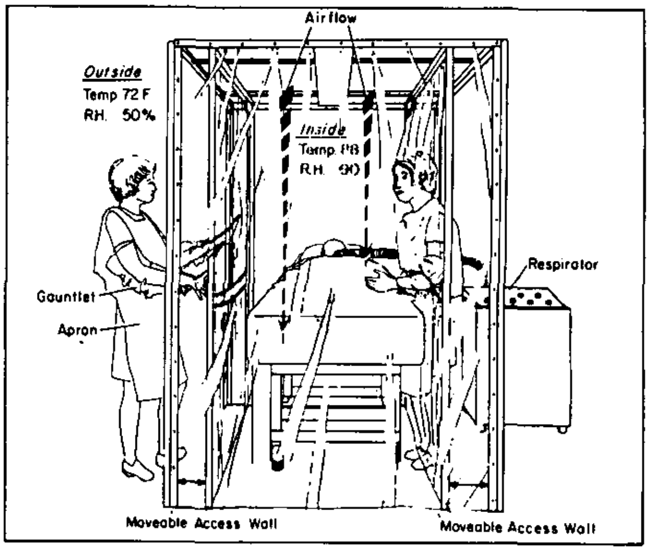


Figure 5. Bacteria controlled nursing unit.

phase of treatment. However, the provision of the single side room is costly not only in terms of energy supply, space and equipment but is also extremely heavy on nursing time. Although some centres have overcome the nursing aspect by the use of television, this can be no substitute for direct supervision and observation of the patient.

It is strongly recommended that where single room or multi-bedded accommodation is provided that a nurse call system is fitted to allow two-way speech between patient and nurse. This not only reduces workload on nursing staff, but it also reduces the number of movements in the unit, and thus the possible spread of infection by staff when understaffed and under pressure.

In several burns centres other isolation methods have been developed to overcome the objections usually raised, where single side rooms are used as the isolation method. It is important that these are not confused with other treatment aids and therefore the relative methods are now divided and discussed:

Isolation Methods
Lamina air flow units;
Plastic isolation bubbles;
The Hoverbed High Air Loss Bed.

Treatment Aids
The Air Mattress;
The Roehampton Frame;
The Air Cushion bed;
The Standard bed with Polyurethane Mattress Egg Box design.

Lamina Air Flow Units

Although there are several designs of these units in use at present (see *Figure 5*), they have many advantages over the single side room (even when single side rooms are designed with lamina flow) due to the fact that the effective area is reduced to the patient zone only. Within the zone the dry bulb temperature and the relative humidity may be varied to suit the patient without affecting the staff. The air velocity used may be varied and a figure of 50-60 ft/min is usually now considered satisfactory for the comfort of the patient, and to prevent air ingress to the

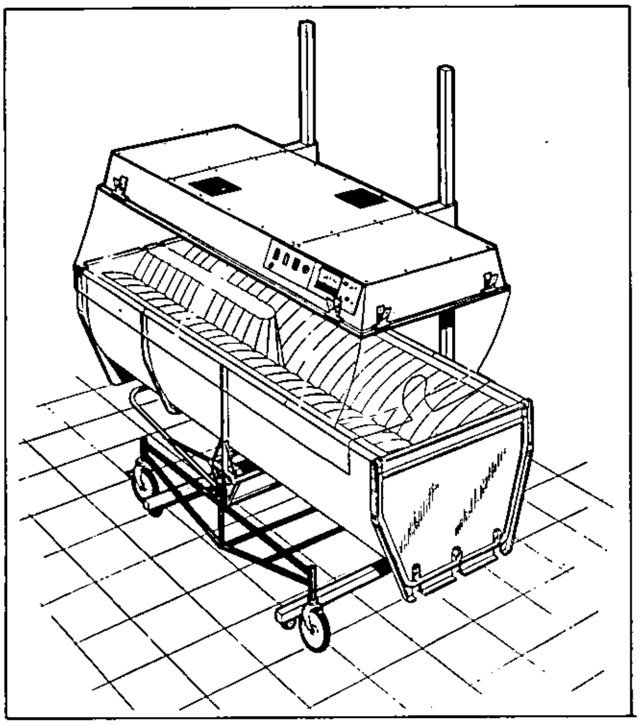


Figure 6. The hoverbed.

unit from other sources. These units may be used in open areas together, which has added advantages from the nursing point of view.

Possibly one of the best examples of these units is in use at the Shriners Burns Institute in Boston, USA and is known as the Bacteria Controlled Nursing Unit. These are proved to have made a significant contribution to the reduction of cross-infection compared with more conventional methods.[7]

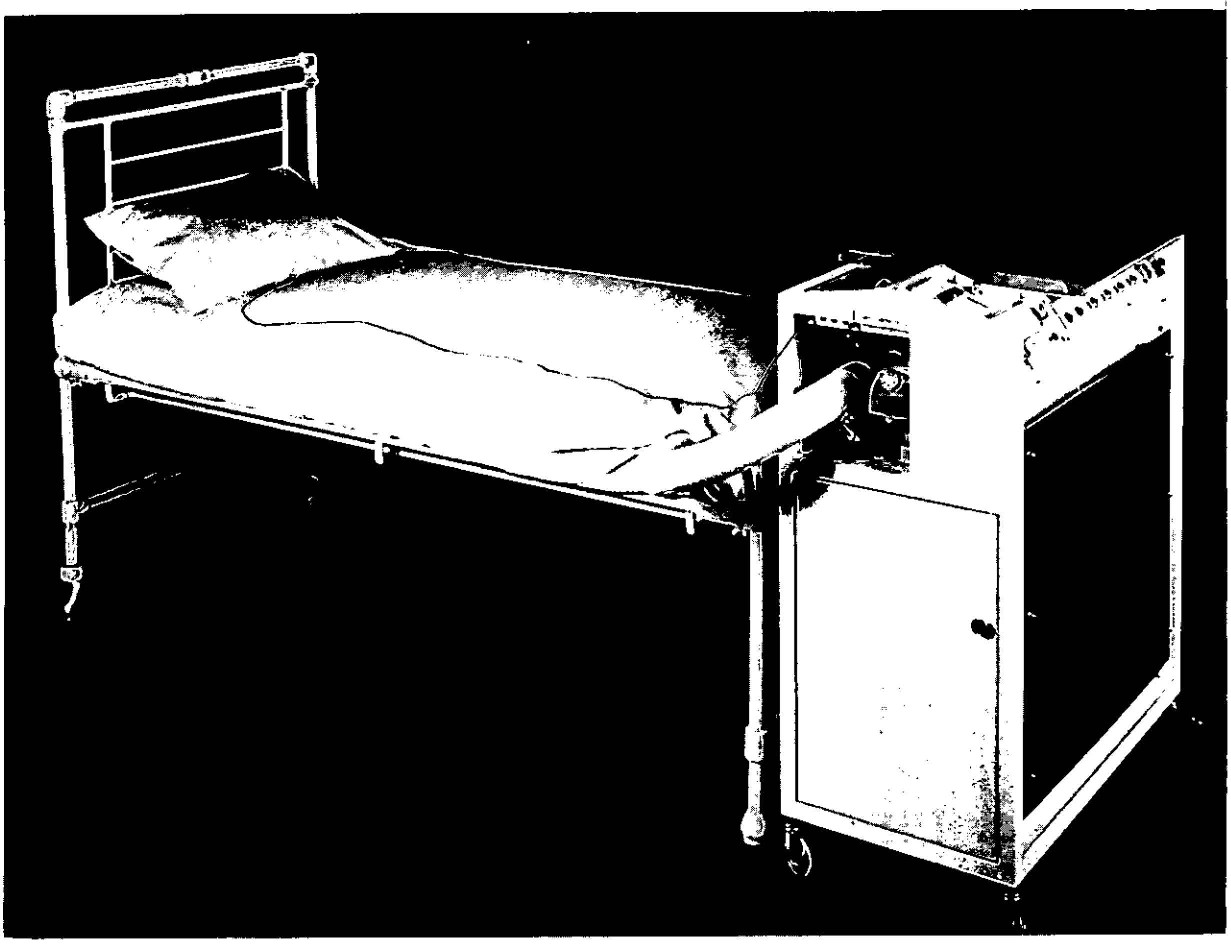
A disadvantage, in medical terms, may be that certain patients who are burnt become disorientated in this type of unit.

The lamina flow unit may be used additionally with any of the patient comfort beds as outlined later. Further research is to be carried out at the Brooke Army Hospital, San Antonio, USA, into the effectiveness of lamina flow in the treatment of the burn injury.

The Plastic Isolation Bubble

Use has been made of large plastic bubbles with burn patients. Their use in transplant surgery where immunosuppression is used, has increased this trend. Basically they are designed with air locks for food and equipment, etc, and have rubber glove access to the patient.[8] They do not seem to have proved popular in practice, however. One particular drawback has been bacterial growth on the plastic bubble itself caused by high humidity (RH) and temperature. This is obviously undesirable.

Figure 7. The air mattress.



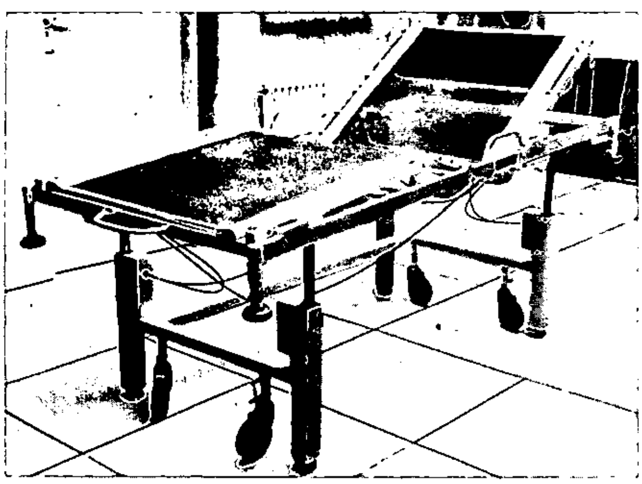


Figure 8. Roehampton Frame.

