HOSPITAL ENGINEERING

September 1979

The Journal of the Institute of Hospital Engineering

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Fort San Antonio

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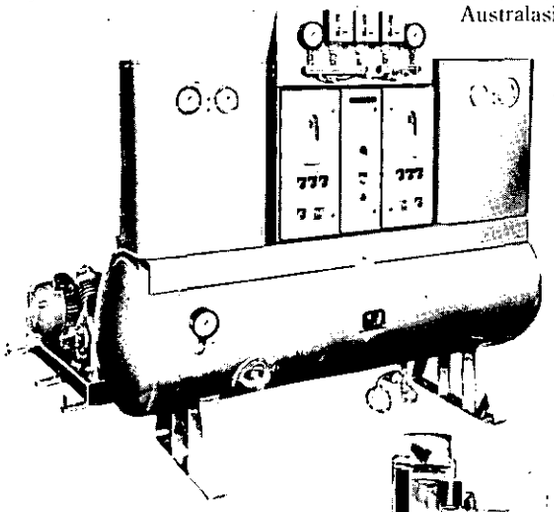

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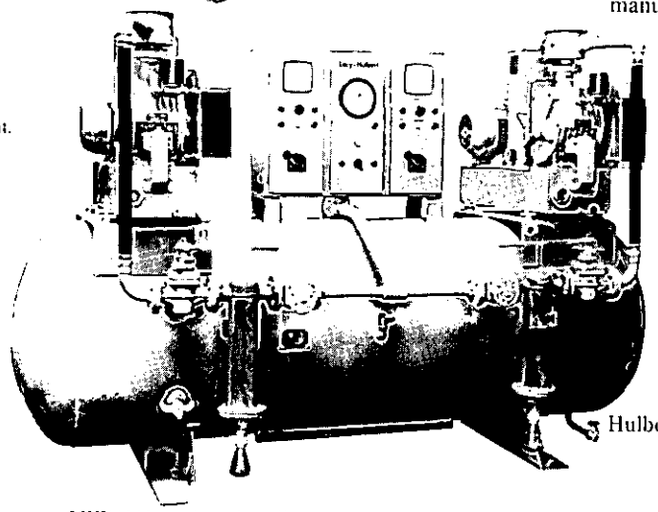

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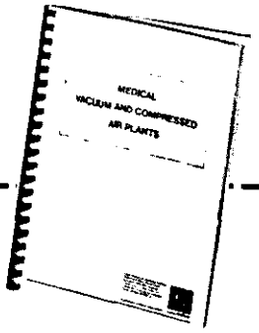

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'Hospital Engineering' is published monthly, except in January and July, by Earlsport Publications

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

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'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

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HOSPITAL ENGINEERING

Vol. 33 No. 7

September 1979

The Journal of the Institute of Hospital Engineering

Contents

Institute News

November One-Day Symposium

The Institute has arranged a joint One-Day Symposium with the Department of Health and Social Security, and full details are given below.

The Institute of Hospital Engineering Joint One-Day Symposium with the Department of Health and Social Security

'Health Buildings – Fire Precautions'

The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London on Wednesday, November 14, 1979

The DHSS has issued, for trial and use, a guidance note covering fire precautions in new health buildings, which will be issued as a Hospital Technical Memorandum towards the end of 1979. The DHSS, jointly with the Home Office, has completed a survey of 45 hospitals to try to establish the financial and practical implications to the NHS if existing hospitals are designated under the Fire Precautions Act, 1971.

At this Symposium, the DHSS and the Home Office will outline the thinking behind the Guidance Note and stress many of its main objectives. They will discuss the results of the survey, the conclusions drawn from it and the design and cost implications. The Symposium will be of considerable interest to all NHS staff involved in planning as well as consultant architects, engineers, surveyors and works staff at all levels in the NHS.

PROGRAMME

10.00 Coffee

10.30 OFFICIAL OPENING by
N. C. STROTHER-SMITH Esq OBE ERD MA CEng MIEE FIFireE Director, Fire Protection Association
CHAIRMAN for the day:
JOHN BOLTON Esq LLB(Lond) CEng FICE FIMechE FInstE HonFCIBS HonFIHospE FIArb Chief Works Officer, Department of Health and Social Security

10.35 Film — 'HOSPITALS DON'T BURN DOWN'
This film illustrates many of the problems which arise at a hospital fire which are of interest to managers, designers, and those responsible for staff training
'DESIGN GUIDANCE FOR NEW HOSPITALS'
Speaker: P. ROBINSON Esq FIFireE HM Inspector of Fire Services, Home Office
Mr Robinson will discuss the kind of standards the Home Office would expect to see in health buildings and the future relationship of health authorities with the fire brigades and the Home Office

14.30 'EXISTING HOSPITALS AND THE FIRE PRECAUTIONS ACT, 1971'
Speaker: CERI DAVIES Esq Assistant Chief Architect, Department of Health and Social Security
Mr Davies will describe a survey carried out at 45 hospitals across the country, the reason for it, the way in which it was carried out, the results and the design and cost implications if existing hospitals are to meet the requirements of the Fire Precautions Act, 1971
Speaker: T. GREENWOOD Esq FIFireE HM Inspector of Fire Services, Home Office
Mr Greenwood will speak about the contents of a Home Office guide which would satisfy the requirements of the Fire Precautions Act, 1971

15.45 DISCUSSION

16.30 CLOSURE

NB *There is expected to be a heavy demand for tickets which will be distributed simply on a 'first come first served' basis*
Tickets are available **only** *from the Institute of Hospital Engineering £13 each, including morning coffee and lunch.*

Energy Issue

The Issue of *Health and Social Services Journal* dated August 17 contained an article headed *The Hole in the Middle* over the name of Joyce Galley, Assistant Editor.

The item dealt with the subject of Energy Conservation and the holding of an International Month in October and contained the astonishing statement that "But so far as I know there is not one Association from within the NHS on the list of supporters, not even the Association of Hospital Engineers who will certainly have more than a passing interest in energy conservation".

We do not know just what 'Association of Hospital Engineers' Ms Galley refers to, but so far as this Institute is concerned we fear that she is most sadly uninformed, and we might suggest that a simple telephone call might have saved Ms Galley from making such an incredible statement.

For her information, so far as International Energy Conservation Month is concerned, through the co-operation of the Directorate of Works of DHSS, the whole of the October Issue of this Institute's Journal *Hospital Engineering* will be devoted to the subject, and comprises a survey of the many Conservation Schemes that have been undertaken.

So, Ms Galley, hospital engineers ARE interested in International Energy Conservation Month and are demonstrating their interest in this way, plans for which, of course, have been afoot for some months.

We would take the opportunity to add, and emphasise, that the Institute's interest in matters pertaining to 'Energy' and 'Energy Conservation' are long standing and continuing. Regularly, these subjects are dealt with during activities organised by the Institute. Plans are in hand for staging another One-day Symposium on 'Energy Savings' and the draft programme for the major Institute Conference next Spring already contains Papers on the subject of 'Energy Conservation'.

Further talks have commenced already with the Directorate of Works, DHSS with the view to staging some 'on-going' programme relating to 'Energy Savings' as a further contribution in the interests of the NHS from this Institute. As these discussions progress, it is hoped to invite NHS Administrators, Nurses and other disciplines to co-operate in the programme.

In light of all the above we are sure that Ms Galley will wish to withdraw what might be construed as an imputation on the lack of interest on the part of 'hospital engineers' in 'International Energy Conservation Month'.

The October Issue of 'Hospital Engineering'

The October *Hospital Engineering* will be a special energy conservation issue and will include a number of papers specially prepared by the DHSS. The subjects covered will be case studies which show how significant energy savings can be made.

As a result, it has been decided to make the October issue an International issue, instead of this one.

6th International Congress of Hospital Engineering

Washington DC — July 1980

Thomas Cook are prepared to arrange a package incorporating air travel and hotel in connection with the above Congress. The basic arrangements are:

Depart HEATHROW, Saturday, July 5, 11.30
Arrive WASHINGTON, Saturday, July 5, 14.35
Met on arrival and taken to WASHINGTON SHERATON HOTEL
Depart Saturday, July 12, WASHINGTON, 21.15
Arrive Sunday, July 13, HEATHROW, 09.00

Inclusive Charges Each Person

	Sharing Twinbedded Room with bath	Single Room with bath
Washington Sheraton	£402	£467

It will be possible also to make bookings for the Congress Social Functions through these Agents.

Full details and forms of application may be obtained from: International Conference Service, Group Travel, Thomas Cook Ltd, PO Box 36, Thorpe Wood, Peterborough PE3 6SB. Telephone: 0733-50 2594005, Mr D. M. Rosambeau, with whom all correspondence should be carried out direct.

Registration as Chartered Engineer

Members will know that in 1978 The Institute of Hospital Engineering was elected to become an Affiliate of the Council of Engineering Institutions.

One of the consequences of this election is that henceforward the Institute may sponsor for registration as Chartered Engineer those of its members who **meet the CEI requirements for such registration.**

Council of The Institute of Hospital Engineering has now established a permanent Assessing Panel whose duty it will be to carefully consider all applications for registration as Chartered Engineer and to forward to the Engineers' Registration Board those applications where it is considered that the member meets the requirements laid down by CEI.

For the information of members we set out below certain basic requirements as stated on the form of application for registration as Chartered Engineer by Corporate Members of Affiliated Institutions (stocks of which form are now held by the Institute).

The Council of Engineering Institutions has decided that such applications will be treated as individual cases. In the first instance consideration will be given only to those applicants who clearly meet the following requirements:

are in corporate membership of the affiliated body at December 31, 1978;
satisfy the academic requirements of By-law 52 (c);
are considered by the affiliated body to have a clear case for satisfying the requirements of CEI Statement No. 11;
have held positions of responsibility as professional engineers for a minimum period of five years immediately preceding the application.

By-law 52 (c) says: 'has passed an examination in the principles of engineering which shall have been set by the Board in accordance with the Board's regulations or has passed such other examination or academic test as may be accepted by the Board as being at least equivalent in standard to the examination set by the Board'.

By-law 53 says, 'The academic standard of the examinations and academic tests set or accepted by the Board pursuant to By-law 52(1)(c) shall be not less than that of a degree in engineering (or in a related subject acceptable to the Board) for the time being awarded by a university in the United Kingdom of Great Britain and Northern Ireland'.

CEI Statement No 11 gives the general requirements for the Training and Experience of Engineers for Chartered Status. Copies of the CEI publication which sets out Statement No 11 in full may be obtained from CEI, 2 Little Smith Street, SW1P 3DL price 35p post free.

It cannot be over emphasised that these new procedures for the obtaining of Chartered Engineer status do not represent a departure from, or a lowering of, the standards of CEI's previous requirements but, rather, an alternative method of registration as Chartered Engineer which hitherto has been obtainable only through Corporate membership of one of the original constituent members of CEI.

Council of this Institute is most satisfied, therefore, that it may now offer this additional service to members.

Working Abroad

Acceptance of a job abroad often brings unexpected problems. A number of articles have been published in various journals and newspapers, offering advice to people who are thinking of taking employment abroad. There are also some pamphlets and books available, amongst which the Daily Telegraph book 'Working Abroad' appears to cover the subject most thoroughly.

Despite this wealth of advice, a number of engineers still find themselves, far from home, as disgruntled expatriates bitterly regretting the decision they made to seek higher earnings within a different culture.

Hospital engineers can be found in this category and the Institute is, therefore, anxious to help members to avoid the hazards which could lead to such disappointment.

With this in mind the Institute consulted the Department of Health and Social Security to see if they could give some official assistance and advice on employment in health care engineering posts abroad.

The Department's reply was that it does not have, nor can it set up, an overseas employment advice service. However, it does have some employees and also records of NHS people who have been employed in health posts abroad in both the public

and private sectors. It is willing to put enquirers in touch with these people but the Department emphasises that it accepts no responsibility for the accuracy and quality of the advice that the enquirer may subsequently receive as a result of informal and unofficial discussions.

It believes that engineers may derive real benefit from such advice because it has evidence that conditions of service offered by some overseas Governments need interpretation and this is best undertaken by someone who has first-hand personal experience.

Engineers who wish to make enquiries should get in touch with the Secretary of the Institute who will then arrange for them to be referred to the Department if a person with appropriate experience can be found who is willing to help.

The New Trade Union Panel Chairman

The Chairman of the Council of Engineering Institutions, Dr G. S. Hislop announced on July 26 that Sir Sidney Bacon CB BSc(Eng) CEng FIMechE FIProdE has accepted an invitation to succeed Mr G. A. Dummett MA FEng FIChemE as Chairman of the CEI's Trade Union Panel.

Sir Sidney succeeded to the Presidency of the Institution of Production Engineers on July 1, 1979. Until his retirement a few months ago, he was Managing Director of the Royal Ordnance Factories.

Mr G. A. Dummett, former Chairman of the CEI in 1976, has been Chairman of the Trade Union Panel since 1975. During his time with the panel he was actively involved in the production of two CEI booklets — 'Professional Engineers and Industrial Relations Legislation' and 'Professional Engineers and Trade Unions', the latter of which has recently been updated as a second edition.

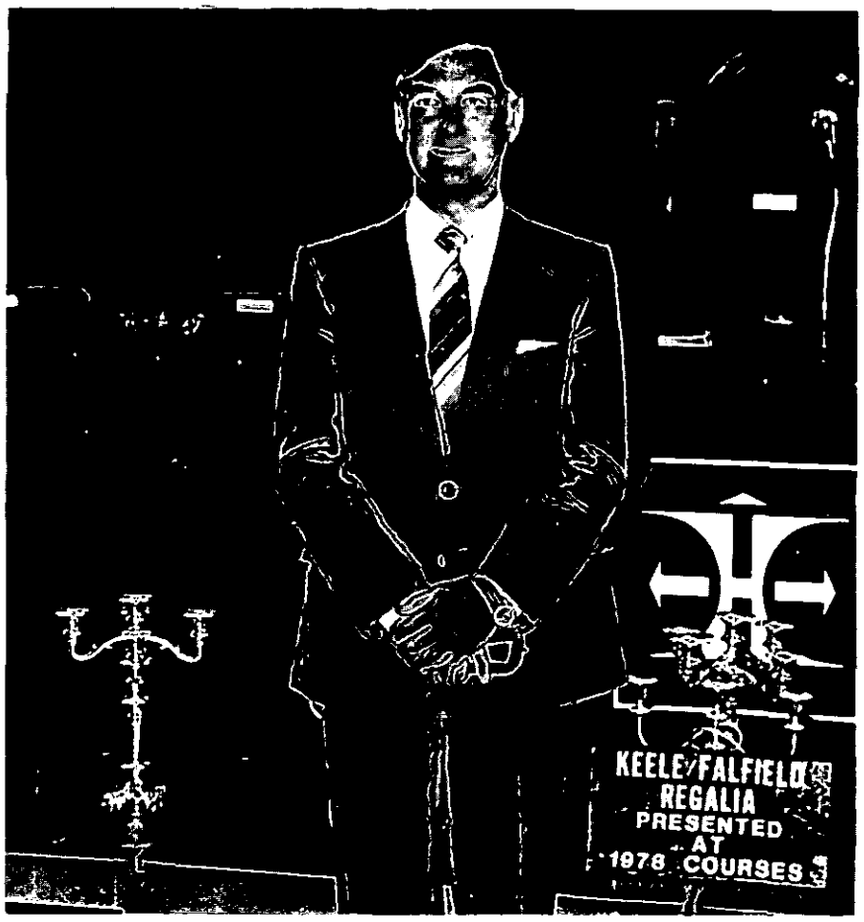
Electro-medical Equipment Management

The General Medical Physics Topic Group of the Hospital Physicists' Association has arranged a meeting on 'Electro-medical Equipment Management in the Health Service' on Friday, October 26, 1979 at the University of Sheffield Medical School, Hallamshire Hospital, Sheffield.

