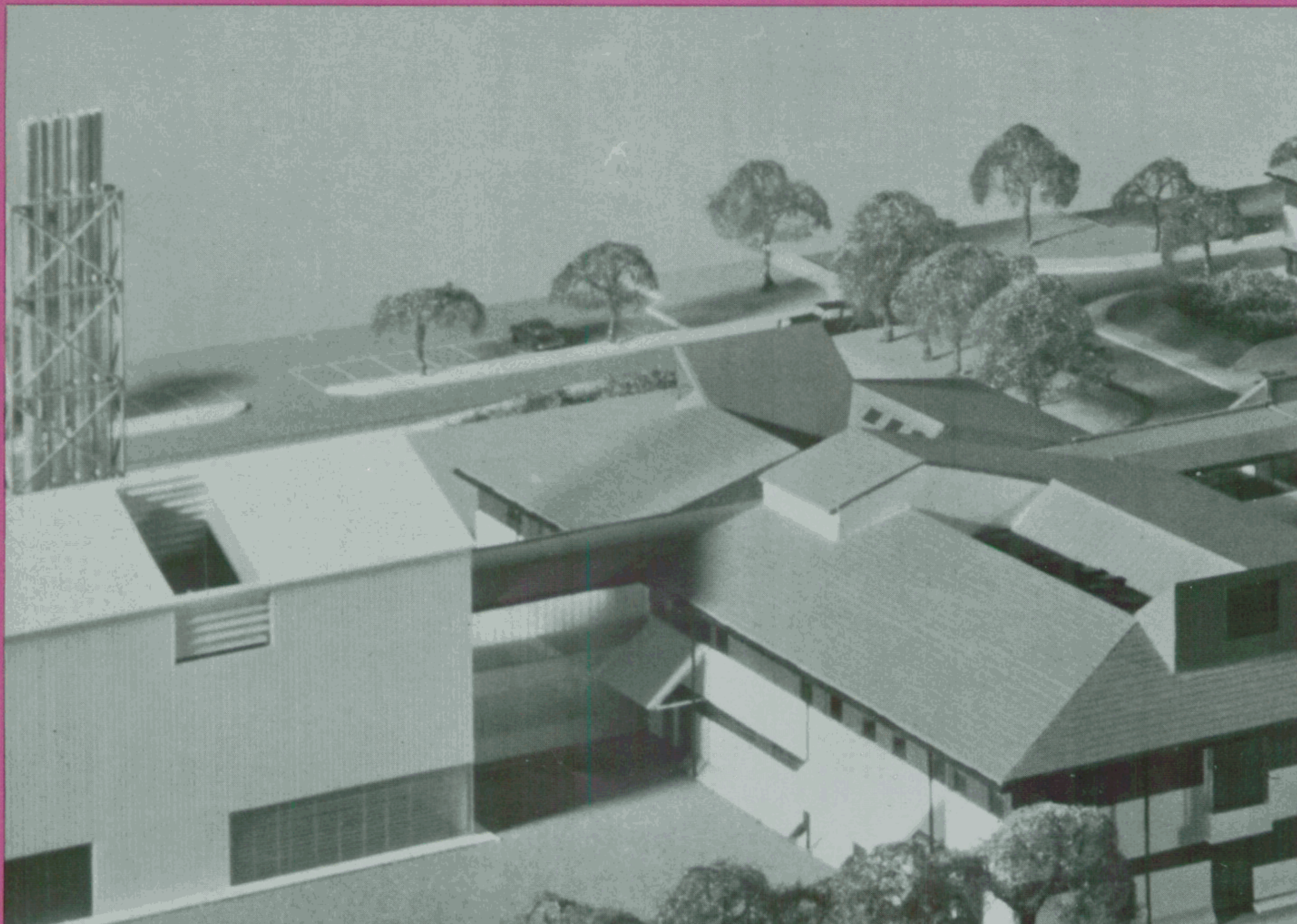
HOSPITAL ENGINEERING

May 1979

The Journal of the Institute of Hospital Engineering



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Editor
Christopher Tanous TD

Art Editor
David Shilling

Advertisement Representative
Alan Jacobs

All correspondence relating to the Journal should be addressed to:

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

Secretary
J. E. Furness VRD*

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

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Vol. 33 No. 4

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Contents

Front Cover: Nucleus Design — Maidstone District General Hospital, scheduled to open 1984. Architects Powell, Moya and Partners.

Institute News

New Registration Booklet

The Engineers' Registration Board has produced a new booklet 'Registration — its Value to You', which outlines the work of the Board and its value to all those involved with the profession. Copies are available free of charge from The Engineers' Registration Board, 2 Little Smith Street, London SW1 3DL. Telephone: 01-799 3912.

New Branch Officers

South West

Branch Chairman: D. J. Shoebridge. Vice-Chairman: J. W. Barnes. Hon Secretary: A. J. Graver, Charlton House, Cirencester Road, Cheltenham GL53 8ER. Hon Treasurer: H. R. Stiddard.

West of Scotland

Branch Chairman: A. Peters. Vice-Chairman: D. E. Moss. Hon. Secretary: J. Strachan, 76 Cardross Street, Glasgow G31 2DG. Hon Treasurer: W. Gormley.

Southern Branch Officers

Principal Officers for the Southern Branch for the coming year will be: Chairman: D. R. Wilson. Vice-Chairman: G. H. Brookbanks. Hon Secretary/Hon Treasurer: J. H. Walker, 182 Salisbury Road, Totton, Southampton.

Medical Laboratory Exhibition

The 1979 Medical Laboratory Exhibition is to be held on October 9, 10 and 11, 1979, at the West Centre, London.

As on earlier occasions, there will be a series of lectures presented during the run of the Exhibition. These will cover specific practical aspects of medical laboratory technology.

Full details are available on request from Gerard Mann Ltd, 16a Beckenham Road, West Wickham, Kent BR4 0QT (Telephone: 01-776 0011).

Guides to Short Courses from the IEE

The Institution of Electrical Engineers (IEE) has prepared two new guides to short courses to be held in the UK up to and including August 1980. They will become available in September 1979. One of these guides covers technical short courses and the other non-technical short courses. They can be reserved at a pre-publication price of £22 each, a saving of £3 on the normal publication price, if ordered before June 15. Orders should be sent (without money) to the IEE, Marketing Department, Station House, Nightingale Road, Hitchin, Hertfordshire SG5 1RJ.

Technical short courses will cover technical subjects with a bias towards electrical, electronics, control, computing and similar matters. Non-technical short courses will deal with fields of interest to those working in an engineering or commercial environment. For example, they will cover project control, finance for non-accountants, technical writing, foreign languages, health and safety, effective speaking and management.

Each guide will contain over 600 entries with subject and location indexes to facilitate quick identification of specific courses.

New Telephone Number for The Institution of Mechanical Engineers

The new telephone number of the Institution of Mechanical Engineers is now 01-222 7899. The change is because the Post Office has had to rearrange certain numbers in the Whitehall area in order to meet the demand for the telephone service.