The Hoverbed High Air Loss Bed

This is a British development which is used in a specially designed room. It basically supports the patient on a cushion of contamination-free air of suitable temperature and humidity (see *Figure 6*). Strictly speaking it is an aid to treatment rather than an isolation method. However, because it is in its own room and because it forms a microclimate around the patient it is both. The Hoverbed has its own canopy, which has the advantage of providing separate comfort zones for staff and patient. It is normally used in the acute phase of treatment after admission of the patient in the first 24-36 hours and has medical advantages and disadvantages. One particular advantage is that the patient has no pressure points on the body, thus reducing aggravation and pain.[9] To date it has not been widely used, mainly because of its cost in relation to the small number of patients who are circumferentially burned each year. However, its development is a considerable technical achievement, and with most advances it has brought about a greater understanding of the 'Air Engineering' requirements in the treatment of the burned patient, particularly where the exposure treatment method is used in the early acute phase of treatment.

Treatment Aids

This group of equipment is used as an adjunct to treatment. The main aims are:

the prevention of body pressure points;
the aeration of the wound;
the prevention of body serum build-up; and
the easy management of the patient from a nursing viewpoint.

The Air Mattress

This development is designed to provide an envelope of sterile air of suitable temperature and humidity around the patient. The mattress as in *Figure 7* is designed to reduce body pressure points, and air is delivered through it at a velocity up to 60 ft/min to help ensure that oxygenation of the skin is constant and complete, and that the microclimate formed gives a good metabolic control.

Its advantage is that it may be used in multi-bedded accommodation, on a standard bed. It is relatively cheap compared to other methods and is suitable for patients who are not circumferentially burnt, where the hoverbed would be ideal. The mattress is the natural development from an ordinary bed and clinical trials between it and the Bacteria Controlled Nursing Unit (lamina flow unit) would I believe be of value at present. It can be used in single rooms or multi-bedded accommodation if required. This type of application does form a microclimate around the patient. It is still under development and in certain situations it could be used as a method of isolation in itself. In a similar way to the Hoverbed, it combines isolation of the patient and acts as a treatment aid.

The Roehampton Frame

This consists of a specially constructed bed frame (see *Figure 8*) upon which is stretched a fine nylon mesh. On this is placed a sheet of sterile polyurethane foam. The patient is directly in contact with the foam. The foam itself does not stick to the wound which as will be appreciated is ideal with the exposure method of treatment. This idea was developed by Mr A. J. Evans, consultant plastic surgeon, during his work at Basingstoke in 1957 and it has been used in many other centres since. It provides the minimum demand on nursing time to keep the wound well aerated and prevents puddling under the mattress which can be a serious drawback to the drying out of the wound where an ordinary bed and mattress is used. This treatment aid is used in single side room accommodation which is specifically designed for the exposure method. Despite advances in the field this method of treatment has stood the test of time and continues to contribute to the high recovery rate of patients at an optimum cost.

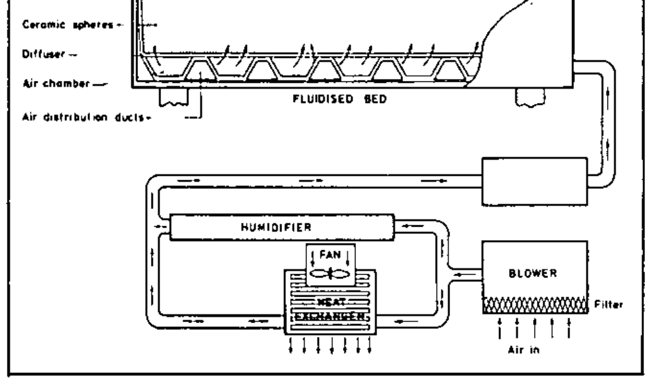
The Air Cushion Bed

This bed is divided into three sections, each containing many individual air cushions, which can have their internal air pressure regulated to suit individual patient requirements. It is also used in geriatric medicine. The main objective of this bed is to prevent body pressure points. The air cushions, which are removable and washable, are directly in contact with the patient. The air in the cushions has to be warmed to a suitable temperature. The bed can be used in all stages of recovery and in all types of accommodation.

The Fluidised Bed

This unit, as shown in *Figure 9*, is primarily designed for use with the exposure method in single room accommo-

Figure 9. The fluidised bed.



dation and is designed to prevent body pressure points and to evenly aerate the wound. Any build-up of body serum from the wound passes through the fine nylon mesh that supports the patient on top of the ceramic beads in the fluidised bed itself.[10] The temperature and humidity of the air supply can be varied to suit patient comfort as required.

The Standard Bed with Foam Egg Box Mattress

This can be used with either exposed or dressed wounds, although it is generally used by the latter group. The foam used has the qualities previously discussed with the Roehampton Frame. The patient may be placed directly on it or on a sheet over it.

Future Developments

In considering the applications discussed above, it will be apparent that there is no concensus of opinion on any 'one best method' and indeed no ideal has been found for every situation — such is the nature of the burn injury.

Both schools of medical opinion, the exposed and the dressed, are developing and refining their methods. The 'exposure' school is pursuing the air mattress with its emphasis on the microclimate at present and this, together with developments using the lamina flow isolation units, looks promising. Those who still believe in dressing the wound continue to develop suitable agents to place as bacterial barriers on the wound. In this respect the Shriners Burns Unit in Cincinatti, USA has developed a spray which acts as a bacteria barrier. It is applied directly to the wound and is a flexible, plastic-like membrane. This remains in position, until the time has come for excision and grafting where this is necessary. Who knows where this development will take us in twenty years' time? Perhaps the circle will turn fully and the situation will be found where patients will be treated with the general hospital population again? However, it must be emphasised that the foregoing is only a part of a certain aspect of treatment. Advances in surgical techniques generally may change the picture entirely again.

Figure 10. Treatment bath with thermostatically controlled water flow panel and attachments.

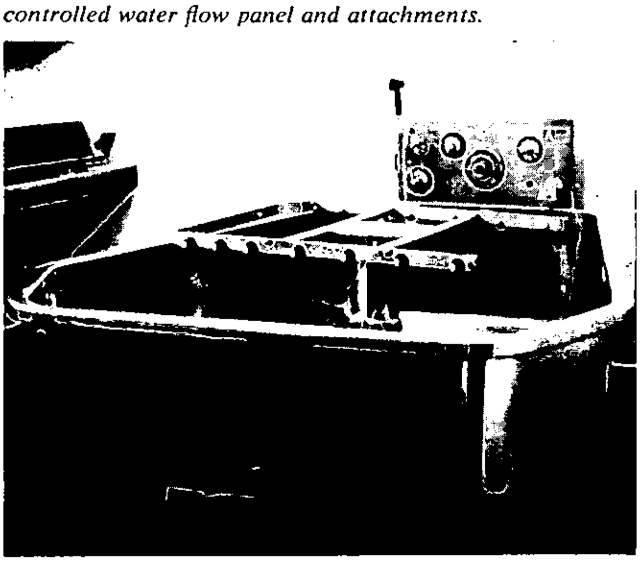
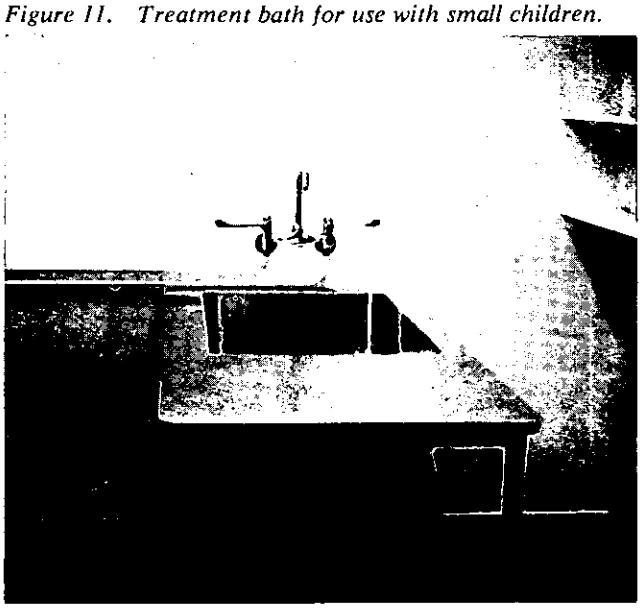


Figure 11. Treatment bath for use with small children.



Special Aspects of Treatment and Accommodation

Treatment Areas

In many burns centres part of the daily treatment is the bath (*Figures 10* and *11*). The main reasons for this are to aid the removal of dressings, physiotherapy and other related medical aspects of treatment, mainly from a bacterial point of view.

During this part of the treatment, patients can be at considerable risk as their wounds are exposed in the same way as during surgery. One type of infection that can be present in these bath tanks is the bacteria pseudomonas aruginosa which can often be found in the waste trap. In order to overcome this hazard many centres have done away with the trap and have provided gullies. However, these too have their drawbacks. Investigations carried out by Kohn[11] at Roehampton have shown that the risk can be eliminated by the design of a special trap for these baths and for wash-hand basins used in burns units themselves. The design includes a 'heating element', that boils the waste trap liquid for a specified period on a timer switch. Equally effective methods have been examined and tested by Maly[5] that show other ways to eliminate the hazard with formalin solutions, and these should be considered carefully as the operational policy is determined for the unit at its conceptual stage.

Special Weighing Equipment

It is important in the critical stage of treatment that fluid loss balance is maintained. Therefore, there is a requirement to weigh the patient regularly during this period. To achieve this, the following methods are in use:

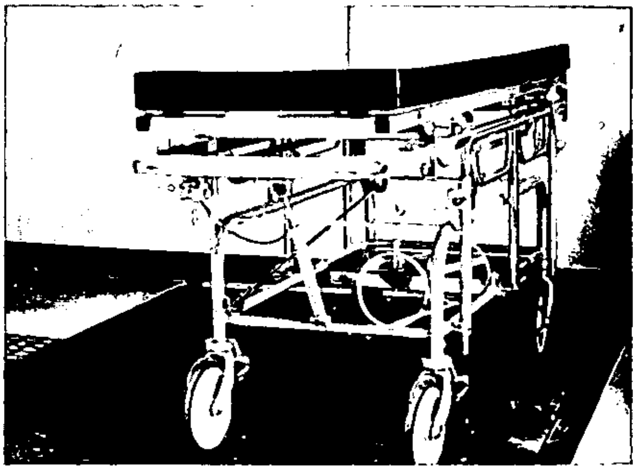
Floor platform — where the patient's bed or trolley is wheeled on to it (*Figure 12*);

Weighing lift — where the patient and bed is lifted on a special device;

Pressure pads — where the hydrostatic pressure is measured under the bed legs and displaced on a digital monitor.