This meeting will be of particular interest to physicists, engineers, technicians and also those concerned with the purchasing and supervision of medical equipment.

Eight speakers will present papers and the meting will conclude with a general discussion. The speakers will represent a wide range of interests including medical, nursing, engineering and physics staff. Invited speakers from the DHSS and medical equipment industry will also contribute. Topics will include the organisation of maintenance schemes, current evaluation projects and their effect on medical equipment design and a variety of viewpoints on equipment management as a whole.

Registration details are available from Dr P. J. Howlett CEng MIEE Area Medical Physics Dept, Rotherham District General Hospital, Moorgate Road, Oakwood, Rotherham S60 2UD.



Duncan MacMillan, a Tutor, photographed in front of some of the 'Keele/Falfield Regalia' during a recent 'Keele Engineering Management Course' held at the HEC, Falfield. It will be recalled that Mr MacMillan received the MBE in the last Birthday Honours List.

High Voltage Switchgear

Thirty papers are to be contributed by engineers from 12 countries at an International Conference on 'Developments in design and performance of EHV switching equipment' organised by the IEE in association with the Institute of Electrical and Electronics Engineers Inc and the Institute of Mathematics and its Applications. The Conference is to be held at the IEE Savoy Place from November 26-28, 1979.

Further details of the Conference are available from the IEE, Savoy Place, London WC2R 0BL, telephone 01-240 1871, quoting reference LS(C).

Electrical Safety

Mr W. A. Harley, whose diagram of a method of wiring electrical connections to thermostatically-operated equipment was published on page 3 of the August 1979 issue, points out that the live and earth sides of the socket outlet are unfortunately shown as being connected in the diagram! We hope that any readers who have used the idea will have spotted the error.

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 the journal.

Here he describes how he spent the £500 award — Council of the Institute hopes that more readers will be encouraged to enter the 1980 competition, whose rules are given opposite.

Bursary Winner in the USA

R. D. BUCKLEY DMS FIHospE MBIM

It was with the greatest pleasure that I learned in early June, 1978, that I had been awarded the Institute of Hospital Engineering's first bursary award. Only later, over the next few months was I to realise the importance and the full significance of such an award. I had proposed that the bursary should be used to enable me to carry out research both in the United Kingdom and the United States of America on the engineering aspects of burns units. As I found out, although at first sight this seemed to be an easy objective to fulfil, the investigation turned out to be rather like a detective story in which the detective uncovers a little evidence all the time, yet the whole story is never quite revealed until the end. The planning of the study tour itself steadily progressed, although I soon found out that to organise a visit in the United Kingdom is a far different proposition than to organise a two-week tour taking in five different centres in the United States of America, from Houston, Texas to Boston, Massachusettes

It was with a little surprise when after I had completed the investigation at home in the United Kingdom I found myself at long last on a foggy November morning at the check-in desk of British Caledonian Airways at Gatwick Airport. "I am sorry, Sir," said the check-in girl, "but BR 245 to Houston has been delayed. The crew ran out of flying time last night on the service from Peru and the aircraft is stranded in Manchester." After a delay of seven hours, including a free lunch and a trip around the Surrey countryside, the service to Houston finally took off at 18.30 hours and arrived ten and a half hours later at midnight local time. Upon arrival, what now appears with hindsight to have been an initiative test was undertaken. This consisted of being presented with the problem of determining how to drive a fully-automatic left-hand drive car on the 'wrong' side of the road fifty miles to Galveston Island on the Gulf of Mexico.

I had set aside the following day as a recovery period. On awakening the warm bright sunlight and the clear blue sky were in stark contrast to the grey gloom I had left behind the previous morning. At long last the thought struck me that this must be the start of an experience that I might never have the opportunity to savour again. The first Monday, my first appointment was with the Chief of Staff of the Shriners Burns Institute which is situated in the magnificent grounds of the University of Texas Medical Branch. After formal introductions and an explanation of the programme that had been arranged for me, I was able to start my investigation in earnest. It quickly became apparent that during my visit I was going to be given the fullest and most comprehensive exposure to the many treatments that are used for burns patients. I was invited to attend ward rounds and tailor my activities, as if I was a member of their own staff. Indeed, I found throughout the study tour that the professional differences that can exist in the United Kingdom do not occur in the United States of America and the engineer is an integrated member of the health care team. Particularly in burns treatment it is considered that each member of the professional staff should fully understand the method of treatment in use and the implications from their own discipline's viewpoint.

My final two days in Galveston were spent in the University of Texas Medical Branch. First I had morning coffee with the President, a meeting that I consider was a privilege — I later discovered that not many had found their way up to his office on the 32nd floor overlooking the Bay of Mexico with its stupendous view. I was then able to spend one day with various senior medical staff, looking at laser surgery and microbiological aspects of burns treatment and the other day with the Director of Engineering looking at the management of the engineering services within the complex.

The next scheduled stop-over on my itinerary was to visit the Brook Army Hospital in San Antonio down beside the Mexican border. By this time my driving and navigation had definitely improved, and I soon found myself on Interstate Highway 10 heading south. On arrival at Fort Sam the following day, I was quickly introduced to the Colonel in Charge. To be honest it was just like walking onto the film set of 'MASH 4077'. He introduced me to a captain from the Construction Corps who had been

personally assigned to look after me. After a most memorable day at the hospital, that is at the forefront of burns research in the world, I was invited out to dinner by 'The Colonel' and his number one, 'The Major' and their ladies. This proved to be a Mexican night out at a restaurant surrounded by colossal stone idols. Like most American gadgets, each idol gave a brief history of Mexico by the depression of a key. The Colonel insisted that we listened to every single one before entering the restaurant. It was with some considerable regret that I said farewell to Fort Sam and the staff of the Brook Army Hospital. However, this was off-set by the freedom of my weekend which I spent on the Saturday afternoon at the Houston Astrodome watching American football and on Sunday at NASA on a conducted tour of mission control and an opportunity to examine Skylab.

Monday of the second week saw the resumption of air travel to Cincinatti and an opportunity to visit the Shriners Burns Institute there. Unfortunately time did not permit any extra-mural activities in the form of sightseeing, and all too quickly I was at my final destination, the Massachussettes General Hospital in Boston, the Boston of tea party fame. It was perhaps fitting that this city saw sight of my only gastronomic failure on the tour. This happened one evening when on entering a pizza parlour, I ordered a 'medium-size American pizza'. Upon arrival its diameter was about 0.5 m, (18 ins for those still hooked on Imperial measure like the Americans). Unfortunately I have to report my failure to consume it all at one go and my submission to the American habit of the 'doggy bag' to take the unconsumed home to try again another day.

Shriners Burns Institute, Galveston.

My 14 days seemed all too quickly to disappear and the time had now arrived to return exhausted to reality.

Twelve months later after time to reflect, it is now quite clear to me that winning the bursary not only provided me with the opportunity to carry out research on a much understudied aspect of health care engineering but also gave me the opportunity to act as an ambassador for the Institute. The response from our colleagues both in the United Kingdom and the United States of America was, I can report, most encouraging. I am quite sure that if future winners of the bursary use it in a similar way, it will help the continued development of the Institute of Hospital Engineering and the International Federation of Hospital Engineering gain a greater standing throughout the world and at the same time contribute to our knowledge in a relatively new branch of engineering that has rapidly grown from its infancy to be recognised now in the world as a very important branch of engineering in its own right.

Institute of Hospital Engineering

Bursary Competition

Council of the Institute is most pleased to give details of the Institute Bursary Award Competition for 1980.

The Institute is indebted, and would like to express its appreciation, to the Board of the King Edward's Hospital Fund for the financial support that makes this Bursary scheme possible.

The aims of the Institute of Hospital Engineering are the advancement, development and application of engineering science in health care and the management of engineering and allied staff employed in this work in Great Britain and abroad.

To achieve its aims the Institute co-operates with the Department of Health and Social Security and with industry in the promotion and organisation of training courses, symposia and seminars.

Papers are read at meetings of branches during the year and visits to health-care buildings and industrial establishments are arranged to broaden the knowledge of those working in hospital engineering.

The Institute is a Founder Member of the International Federation of Hospital Engineering, which was formed in Rome in 1970, and has expanded to take the Institutes or Associations right across the world from New Zealand to the United States of America. It is this involvement which has prompted the Institute to find means of promoting schemes whereby financial aid could be given to engineers to study hospital engineering in the United Kingdom and abroad and to encourage the younger members of the profession to widen their knowledge.

Details of membership and any

other information about the Institute can be obtained from the Secretary.

Bursaries

The Council of the Institute of Hospital Engineering announce the offer of a Bursary to aid young British people in Great Britain and Northern Ireland who are engaged in health-care engineering. The Council's purpose in providing this Bursary is to enable successful candidates to broaden their knowledge and experience by overseas travel in order to study health-care engineering in other countries at first hand or, in certain cases, by obtaining training or industrial experience in this country at an approved college, institution or industrial establishment, and in these ways to equip themselves the better to improve their effectiveness and promotion potential in health-care engineering.

The conditions of entry to the Competition are given below. Further copies of these can be obtained from the Secretary of the Institute of Hospital Engineering.

A Certificate will be awarded to the successful candidates on completion of a satisfactory report of their tours or training taken through the aid of this Bursary.

The Council wishes to express its gratitude for the financial support the Competition will receive from King Edward's Hospital Fund for London which provides most of the Bursary, and for the co-operation of the candidates' employing authorities for permitting the candidates to enter the competition and to take up the Bursary. Thanks are also due to those authorities, companies and colleges who agree to co-operate to permit the successful candidate to follow the chosen study.

Conditions of Entry to the Bursary Competition

1. The Bursary is open to any British person practising or training to practice as an engineer in the fields of design, maintenance or manufacture of equipment or installations used in health-care establishments, who is over 17 years of age and under 35 years of age at the closing date of the competition. Candidates must demonstrate that they are seriously pursuing a career in health-care engineering.

2. Candidates must have studied, as full-time, part-time or evening students, for not less than one academic year, before the closing date of the competition, at a university, college or technical school approved by the Institute for this purpose.

3. Entry will be by paper submitted in accordance with these conditions, in which candidates should describe the study they wish to undertake, giving background information relative to the need for such study. Candidates, also, should indicate the places it is desired to visit, to further the study and indicate the way in which it is felt that the investigations will add to the development of health-care engineering, and to their own effectiveness.

4. Candidates should submit four copies of their entry which should be double-spaced and on one side of A4 paper only, the entry being signed and dated. Photographs and/or drawings of any size may be included in, or in support of, an entry.

5. Only one entry will be accepted from each candidate.

6. The entry must be received by the Secretary of the Institute of Hospital Engineering, 20 Landport Terrace, Southsea, Hampshire PO1 2RG, not later than the date stated at the foot hereof. Any entries received after this date may be disqualified.

7. When considering to where they wish to travel in order to study their required subject, candidates should bear in mind the possibility that the Institute may choose to divide the Bursary. Candidates may, however, take into account any other financial contribution that may be available to them when estimating the cost of their studies.

8. Candidates selected for interview will be required to produce their proposed itinerary with estimated costs.

9. Successful candidates will be required to make their own travel arrangements within the limit of the Bursary and such other finances available to them.

Conditions for the Study or Project

1. Candidates must present, either as part of their entry or at the interview, the estimated time for travel and the preparation of the report on the study together with an estimate of the costs involved.

2. Successful candidates must arrange their own itinerary, make all contacts with those whom they wish to visit in order to seek assistance with their projects, and obtain all necessary approvals to enter premises and to have discussions, where necessary, with subordinates in organisations.

3. The Bursary will be paid to the successful candidate(s) as soon as the Institute is satisfied with their itineraries and that they are in a position to undertake their projects. Candidates shall pay for all expenses in connection with their projects and no accounts shall be paid by the Institute.

4. The Institute takes no responsibility for any of the candidates' actions in connection with their projects including obtaining documents which may be secret or have copyright protection, the taking of photographs, etc.

5. Candidates are expected to produce a comprehensive report at the completion of their studies or projects and to submit a copy for the Institute to retain and publish, if it requires.

6. The Institute reserves the right to:

a. require candidates to attend for interview;

b. publish entries, or reports submitted subsequent to a Bursary, without charge, in the Institute's Journal, retaining the copyright thereof;

c. withhold, or divide, the Award;

d. examine an applicant's birth certificate.

7. Whilst taking every reasonable precaution to safeguard entries and accompanying documents / materials submitted, the Institute accepts no responsibility for loss of, or damage to, material either on its premises, in transit, or elsewhere.

The 1980 Bursary

The total amount of the Bursary for 1980 is £500.

Entries for the competition should be submitted to the Secretary of the Institute by not later than April 30, 1980.

This paper, and the one re-printed on page 16, were presented at the Institute's Annual Conference in May under the theme 'The Public Utilities — Into the 21st Century'. The author is Assistant Director, Corporate Planning, Thames Water Authority.

Tomorrows Water

J. D. PERRET BSc CEng FICE FIMunE FRSH FGS MBIM

The Supply of Water

Water resources are governed by the hydrological cycle shown in *Figure 1*. The residual rainfall, that is the total rainfall minus an allowance for evaporation and transpiration, provides more than adequate water to meet the demand, as shown in *Table 1*. The problem is one of distribution and storage, as unfortunately the rain does not always fall at the right place at the right time. *Figure 2* shows the long term average residual rainfall across the country. Comparing this with the population distribution shown in *Figure 3*, it can be seen that the areas of high population density are often in areas of low residual rainfall. On average there would still be sufficient rainfall everywhere, if it fell evenly throughout the year, but regrettably this is not the case. The long term average for the Thames catchment area shows a minimum of 45.5 mm rain in June and a maximum of 79.0 mm in November. During any one month the actual rainfall can deviate markedly from this average, from under 25% to over 300%.

Sufficient water is available, but the natural storage and distribution systems must be harnessed and controlled so that all areas can be supplied with adequate quantities of water at all times. It would cost far more than the country can afford to supply everyone's unrestrained demands in time of severe drought.

Public water supplies in England and Wales are abstracted from upland reservoirs and streams, from rivers, or from groundwaters and the proportions vary markedly between the various regions of the country. In the North West the upland reservoirs of the Lake District and Pennines supply the majority of the water, whereas the groundwater in the chalk Downs provide the Southern Water Authority with much of their supply. In the Thames Water area the rivers Thames and Lee supply over half the water with the groundwater sources making up nearly all the remainder.

For the purposes of this paper, the author will deal mainly with the possible future resource development within the Thames Water Area, as this is the area most familiar to him. Many of the problems and solutions are of course, also applicable to other areas. It is unlikely that there will be much need for the development of major resources in the Thames area in the foreseeable future.

The Thames Water Area

The 136 miles of the freshwater Thames, from source to Teddington weir, together with its tributaries form the major surface water supply for the area. Water is taken from the river into large reservoirs such as the new Queen Mother reservoir at Datchet and others on the outskirts of London. Apart from storage facilities these reservoirs can act as amenity centres with fishing, sailing, wildlife reserves and picnic areas being found on many. One simple solution for the future resource problems would be to build more bigger and better reservoirs with interlinked treatment and distribution systems, but this would not necessarily be the best answer.