Midlands Branch

At the AGM of the Midlands Branch held on Wednesday, March 7, 1979 the officers elected for 1979/80 were: Chairman: Mr R. J. Sear. Vice-Chairman: Mr A. Round. Secretary: Mr C. Smith.

The following members were elected to Committee for 1979/80: K. W. Ashton, G. E. Atkinson, R. J. Chatwin, D. L. Hall, C. D. J. King, A. Round, R. J. Sear, C. Smith, R. G. Taylor, W. Turnbull, A. W. Unitt, B. S. Wilson.

Following the AGM, West Midlands Gas presented a technical paper entitled 'Energy Conservation in West Midlands Gas'. This paper included facts and figures on the amount of energy saved within their own organisation over a period of three years.

West Midlands Gas also advised members that an Energy Advice Centre had recently been opened in Birmingham. This Centre is the first of its kind in the country which caters for both domestic and non-domestic customers, and will be the focus of energy efficiency activity in the Birmingham area.

The Centre has an extensive energy library, study area, small lecture theatre and display section, which can provide valuable assistance to school children and students, as well as architects, heating design engineers and energy managers. Further information is available from Mr M. Darby, British Gas Energy Advice Centre, 15 East Mall, Birmingham Shopping Centre, Birmingham B24 XJ. Telephone: 021-643 0391.

Marley Extrusions – New Technical Paper

'A report into the efficiency of the Marley UPVC rodding point drainage system at two hospital units after six years' by Rolf Payne, Consulting Engineer, 'is the fifth in a series of Marley Plumbing technical papers by invited authors and contains twenty pages together with illustrations and photographs.

Marley's development programme has resulted in a drainage system suitable for the demands of hospitals today. The system is comprehensive and includes a wide range of pipes and fittings and two components specially developed for hospitals, an early warning device for detecting blockages and a sealed rodding point which allows clearing of blockages to be carried out without opening the drain system.

Copies of Technical Paper No 5 are available at 75p each, including post and packing, from M. R. Boakes, Technical Training Officer, Marley Extrusions, Lenham, near Maidstone, Kent.

CIBS Annual Conference

The Annual Conference of the Chartered Institution of Building Services will be held at The Old Swan Hotel, Harrogate, from May 19-23, 1979.

The technical programme will be devoted to services in the building complex. The opening paper by Sir Hugh Wilson, Past President of RIBA, will deal with the rationale of planning complexes and subsequent sessions will cover shopping precincts, industrial estates and residential areas. The programme will also include technical visits and social functions.

Non-members of CIBS will be welcomed at the Conference and registration forms may be obtained from the Public Affairs Department, The Chartered Institution of Building Services, 49 Cadogan Square, London SW1X 0JB.

West of Scotland Branch Meeting

Mr W. Jack, the chairman welcomed 21 members and one visitor to the January meeting which was a good turn-out considering the extremely bad weather. The speaker was Mr R. Cowtan, from the CSA Supplies Division, Scientific and Technical Branch, who talked on 'Hospital Technical Memorandum No 10 and its application in Scotland'.

He introduced his paper by explaining that HTM 10 was a management document entitled 'Sterilizers' which identified the duties of Maintenance Staff Managers, and users of sterilization facilities in the Health Service. The memorandum was being printed and it was expected that it would be issued by mid-1979. It would probably take some time before it was fully implemented, but it identified important links between the various participants in a system required to ensure a satisfactory sterilizing process.

After the usual break for coffee, the chairman opened a lively question session.

North Western Branch

On March 13, 1979, the branch held its AGM at Warrington District General Hospital which was the best attended AGM for a number of years.

The officers elected for 1979/80 were:

Branch Chairman: W. J. Smith. Vice-Chairman: A. W. Schaffel. Hon Secretary/Treasurer: J. Sunderland.

After the meeting a paper was given by representatives of Sir Percy Thomas (Architects) and R. W. Gregory & Partners (Consulting Engineers) on 'Co-ordinated Building Services Drawings'. This proved an interesting paper and led to lively discussion. After the paper a visit was arranged to the newly completed wing of the hospital, where the plant rooms and operating theatres attracted great interest.

On Wednesday, April 4, 1979, the branch members visited the Salford brewery of Whitbread Pennine Ltd. This was a typical Victorian building and the brewing process has not drastically changed since that period. All this made the visit fascinating and educational. After the visit, members enjoyed refreshments of sandwiches and special brews of beer.

Safety leaflet

The British Safety Council has just issued a six-page leaflet on safety training. The leaflet gives details of 18 different courses ranging from the basic three-day First Aid Course geared to train people to pass the final examination set in accordance with statutory requirements, up to the series of five courses which lead to the qualification Diploma in Safety Management (DipSM), the highest professional safety qualification available anywhere in the world. The Council also runs a unique overseas course on the Diploma which is attended by people from all over the world.

Courses are held in the British Safety Council's two training ships, the St Katharine and the St Lucy, based at the St Katharine Yacht Haven near the Tower of London, and in over eighty different venues throughout the country. In-plant training is also available to companies on specific subjects.

The British Safety Council maintains that correct training at all levels is the most important contribution towards the reduction of accidents, as well as compliance with the law and increased productivity.

In the light of recent legislation which makes Directors directly responsible for safety, the Council has set up a new division called Senior Executive Briefings, to keep them informed.

The leaflet on training courses and information on the Senior Executive Briefings is available on request with in-depth details of any of the courses from Helen Kelman, British Safety Council, 62-64 Chancellor's Road, London W6 9RS. Telephone: 01-741 1231, Ext 259.

CEI Rejects N and F Examination Proposals

The Council of Engineering Institutions (CEI) and its associated Engineers' Registration Board (ERB), representing some fifty professional engineering organisations between them, welcomes the statement by the Secretary of State for Education to the effect that the Government has no intention at the present time of abolishing 'A' level examinations. The CEI sets standards of academic and practical competence for professional engineers and technicians and in a 1,000 word report rejects the proposals of the Schools Council for the replacement of the 'A' level examination by N and F systems.

In its report the CEI argues that the present system is universally understood and is well-balanced in that it can produce the right number of qualified entrants for the places available in higher education. The Schools Council's proposals, it is contended, could upset the equilibrium by producing sixth form classes having wider, more diffused and more shallow curricula. The CEI warns that engineering degree courses would have to be seriously amended and lengthened to compensate for the lack of basic ground work in appropriate subjects in schools. Clearly this would make an engineering career less attractive to the very people who should be encouraged to enter the profession.

The report argues that the 'A' level system should be extended, improved and made more efficient in terms of the time involved by developing core material in a syllabus making long-term study of engineering sciences more effective. More realistic coverage should be achieved by reducing and rationalising the number of 'A' level syllabuses in given disciplines. The CEI also recommends the introduction of a subject in humanities to the existing 'A' level subjects which would have the effect of formalising the work presently done by most sixth formers and thus making the N and F examination proposal irrelevant.