The latter method is perhaps the best in use. It has the advantage that it can monitor continuously the patient's weight, and minimises the movement of the patient.

Figure 12. Weighing platform for use with bed or trolley.



General Considerations

In considering the burn facility much will depend upon the operational policy of the burns team, as has been seen. Basic design concepts and research in this field of medical care are in a state of flux. It is essential that future designs should give as much flexibility as possible allowing engineering services that can be easily modified if a change of accommodation scale is requested. Several other aspects that at first sight may not be apparent are now covered.

Cleaning Policy

The floor cleaning policy can effect the engineering requirement. In some centres it is considered that the wet vacuum floor cleaning method is preferable to mop and bucket, if cross infection is to be reduced to a minimum.[11] In these circumstances the introduction of piped vacuum can have many advantages.

Storage Space and Servicing Areas

Engineers should ensure that there is an adequate provision of this accommodation. It is particularly important that an area is set aside for servicing equipment whether carried out by direct labour or by contract. This department is a high user of sophisticated patient support systems.

Walls and Ceilings

Due to the emphasis on cross-infection, wherever possible engineers should design services that are not difficult to clean. Flush light and piped gas fittings would be a useful contribution in this connection.

General Aspects

One final plea, remember the burn patient can be in this unit for a long time, sixty days plus in some cases. Remember also that air conditioning that seems acceptable in noise level during the day can be intolerable in the middle of the night.

Conclusion

It is hoped that the foregoing has provided a brief insight into the engineering aspects of this type of patient care. The type of medical treatment used can greatly affect the engineer's final design and the degree to which operational maintenance must be carried out. It is recommended that Health Care Engineers should maintain very close links with the burns team and microbiologist where this or related units are operated. Even a minimal change in the method of treatment could cause severe engineering problems, particularly in relation to cross-infection. Although it has not been possible to cover fully all aspects in this field, should engineers wish to pursue any or obtain references, the author would be pleased to hear from them.

Acknowledgement

The author wishes to thank the Institute for the opportunity made available through the 1978 Bursary Award in association with the King Edward's Hospital Fund to carry out the research for the paper.

My sincere thanks are also extended to Mr A. J. Evans FRCS, consultant plastic surgeon, the South West Thames, Metropolitan Regional Burns Unit, Queen Mary's Hospital, Roehampton, for his help and support in the preparation of the research programme and this paper.

Finally my thanks to those who contributed and whose hospitality was so warm, and also to my employers, the Merton, Sutton and Wandsworth Area Health Authority (Teaching), my Area Works Officer and members of the Roehampton District Management Team.

References

[1] **Report of the Action Committee on the Organisation of Burn Care.** *International Society for Burn Injuries,* September 1973, World Health Organisation, Geneva, Switzerland.

[2] **Burn Wound Infection,** David M. Hamback MD, *Journal APIC,* September 1978.

[3] **Hospital Building Note.** *No. 27 Intensive Therapy Units. No. 4 Ward Units. No. 26 Operating Departments.*

[4] **Epidemiology of Pseudomonas in a Burn Intensive Care Unit,** Bruce G. MacMillan et al, *The Journal of Trauma,* 1973.

[5] **Classification and Control of Potential Infection. Hazards on a Burn Wound.** Maley, P. and MacMillan, B. G., *Shriners Burn Institute, Cincinatti, US.*

[6] **Air Conditioning in Hospital Wards and Operating Theatres.** R. P. Clark, *Engineering in Medicine,* January 1977.

[7] **The Contribution of a Bacterially Isolated Environment to the Prevention of Infection in Seriously Burned Patients,** John P. Burke et al, *Annals of Surgery,* Vol 186, No. 3, September 1977.

[8] **Isolated in a Life Island,** Bertha K. Kress and M. Elliott, *The Canadian Nurse,* May 1968.

[9] **Levitation in the Treatment of Large Area Burns.** *The Lancet,* October 1970, No. 7675, Vol 11.

[10] **Fluidised Bed Speeds Healing of Burns.** M. Cairns. *Design Engineering,* July 1970.

[11] **A Waste Trap Sterilizing Method.** J. Kohn. 1970. *Lancet,* No. 1347.

Mr Nicholas is the Area Works Officer to the Suffolk Area Health Authority and was previously a member of the Architects Department of the East Anglian Regional Hospital Board. He has been closely associated with the training of Works Staff in East Anglia and in this article he sets out his impressions on his first year as a tutor associated with the Keele/Falfield Courses.

Keele / Falfield Courses

W. NICHOLAS DipArch (Nottm) RIBA AIArb AIHospE

The Keele/Falfield courses, as they are now known, have been going for 14 years and before giving my impressions of the 1978 courses I shall, for the benefit of those who do not know, outline the history and aims of the courses.

History

Origin

The Keele Courses were, to a large extent, born out of the recommendations contained in the 1962 Tyler Report, in which a strong emphasis was placed on the need for proper training of engineering staff in the National Health Service. As the result of close co-operation between the Department of Health, The Institute of Hospital Engineering and the NHS, a pilot course was held at Keele University in the summer of 1964. This course was attended by 117 students with 12 tutors.

In view of the success of the pilot course, it was decided to hold two similar courses in 1965. These proved the need and over the years the Keele Courses became established as a regular feature in the works training calendar. Since 1965 there have been two courses annually, attended by over 2,200 course members.

Aims and Objectives

While the main aim, originally, was to instruct engineers in technical matters, it was also intended to help them appreciate the importance and effect of good management on their everyday responsibilities and duties and at the same time assist in their future promotion. As the Hospital Engineering Centre at Falfield expanded and developed the technical training of engineers, so the Keele Courses dropped this aspect and concentrated on the principles of management and administration from the technical standpoint. Although the fundamental principles around which the course was first structured remain the same, the aims and objectives are under constant review and are modified to suit changing conditions within the Service.

Target Population

The early course catered for Group, Hospital and Assistant Engineers, but over the years the scope has been steadily widening to cover Regional staff and even staff from Consultants working on hospital projects. Finally in 1976 the Building Profession was included and the courses now cater for all levels of staff from the Works Organisations in the National Health Service. With such a wide range and level of staff to cater for, programmes are designed to develop the more intangible aspects of management, such as inter-discipline (engineer/building) relationships and co-operation with others, team-working, team spirit, leadership, initiative, etc.

Structure and Organisation

Each course comprises some 60 to 65 members arranged in six groups, each group having its own tutor and study room. Plenary sessions take place in a central hall. Involvement by participation of members in the running of the course and managerial exercises is carried out to the maximum extent.

Move to HEC Falfield

In 1976 the Keele Courses were transferred to the Hospital Engineering Centre at Falfield, where they have become part of the syllabus as the 'K' Courses and where they occupy the whole of the Centre to the exclusion of all other courses. The courses have, thanks to the willing co-operation and hard work by the staff at the Centre, not only retained their atmosphere and characteristics developed at Keele, but are building up new traditions round their new home. The Northcroft Hall was built in 1977, in order that the course could be accommodated properly and give facilities for plenary sessions.

Tutors

The tutors are drawn from practising managers within the Health Service and are professional engineers, architects, surveyors and training officers. They are an essential part of the Keele Courses, not only as instructors but also as guides and mentors to their groups.

The 1978 Keele/Falfield Courses

As a newly recruited tutor this was my first encounter with the inner workings of the Keele courses, and, as can be imagined, I felt very much the new boy among so many experienced tutors. However, the welcome I received and the cordial atmosphere between the tutorial team very soon put me at ease.

Introduction and Working-up

I was invited to join the tutorial staff principally because some 40% of the course members are now drawn from the building discipline and it was considered desirable to have at least one tutor from that background.

I received my first impressions of the course programme when I attended a tutor's planning meeting at Euston Tower in December. This was followed by a two-day 'Briefing Session' held at Falfield in May. These two meetings left me both confused and puzzled. To say I was utterly bewildered would be an understatement.

In July however, once the Intermediate course got under way, all the separate pieces of the programme and procedures began to fall into place, operating without a hitch. Both courses were full (in fact they were over-subscribed) — this I learned was the norm for the Keele Courses.

The traditions inherent in these courses were discussed in the March 1975* issue of *Hospital Engineering* and it was most interesting to see how the various factors were woven into the overall plan for the courses. It was also interesting to see how well the courses had settled in at Falfield after only two years.

The Courses

In 1978 some 40% of those attending both courses were from the building discipline, and 20% to 25% from Regional Health Authorities, including the Welsh Health Technical Organisation, Scotland and Northern Ireland. Regions, Areas, Districts and private consultancies were all well represented. A truly international and inter-disciplinary gathering with a great depth of knowledge and experience produced, as can be expected, an extremely high standard.

Both courses followed a similar basic pattern, designed to put everybody at ease, but under pressure, from the moment of their arrival on Sunday right up to their departure on the following Friday afternoon. These pressures appear to be generated by the enthusiasm of the members themselves, the tight programme, and the need to achieve set objectives, all of which help to create an atmosphere of realism. It must be realised that these pressures are shared by the group, according to the personality and ability of the individuals.

The whole-hearted participation by course members is essential if they want to 'squeeze the orange dry' and get the most out of the Course. This includes even those events which might well appear at first glance to be merely a bit of social fun—maybe it is fun, but underneath it has a very serious purpose.

The content of each course has been very carefully considered and structured, with every item and session balanced for the maximum effect. Each is used as a vehicle demonstrating the various levels of analytical thought-and-decision-making process involved in the management activity, but at the same time making participation enjoyable.