The building of a large reservoir can pose very serious environmental and social problems and can be an extremely expensive undertaking. In the Thames area few valleys are available for flooding and reservoirs usually have to be embanked or bunded and are costly and more intrusive on the landscape. Approximately 200 potential sites for new reservoirs have been examined in the Thames' area, varying from small reservoirs to solve local difficulties to the building of a major new resource for a large area. Only six of these sites were considered worthy of further study, and none of these is being developed at the present time.

The present reservoirs could be enlarged by various means, but the increase in capacity would not be very great. If land is available the surface area can be increased, or reservoirs can be joined, to give increased capacity. Reservoirs can also be made deeper by raising the retaining walls or by digging out the bottom. Where this last procedure has been tried it has proved very attractive as the excavated material can be sold for use on civil engineering sites.

Under dry weather conditions river flows can be severely reduced or even dry up completely. Simultaneously demand is often high and the water that is available is likely to be of a lower quality, as there is less natural flow available to dilute the effluents discharged to the watercourse.

There is also a limit to the abstractions from the River Thames as a result of the statutorily protected flow over Teddington weir which was intended to safeguard the tideway from excessive pollution. This flow can be reduced to a pre-set minimum under strictly controlled conditions. Currently it stands at 773 Ml/day with provision being made to reduce this to a minimum of 225 Ml/day. Because of the great improvement made to the quality of the estuarial Thames in recent years it is possible that the minimum flow could be set at a lower level, perhaps even zero!

Table 1. Residual Rainfall/Water Demand.

	Million cubic metres
Average residual rainfall per day	190
Public water supply	*15*
Power stations	13
Other industry	6.5
Agriculture	0.5
Total	35

Public water supply uses 8% available water.

Total abstractions are 18% available water.

In the early 1950s approximately 35 km of the River Thames' tidal reaches were completely anærobic, there was hardly any life to be found and the river smelt badly of sulphide at certain times. The Authority's predecessors inaugurated a programme of work to improve the situation. The four major sewage treatment works have been extended and the quality of their effluents has improved considerably. The effective oxygen load can be used as an indicator of pollution. This is a measure of the amount of oxygen required to oxidise the effluents completely and render them innocuous. *Figure 4* shows how the EOL has been reduced since 1950

Figure 1. The Hydrologic Cycle.

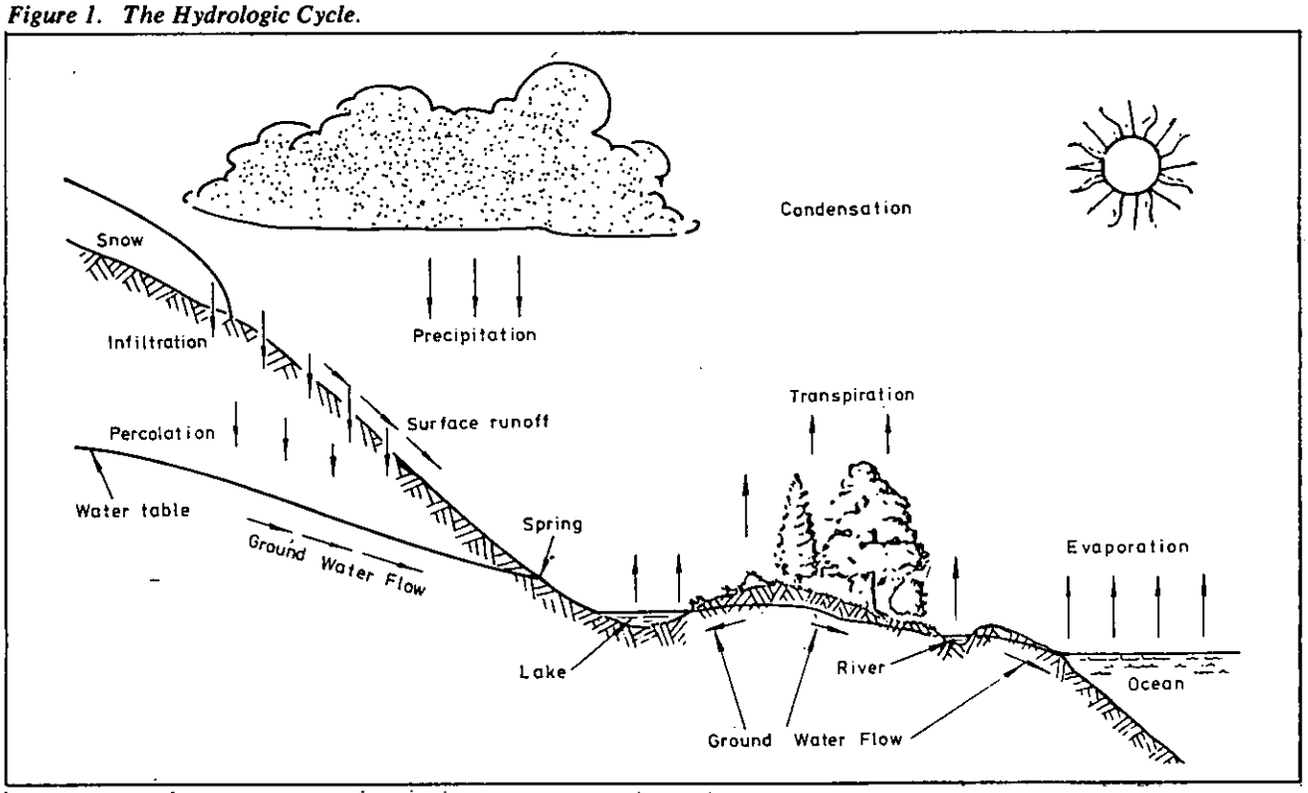


Figure 2 Average Annual Residual Rainfall in England and Wales.

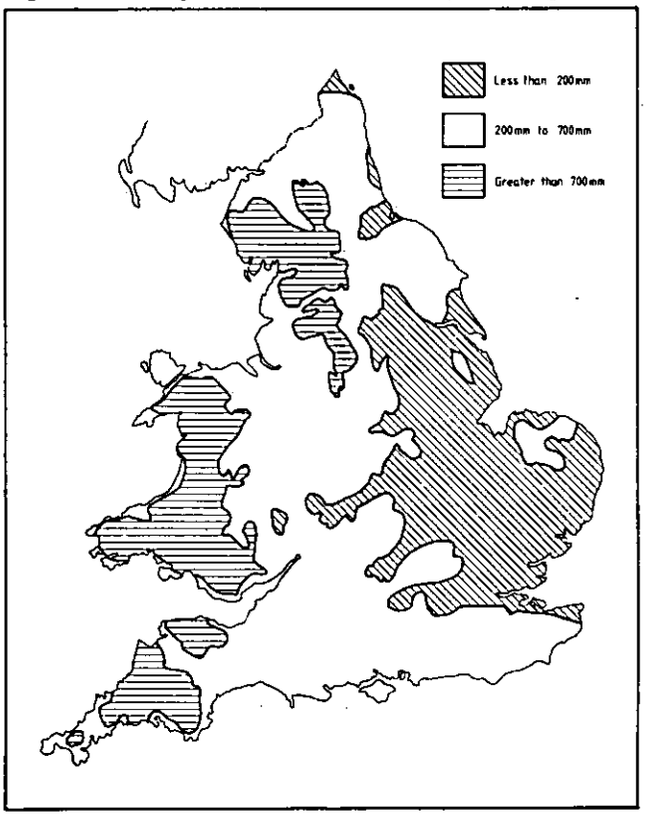
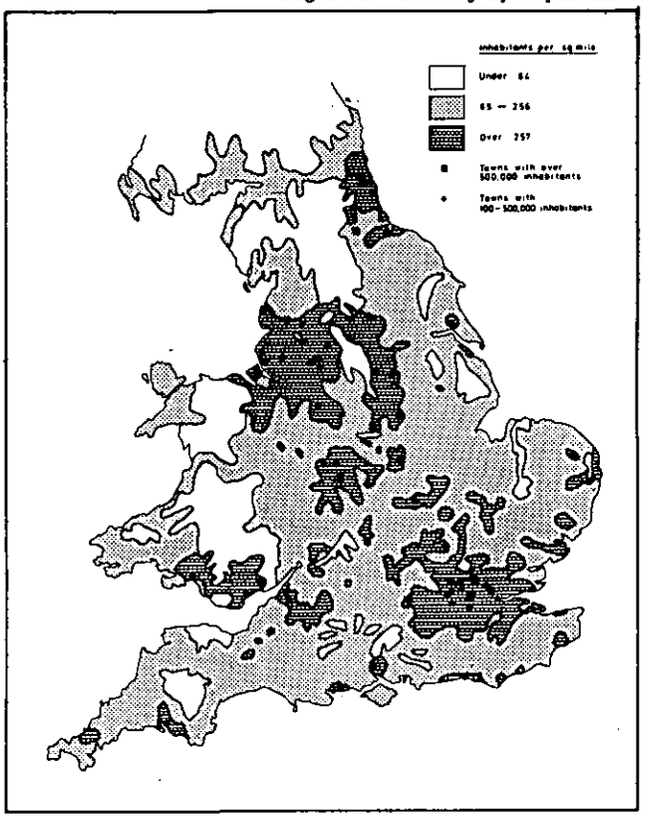


Figure 3. Density of Population.



and *Figure 5* shows the effect on the dissolved oxygen content of the river. It is now suitable for the passage of migratory fish such as salmon.

Making Use of Available Resources

Since the reorganisation of water undertakings by the 1973 Act, the new water authorities have been responsible for river basin management in its widest sense. This enables water authorities to consider all aspects of the water cycle and make the best use of available resources and will be of great value in keeping our major rivers clean and sweet. However, despite this improvement, it is considered that the minimum flow concept should be retained in most circumstances with the possibility of using the water as an emergency reserve during an exceptional drought.

1976 was such a drought and during that year the losses over Teddington weir were such that the level of the river upstream dropped to an unacceptably low level, threatening the water intakes. Under these conditions the losses can be reduced by backpumping the flow over the weir before it has been mixed with the saline tideway waters. This has the effect of raising river levels and enables abstractions to continue safely.

Another way of increasing the water available would be by the re-use of some of the high quality sewage works effluent which is currently discharged into tidal waters. In order to make best use of the effluent it would be necessary to discharge above the lowest public water supply intake, thereby allowing abstractions of an equivalent amount of water whilst protecting the flow downstream. However, this is currently not acceptable because of the implied increased amount of effluent in water supplies. Other schemes for discharge below the water intake would result in much less water being available and such a scheme would yield no more water than can be obtained by backpumping.

Consideration has been given to schemes for the augmenting of flows in the upper reaches of the River Thames by pumping from the lower reaches of the Severn. There are many problems associated with flow augmentation in a river, as both the river functions and the ecology can be adversely affected. For river to river transfers it is vital that the chemical and microbiological qualities of the two rivers are compatible. If this is not so the natural balance of flora and fauna in the river could be disturbed. This balance can also be disturbed if it is necessary to widen or dredge a small river in order to take additional flow, as the natural channel configuration of pool and shallow water, weeds and bankside vegetation will be altered.

The excessive widening and dredging of rivers to take higher flows can also involve expensive reconstruction of bridges and waterside structures and as a consequence the scenic properties of the river would probably be adversely affected. Excessive flows in the rivers would not only cause channel erosion, but could also cause problems for navigation and the leisure uses of the river, such as swimming, punting, etc.

Agriculture could also suffer as raised levels could affect land drainage. Many crops are extremely susceptible to waterlogging during certain critical times of the year, though the effect varies from crop to crop as shown in *Figure 6*.

Two Possible Augmentation Schemes

Nevertheless, such schemes are feasible and two possibilities have been examined. One is the Severn Thames

Figure 4. Effective Oxygen Load (tonnes/day) from the Four Major Sewage Treatment Works on the Tideway.

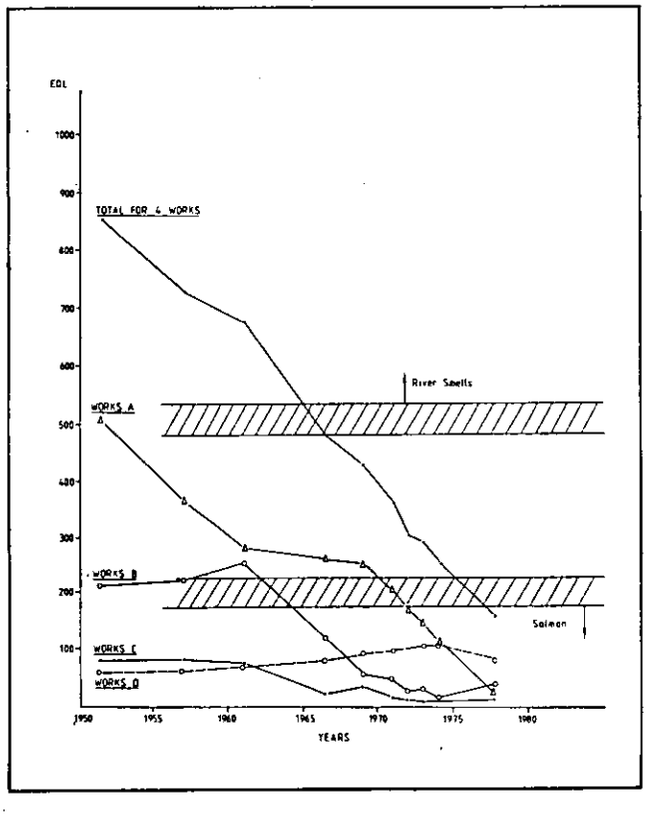
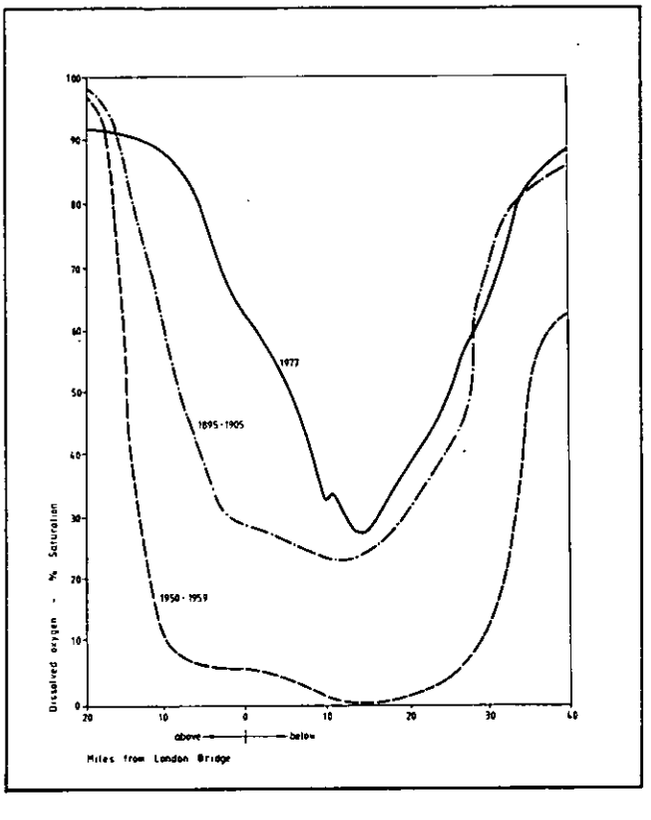


Figure 5. River Thames Dissolved Oxygen Levels.



transfer scheme in conjunction with the Severn-Trent Water Authority. The scheme also involves the Welsh Water Authority as the enlarged Craig Goch reservoir would be used to control the flow in the River Severn.

Many possible transfer routes have been examined and of these four were considered in more detail. Some routes involve abstraction of the water above the confluence of the Avon with the Severn and some are below. Although the water quality upstream of the Avon may be higher, the waters downstream of the confluence are worth considering. The waters could be discharged into the upper Thames or its tributary rivers. There are strong environmental reasons against the smaller tributaries which cannot easily take the higher flows, and the most favoured scheme, should it be decided to proceed with an inter-basin transfer, involves direct transfer to the Thames.