The report emphasises the CEI opinion that 'change-for-change's-sake' does not provide any solution to the problem. Further, the CEI shares the view of other professional bodies that no change in the common examination system at 18-plus is acceptable if it results in any lowering of academic standards reflected in the intellectual abilities of entrants to a professional career.

Call for Nominations for the CEI Board

The Board of CEI is now calling for nominations from Chartered Engineers to fill the six places on the board which will become vacant at the conclusion of the 1980 Annual General Meeting.

Nomination forms are available from the Secretary of CEI, 2 Little Smith Street, London SW1P 3DL and will give details of the nomination procedure but briefly nominations must be supported by 15 chartered engineers and form must be received at CEI by 1200 hours on October 2, 1979 at the latest.

The following elected board members will be retiring but all are eligible for re-election if nominated:

Miss E. G. Dodd FIMechE FIEE
Dr K. W. A. Guy MIChemE
Mr P. T. Houldcroft FIM MIMM
Brigadier T. B. Palmer MIMechE
Mr D. A. H. Roberts MIGasE
Mr E. H. Wakefield FICE FIHE

The Institution with which each retiring Board Member was identified for the purposes of the 1979 election is underlined. Nominations need not however be confined to members of these Institutions. Any Chartered Engineer may be nominated with the sole exception of one who is a member of the Institution of Electrical Engineers only. The elected membership of the CEI Board will continue to include two members who are uniquely identified with the IEE and this is the maximum allowed by the By-laws.

IEE International Conference

The Power Division of the Institution of Electrical Engineers in association with the Chartered Institution of Building Services and the Institution of Electrical and Electronics Technician Engineers are organising an international conference 'Effective Use of Electricity in Buildings' in London, April 29 to May 1, 1980.

The Conference is intended to review the development of electric utilisation as it affects the internal environment and to stimulate further progress.

The scope of the Conference includes the application of electrical energy and the design of systems for heating, cooling, air treatment and lighting. Efficient and effective use will be a common theme with emphasis on building construction, thermal insulation, energy management and control techniques.

Offers of contributions are invited in the following subject areas:

1. Electric Heating Systems
a. Direct acting heating systems, including terminal reheat and other hybrid systems;
b. Storage heating systems, including underfloor, thermal storage and hot water.

2. Air Conditioning and Ventilation
a. Selection of air conditioning plant related to type of building;
b. Limitations on sizing and selection imposed by power supply considerations;
c. Air conditioning for specific applications;
d. Specialist problems of ventilation.

3. Lighting and Fenestration
a. Light sources related to requirements;
b. Luminaires and ceiling systems;
c. Architectural and æsthetic aspects;
d. Security and emergency lighting;
e. Switching and control.

4. Energy Management
a. Energy monitoring;
b. Impact of building regulations and thermal insulation;
c. Heat recovery techniques, including heat pumps, thermal wheels, heat pipes, runaround coils, parallel plate heat exchanges. Combined heat and power;
d. Microprocessors, minicomputers and supervisory control.

5. The Futures
a. Domestic-minimum resources home;
b. Low energy commercial buildings;
c. Industrial energy thrift and audits.

NB — In sections 1-4, case studies will be considered.

Submission of Contributions
The Organising Committee invites offers of contributions for consideration for inclusion in the programme. Those intending to offer a contribution should submit a one A4 page synopsis to the IEE Conference Department by June 1, 1979.

The authors whose synopses are selected for development into full contributions for further consideration will be asked to provide a typescript of not more than 4,000 words of text, or correspondingly less if illustrations are included, for assessment, by November 5, 1979.

Deadlines
Intending authors should note the following deadline dates:
Receipt of synopses — June 1, 1979;
Notification of provisional acceptance of synopses — July 1979;
Receipt of full text for final review — November 5, 1979.

Working Language
The working language of the Conference is English which will be used for all printed material, presentations and discussion. Simultaneous interpretation will not be provided.

Venue
The Conference will be held at the Institution of Electrical Engineers, Savoy Place, London WC2.

Registration
Registration forms and further programme details will be available a few months before the event from IEE Conference Department, Savoy Place, London WC2R 0BL. Tel: 01-240 1871.

The author is editor of the Industrial Relations Briefing, *which is a widely-read periodical specialising in employment, safety and trade union law. He presented this paper at the Institute's Autumn Seminar on 'Safety — Management Implications' held in London last year.*

Technique of Safety Inspection

ROBERT MACKMURDO

I am afraid that managers have not yet considered how safety inspections should be carried out, even though the legal powers giving union appointed safety representatives to engage in such investigations have recently become effective. An employing health authority which does not know how to carry out competent coherent safety inspections through its own managers will be at a sharp disadvantage when the SRSCR's take full force. My paper concentrates on an illustration of the problems and gives indication of how these may be treated. This précis concentrates on the five essential factors that must be considered when working out just how safety inspections will work under the new requirements.

Employer's Safety Policy

If this fulfils the requirements of s2(3) of the Health & Safety at Work Act in that it identifies general policy, arrangements and organisation, and if it is structured to allow for reassessment and up-date as necessary, it will probably have achieved a degree of acceptance and respect that allows it to be used as a guidance document during safety inspections. If this position has not yet been achieved, it should now be regarded as a constructive objective.

Layout Plan

The basic layout plan of each area to be inspected must be drawn up. This can be reproduced several times to enable a variety of useful layout plans to be made.

The Need for Inventories

Inventories of all articles and substances used, stored or produced in the workplace should be obtained. These might include fixed plant and equipment, machines, mobile plant, hand tools, vehicles, liquid chemicals, powders, other materials and the like. Classification of items will depend on the hazards involved and the nature of work carried out. But full use of inventories must be made in producing useful layout plans for, say, machinery, fire, storage, first aid, etc. The layout plans will form the basis of systematic safety inspections. These plans can be used by management in order to conduct management safety inspections, to anticipate queries, and to offer as a basis for safety representative inspection if such is thought desirable.

Records of Accidents

Accident records and records of near-misses will provide a useful but by no means exhaustive series of indications as to areas of difficulties. Indeed, some employers should bear in mind that the commencement of trade union safety inspections will mean that accident records will be more meticulously scrutinised — and perhaps more effectively maintained. In addition, inspections may impel establishment of such records where such are not mandatory.

Details of Hazards

Knowledge of inherent hazards and hazards associated with use of all items recorded on the inventories, and identified on plans, will dictate how inspections should be carried out. Three major sources of knowledge are: —

Information about tests and safe use provided to employers under s6 of the Health & Safety at Work Act 1974;

Discussion with operatives about experiences, problems and observations about use; and

Training and experience of persons conducting safety inspections.