Tournaments

The tournament on the Monday evenings is designed to allow course members to mingle and get to know each other quickly. It also demonstrated early in the course programme the capacity needed to plan and organise speedily. Everybody took part.

Both tournaments were organised by blue and green groups. In September of course, the outside competition was not possible due to the earlier dusk, so events much enjoyed in July, such as the tug-of-war, were replaced by indoor activities.

The 1974 Keele Challenge Cup is presented to the winning group. The cup for both courses was presented by Dr K. I. Murray (Assistant Chief Engineer, DHSS), on behalf of the Institute of Hospital Engineering.

The Debates

It has been the practice for some years to hold a lighthearted debate on the Wednesday evenings, which is intended as an exercise in public speaking, and in marshalling and presenting the points to be argued. The level of debating was extremely high, if somewhat unorthodox compared with such chambers as the House of Commons. All in all, both evenings were very lively and most enjoyable. I regret to have to report that there was considerable heckling which appeared to get out of hand and resulted in certain individuals being ejected from the hall by official bouncers.

The motion for both debates was—'Modern Society Tends to Stifle Initiative'. The guest speakers, who gave opposing views were (in July) E. A. Johnson (Chief Engineer to WHTSO) and The Rev C. J. King (Oxford RHA), and (in September) R. Manser (Assistant Chief Engineer DHSS) and K. J. Eatwell (Regional Engineer SW Thames RHA).

The Project and Visit

This is an end of course exercise in which groups and syndicates are able to put into practice some of the techniques learned. The 1978 projects were based on the concept of team management by consensus and could have used, as its real life counterparts, either the Area Team or the Regional Team as models. However, for the purpose of these courses, the District Management Team was chosen, as being the level dealing with day-to-day operational problems, and the one of which staff at all levels should have a working knowledge.

Before the project six actual problems or situations were investigated and studied by the groups, during a visit to Southmead Hospital. During the project, the problems were discussed by groups acting as DMTs and arriving at solutions by consensus. Later, DMTs from the two Syndicates performed before the assembled course, which was followed by comments from a panel of tutors and a general discussion.

Without the help and co-operation of the Southmead Health District and the staff of Southmead Hospital (particularly the members of the Works Department who gave so willingly of their time to help organise the visit) the project would have been far less effective.

The Course Dinner

The formal highlight of the course is the Course Dinner on the Thursday night. This is a very pleasant evening, which fits in well after four days (and nights) of strenuous working.

This is also the time for presentations, of which there appeared to be more than usual in 1978. First we had the 'Maurice Burke Shield' for the most improved speaker of the week. It was won by Errol Macdonald in July, and jointly by Tommy Thomas and Andy Waters in September.

July saw the formal parting from that stalwart supporter and longstanding friend of the Keele Courses, Charles King, better known now as The Reverend Charles King. He was presented by his fellow tutors with a delightful leather case, thought to be ideally suited for sermons.

That was not all! The course members had put their heads together. They felt that the connection between Falfield, Keele, The Institute of Hospital Engineering and the Department of Health should be marked in some tangible form and, as they also wished to pay some form of tribute to the Principal and staff of the Centre, they decided to inaugurate a set of table 'Regalia'. At an appropriate moment during the evening, three stalwarts ceremoniously carried in three silver three-branch candelabra with the candles ablaze, for presentation to Mr T. A. Nicholls (Chief Engineer DHSS), the chairman for the evening, who was pleased to receive them for safe keeping at the Centre.

The September course dinner also had three significant events to record. The first of these was the acknowledgement paid by all the male course members to the only lady member, Miss Susan Miles, ever to attend the

*The End of a Decade—The History and Development of the Keele Courses by Maurice J. Burke.

Keele/Falfield courses. She was presented with a magnificent bouquet of flowers sealed with a kiss, a natural but unscripted bonus. Miss Miles is an architect and an Area Building Officer with the Cambridgeshire Area Health Authority (Teaching).

This was followed by a repeat of the July presentation, except that this time the candelabra were five branch ones, two of which were presented by the course members, while the third was a gift from Mr Richard Harrison (President of the Institute of Hospital Engineering) in the name of the Institute.

The tutors not to be outdone, but somewhat less in number and indeed poorer in pocket, presented a fine walnut gavel, with a flat head and a sharp head. It was described by John Clark (Deputy Course Director) who made the presentation, as specially designed for dealing with the splitting headaches created by the courses. Mr John Bolton (Director of Works DHSS), chairman for the evening, was pleased to accept the additions to the Regalia.

The Regalia

The Keele/Falfield Regalia are now well established at the Centre and comprise nine pieces — no doubt these will be added to. It is intended that the Regalia will be used at all special functions at the Centre, such as course dinners and Seminars. In the meantime all the pieces will be labelled with details of donors and put on display.

First year impressions

Before being associated with these courses, I had heard much that reflected great credit on everyone connected with them. The excellence of the organisation, the administration and service at the Centre, programme content, companionship and atmosphere, all were described with enthusiasm and zest.

In my first year as a tutor, I have found that there was more than a little truth in these reports. Now I feel a certain pride in being a member of the tutorial team. I can only suggest that the whole course can best be described in the one phrase 'It is an experience'.

At lunch on the final Friday, one could sense that the tutors were breathing huge sighs of relief that two more courses had been satisfactorily and successfully completed.

The New Look 1979 Courses

Preparations for the 1979 programmes are now well in hand — this year they are being given a new look to suit the ever-changing conditions in the Service. Even the names are to be changed — in future they will be known as the middle and senior management courses. New sessions embodying fresh ideas will be introduced without unduly disturbing the basic pattern of the courses.

One of the reasons for the success of these courses has been the careful selection and planning of the various subjects and projects. All the sessions are linked and lead to the final project, where all the subjects are used in its preparation and presentation.

While there are certain subjects that continue to appear year after year, the Course Directors are always considering new ideas and subjects for inclusion in future programmes. For instance, the comments made by Course members on their assessment forms at the end of each course are extremely helpful, but can only be considered in the light of the new form of courses and what is already being offered on other Falfield Courses. Introducing new subjects is not as easy as it first appears. Experience has shown that changes must be gradual, a process of evolution rather than radical change.

The Intermediate and Advanced courses have always had similar content. The interpretation by the course members of the subject matter creates the main difference between the two courses — the Advanced course members concentrate on certain subjects because of their greater experience and knowledge.

With the upgrading of the Senior course, the differential between the two courses will be increased. All potential changes must be considered and will, where possible, be incorporated in the 1979 courses so that the spirit and enthusiasm inherent in past courses is maintained. Apart from any other reasons, this continuous updating ensures that the maximum will be obtained by members who have attended previous courses as well as by those attending for the first time.

In view of the continued increase in attendance by members of the building discipline, a professional surveyor will be included in the tutorial team.

As a result of many requests, the practical aspects of industrial relations will again be dealt with in 1979. It is hoped, if circumstances permit, to have a member of the Government, together with other speakers experienced in the subject, to lecture on the day-to-day problems and their solution.

Content and Dates for 1979

The programme content will be formed around various modified and updated subjects and exercises connected with management, administration, human relationships, initiative, drive, consideration and valuation of other points of view. These include:
communications; reporting; verbal skills; team work; committee working; industrial relations; time and resource management; organisation and administration; presentation; behaviour problems and patterns; leadership; problem solving; decision making; and analytical methods.

Target Population

Broadly speaking, the courses are split into the following categories:

Middle Management Course (K7)
From July 9 to 13, 1979
Technician Level and new entry professional — Engineers and Building Officers; Foremen with potential for promotion; Senior Engineers, Senior Building Officers and Third in Line Works Staff (particularly new entries); and RHA Works Staff up to and including TA1.

Senior Management Course (K8)
From September 16 to 21, 1979
Profession Level—Area and District Works Officers, Engineers and Building Officers; Third in Line Works Staff at Area and District (with potential for promotion); Experienced Senior Engineers and Senior Building Officers (with potential for promotion); Senior RHA Staff (up to REs, RAs and RQSs); and Professional Staff of Consultants.

Course Fee
The course fee for members within the NHS is £100, which includes meals and accommodation. For those outside the Service the charge is £200 (both charges are exclusive of VAT).

Nominations and enquiries should be made to the Principal, Hospital Engineering Centre, Eastwood Park, Falfield, Wotton under Edge, Gloucester GL12 8DA. Telephone: 045 48 207. An early application is advised.

This paper was presented at a London Branch meeting of the IHE by the author, who is a partner in Troup Bywaters and Anders, consulting engineers in London. A summary was given in the March 1978 issue of the Journal, but this is the full paper.

Fan Systems and Energy

DAVID ARNOLD MSc(Arch) CEng MIMechE MCIBS

Introduction

Between 25 and 30% of the electrical energy used in large modern buildings is required solely for the purposes of distributing heating and cooling energy and providing ventilation. A study of office buildings has shown that two-thirds of this energy is used by fans and whilst considerable interest has been shown in fan efficiency, scant attention has been paid to the components that comprise the fan system and determine the basic energy requirement.

Figure 1 shows that for air conditioned office buildings the average electrical energy consumed by fans per annum is typically 160 MJ/m². Unfortunately, similar information is not available for air conditioned or mechanically ventilated hospitals but it is likely to be of the order of 300-400 MJ/m² per annum as the running time is two to three times longer.