An alternative scheme is to augment river flows by pumping from the groundwaters in the chalk aquifer. Initially augmentation would be close to the pumping rate, but after a time the depletion of the groundwaters would affect natural river flow causing a reduction in the net gain. This system would only be used in drought conditions and the depleted groundwaters would recover during winter.

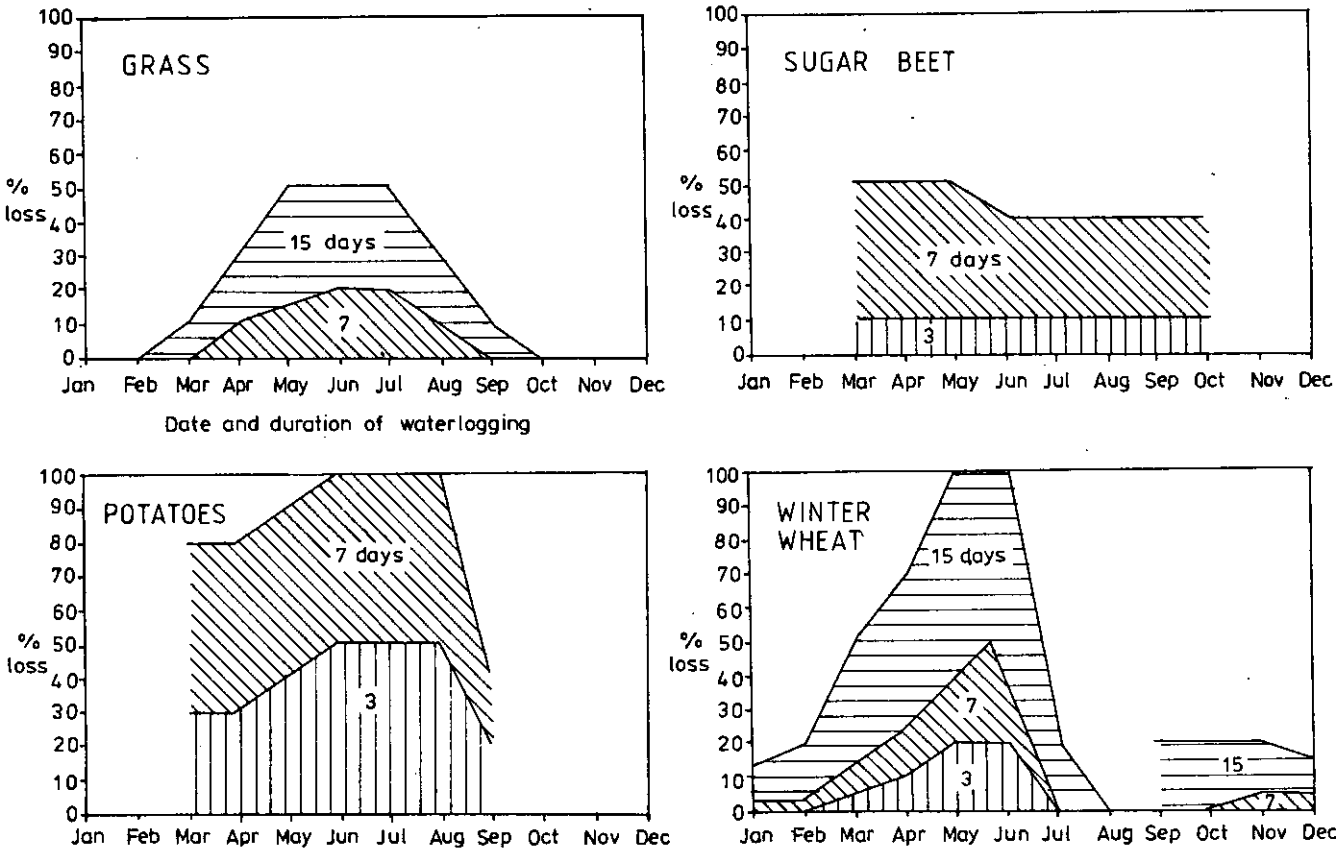


Figure 6. Loss in Crop Yield due to Waterlogging.

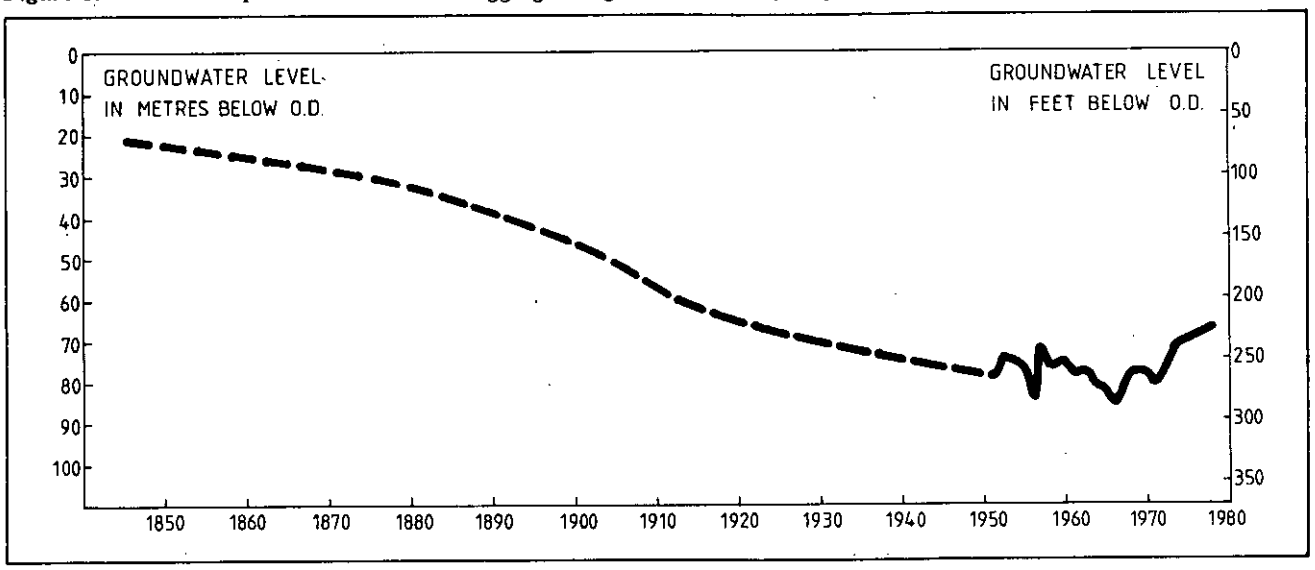


Figure 7. Well Hydrograph, National Gallery — Trafalgar Square.

Need for Data

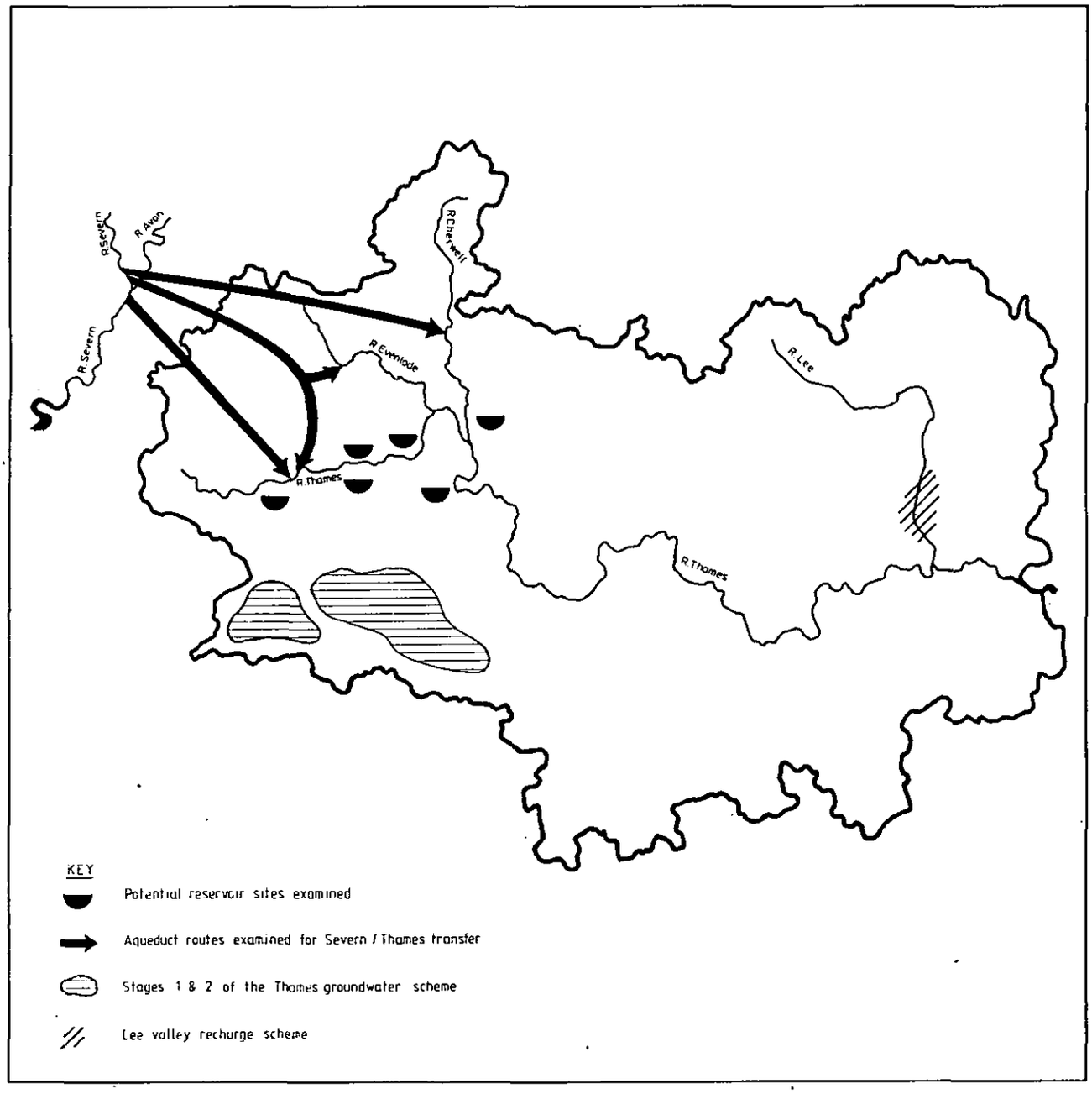
In order to make the best use of resources and to monitor and control schemes such as the Groundwater schemes, a great deal of data is required. The recently inaugurated Thames Water telemetry scheme is the first stage of an integrated system to provide information on river flows for use in flood prediction and warning and river quality. There are 68 outstations currently feeding information into the system, 57 gauging flow and 11 analysing water quality. As well as the traditional gauging weirs Thames Water also incorporates ultrasonic flow recorders into the network.

Reductions of Groundwater Levels

The water abstracted in the groundwater scheme discussed above is used only for augmenting river flow to maintain public water supplies downstream, but is not itself used for direct water supply. The groundwaters of the Thames and Lee catchments are, however, extensively used for this purpose. In some areas overpumping, that is abstracting more water than is replaced by natural means, has resulted in considerable reductions of groundwater levels. The London basin is a good example, as shown in *Figure 7*. The feasibility of artificial recharge of the aquifers has been examined and it is thought to be possible in certain areas. In this scheme fully treated water is pumped into the aquifer when water is readily available, and can be extracted for use when subsequently required.

A pilot scheme started operation in the Lee Valley in 1976 with the first operational recharge starting late in 1977. The recovery rates were encouraging but other areas may not be so favourable. In some areas the

Figure 8. Potential Regional Water Resources.



recharge with potable water may reduce the saline intrusion which would be advantageous. The areas where this type of scheme can be undertaken are limited as obviously the recharge water must come from a surface source which has little effect on natural groundwater levels, and there must be a surplus supply available at suitable times. It is necessary to use fully treated water in order to prevent blocking or pollution of the aquifer.

Future Resources

The possible future resources for Thames Water are summarised in *Figure 8*. These are:

New reservoirs and/or extensions to existing reservoirs;
Extensions to the groundwater scheme;
Severn-Thames Transfer;
Artificial recharge;
Gravels.

This last area is a potential resource, but much exploratory work is needed and at present this should be regarded as a reserve for unforeseen emergencies.

As an aid to water resource planning, a simulation model of the water conservation system for the Thames Water region has been developed. The model can evaluate the performance of the surface and groundwater resources throughout the region for any given demands and hydrological and meteorological conditions. It can also be used to assess the reliability with which the existing or any proposed system can meet current or forecast demands. It is also possible to use it to propose strategies to meet forecast shortfalls in supply and analyse the effect of restrictions. Operating rules for deciding when sources should be used can also be evaluated.

Apart from the conventional resources discussed so far, there are other possibilities less applicable to Thames Water.

Estuarial storage, that is the building of large freshwater reservoirs on the lower reaches of rivers by the construction of tide-excluding barrages, is being considered in several areas, notably the Wash and Morecambe Bay, but there are many problems to be overcome. Some of the areas requiring further study are the effect on estuarial wildlife, the silting up of the reservoir and the change in configuration of sand and mud banks caused by the change in tidal flow patterns.

Desalination is unlikely to be used in areas with sufficient supplies of fresh water available as it is still an extremely costly method of producing potable water. It is of use mainly in hot, dry countries with a readily available source of cheap energy, such as the Arabian Gulf. It is likely that increasing energy costs will make desalination even less attractive.

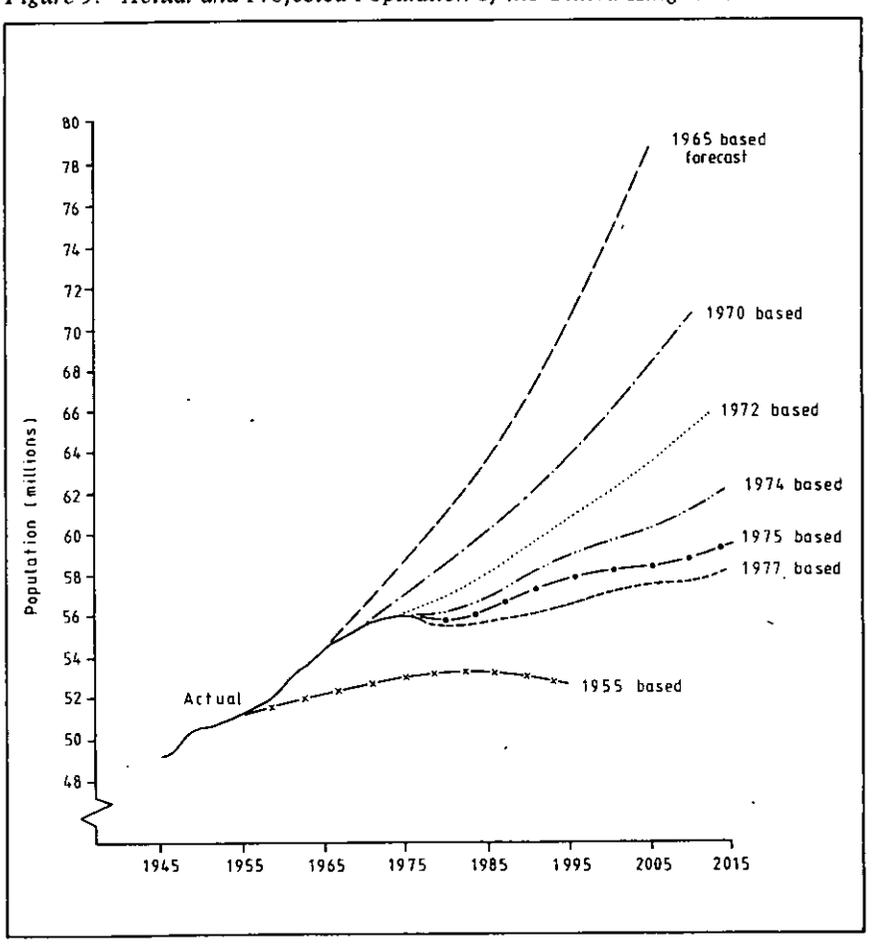
Other, more exotic schemes, such as towing icebergs from polar regions, or the changing of rainfall patterns by artificial means, have been proposed by countries with severe water shortages.