In addition to safety representatives' formal entitlement to inspect documents which the employer must keep by law, paragraph 6(b) of the Code of Practice tells that each employer should provide:

"Information of a technical nature about hazards to health and safety and precautions deemed necessary to eliminate or minimise them, in respect of machinery, plant, equipment, processes, systems of work, and substances in use at work, including any relevant information provided by consultants or designers or by the manufacturer, importer or supplier of any article or substance used, or proposed to be used, at work by their employees."

Employers must take account of the fact that the existence of these makers' and suppliers' specification sheets, warning notices, and the like, will be known to safety representatives and so will come to be requested for examination during safety inspections or when making preparation for such exercises.

Benefits to Management and Employees

In conclusion, I would like to stress that implications for management are far-reaching, but I consider the most important and most immediate repercussions will benefit both management and employees. Even after four years of safety law which imposes general duties on employers to ensure, so far as is reasonably practicable, the health, safety and welfare of all employees, managers still complain that, as much as they would like to, pressure of time and lack of resources simply prevent the degree of attention required. The prospect of criminal or administrative sanction has not forced the effort required by law. But when safety representatives begin to exercise their newly acquired entitlements to carry out their own safety inspections, management will be forced into a position to pay full attention to health and safety matters.

The author, who is Chief Works Officer, Department of Health and Social Security, presented this paper at the Biennial Scottish Conference of the Institute last Autumn.

The Development of the Hospital and Some Current Concepts

JOHN BOLTON LLB(Lond) CEng FICE FIMechE FInstE HonFCIBS HonFIHospE FIArb

Medicine in Ancient Greece and Rome

Men have treated other men for physical and mental complaints since the earliest times. There is evidence of this, from archaeological records of civilisations which rose and fell thousands of years ago. But medical treatment has never been restricted to sophisticated civilisations; we also find it among primitive societies throughout the world.

Throughout the centuries when Greece and Rome were at the height of their glory, the medical practices of their countries, were largely similar to those much earlier practices of Mesopotamia and Egypt, where medicine was a branch of religion, where the gods and the stars controlled diseases and the healers were mostly priests attached to temples. But they were not all priests. There were also large numbers of lay physicians trained by apprenticeship — often in family groups — and it was into such a group that Hippocrates, justly known as the father of medicine, was born in the year 460 BC. It was he who first broke away from the beliefs in supernatural causes of diseases and began to rationalise the practice of medicine and in the island of Cos, where he practised his art, can still be seen the ruins of the Asclepeion, the medical treatment centre dedicated to him. The Hippocratic physicians paid daily calls on their patients and kept clinical records. When such records lapsed they were not resumed by physicians for nearly two thousand years. It is interesting to note that some five hundred years later, Galen tended to follow the general teaching of Hippocrates, whilst attempting to rationalise medicine still further. The Greek medical system passed to the Arabs after the rise of Islam but it was not until 1525 that the Hippocratic writings were translated into Latin.

The Beginning of Hospitals

Ignoring the role of the early temples and specialised medical treatment centres, hospitals as such, have nevertheless been in evidence for a very long time. But it would seem that the early hospitals were not in any way concerned with teaching medicine. Indeed general medical thought at the time of the early development of hospitals, was contrary to such a concept. Hospitals, were in fact, the result of a complete change of attitude towards medicine following the general acceptance of Christianity.

St Jerome writing in AD 400, said that the first hospital had been built by a friend of his, a Roman lady by the name of Fabiola. He could find no Latin word to describe this 'new thing' but as usual the Greeks had a word for it and in his writing St Jerome left this word in the original Greek.

Subsequently mediæval Latin used the word 'hospitium'. Although this word means a place for guests (hospites) and indeed the early hospitium did take in any person in need of shelter, we should remember that its meaning in those days would be more what our forebears called an 'almshouse', a 'casual ward' or a 'spytell house', and the mediæval hospitals were just that — as there is evidence that the buildings were, in general, a mixture of chronic sick wards and homes for the aged.

It is probable that the first hospitals in Great Britain were built by the Romans and in fact the remains of a Roman legionary hospital were unearthed in 1958 at Inchtuthill near Perth. There was a central court around which were long corridors and off the corridors were built sixty wards for the treatment of the sick and wounded Roman soldiers.

We have definite knowledge of early Saxon hospitals at St Albans, at Flixton in Yorkshire and St Peter's Hospital in York itself founded by King Athelstan in 937. In 1909 Mary Clay listed over 700 establishments founded between the Norman Conquest and the middle of the 16th century, the earliest being St Wulstan's Hospital at Worcester founded about 1085.

All monasteries and nunneries had infirmaries, which catered for those monks and nuns who were too sick to take their places in the choir. A monk who was too ill to remain in his dormitory took with him to the infirmary his own bed and bedding from the dormitory but the Infirmarer kept a number of flock and feather cushions for the comfort of his patients. The Infirmarer was not a doctor but one of the senior brethren of the monastery and was usually appointed for his administrative ability. The infirmary itself appeared to follow a common pattern or design — a long nave or hall with an altar at the east end and a door at the other end, and with the beds arranged in two rows with their heads to the side walls. It is what we would describe today as the 'Nightingale Ward' and the similarity between the old and the new does not appear to be accidental.

St Mary's Hospital at Chichester (now an almshouse) is a good example of this type of building. So too are the ruins of the infirmary buildings at Christchurch, Canterbury and Castle Acre in Norfolk, which conjure up an impressive picture of what these buildings were like when intact..

The irony of the situation at that time was, that although the Christian revolution could be said to have been the cause of the beginning of the modern hospital, it also resulted in the postponement of scientific medicine for almost a millenium. It swept away all notion of material causation of illness and substituted a system based on morality and theology. The primitive notions of physical causation which were beginning to develop following the example set by Hippocrates and Galen were completely suppressed by the Church and the belief in sickness as retribution for sin was substituted. But in spite of the attitude of the Church it is hardly surprising that even the most devout of Christians failed to accept totally the official treatment of repentance and prayer when suffering severe pain or illness. As Dr Newman put it: "like the pilgrim on his way to Lourdes, people asked for a seidlitz powder to be going on with — or at least the Dark Ages' equivalent of one."

But on the reverse side of the coin, the Christian revolution introduced an entirely new attitude towards the sick, an attitude of pity arising from God's love, of a desire to help strangers and — even more remarkable — the poor. It was such an attitude which led to the foundation of hospitals and for nine centuries, the pilgrim, the wayfarer, the pauper and the sick counted on the hospitality of abbots and friars.

The work of the hospitium increased but the Infirmarer was often forbidden to practise the art of medicine. Later on he was allowed to bring in doctors to treat the patients. There is written evidence of doctors attending infirmaries in the 13th century and there were certainly male nurses in existence in the 14th century.

Treatment in Mediaeval Hospitals

Criticism is often made today of treatment received in hospitals. It is to be wondered what the patients of today would think, if they received the same treatment, meted out to their mediaeval forebears — the exhibition of holy relics, the use of charms, cuppings, applications of ointments and plasters, suppositories of honey and salt and the sipping of crab apple wine to name but a few. It became obvious to the Church towards the end of the 13th century that the purely religious side of its houses must be separated from the infirmary wings which were by this time becoming specialised institutions for the care of the sick — hospitals in the modern sense of the word — and as early as 1200, the government of both St Thomas' and St Bartholomew's became vested in Masters.