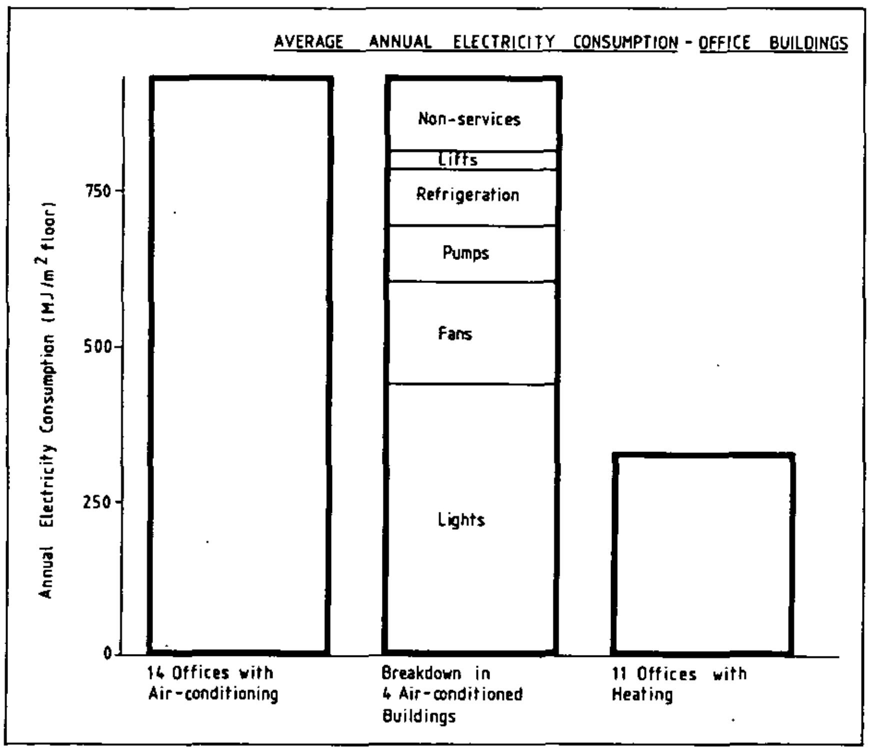
Apart from the energy consumed directly by the fan in providing motive power for ventilation and energy distribution, the rate of air flow and methods of control affect the energy consumed in the heating, humidifying and cooling processes that form part of the system. Usually, each component is treated separately, using empirical data or even arbitrary values to estimate size.

To determine the least energy requirement overall, it is necessary to consider all components as parts of one system and to analyse the complete installation.

Almost all the codes, standards and design criteria of fan systems precede the 1973 increases in the cost of energy. These codes should be reviewed in the light of the present and likely future costs of energy, and should be changed where necessary to ensure the best use of our depleting fossil fuel reserves.

The object of this paper is to demonstrate an analysis that can predict the conditions under which a system will deliver and treat sufficient air throughout the life time of the building at the lowest total (initial plus running) energy consumption that fulfils the performance requirements of that system.

Figure 1.



System Analysis and Energy Cost

System Analysis

Consider the simple fan system shown in *Figure 2* with the objective of ensuring that the least amount of energy is used in constructing and running the system throughout its life. Firstly, we must examine critically the air quantities that should be delivered and whether they change at different times of the day or year.

Secondly, the need and/or capacity of each component must be checked for energy wastage such as re-heating cooled air or silencing fan noise generated unnecessarily.

Thirdly, the air velocities through components and ductwork should be examined to ensure that the optimum relationship between pressure loss (and consequent fan power) and running time of the system has been selected. In effect three questions are posed:

— How much air is necessary and when?

— What is the minimum air treatment necessary?

— What are the optimum velocities?

The answers to these questions must be in a common unit to allow comparison between alternative solutions. All three can be answered in terms of the energy used either during construction of the system or for the total duration of the operating period or as a combined value.

Energy Cost

Techniques to determine the lowest overall total financial cost involve methods of discounting either present or future sums of money to some common basis for both types of expenditure for the purpose of comparison. This procedure has certain disadvantages:

(i) The accuracy must always be in doubt as it is practically impossible to determine an accurate rate for the discount calculations. This rate, which represents the return on capital investment after tax, has varied considerably in recent years from 2-3% up to 15-20% for investment in various industries;

(ii) The lowest cost and lowest energy solution may not be the same. The cost of energy is particularly susceptible to fiscal measures and political actions, either of which can make calculations based on the present cost of fuel quite valueless;

(iii) The selective effects of inflation are usually ignored when comparing high and low capital cost schemes. For example, after payment of the initial costs in capital intensive schemes the effect of inflation will be small, whereas in low capital with consequently high running cost schemes the effect of inflation will continue to have a major influence throughout the life of the project;

(iv) The discount rates used, typically of the order of 5-10%, are intended to represent the average profitability on capital employed in industry after tax and favour the short term. While this may be wise in the speculative field of finance, it is not necessarily the best engineering solution;

(v) The technique ignores the difference in taxation and capital allowances between industry, institutions, government and the individual.

It is suggested that a simpler and more acceptable approach, particularly in the case of fan systems, where there is a limited range of alternatives, would be to attempt to determine not the lowest cost but the lowest **energy** cost.

The design solution to be achieved would therefore be that which gives

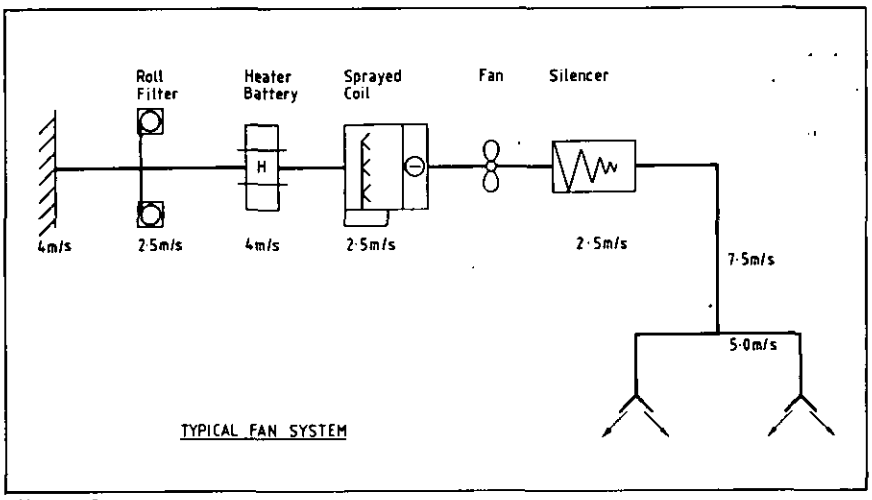


Figure 2.

the lowest total energy requirement during both the initial construction and the life of the system. The change of objective from monetary costs to energy costs should give more validity to the engineering solution.

The main running energy cost of any fan system would be that used by the fan to overcome the resistances to airflow in the system. This energy can be determined easily but it must be balanced against the energy used in manufacturing and installing the system. However, should the unit of energy used in ten to twenty years' time to drive the fan be considered to have the same intrinsic value as a unit of energy used in the manufacture of the fan today, or should energy costs be discounted in a similar manner to financial costs? The amount of energy available for constructing and running the systems in terms of fossil and nuclear fuels is finite. Consequently a unit of energy saved this year will have a greater inherent worth next year as the total reserves of fuel from which it comes will be less. By how much less is open to debate, but certainly the figure will be low, less than the 5-10% used for discount rates. This can be seen by examining the curves in *Figure 3* (overleaf) optimistically based on the assumption that, by *energy conservation*, we can limit our use of fuel reserves to a fixed proportion of the remaining reserves each year. Therefore, in real terms, we can use progressively less and less fuel year by year. A further argument in favour of giving fuel used now a greater intrinsic value is the increasing difficulty and consequent reducing efficiency with which future energy will be obtained.

It will therefore be necessary in any energy analysis to increase the intrinsic value of fuel to be used at some future date or, alternatively, to discount the value of future fuel to its present worth. The latter is probably easier for calculating purposes as every unit of fuel can be discounted easily to the same year ie the time of initial construction of any system.

Future quantities of energy can be discounted to the equivalent present value by the same expression used for discounting future sums of money:

$$Ep = Ea\frac{(1 + x)^{n-1}}{x(1 + x)^n}$$

Where: Ep = equivalent present energy value
Ea = annual energy quantity
n = number of years
x = annual rate of change of intrinsic value

It is of course necessary to estimate the value x for the period under consideration which may be anything from a few years up to fifty or even 100. Taking into account all forms of fuel likely to be available and the increasing difficulty of obtaining and utilising these forms of energy, it would appear that a suitable value for x would be between 1 and 3%, the higher value is used for calculations in this paper.

Air Quantity

How much air is necessary? This question is particularly important as the rate of air flow not only determines the fan energy requirements but also, to a large extent, the energy used by heating, cooling and other devices that form part of the system.

It is important to distinguish between the air flow rates required for some form of process ventilation and those necessary to maintain comfort. With processes the rate of ventilation can usually be determined definitively by the quantity of air necessary to dilute some pollutant produced at a known rate to some acceptable or safe level. In hospitals there are a number of situations where this occurs, particularly when dealing with medical gases, radio-active particles or in clean rooms. However, it is suggested that the greater portion of ventilation is provided for comfort reasons where the minimum rates are much more difficult to quantify.

There are two main criteria that determine the rates of ventilation for comfort:
that odours and pollutants such as tobacco smoke are diluted below a perceptible or acceptable level; and
that an acceptable degree of thermal comfort can be maintained.

In the past, design guides have generally attempted to provide an empirically based rate, for a particular building activity, that would satisfy both requirements. Even if the rate is adequate it can be shown that year round use of the ventilation system at one rate will inevitably waste energy.

Of the two criteria it is probably easier to determine a satisfactory rate for thermal comfort rather than odour dilution. The admittance procedure[1] developed at the Building Research Establishment and adopted by the CIBS (IHVE) can, with a minimum of calculation, provide the peak rate of ventilation required for thermal comfort in summer. As this is a peak rate, some form of control would be necessary at other than peak times to reduce the rate to the minimum necessary to maintain comfort. While this method can be used with relative ease to determine the peak rate for thermal comfort, it is unlikely that the minimum rate necessary to limit odours is anything like this value. For example, research by Smith and Rae[2] in the experimental ward at Hairmyres Hospital has shown that a satisfactory environment can be maintained with only three air changes per hour ventilation with 80% recirculation *ie* 0.6 fresh air changes per hour. Whereas research by Loudon[1] has demonstrated that lightweight buildings can require 30 or more fresh air changes in order to maintain satisfactory thermal comfort. These extreme cases show a range of ventilation rates of 50 : 1. In practice this range is often anything from 5 : 1 to 20 : 1.