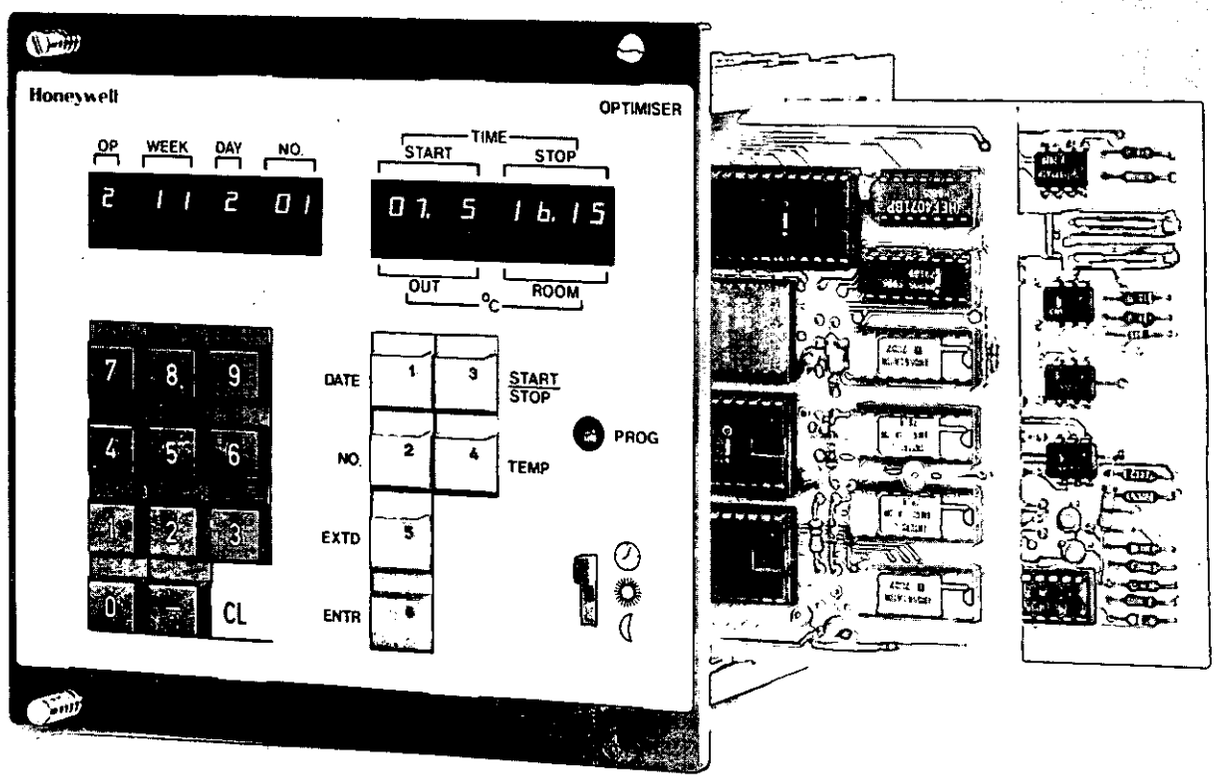
In order to alleviate future supply problems the dual supply concept could be used. There would be two grades of water available, one to the same high quality as currently supplied and one lower grade supply for uses in areas where quality is not important. This could result in the operation of sources which are presently not used for quality reasons, leaving the high quality sources for more critical applications. Although suitable for some industries, this is unlikely to be suitable for use in hospitals, because of the very serious potential consequences of wrong connections.

Distribution systems can also be improved, resulting in less water loss and higher reliability and giving some measure of storage within the distribution system. The tunnel ring main being considered for the Metropolitan area is one such system. Large efficient filtration works could be operated feeding high flows of high quality water by gravity into a large diameter water tunnel. This would operate at low pressures, reducing leakage and would feed local distribution systems. Reservoir capacity could also be reduced.

Planning for the future is not an easy task. A major new water resource takes many years from conception to operation and can cost many millions of pounds. Decisions on such projects must be made on the basis of the best available data on such subjects as population, domestic and commercial water use, industrial expansion, etc. Some of the problems can be seen from *Figure 9* which

Figure 9. Actual and Projected Population of the United Kingdom.





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shows the variation in population predictions made over the years. On the basis of 1965 projections alone, it may have seemed necessary to construct new resources with some urgency, which would later be shown to be unnecessary.

On the basis of current forecasts it is not expected that the availability of water to hospitals in the UK will be significantly altered in the years ahead.

This paper was also presented at the Institute's Annual Conference in May. The Author is National Energy Sales Manager, The Electricity Council.

The Assured Future of Electricity

JOHN PLATTS BSc(Eng) CEng FIMechE FIEE

The Energy Outlook

The public electricity supply in Britain has an assured future so it will gain an increasingly important position in relation to the overall and changing energy scene and to other forms of energy. Against this background of assurance there will be greater confidence established in the minds of designers to adopt an all-electric approach for all types of new buildings.

The action of the OPEC countries in 1973 brought about a new world energy situation but it is important to recognise the precise nature of that changed situation. It is not that the world is short of energy or that it is suddenly about to exhaust its reserves, though in the long term this will undoubtedly be the case. The new situation arose from the fact that the price of oil, traditionally the cheap marginal fuel of most energy economies, increased fourfold in just over a year, and as a result energy became much more expensive than ever before.

From now on, the fuels most convenient to use are either going to be scarce or expensive and probably both. This is brought out in the Government's Green Paper on energy policy of February 1978, which says that the 'average level for energy prices must be expected to rise, perhaps about double in real terms by the year 2000, reflecting the increased resources which would have to be put into producing energy as supplies get scarcer and as more capital-intensive sources are developed. One of the main ways in which the adverse effects of this on living standards can be minimised is for consumers to use energy more efficiently.

If our energy strategy is successful, consumers can expect that energy supplies will be adequate in total, but they will not necessarily be able to go on using the fuel they are using now. By the end of this century oil, for example, is unlikely to be available for all the uses to which it is put today.

Price relativities will change as oil's increasing scarcity is reflected in its price. Price relativities will change as natural gas is replaced by synthetic natural gas. Price relativities will change as increasing amounts of electricity become available from nuclear power stations.

Electricity prices in the post Second World War period have been stable in real terms, ie the average increase in price has approximately equalled that of the retail price index.

For the future, prices will probably increase broadly in line with general inflation. It is difficult to be more precise than this in view of the many uncertainties that obviously exist. What is certain, however, is that the electricity supply industry will continue to offer all customers the option of a tariff with a much cheaper night rate than the normal day price.

Electricity Supply Capacity

One essential basic requirement of our industry is to provide an assured generating capacity to supply electricity at the lowest practical cost. Existing coal-fired capacity is adequate for expanded use of coal if the price is kept favourable relative to oil.

In 1978, power stations accounted for a consumption of 80 million tonnes of coal out of the total annual consumption of 120 million tonnes coal used by the nation.

Nuclear power stations provide the cheapest electricity production throughout their life. With the stations now under construction, and the additional stations authorised for ordering, the nuclear component will be steadily increasing as we approach the 21st century when indigenous natural gas and oil are predicted to have passed their peak outputs.

It is in the interests of energy conservation to bring the advanced gas-cooled reactor nuclear stations into service as quickly and effectively as possible. Since the AGRs operate at high temperature, they have a much improved thermal efficiency of about 40%, which is higher than any other commercial nuclear power station

operating anywhere in the world.

This 'mix' of supply capacity, ie coal, oil and nuclear demonstrates the future ability of the electricity supply industry to hedge against primary fuel uncertainties, whether over prices or supply difficulties. Therefore, any regional health authority adopting electrically dependent buildings will automatically be insuring against those risks of primary fuel uncertainties to the same degree.

It would be prudent for designers of any new hospital which is destined for at least sixty years of useful life, to take advantage from these electricity supply safeguards. This can be done either by designing long life buildings initially as all-electric buildings like Britain's first all-electric hospital at Peterborough, or by prudently designing on a dual fuel basis which will provide for the buildings to be adapted wholly for electrical energy in the longer term.

Of course, much has been said about two-thirds of primary fuel input being 'wasted' in electricity generation as though losses in energy conversion were the sole prerogative of the electricity supply industry.

The price of electricity reflects not only the thermodynamic laws of the 'conversion factor' and the capital investment involved right back to the production of fuel, but also the advantages of using low-grade basic materials. Quite clearly the price at point of delivery is the proper place to start in ensuring the best use of resources overall.

It is, however, only the starting point, for adoption of electricity means that the process of combustion has been eliminated from where it is ultimately put to use. Being potentially 100% efficient at point of delivery means that you can use effectively all that you pay for. With direct use of fossil fuels a significant amount of the fuel that is purchased, more than 50% in some circumstances, is used up in the conversion process of combustion. Also, a great deal of costly plant, land and building space to carry out that process must be provided — and combustion process plant, instrumentation and controls always mean much costly maintenance and repairs.

In the final analysis, it is all resources used and total cost in use that really count, both for individual projects and the nation. It is on this score that electricity wins hands down. Not only because electricity can be 100% efficient at point of delivery, not only because it eliminates combustion at place of use, but because being the technology of pure energy, electricity enables the ultimate purpose to be achieved in new ways which fossil fuels can never match. For example, heat can be delivered where it is wanted, when it is wanted, with no intrusion into medical treatment areas.

Efficiency

Raw materials used to generate electricity are not conspicuously sought after for alternative purposes.

Coal for instance, reached its peak output before World War 1. It is almost twenty years since the gas industry began to abandon it and they ceased using it some time ago.

Throughout a similar period, manufacturing industry as a whole has been using less and less of it. Ocean shipping vessels no longer use coal. The railways no longer need it: commerce does not want it and householders have been giving it up — to the extent of four million tonnes per annum between 1973 and 1978.

In fact it is not unreasonable to suggest that if it was not for electricity production there would be no coal industry, as we know it, left today. At the right price the electricity supply industry could expand coal burn even with existing plant.

With oil, it is the residues from the oil-refining process which we use for steam-raising, the 'left-overs' after the premium-value lighter fractions have been taken for transport and petrochemical uses.

Processed uranium ore, providing an ever-increasing proportion of electricity production from nuclear power stations cannot be used for any other peaceful purpose. People are realising more and more that it is likely to become the salvation of all developed industrialised countries before this century is out.

There are, in fact, few operations more inherently worthwhile than to take these materials, either useless or unpromising and virtually unwanted for themselves, and converting them into electricity, the pure energy.

Electricity is an energy form which, because it is pure, is inherently clean, adaptable, controllable and so versatile that it enters significantly into almost every field of human activity and endeavour. It also makes a positive contribution to improving the environment wherever it is used as it is the only form of energy which is potentially 100% efficient at the point of delivery.

Renewable Energy Sources

The prospect of power from waves, wind, tides and the sun at first conjures up the idea that these renewable sources offer a panacea. They are, however, only ever likely to offer a small percentage contribution and then it will be through the medium of electricity.

Wave Power

Our sea-encompassed islands offer great potential, but it is too early to make any meaningful estimate of the ultimate economics of wave power for electricity generation. There are a multitude of immense problems associated with wave power, such as the variability of supply. It is known from surveys in the North Sea that there are not only seasonal but also great annual variations in wave potential. Whilst many devices currently under research, including ramps, floats, flaps and wave pumps, are known to operate well on a small scale, there are some considerable problems in scaling up the size for commercial operation. Factors of about ten are involved even compared with North Sea Oil drilling platforms.

Assuming these problems can be overcome, there are also similar problems of transmission to a land base which is likely to be remote from industrial load centres for electric power. Other factors involved are the likely impact of large wave power generating stations on the environment in terms of the breakwater effect and silting, and the consequent effect of storm damage, marine growth and effects in terms of reliability and maintenance. Wave power may be able to offer an alternative energy source, but only in the long term, perhaps in the 21st century.

Tidal Power

France and Russia have tidal power stations in operation and there are a few opportunities throughout the world but that of the greatest potential in the UK is the Severn Barrage Scheme in the Bristol Channel. However, the straight economics make such a scheme uncompetitive with present-day costs of nuclear power station construction.

Geothermal Power

The only possibility of exploiting geothermal power currently being considered is the heating of water by

hot rocks. In both Italy and New Zealand there are geothermal power stations which have been operating for a number of years, but there are no similar geological features offering potential within the British Isles. However, there do exist geothermal sources of heat from hot rocks in basins located in Hampshire, Bath and Cornwall, which could possibly be adapted for water heating for a simple district heating scheme. There is no simple answer regarding whether geothermal sources are economic within the UK, although it appears that they may justify examination in greater detail.

Wind Power

Small scale generation of electricity from wind power is technically well established, but it has never proved to be competitive for the public supply, largely because storage has to be provided to cover windless periods. If all potential sites in the UK could be harnessed, these would only provide about 4% of total present-day electricity requirements.

A very limited amount of electricity could be provided by wind-powered generators at a cost which might prove to be competitive with existing coal and oil-fired power stations. This would, however, only be possible at an environmental cost which is unlikely to be acceptable as long as other sources are available.

Solar Energy

In any one year the earth receives from the sun some 1,200 times as much energy as was actually consumed in the world in 1970, but it should be recognised that a large part of our energy consumption is derived from the need to make up deficiencies of heat and sunlight in Northern latitudes in the winter. It is because the amount of direct sunlight falling on Britain is very variable, particularly in winter, that direct solar generation of electricity seems to have little prospect. Orbiting solar collectors have been considered as well as biological conversion, but both these routes towards commercial electricity generation appear to be centuries away.

A more promising way of harnessing solar energy in the UK appears to be solar collectors for domestic water heating. Whilst these are rarely an economic proposition at present, it is estimated that domestic solar power could become a substitute for about 4% of our present energy needs.

Fuel Situation

Compared with most industrialised countries the United Kingdom is favourably placed with energy reserves. We are self-sufficient in coal and have at least 300 years reserves. We have very substantial experience of nuclear power. We are already self-sufficient in gas and shall be in oil by 1980, although these reserves will last for a comparatively short time. The economic benefit of North Sea Oil and Gas gives us the opportunity to strengthen our industrial base and improve our economic performance, but they are not a panacea for all our troubles.

Unless these resources are wisely used we could become energy vulnerable in the 21st century.

In this situation of great uncertainty it would be prudent for hospital engineers to hedge against risks related to fossil fuels by taking greater advantage of electricity as the predominant energy form. This is particularly so for new hospital buildings on the drawing board with a planned life of sixty years or more.

Secondly, looking at the longer term energy requirements it is evident that for the rest of this century a major contribution must be sought from nuclear fuel. This can only be achieved through the route of electricity generation, and with successful development of the breeder reactor it will be possible to minimise the effects of the scarcity and the high price of uranium ore.