St Thomas' and St Bartholomew's — two of our most famous hospitals — were founded in the 12th century in London. St Bartholomew's, which claims to be the older of the two, was founded in 1123 by Rahere following a pilgrimage to Rome where he was taken ill. He vowed that if restored to health he would build a hospital on his return. He was restored to health and St Bartholomew's was founded.

The origin of St Thomas' is not as clear. Some of its supporters would dispute the statement that it was founded after St Bartholomew's and quote a 'tradition' that the original priory was founded about 1106. It could in fact have originated as an infirmary attached to the priory of St Mary Overie on which site now stands Southwark Cathedral. The Southwark Hospital was destroyed by fire in 1212 but a new St Thomas' hospital was constructed in Borough High Street where it remained until moved to its present site in 1871. And now a hundred years later a new St Thomas' hospital has emerged on the same site.

The Evolution of UK Hospitals

The Act of Supremacy in 1534 and its aftermath interrupted both the natural evolution of our hospitals and the science of medicine. By the end of the 17th century England was well behind a number of other countries, and in particular France, in philosophical and medical thought. It is hardly surprising therefore, that the charitable movement, which, in the latter half of the 18th century brought a measure of glory to our name, was rendered spectacular because of our earlier backwardness. There is no doubt that a good measure of generosity and goodwill prevailed at that time. But although we had differentiated several of the infectious and other diseases, and leprosy, sweating sickness and bubonic plague had disappeared there was in truth an unconscionable gap to fill. So far as treatment was concerned at that time, some fresh air was now allowed into the sick room, and a limited supply of piped water had become available.

There followed the voluntary hospital movement and one of the early voluntary hospitals in London came about through the efforts of Thomas Guy. He was the first to be able to finance such a venture and he lived to see the roof on his elegant building. Thomas Guy was also a Governor of St Thomas' Hospital, and so was familiar with the problems of caring for the sick. He may have been influenced in his thinking by John Bellars a Quaker, who as long ago as 1714 advocated 'a state supported service with hospitals at or near London and with one for each capital distemper.' The Westminster Hospital opened in Petty France in 1720. St George's Hospital appeared after Guy's and the London Hospital designed by John Harrison, the surgeon, opened its doors in November, 1740. The voluntary hospital movement spread early to the provinces, Winchester and Bristol, claiming pride of place.

In spite of the supposed decline in religious zeal in the reign of George I there seems to have been little decrease in philanthropy, and new voluntary hospitals continued to appear. To a large extent this was due to the great increase in foreign trade, and the prosperity of the merchants, in that long era of peace, under Walpole's Ministry. Furthermore a subscriber to a hospital was in a privileged position because he acquired prestige, in the eyes of his neighbours, his employees, and his tradesmen. The right of admission to hospital was virtually in his gift and he received an excellent return for his guinea.

Between the middle and the end of the 18th century the chief towns of the country had established voluntary hospitals. Most of them began in ordinary houses but were soon being partly or wholly re-built to accommodate an increasing number of patients.

In an age of large private mansions the hospitals retained a good deal of the domestic quality of their origins. Nevertheless hospital buildings were already different from ordinary houses. One of the most important differences was the attention paid to problems of ventilation because of the natural association in people's minds of foul air and sickness.

With the coming of the 19th century the voluntary hospitals were firmly established and before long every small township called for its cottage hospital. Both for the community and for the doctors the voluntary hospital had become a social distinction as well as a necessity.

Some of the early medical claims bordered on the miraculous. The Governors of Winchester Infirmary boasted of having cured a paralytic who had lost the use of his legs for several years and also of the recovery of a patient who had been totally blind in one eye, while at Exeter there was a story of the miraculous recovery of two men so far gone as to be admitted in open coffins.

The rules of hospitals, however, could be very strict. As late as the year 1828, a man died outside St Bartholomew's Hospital because he had neither of the alternatives necessary for admission, the fee or the letter. One man died of cold outside a hospital, while waiting for the doors to open on admission day.

Time is not available to discuss the evolution of naval and army hospitals nor indeed the development of special hospitals such as Children's, Maternity and the like. Mad houses as such, had been in existence for a long time, where the patients were usually kept in a filthy condition in chains. Often the only fire on the premises was in the kitchen. Members of the general public were admitted to many mad houses, and for payment of a penny the public thronged the penny gates of Bedlam, passed inside, and made sport of the miserable inmates, provoking them into furies of rage. The lunatics of Bedlam were long regarded as one of the sights of London. Some physicians actually expressed the view that such contact was beneficial to the patients.

A new word — asylum — came into fashion in the 1770's to denote institutions where any kind of relief or treatment was given. But humane treatment of mental patients took a long time to achieve.

In the year 1722 parishes were enjoined by Act of Parliament to provide workhouses for their paupers but workhouses did not become generally established until the passing of the Poor Law Amendment Act of 1834. The conditions in most of them were disgraceful. The unfortunate inmates were herded in insanitary and badly equipped buildings with totally inadequate medical and nursing care and were locked in at night with no help at hand. Charles Dickens has painted for us a vivid picture of what life was like for anyone unfortunate enough to be an inmate of a workhouse.

Hospital Construction and Planning

Sound principles for the planning, construction and ventilation of hospitals had been propounded as early as the middle of the 18th century but with notable exceptions they had either been ignored or the lack of finance had resulted in the maintenance of too low a standard of upkeep and care. But by the late 19th century some improvements were effected, largely the result of forward thinking men and women, the most notable example, being Florence Nightingale.

It was commonly believed from the 18th century onward that some connection existed between the spread of disease and the foul air present in hospital wards. Stephen Hales undertook the first trial of ventilators in a hospital, when he installed some at the County Hospital, Winchester in 1758. He adapted ventilators which he had designed for ships and in his *Treatise on Ventilators* published in 1758 he stated that 'they could be worked with ease by those in the ward by means of a lever fixed across the ward between the beds.' He had a rare appreciation in his day of the problems of air movement and ventilation. "Fresh air", he said, "must by no means enter at the windows in cold weather because such cool air will fall precipitately down through the warmer air of the ward, and thereby greatly incommode the patients."

But for many reasons mechanical ventilation was not to succeed in those days. Even a hundred years later Florence Nightingale, like so many of her contemporaries, disapproved of it, preferring natural cross ventilation. And even today there are still many who are against the use of mechanical ventilation or air conditioning.