The work by Smith and Rae was restricted to a particular ward and the results cannot be extrapolated to other types of ward and areas with different odour sources and frequencies. Their satisfactory fresh air supply rate of 0.6 air changes/hour compares with the DHSS Hospital Building Note recommendation of 3.0. Most of the ventilation rates given as guidance in the Hospital Building Notes appear to be a compromise between a satisfactory rate of odours and thermal comfort. There is a limited amount of information available on the necessary ventilation rate for a satisfactory odour environment and most of it is based on the work of Yaglou et al in the 1930s. The table above is an extract from the IHVE Guide and based on that work.[3]

Table 1.

Minimum Fresh Air Ventilation Rates

(Smoking not permitted)

Air Space Per Person m³	**Fresh Air Supply per person l/s** Minimum
3	11.3
6	7.1
9	5.2
12	4.0

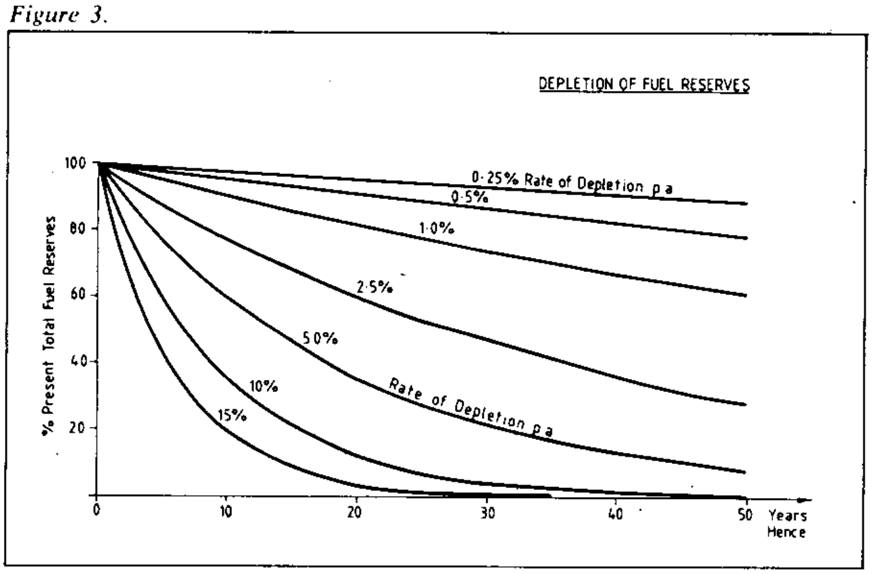
The air space per person in the table is only relevant when an odour is building up, ie intermittent occupation. When a steady state has been achieved the space per person is irrelevant.

It is unusual for this space to be less than 12 m³/person and the value of 4.01 l/s person appears suitable as a minimum value. This should be checked against any statutory requirement. Where smoking is permitted the IHVE Guide appears to have arbitrarily doubled the minimum value. However, if an estimate of the numbers of smokers and smoked cigarettes can be made, the results of more recent research may be a better guide.

The following is one of the conclusions from experiments by Johannson in Sweden[4]: "In order not to report irritation or annoyance smokers would have required an air supply of about 15 m³/h,cig, while the non-smokers would require twice as much. In order to eliminate reports of 'definite odour' an air supply of about 60 m³/h,cig, would have been required."

Hence there are two quite distinct rates of ventilation necessary — that required for thermal comfort and that for odour dilution. To achieve these two rates with the least use of energy it is necessary to use either two fans or some form of controlled ventilation such as 'Variable Flow Rate Ventilation'[5, 6].

Figure 3.



Air Treatment

Having estimated the minimum air flow rates under various circumstances, it is now necessary to determine the minimum air treatment that fulfils the performance requirements of the system. There are four main types of treatment:

a. Heat Transfer (heating and cooling);
b. Vapour Transfer (humidifying or dehumidifying);
c. Filtration;
d. Attenuation.

Before attempting to assess the capacity of any treatment component it is important to question whether that treatment is necessary. For example, why use an attenuator to reduce the noise from a noisy fan when a quieter fan may be available. The next step is to make certain that the component is not oversized and presents an air flow resistance penalty for the life of the system.

Heat Transfer

Heating and/or cooling can be estimated with reasonable accuracy for most systems. If a two speed or variable flow rate system is used, the heater battery would normally only need to be sized to raise the air temperature of the lowest volume flow rate ie that relative to maintaining a satisfactory odour level.

Vapour Treatment

Before considering how much energy should be used for humidification, the question should be raised whether or not a specific humidity is necessary for the comfort of the occupants.

If it is necessary to satisfy some process, for example to reduce static electricity charges in operating theatres, there is no doubt of its necessity. However, considerable evidence shows that there is little effect on thermal comfort, providing compensation is made for temperature within the range 20/90% RH. Humidification is advocated under certain circumstances to reduce the discomfort in rooms fitted with synthetic carpets where static electric charges occur frequently, but it is suggested that it would be more economic to treat the carpet, or use an alternative form of floor covering.

Filtration

Filtration is usually required either to meet a filtration standard required by some hospital process, or in particular to keep wet cooler batteries and ductwork distribution systems clean.

It is argued that filtration reduces the need for cleaning and redecoration of rooms, but there is little evidence to justify this. The major source of dust in rooms is generated within the space rather than brought into the ductwork.

The first named requirement for filtration can be defined relatively easily as it is a process requirement. The latter requirement — that of keeping the inside of the plant distribution ductwork clean — is much more difficult to assess. There do not appear to be any published results from research into whether this requirement is economic. It may, for example, be more energy conscious to clean at regular intervals the components likely to collect dust, rather than to provide any filtration. It is possible that regular cleaning could prove unnecessary as the system would be continually flushed with air. Only moist surfaces would be likely to collect and continue to collect significant amounts of dust under these circumstances.

These are limited in number and can be identified and cleaned with relative ease. This is an area where the quantified results of practical research would help immeasurably. The replacement cost of filter media, the labour cost in changing and the pressure loss across the filter are significant energy users in any ventilation system. Whilst it has been considered good engineering practice in the past to provide filters, it may well be that filtration is unnecessary, and this must be reviewed in the light of current energy costs.

Attenuation

Silencing would not normally be considered as air treatment but it is a significant energy user in a number of central air handling plants. Silencers became popular in ventilation plants some 10-15 years ago with the popularity of axial flow fans. With regard to capital cost only, it is often cheaper to use an axial air flow fan and silencer rather than an alternative fan which would not require a silencer.

With the advent of inherently noisy fans has come the increased use of high pressure systems such as induction, dual duct and variable volume air conditioning, where the use of the silencer may well be necessary because of the pressures generated by the fans in these systems. However, for more conventional ventilation systems it is suggested that the fan system and components should be analysed and adjusted to allow the use of a fan without silencer, rather than use energy to generate the noise and lose more energy in attempting to eliminate it.

Air Velocity

Each component in an air system presents a resistance to air-flow and has a consequent affect on the fan power throughout the life of the installation. The rate of energy relative to each component can be estimated from the expression:

$$Ec = \frac{\Delta pc \times Q}{\eta \text{fan} \times \eta \text{drive} \times \eta \text{motor}}$$

Where: Ec = rate of energy input for the component W.
Δpc = air path resistance of component N/m^2
Q = air quantity m^3/S
η = efficiency

The air quantity is the product of the cross section area and the velocity (m^2 × m/s = m^3/s). It can be seen that the energy requirement is, therefore, related to velocity. *Figure 4* shows the relationship between velocity and annual fan energy requirement for a 100 m length of ductwork in a system operating sixty and 168 hours per week. The curves indicate that the lower the velocity, the lower the annual energy requirement. But as the velocity drops a larger duct is required to carry the same quantity of air and consequently more energy would be used in constructing the ductwork.

For comparison purposes it is necessary to estimate the amount of energy used in initial construction and there are various ways to do this. Generally, they rely on estimating the total energy input to any industry divided by the unit output. Unfortunately such detailed information in the precise manner necessary is not available in the building services industry. It is suggested that an alternative would be to convert the costs of construction into the equivalent amount of energy at current cost. This exercise has been carried out for ductwork and the results are shown in *Figure 5* for various air quantities. The future annual energy requirements can be discounted using the expression (1.0) and the curves in *Figures 4* and *5* added. The result is shown on *Figure 6*. The optimum velocity is the

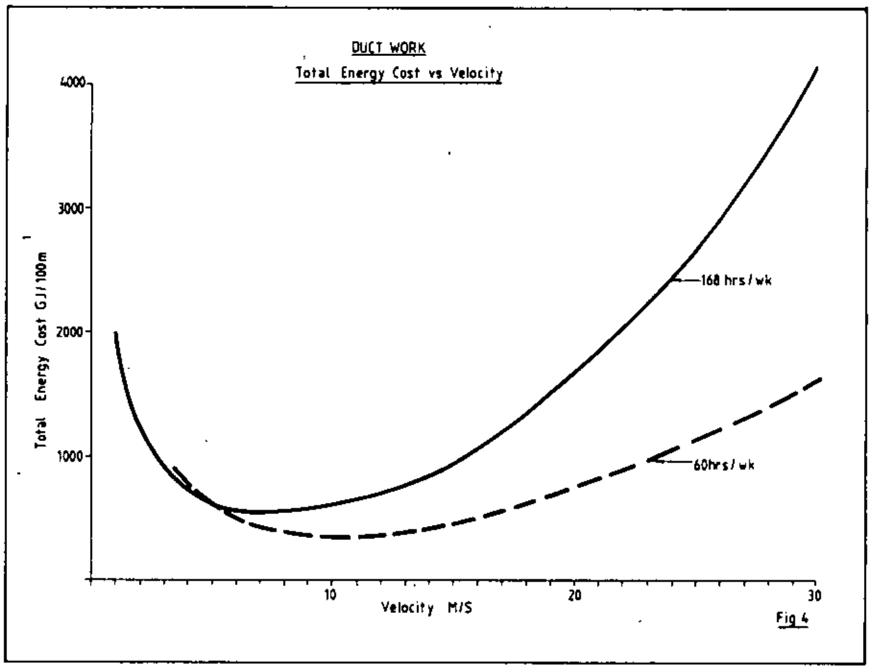


Figure 4.