Beyond the end of this century we may expect to see some other possibilities of energy supply from the renewable sources such as wave power and wind power. Although these sources are only ever likely to offer a small percentage contribution, they too will provide energy to buildings through the medium of electricity.

Thirdly, amidst all the uncertainties several points do stand out clearly whatever views are taken of the future. Energy will become more scarce, will become more expensive and the need to conserve it is imperative. As a result, energy prices are clearly going to become an even more significant element of operating costs than they are at present. This means that if energy management is not taken seriously now, when oil and gas run out nothing will have been done to prepare for the infinitely higher costs of imported energy.

There is, therefore, a clear case for improving the energy effectiveness of all hospital buildings with the objective of saving money on operating costs.

Building Energy Estimating Program

The design of buildings and their environmental systems for economic construction, operation and ownership is a complex procedure involving many conflicting and inter-relating requirements. There is also an interrelationship with electricity tariffs from a point of view of minimising operating costs.

The complex nature of this interrelationship has meant that its investigation and appraisal are often not carried out in adequate depth at the early design stage. To facilitate the process, the electricity supply industry has introduced the computerised building energy estimating program — BEEP — which is available through all electricity boards. BEEP enables an estimate to be made of the effects on energy consumption of the various structural options as well as of different fuels and heating, cooling and heat recovery systems. These variables can also be considered in relation to the various tariff options, and with fossil fuel heating systems at predetermined market rates for oil, gas or coal. The output of the programme gives the following:

Details of input information;
Design heat loss and heat gain of each zone;
Design heat loss and heat gain of the total building;
Monthly breakdown of heating and cooling requirements of the building;
Monthly and annual demand and consumptions of the heating, refrigeration, lighting and system auxiliaries for each design;
Summary of the energy consumptions and costs of the chosen design alternatives from which comparison may be drawn.

Many consultants who have used a BEEP appraisal when their project was at the embryo stage, and all concerned with the building, have been glad to find that the predicted figures are proving to be accurate in practice. Advice is always available from electricity boards about the application of BEEP to particular projects to help hospital engineers ensure that every kWh of electricity consumed is used wisely.

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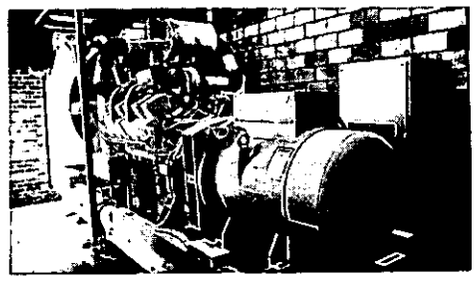

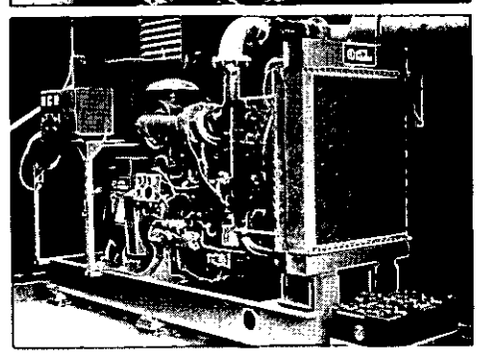

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The author is District Pharmaceutical Officer at St James's University Hospital, Leeds.

Particles in Manufactured Intravenous Solutions

IAN W. MARSHALL BSc MPS

The Problem of Contamination of Solutions

There are many drugs and solutions prepared in the hospital pharmacy which must not only be sterile but also free from particulate matter, *especially if the product is to be* injected into the bloodstream. Insoluble foreign particles in the bloodstream are potentially harmful and there is evidence to suggest that the tissues of the brain, eyes and lungs are particularly affected[1]. In 1955 Bruning[2] observed damage to infants' lungs caused by cellulose fibres from intravenous solutions and Sarrut and Nezelof[3] produced a similar report in 1960. Further reports appeared from Garvan and Gunner in Australia in 1963[4]. Unfortunately it is regarded as inevitable that contamination of solutions for injection will occur during and after manufacture, but the number and size of particles permitted in the final preparation *is now limited by the British* Pharmacopœia (BP) specification for injections.

Eliminating Particles from Solutions

During the past ten years much work has been done in hospital pharmacies on eliminating particles from solutions and this is reflected in the general high quality of the five million containers of solution manufactured in hospitals per annum. This is only *part of the present total demand for* sterile fluids, the remainder being supplied by the pharmaceutical industry. The quantities of these solutions produced in individual hospitals varies considerably, some pharmacies making no intravenous fluids and others making only a few litres per week usually of a formulation not commercially available. A few hospitals make more than 5,000 litres per week.

No matter what the quantity the final product must be of a satisfactory quality and in each situation manufacturing conditions and procedures should be similar in most respects. It is the manufacturers' responsibility to use every possible means to avoid the *introduction of contaminants during* manufacture, and to provide for the removal of contaminants after they have found their way into the product before the final process is complete. Accepting this, it is of course, important to know what type of contaminants are found in solutions and with this information approach the problems of removing them. Broadly speaking there are three types of contaminant with which the pharmacist is concerned — dissolved impurities; mircro-organisms; and suspended particles other than micro-organisms. The difficulties associated with dissolved impurities are beyond the scope of this essay but the problems of particulate contamination will now be examined further.

Live Bacteria

The most dangerous particles which can contaminate intravenous fluids are live bacteria and even the presence of dead organisms can cause serious illness. The BP, therefore, gives *detailed information to ensure sterility* and freedom from pyrogens (substances causing a rise in temperature when injected). These precautions have been strengthened by the Department of Health[5] and particularly the Medicines Commission[6] following the Davenport incident where several patients died after the infusion of infected intravenous solutions.

Other Insoluble Particles

Less precise regulations govern the presence of other insoluble particles although a defined standard appeared for the first time in the 1973 edition the BP. This standard is based on work by Groves[7] in the United Kingdom and Garvan and Gunner of Australia and limits the number and size of particles permissible in a one millilitre sample of solution. The *value of the test procedure is limited* by the inability of available instrumentation to easily measure and count particles of widely varying shapes and sizes. However, coupled with visual examination a useful guide to quality and hence production standards is achieved.

It is an expensive exercise to make a batch of solutions only to find that 95% fail to meet the standards described above and indeed without due care this could occur. The flotsam and jetsam found in sterile solutions, outwardly ready for injection, have included scrap metal, bits of reclaimed motor tyres,[8] ants,[9] glass, fibres of all descriptions and moulds — and the list could go on. Common contaminants in mixed solutions prior to bottling include metal from containers and mixing vessel cleaners, asbestos from filtration processes used in maufacturing the raw material ingredients, *cotton and other fibres from* clothing and sacking, plastic from storage bins and bags, paper pulp fibre from cardboard containers — the variety is endless and includes of course micro-organisms. These particles must be removed but this is the

relatively simple part of a complex process. It is no use cleaning the solution mix, if the final container is contaminated at the point of filling, and, therefore, three processes must be carried out with a high degree of efficiency. The first is to clean the final container and closure, the second is to clean the solution and the third is to keep both the final container and the solution clean up to the point of sealing the filled container from the external environment. Having identified the types of contamination the occurrence of the particles in the prepared intravenous fluid can be related to four major sources — the solution mix; container and closure; the environment, particularly airborne dusts; and employees.

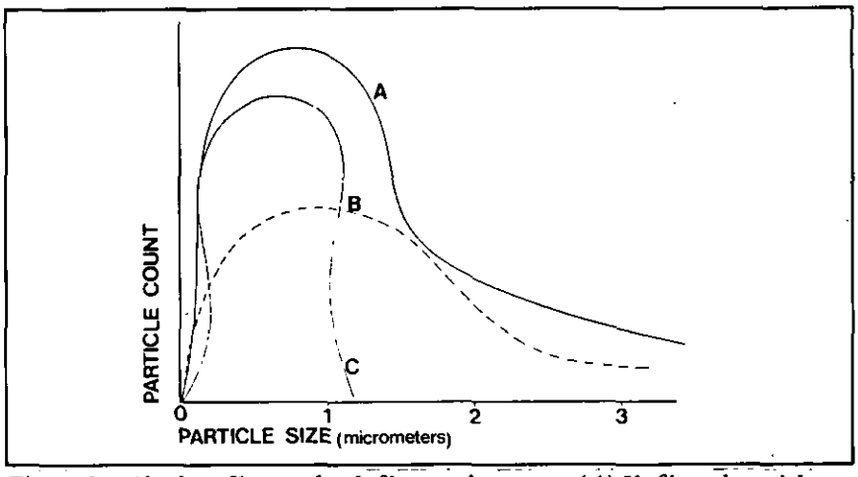

Figure 1. Absolute filter vs depth filter performance. (A) Unfiltered particle size distribution. (B) Distribution after depth filtering. (C) Distribution after filtering through 1 μm absolute filter.

The Solution Mix

Taking the solution mix, the most important manipulation in the manufacturing stage to prepare a particle free solution involves the filtration system. For injectable solutions absolute filtration is essential where particles larger than a specific size are removed. The types of filter used belong to one of two classes, the depth filters and screen filters. Each type has advantages and disadvantages and in practice they are often used together. With the depth filter, as the name implies, filtration occurs in the depth of the filter matrix and it is constructed of randomly orientated fibres and particles that have been pressed, wound, or otherwise bonded together to form a tortuous maze of flow channels. Examples of such filters are sintered glass and metal, cotton and resin bonded laminates of paper, glass fibre, polyester, and polyolefin fibres. The main advantage of depth filters is the large dirt holding capacity, the particles being held within and on the surface of the filter matrix. Of a number of disadvantages, there are two important ones.

A depth filter has no definite pore size and, therefore, imposes no definite limit on the size of the particles allowed to pass through it. As the filter clogs, particles tend to migrate through the matrix and the matrix itself breaks up to yield many particles to the filtrate, particularly if the pressure differential across the filter is increased to maintain flow rate.

The screen filters are also aptly named because they retain particles on their surfaces by physically 'screening' them from a liquid. The size of pore opening is predetermined in the course of manufacture. Pores of a fixed size will pass through. This type of filter overcomes most of the disadvantages of the depth filter but because retention is limited almost entirely to the upstream surface area and not to the depth of the filter matrix, a screen filter has a relatively low dirt holding capacity. In practice the filtration system used is a depth filter followed by a screen filter immediately before the solution passes into the final container. *Figure 1* illustrates absolute screen filter performance against depth filter performance.

Despite using high quality raw materials to British Pharmacopoeia specification, a considerable amount of debris is found in the mixed solution. Although some of this contamination comes from the ingredients of the mix, many particles can also be released from the manufacturing equipment. An unpolished, poorly welded mixing vessel can permit unseen rust spots and pitting to develop, a badly maintained flexible vane pump (the commonly used pump in hospitals) or solenoid valve can produce unlimited numbers of particles of metal, rubber, and plastic. Pipelines, flexible tubing, filling machines, can all release particles to the solution. For mixing vessels, fillers, pumps and fixed pipeline, highly polished stainless steel is the material of choice and the units should be easy to clean, even if dismantling is required. It should be posible to autoclave enclosed sections of tubing and vessels or alternatively provision should be made to inject low pressure steam in order to sanitise and prevent bacterial growth. Equipment must be kept scrupulously clean and rinsed with filtered, freshly distilled water after cleaning. As a last barrier to likely contamination, the final filtration equipment must be as near as possible to the filling nozzle, and tubing, valves and metering equipment should be upstream of this point.

Container and Closure

The solution should, at this stage, be clean and most likely filtered to exclude particles greater than 0.45 micrometres but the container and its closure present further problems. At present only glass containers are used in hospitals for the production of IV solutions. Although glass is a relatively inert substance, bottles are chipped due to handling in the filling process and injection of such particles could prove hazardous. A far greater problem is the rubber bung of glass containers which often yield huge quantities of particulate matter to the solution. If the rubber surface is lacquered, this can flake off. If unlacquered bungs are used, there is a greater danger of fillers, vulcanisers, fungal spores and other accidental or intended ingredients of rubber entering the solution. Both bottles and bungs are often delivered in cardboard cartons or wooden boxes which in themselves are a source of contamination and, therefore, rigorous washing is essential.

Gentle agitation of bungs in warm detergent followed by careful rinsing in filtered, distilled water has taken over from more vigorous treatment advocated some years ago in the hope that the closure surface will not be eroded. Bottles are treated in general

by jetting on a semi or fully automatic machine. There is a tendency to move away from rotary bottle washers since the clean bottles must of necessity come off very close to where dirty bottles are put onto this type of machine. Clean and dirty do not and should not mix and the trend now for large scale production is to use a straight through washer, with a physical barrier between the input and take off point. Machines are fitted with distilled water rinse facilities, the delivery end being in a positive pressure clean room and within a metre of the solution filling point. When a rotary machine is used the bottles are usually rinsed near the filling point in a clean environment, but away from the washers.

The Environment

No matter how clean the solution and container might be, unless the environment between the bottle rinse stage and the bottle fill stage is also ultra clean, the solution and container cleaning process are rendered useless. The air must be as clean as the solution and the usual method is to clean as small a volume as is necessary to Class 100 standard. This American classification (Federal Standard 209b) has been generally adopted to describe the quality of air in a defined space. Class 100 refers to a room or work space in which the particle count does not exceed 100 particles of 0.5 micrometres or larger per cubic foot of air. This is exceedingly clean. A Class 100 condition can only be created in a defined space by cleaning air using Laminar flow HEPA (High Efficiency Particulate Air) filters. The more recent British Standard is BS5295: 1976.

Employees

Unfortunately employees must often work in this cleaned environment and can produce many thousands of particles per minute including hair, skin scales, water droplets, make-up particles, clothing fibres and bacteria, to name but a few. A satisfactory way of minimising this contamination getting to the product is to wrap the person up in clothing producing few, if any, particles (ie lint free) and which prevents body-generated particles getting outside the suit. This in fact is what is done and finely woven cloth of monofilament terylene or nylon yarn is used to make a head-to-foot cover.

Filling Areas

Needless to say, having taken such stringent precautions in the manufacturing process it is essential at all costs to avoid introducing bits into the field of filling and such areas should not be used for storage or procedures not requiring such rigid measures of cleanliness. Dust harbouring equipment, pipes, ledges, window sills etc. should be at a minimum in the manufacturing area. Easily cleanable floors, walls, ceilings and light fittings are essential.

Chemical Reactions

The precautions necessary to produce a clean solution have been outlined briefly and once the solution is sealed into the final container it would seem that all that is required to render it fit for injection is that it should undergo a sterilization process satisfactorily.

However, the nature of some chemicals in solution is such that they can interact with the container material or with each other to form insoluble matter, particularly at high autoclave temperatures. A typical example is the problem presented when concentrated solutions of sodium bicarbonate are autoclaved in glass containers. Minute quantities of metal impurities such as iron calcium and magnesium are leached from the glass and react with the alkaline solution to form basic insoluble compounds which make the solution unsuitable for injection. In an attempt to overcome this chemical reaction, a chelating agent is added to the solution (usually sodium edetate) which effectively removes the unwanted metal ions so that they are not available to react with the alkaline bicarbonate. This type of interaction can occur at room temperature over a prolonged period of time with a number of common ingredients of infusion solutions. This contamination is guarded against but not entirely avoided by including specific instructions on the label such as 'This solution may cause separation of solid particles in storage. A solution containing such particles must not be used'. An expiry date is also added to prevent prolonged storage.

There is recent evidence that even the use of plastic, which in general yields fewer small particles to a solution than glass, is not the final answer in producing particle-free solution, since the polyamide component of the plastic lubricant can form a flocculent precipitate in the solution.