Improvements in Hospital Design

According to Douglas Galton, improved hospital construction in England may be said to date from the Report of the Royal Commission on the Sanitary State of the Army, of 1857, which in his words 'for the first time laid down those principles without the observance of which no hospital can be kept thoroughly clean and healthy.' This was the Commission to which Florence Nightingale gave evidence. In his book published in 1869, Galton describes in detail the form and distribution of the various parts of the hospital which will achieve the best results. He concluded that many errors were committed in the design of hospitals and gave the following advice: —

'The architect should make his whole design subservient to the principles of hospital construction; he should be permeated by them; his watchwords should be — light, air, speedy removal of refuse, and great facility of cleansing.

The smallest number of parts compatible with the requirements of the hospital should be arranged in the simplest form, and solely with reference to the wants of the patients, and to the way in which the service can be carried on with the smallest number of attendants.

The architecture should be an expression of the need, and nothing more. Any sacrifice of sanitary requirements to architectural features is wrong; it adds uselessly to the cost. Ornament means too frequently the creation of corners and projections, which delay and stagnate the air, and form receptacles for dirt; it means present outlay and continual cost in repairs.

While so much suffering remains unprovided for in the world, it is melancholy to see a large portion of the money which has been gathered with so much difficulty, for the relief of that suffering, diverted from its main object, in order to create a monument of the architect's taste.'

Advice, if I may say, which is equally true today.

One of the most impressive and mammoth works of the late 19th century was Burdett's *Hospitals and Asylums of the World*, published in 1891. The work is in four volumes with a portfolio and includes references to the origin, history, construction, administration, management and legislation of the hospitals in existence at that time. It makes fascinating reading.

The main divisions of Burdett's building classification were: —

Pavilion Hospitals;
Block Hospitals;
Corridor Hospitals;
Composite or (as described by Burdett himself) Heap-of-buildings hospitals of which he instances Addenbrookes, Cambridge and the Edinburgh Royal Infirmary.

Developments in 19th and 20th Centuries

The late 19th and early 20th centuries saw considerable developments in the medical field, many of which in turn had an effect on hospital construction. For example, in 1867 Joseph Lister introduced the carbolic acid spray into the operating theatre. Then followed the development, first of antiseptics and then of aseptic techniques together with improvements in sterilizing equipment and theatre instruments all of which led to spectacular achievements in surgery.

By the middle of the 19th century most of the general hospitals were suffering from a lack of funds. In 1821 visitors to the Radcliffe Infirmary complained that sheets were either not washed at all or were kept on the beds for months — even if a patient had died in them — and as late as 1869 the Infirmary was begging for old sheets and rags to make dressings.

The bug ridden wooden beds of St Bartholomew's were not replaced with iron beds until 1815 although large amounts of money had been spent on attempts at disinfection. As late as 1828 the Westminster Hospital had only cold baths and when water closets were finally installed they were positioned behind thin wooden partitions at the ends of the wards and so badly installed that one leaked down on the kitchen below. Maladministration abounded throughout the hospital world and nursing too remained at a very low ebb, it being accepted that only the lowest type of women would undertake such disagreeable work.

It is not to be wondered at that in such conditions sepsis was rife and according to Sir James Simpson, speaking at a meeting of the BMA in Leeds in 1869, two men out of every five died, after the amputation of a limb in our larger British Hospitals. In the large Parisian hospitals two men out of every three died. The mortality rate in the smaller hospitals was better and tended to decrease to about one in seven in cottage hospitals.

The Designs of Isambard Kingdom Brunel

Most engineers are familiar with Isambard Kingdom Brunel, that great engineering entrepreneur, famous for his railways, his bridges, and his steamships, but not many people are aware that he designed and produced a remarkable prefabricated hospital for Renkioi during the Crimean War, and which came about following the revelation of the scandalous conditions at Scutari. The initial contract was for a hospital of 1,000 beds.

He explained the idea behind his designs for the hospital and, because it has governed the layout of similar temporary buildings ever since, it reads now like a statement of the obvious, but it was not so then. It was 'that the aggregate of the buildings should consist of such parts as might be conveniently united into one whole under great variations of conditions of the form and nature of the site. That the several parts must be capable of being formed into a whole united by covered passages, and that it should be capable of extension by the addition of parts to any size.' He then went on to explain the layout in detail. Each standard unit would consist of two wards each for 24 patients and it would be completely self-contained with its own nurses' rooms, water closets, outhouses and other details 'so that by no accident can any building arrive at its destination to be erected without having these essentials complete.' Each patient was allowed 1,000 cubic feet of air space and one large ventilator fan was provided for each unit. This fan, he was careful to point out, was designed to force air into the wards and not to extract it as that might draw smells from the closets into the wards. There were fixed wash basins and invalid baths of his own design, while each unit would be sent out with its own wooden trunk drainage system. Surgery, dispensary and officers' rooms would consist of the same standard units; only the kitchen, laundry and bakehouse would be metal instead of wooden buildings, because of the fire risk. In the wooden ward buildings, all heating and lighting would be performed by candles which Brunel considered the safest means then available.

I should like to read an extract from a letter which he wrote to a Government official:—

"I have added twenty shower baths, one for each ward and six vapour baths. You will be amazed to find also certain boxes of paper for the water closets — I find that at a cost of a few shillings per day an ample supply could be furnished and the mechanical success of the WCs will be much influenced by this. I hope you will succeed in getting it used and not abused. In order to assist in this important object I send out some printed notices or handbills to be stuck up, if you see no objection, in the closet room opposite each closet exhorting the men to use the apparatus properly and telling them how to do so. If you do not approve of such appeals the paper can be used for other purposes and perhaps impart some information in its exit from this upper world."

Erection took somewhat longer than Brunel had expected, this was because Brunton, one of Brunel's assistants, was unable to find any local labour which he could trust, consequently the hospital was built entirely by the little gang of 18 men who had been sent out from England to supervise the erection; nevertheless after about 18 weeks the hospital was ready to admit 300 patients, and some twenty weeks later it was equipped with its full quota of 1,000 beds. It was thanks to Brunel's foresight that the work of erection went perfectly smoothly and the Renkioi Hospital was a complete success. In the short time it was operating before peace was declared close on 1,500 sick and wounded men passed through its wards of whom only 50 died, a very different record from that of the fearful charnel house at Scutari.

The Hospitals' Lack of Funds

But the situation in this country became steadily worse and it was not only the voluntary hospitals which were in dire need of funds. The other main group of hospitals, those under the control of the local authorities, were also suffering, largely through the cheeseparing efforts of the authorities in regard to the amounts they were prepared to expend from the rates towards the maintenance and improvement of their hospitals. The Voluntary Hospital Commission was created in 1935 but it became obvious that direct government intervention was required not only to provide financial aid to keep the services running, but also to organise the hospitals into a proper system, in order to ensure, as far as possible, a standard degree of care for all people throughout the country, which would involve provision of adequate facilities within reasonable distances of their homes.

The National Health Service

The 1939-1945 war intervened but at last the National Health Service Act was passed in 1946 and became effective on July 5, 1948, when some 2,800 hospitals — the majority of hospitals in this country — passed to the Crown as part of the new Health Service. It should be remembered, however, that 75% of these were built before the 1914-18 war and 20% built before 1861. There was clearly much work to be done.