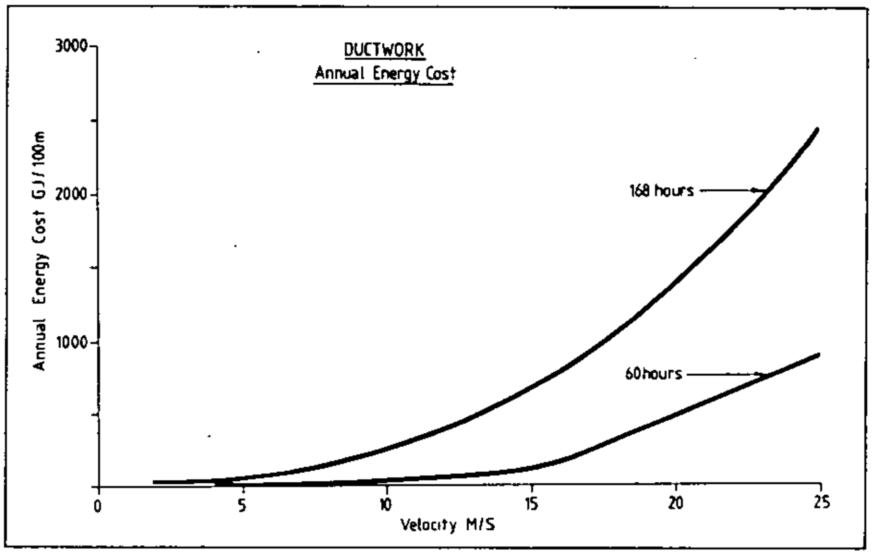


Figure 5.

lowest point on each curve ie the minimum total (initial plus running) energy requirement. Similar exercises can be carried out for all components in a system. The results of such exercises are shown in *Figures 7* and *8* for an autofilter and cooler coil.

Conclusions

The method of analysis described in this paper is basically a step by step reply to three relatively simple questions:

How much air is necessary and when?

What is the minimum air treatment necessary?

What are the optimum velocities?

All three questions can be answered in terms of energy.

It is argued that an analysis in terms of energy provides a more valid engineering solution than one that can be changed overnight by fiscal measures, although speculation is involved as to the future availability of energy. A method of discounting future quantities of energy is provided, which allows a present value comparison of initial and running energy costs.

Examination of the minimum requirements for air flow rates shows that there would generally be two minimum values, one that would maintain satisfactory thermal comfort in summer and another much lower value that would maintain a satisfactory dilution of odours. An analysis of whether data would provide the length of time the system would run at each rate and the consequent energy requirement would be necessary.

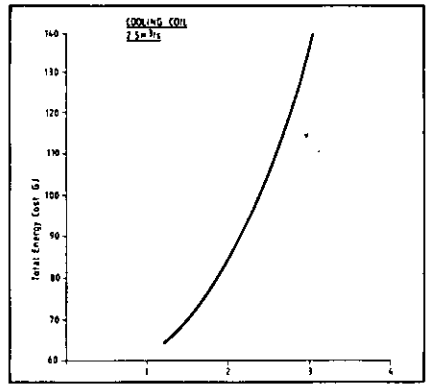


Figure 8.

The need for each form of air treatment in a system should be established before estimating the capacity required in any process. The need for vapour transfer processes, filtration and attenuation are questioned in the light of the requirements of thermal comfort and least energy use.

A method for estimating the optimum velocity in ductwork and air system components is given that uses the energy discounting procedure. The step by step analysis described shows a quantitive means of designing fan systems with the objective of ensuring that the least energy is used throughout the life of the system.

This paper has described techniques that can provide solutions and it is suggested that further work in this area should involve pre-calculated answers for typical conditions.

Figure 6.

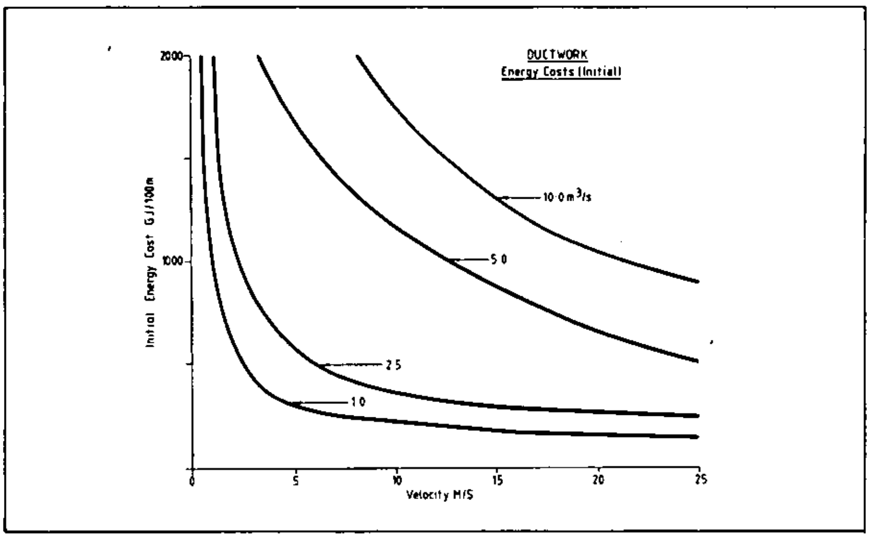
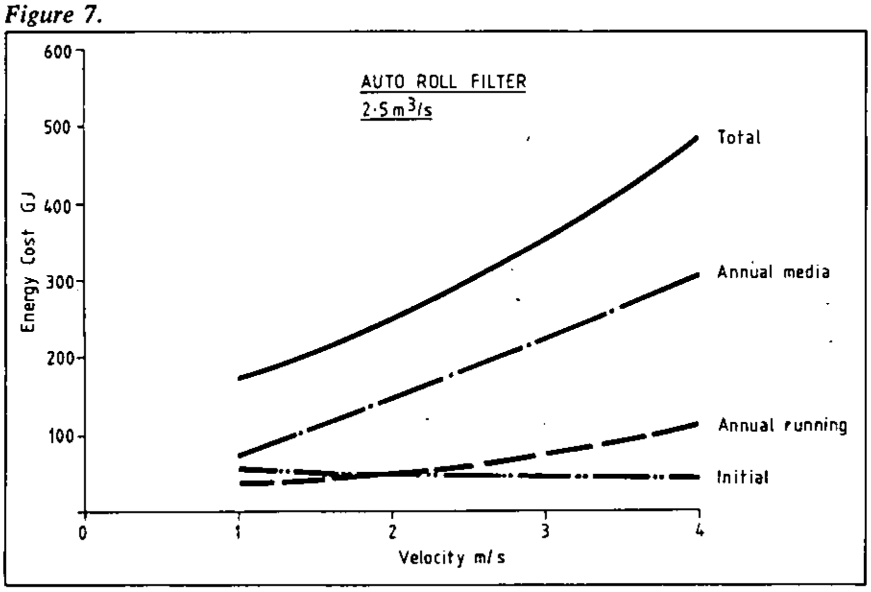


Figure 7.



References

[1]Loudon, A. G. *Summertime Temperatures in Buildings.* IHVE/BRS Symposium, February 1968 (BRS Current Paper 47/68).

[2]Smith, R. M. and Rae, A. *Odour and Ventilation in Hospital Wards.* Building Services Engineer, March 1977, Vol 44, pp265-271.

[3]*IHVE Guide* — Book A, 1970, Section A1.

[4]Johansson, Curt R. *Tobacco Smoke in Room Air.* Building Services Engineer, March 1976, Vol 43, pp254-262.

[5]Arnold, D. *Variable Flow Rate Ventilation.* Proceedings of the 1976 CIB International Symposium. The Construction Press, pp480-493.

[6]Arnold, D. *Comfort Air Conditioning and the Need for Refrigeration.* ASHRAE Transactions 1978, Vol 84, Part 2.

Product News

Variations of a Simple Hose Clip

The manufacturers claim that the simple worm-drive hose clip has been given a new lease of life in an ingenious banding system developed in the Midlands. 'Stranglehold' has taken the hose clip to pieces, stretched it and come up with a banding system which will it is stated put the squeeze on almost anything. Unlike conventional systems, it can apparently be used again and again.

Supplied in standard 100 ft (30m) dispensing packs, it takes only a few seconds to form a worm-drive or adjustable toggle clip which can be used in many situations where band fastening is required.

Further details are available from: Elms Lightning Tools & Fasteners Ltd, Lightning Way, Alvechurch Road, Birmingham 31. Tel. 021-475 1373.

Wire and Cable Chart

A new A3 size colour wall chart giving comprehensive information on thermo-couple and compensating wires and cables is available free.

Apply for your copy to: Labfacility Limited, 26 Tudor Road, Hampton, Middlesex TW12 2NQ. Tel. 01-941 4849.

'Ultraclean' CA Filter

The new 'Ultraclean' SC2 range from Spirax Monnier incorporates an indicator, conspicuously housed in a sight dome, which emerges as an orange warning of exactly how conditions stand and how long before replacement of filter elements must be made. You can see the state of the filter element whether air is flowing or not. Even when the system is at rest the indicator retains its aspect. Resetting is simplicity itself. Replace the filter, unscrew the sight dome and push the indicator to zero.

In applications where the highest quality compressed air is essential, monitoring of filtration conditions is vital. The 'Ultraclean' is claimed to do this automatically and reliably, reducing inspection and maintenance time. The Spirax Monnier 'Ultraclean' SC2 (whose spares are the same as for the SC1 range) is offered in sizes of $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{1}{2}$ inch. As with the SC2A range, it is also available with automatic drain.

Further details are available from: M. S. Stewart, Spirax-Sarco Limited, Charlton House, Cheltenham, Glos. Tel. 0242 21361.

Ultraclean CA Filter.