Hospitals as Manufacturing Units

Particles produced after the solution is manufactured are in some aspects beyond the scope of the production engineer and pharmacist, and only careful handling after production can eliminate this unless an absolute filter is used of small pore size at the point where the solution goes into the patient[11].

However it is generally admitted that the presence of extraneous matter in solution only betrays a poor working method, and the regulations under the Medicines Act shift charges from product to production operation with a view to eliminating poor manufacturing practices.

In the past hospitals have not been classified as manufacturing units and the vigilance of the pharmacist has maintained the high standards of hospital intravenous fluid production. Some believe that hospitals should not be involved with work which commercial organisations could undertake. The facts are that the pharmaceutical industry is uninterested in producing 'special' solutions in small bulk because the process on this scale is not viable economically. It is also true to say that the industry could not meet the NHS requirements for all standard sterile fluids at the present time.

It seems clear that for some years to come, hospital pharmacists and engineers will be involved in operating IV fluid manufacturing units where only the highest standards will be acceptable.

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Product News

British Safety Council Extends In-Plant Training

The British Safety Council — the world's largest occupational health and safety organisation — has issued a six-page leaflet on in-plant safety training which outlines the new, expanded service it now offers. As well as training 26,000 people through external courses, last year the Council instructed 9,000 people at their actual workplaces on a wide range of safety courses specifically designed for individual company problems and needs.

Demand for in-plant training is rising continually, and the Council has now increased both the number of in-plant training staff and the number of courses — all of which are described in the leaflet just published. Courses range from fork lift truck training to accident investigation, noise and hearing, and summaries of relevant legislation, including the 1974 *Health and Safety at Work Act*. In order to make the courses as relevant and effective as possible, companies can choose from different subjects to build up a one-day safety training course. There are two- and three-day courses available too.

There is also a four-page leaflet available depicting posters which can be bought through the Safety Council.

Further information is available from British Safety Council, 62-64 Chancellor's Road, London W6 9RS. Tel: 01-741 1231.

Seats for Handicapped Children

KL Jeenay child safety seats, designed for use in cars, are being adapted to help handicapped children. The Leicester firm of R. C. Hayes has two applications for the KL seat. In one, it is built into a combined chair and table, and has been modified with a slot running down the centreline of the back to accommodate spinal deformities with the minimum of discomfort.

The second product is a 'Speed Transporter' for children with both legs in a plaster cast and abducted, or splayed outwards, while they are recovering from an operation. Although the Transporter is propelled by an adult walking behind, a toy steering wheel provides extra amusement for the patient.

Further information is available from: KL Automotive Products Ltd, 137 Homerton High Street, London E9 6AT. Tel: 01-986 8311.

Harness Manufacturing Accessories

Hellermann Insuloid have added to their range of harness manufacturing accessories. Called 'Loom Breakout Springs', the components are stainless steel extension springs which can be used to separate and hold cable ends during harness manufacture.

Loom Breakout Springs are available from Hellermann Insuloid, Sharston Works, Leestone Road, Wythenshawe, Manchester M22 4RH. Tel: 061-998 8551.

Recent Acquisition

British Sterilizer Company Limited have expanded by the acquisition of Blease Medical Equipment Limited, Chesham, Bucks, manufacturers of anæsthetic, resuscitation and lung ventilation equipment.

The existing policies of Blease of growth with research and development into new and improved models will continue. They will operate as an independent unit within the group under their existing management.

Load Spreading Can Save on Industrial Energy Bills

A Maximum Demand Controller, designed to save up to 20% on industrial electricity costs without reducing power consumption, is being marketed by Servodyne Controls Limited. Basically the controller makes the best use of present industrial tariffs which impose a second 'maximum remand' charge in addition to the charge for current used. The second charge is proportional to twice the number of KVA or KW supplied during any half-hour period.

Controlling the level of highest demand — by spreading the load over several half-hour periods instead of maintaining a series of undulating peaks and troughs can save up to 20% on a factory's electricity bill without actually using less energy. If overall energy consumption is also reduced, savings should be even higher.

Further details are available from: Servodyne Controls Limited, Sadler Forster Way, Teesside Industrial Estate, Stockton-on-Tees, Cleveland TS17 9JY. Telephone: 0642 593718.

Air Purifier

Colt International Limited have introduced a high volume air purifier for commercial and industrial use. Called the Colt Conditionair 1700, the unit provides 'whole bench' protection for up to three workers, cleaning and recirculating the air in the work place.

The Colt Conditionair is available in single- and three-phase versions and will handle 1,700 m^3hr (1,000 cfm) of air.

Further information is available from: Colt International, New Lane, Havant, Hants PO9 2LY. Tel: 0705 451111.

Ver-Light

Ver Controls announce their portable 'Ver-Light', a contribution to safety and security in areas where a standby emergency light is essential. This light is basically a Hand Lamp, placed in a wall mounting holder, which automatically switches itself on during power cuts.

A full three hours' light is available from rechargeable cells which are normally maintained in readiness by an electronic charger. A 'Press to test' button is also provided.

Further details are available from: Ver Controls (St Albans) Ltd, 27b Townsend Drive, St Albans, Herts AL3 5RF. Tel: 0727 54113.

The Portable Ver-Light.

New Catalogue

The Royal Society for the Prevention of Accidents has published a new and completely revised catalogue of over 100 work safety publications and twenty films.

Many popular items have been retained from previous catalogues, for instance 'Care in the Office' which has sold over 200,000 copies. New items, such as Dennis Rousell's 'Eye Protection' and three new books from the International Loss Control Institute have been added.

A listing of films available from the new Occupational Safety Film Library is included for the first time.

Free copies of the catalogue are available from Ian Mountford, RoSPA, Cannon House, Priory Queensway, Birmingham B4 6BS. Tel: 021-233 2461.

Air Call Communications Systems

Hospitals and medical services are major targets for Air Call Ltd — Britain's largest commercial operator of radio telephones, paging and telephone answering services — which has now moved into the sale, installation and maintenance of communications systems.

To aid the promotion of sales, Air Call has commissioned the first of two £30,0000 demonstration vehicles which will visit many area health authorities.

Authorities visited by the vehicles will find the full range of Air Call's radio telephone and paging systems on show. All the communications equipment is operational and comprises UHF tone and voice paging for on-site or wide area locations plus on-site tone or tone and voice inductive loop paging. The radio telephone installation comprises a comprehensive range of AM and FM base stations and mobiles with associated hand-held equipment plus remote control units and selective calling systems.

Further details are available from Air Call Limited, 105/111 High Street, Houghton Regis. Dunstable, Bedfordshire LU5 5EL.

1024 Hazard Alarms on one Pair of Wires

The Kidde Dynaplex III and KDS Systems have been developed to provide a large number of functions for many types of Life, Safety and Asset Protection Systems, and they accomplish these functions with economies not previously available. Designed to meet National Fire Protection Standard 72 and Underwriters Laboratory Standard 611, the equipment has been widely used in North America for several years.

Kidde Multiplex Systems offer a flexible approach to the handling of hazard alarm problems, enabling the engineer to accomplish functions with economies not previously available.

Further information from: The Walter Kidde Co Ltd, Midland Regional Office, 143 Birmingham Road, Lichfield, Staffordshire WS14 9BJ.

Contactor with Display

Thorn Ericsson have launched an entirely new pocket paging system, the Ericall Contactor with Display. In addition to the normal function of contacting the person carrying the pocket receiver, it receives code messages of eight characters in length, thereby eliminating the need to contact the telephonist to find out what the message is.

Further details are available from: Thorn Ericsson Telecommunications Ltd, Viking House, Foundry Lane, Horsham, West Sussex RH13 5QF. Tel: 0403 64166.

Vinyl Flooring

To demonstrate the hardwearing qualities of the HD Vinyl flooring, Marley decided to drive a tank over it.

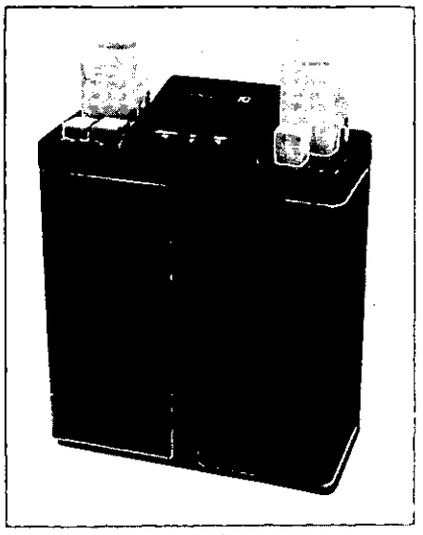
The Scorpion tank powered its way round the Alvis test circuit at over 50 mph and parked its 7,983 kg on a 20 ft strip of HD Vinyl. For an hour it ran across it from all directions in most of its seven forward and reverse gears and then proceeded to carry out emergency stops. The result was virtually no damage, merely superficial track marks.

Marley HD Vinyl is a tough contract flooring available in sheet and tile and suitable for heavy commercial installations.

Further information is available from Marley Floors Limited, Lenham, Maidstone, Kent.

'Kodak' Automixer IPD

Kodak Limited has introduced the new 'Kodak' Automixer IPD. This is an automatic chemical/water mixing unit and replenisher tanks combination, which is coupled to an automatic X-ray film processing unit — such as a Kodak 'X-Omat' film processor — and supplies the chemical tanks with developer and fixer replenisher solutions. The 'Kodak' Automixer IPD replaces conventional automatic processor replenisher tanks.



The Kodak Automixer.

Further information may be obtained from Kodak Limited, PO Box 66, Kodak House, Station Road, Hemel Hempstead, Herts HP1 1JU. Tel: Hemel Hempstead 61122.

New Lamp Range has Electronic Dimmer

One of several new features evident in the 1979 range of Brandon mobile lamps for operating theatres is an electronic dimming device which is claimed to provide variable intensity control for the first time on a mobile lamp.

Other features include a redesigned base and central column with neater appearance and greater stability without the need for counter balancing weights. Fingertip adjustment to the head using a sterilizable detachable handle is achieved without the lamp 'creeping'.

Suitable for use in clinics, veterinary and research establishments, mobile medical centres and field hospitals, the Brandon range is finished in surgical white and chrome.

Further information from: Brandon Medical Equipment Company, Leathley Road, Leeds, West Yorkshire LS10 1BJ.

Classified Advertisements

APPOINTMENTS AND SITUATIONS VACANT

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HIGHLAND HEALTH BOARD

ENGINEER

The post will be based at Inverness and the holder will be responsible in the first instance to the Senior Engineer based there for the operation and maintenance of all mechanical and electrical plant and equipment at hospitals and associated properties. A current driving licence is essential.

Salary — £4,497 rising by five increments to £5,073. An incentive bonus scheme is currently being introduced and participating P T B staff are receiving a 10% allowance.

Further information may be obtained from the District Engineering Officer, 28 Queensgate, Inverness. Telephone No Inverness (0463) 221771.

Application form and job description from the District Personnel Officer 14 Ardross Street, Inverness. Tel No Inverness (0463) 32401 Ext. 44.

Closing date for receipt of completed application forms October 1, 1979.

BIRMINGHAM AREA
HEALTH AUTHORITY (TEACHING)
NORTH BIRMINGHAM
HEALTH DISTRICT

SENIOR ENGINEER

based at Highcroft Hospital, Erdington

Salary: £4,938-£5,718 plus 'On-Call' and bonus payments

The above vacancy has occurred due to the promotion of the present post-holder. Highcroft Hospital is an 850-bedded Psychiatric Hospital and includes the District Laundry, serving other hospitals in the District, on site. Phase 1 of a modern coal-fired Boiler Plant is in progress at the present time.

Candidates must be qualified to HNC Electrical with Mechanical endorsement or HNC Mechanical with Electrical endorsement standard or hold an equivalent qualification.

Application forms and job descriptions are available from the District Works Officer, North Birmingham Health District, Good Hope General Hospital, Rectory Road, Sutton Coldfield, West Midlands B75 7RR. Tel: 021-378 2211, ext 3589.

Greenwich Health District
Brook General Hospital
Shooters Hill Road, Woolwich SE18 4LW

Engineer

The Officer appointed will be responsible to the Senior Engineer in the full range of his duties in the operation and maintenance of engineering plant and services. He/she should have served an apprenticeship in Mechanical or Electrical Engineering, or otherwise have acquired a thorough practical training as appropriate to the post, and hold one of the following qualifications:

Ordinary National Certificate in Mechanical or Electrical Engineering, or an alternative qualification acceptable to the Secretary of State.

Salary: £4,497 to £5,073 plus £354 London Weighting.

Applications should be addressed to: Mrs M. Smith, Personnel Officer, Greenwich Health District, Morgan Grampian House (2nd Floor), Calderwood Street, Woolwich SE18 6RB.

National Heart and Chest Hospitals

SENIOR ENGINEER

with HNC or equivalent qualification, to be responsible for the building, engineering and associated technical services and activities, together with control of maintenance staff. Salary on scale £5,292-£6,072 inclusive of London Weighting allowance.

ENGINEER

required for the design of engineering services as applied to modern hospitals including mechanical and electrical services. Minimum qualification ONC in mechanical engineering. Salary on scale £4,851-£5,427 inclusive of London Weighting allowance.

Informal enquiries welcomed by the Group Engineer, Mr J. Lee, Telephone 01-352 8121 Ext 4330, from whom further details of both posts are available.

Applications in writing, giving full details and names and addresses of two referees, should be sent to Mr J. Lee, Group Engineer, National Heart and Chest Hospitals, Brompton Hospital, Fulham Road, London SW3 6HP, immediately.

WEST GLAMORGAN HEALTH AUTHORITY **WG**

Assistant Area Engineer

NORTHERN SECTOR

Salary: £5,328 per annum rising by six annual increments to £6,309. Plus bonus payments in accordance with the National Scheme.

Applications invited for the above post nominally based at Morriston Hospital.

This 400-plus bedded Hospital is a site upon which a new Nucleas Hospital — Phase 1 is due for start in Autumn 1980.

The successful applicant will be required to carry out the duties ascribed to the grade of 3rd in Line Engineer in accordance with the National agreements generally, as under:—

(a) General maintenance and operations.
(b) Specialised maintenance services.
(c) Engineering and Design construction as required to meet the needs of the Area Works Dept.

The successful candidate will be responsible to the Area Engineer.

Applicants should have a good working knowledge of Engineering standards and techniques, particularly those applicable to design and operation of all building services and environmental control systems, as applied to properties within the National Health Service estate.

The appointment, although based at Morriston Hospital will be, as is the practice in West Glamorgan, subject to flexibility of operation, and the appointee may be asked to carry out duties in line with his grading either at another Sector or at Area Headquarters — as the need arises.

Experience of management at Hospital level will be advantageous.

Applicants must satisfy the qualifications criteria set out in the appropriate Prof & Tech Staff B Whitley Council handbook as applied to such posts.

Application forms and further particulars are available from the Area Personnel Department, 36 Orchard Street, Swansea. Application forms are to be returned by September 24, 1979.

Lacy-Hulbert

Lacy-Hulbert & Co Ltd

ENGINEER

Due to expansion, the Market Leader in the manufacture of Medical Vacuum and Compressed Air Plants require an Engineer to assist the Contracts Manager in the preparation of tenders and specifications.

Experience of Medical Gas Installations and knowledge of HTM 22 desirable. The scope for career development is excellent. Salary Circa £5,500 pa plus pension and relocation expenses where applicable.

Apply in writing with full CV to: Sales Director, Lacy-Hulbert & Company Ltd, Richmond Road, Beddington, Croydon CR9 4EA.