From a relatively small beginning in 1948 considerable progress has been made in the improvement and maintenance of our hospitals to the extent that the current annual capital expenditure is about £300m with a further £200m per annum being spent on operation and maintenance of engineering and building services. But this rate of spend was not achieved overnight. In the immediate post war period very little was done by way of capital improvement until the advent of the ten-year capital programme instituted by Mr Enoch Powell, the then Minister of Health. But during the last twenty years a considerable investment has been made, in the provision of new health buildings and the upgrading of existing stock.

Present Problems

The problems of today associated with the planning of services, the building of new hospitals and the maintenance of existing stock are enormous. No longer can we afford to think in terms of the design of large 'one-off' hospitals which involve, quite apart from the cost, years of planning and design. We have to accept the fact that some degree of standardisation is necessary. There is, after all, very little variation between the bodies (and their ailments) of people in Leeds and people in Brighton. We have come to the end of the era of the large ad hoc designed hospital — particularly the large teaching hospital. One is sometimes tempted to think that the former Boards of Governors and their architects were guided by Wren's epitaph — 'Si monumentum requiris, circumspice' — if you seek his monument look around you.

The improvements in medical treatment and techniques over the past fifty years have been spectacular and the rate of change continues to increase year by year. What we design today can be out of date by tomorrow. Thus speed of planning and construction coupled with a flexible solution are the key requirements of today.

Research and Development

Research and Development in the hospital construction field therefore, play an important part in the work of the Department and the Health Authorities. Investigations in this field have resulted in projects such as the new Greenwich Hospital, the Best Buy Hospitals, Standard Departments, the Oxford Method, Harness and more recently Nucleus. From the economic aspect it is true to say that hospitals cost a great deal of money to build, but the Departmental system of hospital building notes, coupled with cost control, has tended to ensure the provision of adequate facilities in all new hospital buildings whilst at the same time militating against their unnecessary embellishment. It is this joint effort between the Department and the National Health Service which has resulted in the United Kingdom being recognised as one of the world leaders in hospital building and health care.

The thread of our research and development work has been the means of trying out and either rejecting or developing ideas which have emerged, for example:—

(i) A system of parallel working with Contractors was tried at Greenwich and elsewhere by RHAs and discarded by the Department. Other unconventional methods of contracting have been tried and we are always willing to consider others, subject to the general rules on public accountability.

(ii) Deep services voids were tried at Greenwich and although found to be satisfactory were also found to be of limited application in relation to cost and space.

(iii) Activity Data which had previously been developed was continued at Greenwich, found to be universally applicable, and as a result further developed and refined. It is now used for all projects.

(iv) The production of guidance such as HTMs, HBNs and Data Sheets, which have all proved their usefulness, has been continued and extended.

(v) The work of Study Groups to obtain rationalised engineering standards — eg, lighting levels, standard specifications, economic considerations, rationalisation of engineering plant, to name but a few, continues.

(vi) Work with policy divisions and with Medical and Nursing colleagues to help identify client needs now and in the future continues.

The Future

What of our current and future work? It is clear to everybody that new medical techniques bring their problems, and the operation and maintenance of modern hospitals, with their highly sophisticated plant and equipment, call for considerable and expensive expertise and resources. We must always be thinking of the future and the effect which new medical techniques and political decisions will have on the planning, construction and operation of future hospitals. In this respect use is made of statistics and operational research which consider aspects of such things as epidemiology, geographical factors, cost of access, sociological factors and hospital sizes.

The adoption of such techniques obviously tends to improve the decision-taking processes, in the meantime a number of technical problems remain to be solved, for example, some matters of air conditioning and ventilation in hospitals, lighting levels, energy saving and the like; it is still a matter for debate, bearing in mind the cost and the need for energy conservation, whether or not we should provide air conditioning in hospitals and whether more importantly we should allow planning to dictate the need for it. So far as lighting levels are concerned our views have never coincided with the standards laid down by the IES. Studies undertaken at the time of the industrial action and as a result of energy conservation have tended to confirm our view; work is proceeding in this area, but side by side with IES (now part of CIBS).

We have given a good deal of guidance in the matter of energy conservation. A full note of our efforts and what we have been able to achieve throughout the Service was given by me in a recent paper at the International Congress of Hospital Engineering in Portugal (20% saving in energy over four years).

Co-ordination of Engineering Services

Another problem which has been receiving much attention over the past few years is that of the physical co-ordination of engineering services, one with another, and with the building itself.

One solution was the adoption of layering of services within the ceiling void. This achieves a coarse co-ordination and, although it can be used very widely, it is very often difficult to persuade clients and architects to adopt the philosophy other than for a specific range of buildings such as Harness or Nucleus, as superficially it seems wasteful of space.

Another solution is that of paying extra fees for a more extensive degree of design co-ordination than is currently the case with the majority of consultants and designers. With us this has taken the form of a new agreement with the ACE as a means of enabling Consulting Engineers to provide more by way of co-ordination before tender stage. We have negotiated the new agreement with the ACE covering co-ordination and co-ordination drawings and builders' work information and this has been published as a new 'Supplementary Annexure'. The drawings which will be provided as part of this service by the Consultant will form part of the tender documentation and we hope that this will lead to keener tender prices and a reduction in the need to issue variation orders. But one of the most important results will be a reduction in Claims for Disruption.

The Supplementary Annexure also covers cost planning and post contract cost control, tender analysis, engineering commissioning and the preparation of service manuals — client decides which (if any) of the services he requires on a particular scheme.

Our next task is to prepare in co-operation with the ACE a single document for health buildings, which will incorporate Model Form D, the Hospital Annexure and the Supplementary Annexure.

As regards engineering commissioning, the revision of HTM 17 which deals with the Commissioning of Engineering Services in Health Buildings should help. All necessary interests were involved in the revision — the CIBS, the ACE, the trade, RHAs and the Department — to ensure that the documentation was right for the job.

Use of Computers

We have done a lot with computers over the past few years, and for the longer term we are developing a computer method for identifying physical clashes between the services themselves, and between the services and the building. This goes under the name SCAMP (Services Co-ordination and Modelling Programme). The process will be fully automatic, ie, carried out completely by the machine. It will only identify areas of interference, not correct them, this must be done by the designer.

Let me describe the operation in simple terms: —

The designer makes a felt pen sketch of his services layout on an ordinary architect's plan as he would do at present.

The architect's drawings complete with sketched services are put into the machine by 'the digitiser'. The drawing is laid on the 'drawing board' and each point rapidly lifted off by touching with the pen. Components are taken up by touching the appropriate pieces on the key or 'menu' board again with the pen. The machine will then rapidly print out a drawing highlighting the areas where interferences occur. The designer must then re-route his services to clear obstacles, put the changed section back into the machine in the same way as before and again receives another print showing the remaining problem area if any.

The programme is also designed to print out perspectives of the building (plus engineering) from any viewpoint, without any further input other than the necessary instruction.