Re-Chargeable Spray Canister

The Jenni Can, a new re-fillable spray canister which will spray most liquids by air obtained from an airline, foot pump or bicycle pump has been launched by 5 Star Products. The 600 ml (one pint) Jenni Can will spray lubricants, penetrants, rust inhibitors, electronic cleaners, heavy duty cleaners and cellulose paint. There are also applications for just spraying compressed air. All the user does is fill to two-thirds full, pressurise with air to about 50 psi and use as an ordinary aerosol. When empty it can be refilled again in the same manner, thus making important savings over conventional methods. The 600 ml Jenni Can retails for £11.80 inc VAT.

Further information is available from: 5 Star Products, 55 The Street, Shalford, Guildford. Tel. 0483 61447.

Instant Road Repairs for Car Parks, Roads and Drives

Rentokil Products Division have acquired the UK marketing rights of Instant Road Repair from Emcol International. Instant Road Repair which looks like tarmacadam yet has none of tar products' disadvantages is stated to be ideal for repairing potholes and cracks in drives, car parks, roads and all tarmac asphalt and concrete surfaces. It consists of a specially formulated binder together with selected aggregates. The manufacturers claim that Instant Road Repair is not affected by extreme temperatures, snow, frost or wet conditions and that there is no shrinkage and no pick-up on footwear or tyres. Application is simple; just brush loose debris out of the hole, including standing water or oil. Tip out sufficient Instant Road Repair to slightly overfill the hole and compact it with a shovel or tamper. Traffic can be allowed immediately. Instant Road Repair comes in 25 kg sacks.

Further details obtainable from: Rentokil Limited, Products Division, Felcourt, East Grinstead, West Sussex. Tel. 0342 833022.

Building Automation and Energy Management System

The Sauter EY 1200 'Centralised System for Building Automation, Energy Optimisation and Security' can if correctly applied claim the manufacturers lead to substantial savings in energy, reduced manpower costs, increased building and maintenance efficiency and give greater fire and security safeguards.

The system is based on the techniques of micro-electronics using mini-computers. Advances in this technology give greater flexibility of customer requirements in software and allow easy adaption to the building complex. The EY 1200 Data Centre, which provides supervision of all services, automatically controls, evaluates and actions control procedures. It displays the information at the control centre from the various plant rooms or areas in a building.

This system was described fully by Mr J. Flury in his article 'Centralised Control of Engineering Services' published in *Hospital Engineering* of March 1979. We understand that earlier EY Systems have been installed by Sauter in Hallamshire Hospital, Selly Oak Hospital and Kingston Hospital.

Further information is available from: P. B. Lovering Esq, Regional Sales Manager, Sauter Automation Ltd, 165 Bath Road, Slough, Berkshire SL1 4AA. Tel. 0753 39221.

Classified Advertisements

APPOINTMENTS AND SITUATIONS VACANT

BRENT AND HARROW AREA HEALTH AUTHORITY
Brent Health District

Engineers

Senior Engineer

Required to assist the Assistant District Engineer in the implementation of Planned Preventative Maintenance and Bonus Systems. Qualifications required are Apprenticeship plus HNC or City and Guilds (293 or 225) in Mechanical or Electrical Engineering.

Salary: £5,292-£6,072 (including London Weighting) plus Bonus.

Senior Electronics Technician

This post provides interesting and practical work on the Maintenance and Safety of Electro Medical Equipment in a peripherial teaching hospital which has many specialist departments. We are seeking a person to set up a new department with new workshops to work closely with Health Monitoring Physicists. The post will provide a stimulating challenge to the right person.

Relevant experience and HNC/HND or equivalent qualification in electronics needed.
Post based at District Headquarters at Central Middlesex Hospital.

Salary Scale: £4,098-£5,142 (inclusive)

Closing date: April 18, 1979.

Please contact Mr M. Woodroofe, District Engineer, Central Middlesex Hospital, Acton Lane, London NW10 7NS. Tel. 01-965 5733, Ext 223.

BERKSHIRE AREA HEALTH AUTHORITY
WEST BERKSHIRE HEALTH DISTRICT

ASSISTANT DISTRICT ENGINEER

Assistant District Engineer required for the supervision of maintenance and minor capital works in 21 hospitals and other properties.
Must have sound experience in the operation and maintenance of building services and plant.
Minimum qualification — HNC in Engineering.
Salary: £5,328-£6,309.
Application forms and job description from Area Personnel Officer, Berkshire Area Health Authority, Great Western House, Station Road, Reading. Telephone: Reading 586161, Ext 268.
Ref. A 531. Closing date: April 20, 1979.

AREA WORKS OFFICER

Salary Scale: £9,714 - £11,871 per annum

Applications are invited for this senior post in a single district area serving a population of 166,000 with a revenue allocation of approximately £10m per annum based at South Shields, Tyne and Wear. Major capital developments are anticipated over the next decade.

Applicants should have appropriate experience at a senior level preferably within the National Health Service and must be corporate members of either the Institute of Civil, Mechanical, Electrical or Electronic and Radio Engineers, or the R.I. of Chartered Surveyors, or Qualified Architects. The qualification requirements for "transferred Officers" within the NHS will be modified in accordance with P.T.B. conditions.

Further details of the Area and the post can be obtained from the Area Administrator or Area Personnel Officer (Tel. South Shields 567711).

Application forms and job description can be obtained from the Area Personnel Officer, South Tyneside Area Health Authority, Newcastle Road, South Shields, Tyne and Wear NE34 9PA.

Closing date for receipt of applications: April 19, 1979

Required

CHIEF ENGINEER

For the
Ministry of Public Health, Kuwait

Applications are invited from experienced Senior Executive Engineers for the new post of Chief Engineer in the Ministry of Public Health, Kuwait.

The Chief Engineer will be required to lead a management structure that consists of Operation and Maintenance, Development, Capital Works, and Central Workshops Sections.

10-15 years' experience in the design and maintenance of electro-mechanical services in buildings and in the management of major contracts for these services especially in health care facilities is required, in addition to leadership qualities.

Copies of Academic Transcripts, Work Experience documents, and personal CV should be mailed within 4 weeks to: **The Director, Central Administration for Technical Services, Ministry of Public Health, PO Box No 1519, Safat, KUWAIT.**

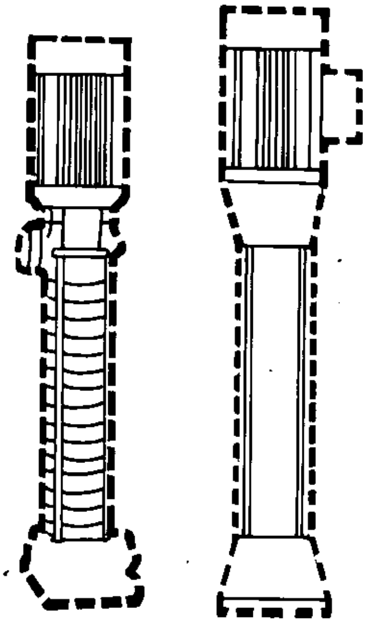
East Roding Health District

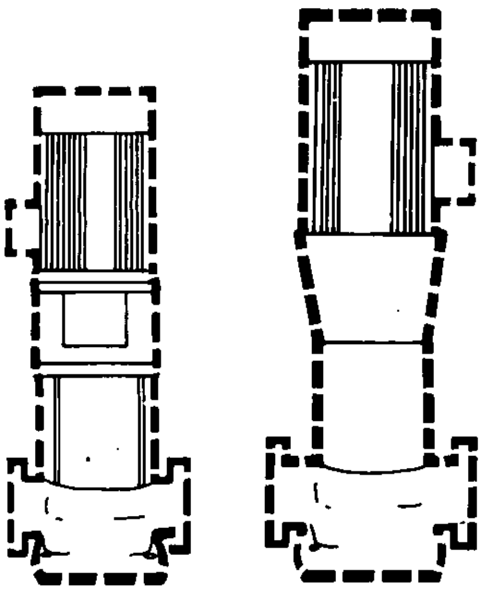
ASSISTANT DISTRICT ENGINEER (SECTOR)

(£5,682-£6,763 inclusive)

We require an experienced and qualified person to join a small team in a District where a major expansion is about to begin. He will be involved in the management of all engineering maintenance and minor capital programmes on behalf of the District Engineer, and will have specific responsibilities for energy conservation for Health Centres and Clinics.
Application forms and job description are available from Janis Patrick, District Personnel Department, King George Hospital, Newbury Park, Ilford, Essex, or ring 01-518 1702.
Informal enquiries to Alan Goffee, District Engineer, 01-554 8811, ext. 345.

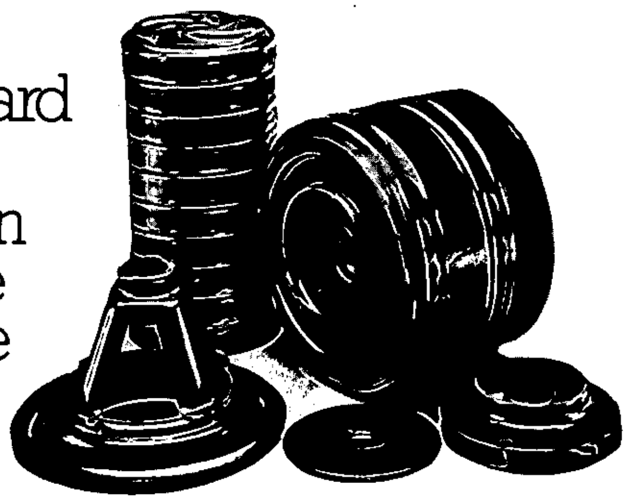
For many years there have been pumps which look like our 'CP' units.





Now there are some which look remarkably like our 'CR' units...

...but don't be fooled by outward appearances, it's the stainless steel and tungsten carbide components inside which make **Grundfos** the best pumps in the world.



GRUNDFOS

Often imitated, never equalled.

Grundfos Pumps Ltd. Head Office: Grovebury Road, Leighton Buzzard, Beds. LU7 8TL. Tel (0525) 374876. Telex 825544.
Northern Area: Gawsworth Court, Risley Road, Risley, Warrington, Cheshire. Tel: Padgate (0925) 813300. Telex 628162.