SOUTH BIRMINGHAM HEALTH DISTRICT

Sector Engineer

(Salary scale £5,328- £6,309 pa increase pending)

Applications are invited for the above post, based at Selly Oak Hospital. The post holder will have responsibility for all maintenance operations and an involvement in minor new works at six premises in the district — Selly Oaks Hospital, Head Injuries Rehabilitation Centre, Artificial Limb and Appliance Centre, The Birmingham Accident Hospital, Sorrento Hospital and Moseley Hall Hospital.

The successful applicant should hold an HNC in Electrical or Mechanical Engineering or equivalent qualification.

Job description and application forms from the District Personnel Officer, South Birmingham Health District, Oak Tree Lane, Birmingham B29 6JF, telephone 472 5313, ext. 4535.

Closing date Friday 28th September 1979.

AREA WORKS DEPARTMENT

ROYAL SHREWSBURY HOSPITAL SOUTH (SUB-GROUP)

SENIOR ENGINEER

The above vacancy has occurred due to the promotion of the existing Engineer. The salary for this position is £4,938-£5,718 plus 'On Call' and Bonus Payments. This is a Senior Management position with many of the standard departments apertaining to an acute hospital.

In addition to the main acute hospital, there are smaller units and health properties for which the manager will have responsibility. The successful candidate will be involved in modern methods of management control, PPM and Bonus Schemes. They will be expected to show proven ability to undertake the co-*ordinating responsibilities for works activities associ*ated with the position.

Qualifications will be consistent with Whitley Council Agreements.

Application forms and job descriptions can be obtained from Mr R. Edwards, Area Engineer, Area Works Dept, Royal Shrewsbury Hospital South, Mytton Oak Road, Shrewsbury, Salop.

Closing date for applications: September 21, 1979.

Salop
Area Health Authority

ENGINEER OFFICERS

Queen Elizabeth Hospital
Birmingham Children's Hospital

Both posts offer an opportunity to Engineers who wish to embark on a worthwhile and rewarding career in the Health Service. You should have completed an apprenticeship and obtained a minimum qualification of ONC in Engineering, or equivalent.

As an assistant to the Senior Engineer, we can offer the chance to gain further experience in the operation and maintenance of complex engineering plant, equipment and services. Encouragement is given for career development and where appropriate, assistance with further education may be granted.

In addition to considerable job satisfaction, staff can enjoy an unparallelled social club with squash courts, swimming pool, bar and many organised activities.

Salary scale: £4,497-£5,073 plus 5% bonus increase pending.

Job description and application forms are available from: Assistant District Personnel Officer, District *Offices, Central Birmingham Health District,* Queen Elizabeth Medical Centre, Edgbaston, Birmingham B15 2TH.

CENTRAL BIRMINGHAM
Health District

BIRMINGHAM AREA HEALTH AUTHORITY (Teaching)

BBC Bristol require

HOUSE SERVICES ENGINEER

Salary in the range £6425p.a. to £7955p.a.

BBC Bristol's Network Production Centre is embarking on several years of redevelopment. The existing Engineering House Services plant which services old converted buildings will gradually be phased out and replaced with new equipment servicing a modern broadcasting centre, to professional standards laid down by Head of Television House Services Engineering.

THE DUTIES WILL INCLUDE: the management of engineering and the building maintenance team, the development of operational and maintenance techniques, the planning, costing and organising general building maintenance and minor alterations and ensuring that all relevant safety legislation is complied with.

The postholder, male or female must have had experience of modern engineering house services plant and theoretical knowledge equivalent to H.N.C. level, and will be expected to be closely involved in the introduction of such plant in the phased re-development of Bristol Network Production Centre.

Membership of an appropriate professional Institute would be desirable.

Requests for application forms to the **Engineering Recruitment Officer, BBC, Broadcasting House, London W1A 1AA,** quoting ref. no: 79.E.2319/HE.

BBC

SENIOR HOSPITAL ENGINEER

based at North Middlesex Hospital, London N18

The successful applicant (male/female) will manage mechanical and electrical staff, and will also be responsible for the maintenance programme and the implementation of the Incentive Bonus Scheme. Applicants should be in possession of a HNC in either Mechanical or Electrical Engineering, or an appropriate C & G Certificate.

Salary scale: £5,292 to £6,072 (under review) inclusive of LW plus on-call and overtime payments where applicable. Percentage payment will be made when the IBS becomes operational.

Application form and job description from: District Works Officer, Haringey Health District, Mountford House, The Green, Tottenham, London N15.

TAYSIDE HEALTH BOARD
Angus District

SENIOR ENGINEER

(Re-advertisement)

Applications are invited for the above post which has become vacant due to the promotion of the present holder. Although the post is based at Sunnyside Royal Hospital, Montrose, the successful applicant will be required to travel to Hospitals and establishments within the Arbroath and Montrose Sectors of the District.

Candidates from outwith the National Health Service must have completed an apprenticeship and possess either a Higher National Certificate of City and Guilds Certificate in Mechanical or Electrical Engineering with either Electrical or Mechanical and Industrial Administration endorsements or alternative qualifications acceptable to the Secretary of State.

Salary scale: £4,938 rising to £5,718 per annum in five annual increments plus incentive bonus scheme payments.

Application form and job description can be obtained from the District Administrator, Tayside Health Board, Angus District, Whitehills Hospital, Forfar to whom completed forms should be returned by September 17, 1979.

Technical Superintendent

The Hospital Board proposes to appoint a Technical Superintendent to supervise and co-ordinate the maintenance programme for the Technical and Associated Services in St James's and the seven Hospitals in the Federated Dublin Voluntary Hospitals Group.

St James's is a teaching Hospital associated with the Medical School of Dublin University, and is designated for further and extensive major development in the near future.

The Board invites applications from persons with a high standard of technical training and experience in the maintenance of buildings and plant. A professional qualification in Architecture or Engineering is desirable.

The post, which is permanent, attracts a salary within a scale of £6,089 to £6,770 per annum, and carries pension rights.

Application forms and all relevant particulars may be obtained on request from the Personnel Officer, St James's Hospital, PO Box 580, Dublin 8.

The latest date for receipt of completed application forms is September 30, 1979.

ST. JAMES'S HOSPITAL

ESSEX AREA HEALTH AUTHORITY

SOUTHEND DISTRICT

ENGINEERING OFFICER

(Male/Female)
Southend Hospital

to be responsible to the Senior Engineering Officer over the whole range of engineering services. This post offers an excellent opening for an interesting and worthwhile career in Health Service Estate Management.

Applicants must possess a minimum qualification of an ONC or OND in Engineering and have completed a recognised Engineering Apprenticeship.
Salary: £4,497 pa, annual increments to £5,073 pa plus bonus payments up to a maximum of 15%.

Application form and job description available from Mr L. R. Bacon, District Personnel Officer, Southend Hospital, Prittlewell Chase, Westcliff-on-Sea, Essex SSO ORY. Southend (0702) 48911 Ext 423.

CROYDON AREA HEALTH AUTHORITY

ENGINEERS

To work within the engineering section of the Works Department. The appointments will in the first instance be to either Warlingham Park, Mayday or Croydon General Hospitals but staff will be expected to work throughout the Area.

Previous hospital experience, whilst an advantage, is not a requirement. Technical competence, a professional attitude and an enthusiastic approach to the job are the main qualities needed.

Day release may be available for the appointed applicants to continue studies. There are facilities for training within the service in specialised subjects. Every opportunity will be given to the persons appointed to develop their career within the Health Service. The successful candidates should hold ONC Engineering or similar qualification and have completed an apprenticeship in mechanical or electrical engineering.

Salary: £4,851 pa rising by increments to £5,427 pa including London Weighting. Additional payments of approximately 15% may be available when the Craftsmans Bonus Scheme is installed.

Promotion within the Service is possible to posts in excess of £10,000 pa.

Applications and job descriptions from: The Area Personnel Department, General Hospital, London Road, Croydon CR9 2RH. Tel: 01-688 7755 ext 29/31.

SOUTHERN DISTRICT of the HIGHLAND HEALTH BOARD

SENIOR ENGINEER

The duties of the post will be mainly involved with electro-medical and other specialised electronic equipment in the District, including scheduling maintenance and replacement of such equipment. The successful candidate will liaise closely with medical, nursing and other personnel.

Salary – £4,938 per annum rising by five increments to £5,718. An incentive bonus scheme is currently being introduced and participating PTB staff are receiving a 10% allowance.

The post will be based in Inverness and will involve travelling throughout the District, a current driving licence is therefore essential.

Any further information can be obtained from Mr G.Doherty, District Engineering Officer, 28 Queensgate, Inverness. Tel No Inverness (0463) 221771.

Application forms and job descriptions from the District Personnel Officer, 14 Ardross Street, Inverness IV3 5NT. Tel No Inverness (0463) 32401 ext. 44.

Closing date for receipt of completed application forms is October 1, 1979.

Senior Engineer

(Barnet and Finchley Sectors 526 beds)

For management duties within the Authority associated with the maintenance and operation of engineering services. Duties will include the implementation and operation of a Planned Maintenance and Bonus Incentive Scheme. The post will be based at Barnet General Hospital, Wellhouse Lane, Barnet, Herts. Previous hospital experience is desirable.

The post will give an ambitious Engineer considerable delegated management responsibility. Applicants (male or female) shall have completed an apprenticeship in mechanical or electrical engineering or have otherwise acquired a thorough practical training as appropriate to the duties and responsibilities. He/she shall have a minimum qualification of an HNC in Engineering or an appropriate equivalent with five years' relevant experience in the management of mechanical and electrical plant and up to date methods of maintenance planning; in the control and deployment of maintenance and operational staff; in the preparation of maintenance estimates and of reports and in the carrying out directly or by contract, small works of engineering construction or renewal.

Salary scale: £5,292-£6,072 plus incentive Bonus Scheme Allowance in acordance with appropriate PTB agreements.

Engineer

The post offers a worthwhile career in Hospital Engineering with the opportunity of day release to continue studies.

Applicants (male or female) shall have completed an apprenticeship in mechanical or electrical engineering or have otherwise acquired a thorough practical training as appropriate to the duties and responsibilities and shall have a minimum qualification of an ONC in Engineering or an appropriate equivalent.

Salary scale: £4,851-£5,427 plus Incentive Bonus Scheme Allowance, in accordance with the appropriate PTB agreement.

For further information about the post, interested applicants should telephone Peter Horne, District Works Officer 01-440 5111 Ext 458.

Application forms and job description from District Personnel Department, 1 Wellhouse Lane, Barnet, Herts 01-440 5111 Ext 450 or 01-441 4568 (24-hour answering service).

Closing date: November 7, 1979.

BARNET/FINCHLEY
Health District
Barnet Area Health Authority

SENIOR ENGINEER

Applications are invited for the above post which will be hospital based and involve responsibility to the Assistant District Engineer for the upkeep, maintenance and operation of engineering services, plant and equipment at the Hospitals and other premises within the District.

Applicants should have completed an apprenticeship in mechanical or electrical engineering or have otherwise acquired a thorough practical training as appropriate to the duties and responsibilities of the post and have five years' relevant experience. In addition they should possess the following qualifications:

Higher National Certificate in:—

(a) Mechanical Engineering together with certificates of a Technical College or a College of Further Education in Electrical Engineering and Industrial Administration if these were not taken as subjects of the course; or

(b) Electrical or Electrical and Electronic Engineering together with, in each case, certificates of a Technical College or a College of Further Education in Applied Heat, Applied Mechanics and Industrial Administration if these were not taken as subjects of the course; or

(c) an alternative acceptable qualification.

Salary commences at £4,938 pa and rises by five annual increments to £5,718 pa for a 37-hour week. A bonus scheme is in operation and a percentage allowance on salary is payable in respect of bonus scheme responsibilities.

Job description and application forms are available from the Personnel Officer, Rugby Health District, 24 Warwick Street, Rugby or Telephone Rugby 72831 Ext 458. Closing date for applications, September 20, 1979.

RUGBY DISTRICT
Warwickshire Area Health Authority

THE NATIONAL HOSPITALS FOR NERVOUS DISEASES
Queen Square, London WC1N 3BG

This Post-graduate Teaching Hospital Group requires a second

ENGINEER

who will be required to assist the Senior Engineer over the whole range of his duties.

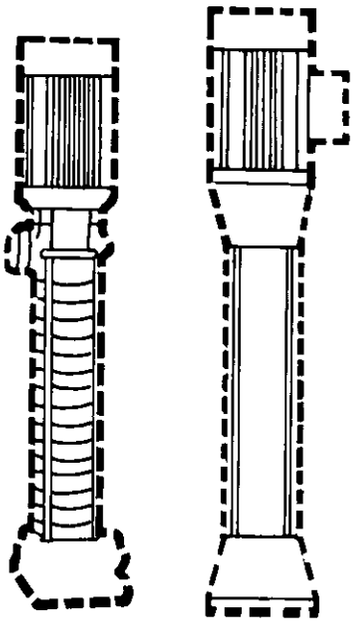
Salary scale: £4,497-£5,073 per annum, plus £354 London Weighting Allowance and bonus scheme allowance.

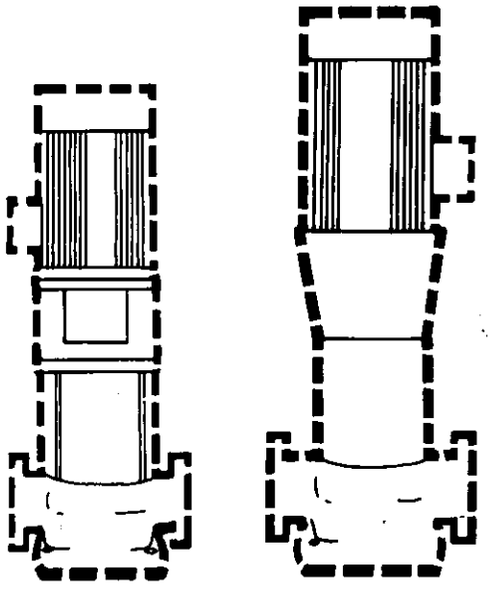
Applicants must have completed an apprenticeship in Mechanical or Electrical Engineering, have a thorough practical training as appropriate to the duties and responsibilities of the post and have five years' relevant experience. Candidates should possess an Ordinary National Certificate in Engineering, a higher qualification, or an alternative qualification acceptable to the Secretary of State.

Application forms and job descriptions may be obtained from the Personnel Officer at the above address, Telephone: 01-837 3611, Ext 65.

Closing date: September 28, 1979.

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





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

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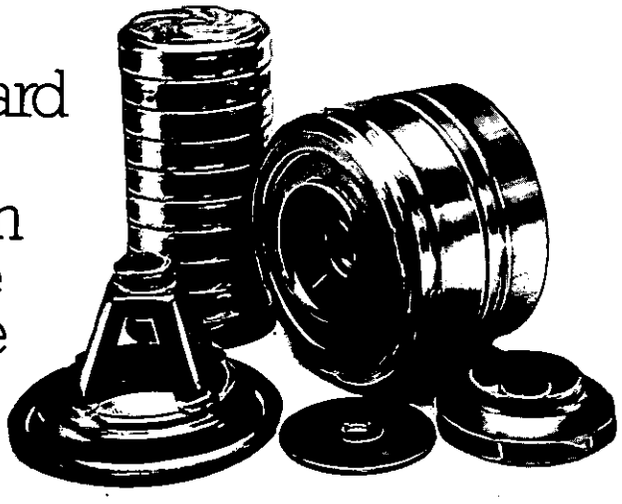

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Northern Area: Gawsworth Court, Risley Road, Risley, Warrington, Cheshire. Tel: Padgate (0925) 813300. Telex 628162.