The millenium is almost here—(we think in about 12 months it will be operational, pilot fashion). Even now it is possible to put the drawings into the machine and print out perspectives on demand. Obviously they themselves are of great value and constitute a major advance towards the automatic identification of clashes.

When completed the facility will be made available by DHSS to RHA users. The mechanics of this are under discussion at the present time.

A little reflection will show that many other interesting things can easily be done by this tool such as accommodating change rapidly and easily, and site control, to name but two obvious ones.

It is not intended to replace either the designer or draughtsman — a moment's thought will show that it cannot. It will, however, make their lot much pleasanter by removing much of the tedium and source of dispute from their day's work.

With the ever increasing pressure on capital costs, running costs and the increasing complexity of modern hospitals the designer of the future will need all the help he can get in any form available. It is the aim of this facility together with other DHSS development work to give him just that. The days of the individual (and often slightly eccentric) entrepreneur are gone. But we need something to replace him — to improve the professional breed so to speak. We hope that the work which we are doing in the Department, helped by the NHS and Consultants, will achieve this.

I have now come to the end of my story. We have flitted from ancient Egypt, Greece and Rome to Islam, to the mediaeval period, through the Middle Ages up to the present day — a mere drop in the ocean of time, yet one during which much has been achieved. It is the rate of increase of change today which enables us as works officers to make a significant and worthwhile contribution to patient care.

The author, formerly a legal officer with an employers' association is now senior lecturer in Industrial Relations at the Portsmouth Regional Management Centre, where he is involved with middle and senior management courses for the NHS.

Industrial Relations—Putting Discipline into Perspective

DAVID JACKSON LLB(Hons) MSc(IR)

Many managers have viewed with bewilderment the onslaught of employment legislation over the past decade. As costly mistakes made by colleagues increased in number, each further decision of the Industrial Tribunals served to confirm their initial view that their right to manage was being seriously eroded, so that any disciplinary action against employees must be dealt with a caution bordering on nervousness. Initial misconceptions have produced the myth that a recalcitrant employee can indulge in unsatisfactory conduct or a poor standard of performance and emerge unscathed.

Two consequences have emerged — the first is that many organisations have looked at their grievance and disciplinary procedures, and to protect themselves have produced judgement mechanisms which are both cumbersome and complicated. Many public sector organisations have even gone as far as to organise quasi-judicial enquiries in order to deal with essentially straightforward matters of discipline. The result is that decisions on discipline become protracted and expensive, and in themselves have had the effect of reducing the authority of the manager to make any confident recommendations on discipline. Ironically this over-reaction could be argued to have reduced the right to manage of the individual manager far more effectively than the new law has.

A second consequence is that no self-respecting management course fails to devote some time to employment legislation. But the problem here is that such sessions have tended to confront the participants with lists of cases and section numbers, all of which serve to re-enforce the initial apprehension that they are dealing with an exceptionally complex body of law. But this is not so. The rules governing dismissal are, in fact, one of the simpler areas of law.

How then can these misconceptions be laid to rest? It has been said that the guide to simplicity is complete understanding. It may be profitable, therefore, to go back to square one and reflect upon the essential nature of the rules of unfair dismissal, and from this base suggest some guidelines for the practical manager.

To start with, it is necessary to understand one fundamental point — once dismissal has been established, the onus is on the employer to justify his action by demonstrating that he acted fairly and with equity in accordance with the facts of the case.

It sounds simple enough — but what does it mean? In particular, what is the significance of the word equity? Familiarity with a word often precludes thought as to its real meaning, and it is the concept of equity which is the key to understanding much of the protective legislation. Basically equity involves the idea of natural justice, or as the Americans call it 'due process'.

The terms most frequently used to describe the treatment of others are the words 'just' and 'unjust' and the implication is that ideas of justice and morality are co-extensive. Yet it is most important to understand that justice is a distinct part of morality. A man who is guilty of gross cruelty to his child may often be described as having done something morally wrong, bad or even wicked. In other words he has disregarded his **moral** obligations to his child. But it would not be accurate to describe his conduct as **unjust.** 'Unjust' would only become appropriate if the father had arbitrarily singled out one of his children for more severe punishment than that given to others guilty of the same offence, or if he had punished the child without taking steps to see whether he was really the wrongdoer, or even if he was aware that what he was doing was wrong in the first place.

These simple notions of justice spring from the roots of our society. Yet again familiarity with the terms used to describe them has tended to preclude a precise understanding of their implications. In practice the rules of equity demand that before redress be actioned certain steps should be taken. In any situation the questions to be asked are:—

how did the offence occur?
who committed the offence?
did he know he was doing wrong?
is the redress consistent with that handed out to others?
has a reasonable attempt been made at objectivity?

Or to rephrase it:

carry out a *full investigation of all the* circumstances;
institute a system of warnings to be applied consistently;
give the opportunity to appeal to someone *not previously involved in the* situation.

Put in the latter form the rules of equity become instantly recognisable as the essence of the Code of Practice on Disciplinary Practice and Procedure originating under the Employment Protection Act 1975. (The current code in fact re-emphasises the procedures dating back as far as 1971).

The essential features of good disciplinary practice are still, after several years, not as well known **and**

understood by management as they should be. It is even more surprising in as much as they literally represent common-sense, but it must be said that the one feature of common-sense which distinguishes it from other types of sense is that it is by no means common.

Perhaps the most important part of the Code is that relating to warnings. In practice, negotiated procedures usually provide for three warnings — a formal verbal warning and two written warnings. Again, let us pause and reflect on the implications of this statement.

A disciplinary interview is a serious affair and should be conducted with appropriate formality, and every effort should be made to follow the recommendations of the Code.

Investigate the facts

Prior to dismissal, the canons of natural justice dictate that a full investigation of the facts be made One of the recommendations of the current Code of Practice is that the procedure should 'provide for speedy operation'. Although the investigation should not attempt to rival that of the KGB, the results should certainly be well documented. Again, sticking to the theme of justice, it is a cliché, but nevertheless valid, that 'justice should not only be done but seen to be done'. Therefore, during the period of the investigation, suspension of the recalcitrant (on full pay) is advisable for a short period, if only to make it apparent to onlookers that adequate time has been made to carry out the investigations. It is another frequent misconception that suspension is a punitive measure, but **this is not necessarily the case.** It is primarily a device to enable the employer to sit back and marshall such facts as are available to him.

The first stage having been completed, the employer should interview the employee (in the presence of a union representative, should this be requested) and care should be taken in the interview:

to state the facts as known to the employer; and
to ask the employee for his side of the story.

This should be done, again so that 'justice can be seen to be done', but the manager must resist the temptation to reach his own private conclusions. The decision of management should then be presented to the employee, who should again be given the opportunity to make any further comments.

Record the facts

Because the disciplinary interview is a formal affair, it is logical that the whole meeting be systematically recorded in the form of minutes. A copy should then be presented to the employee for him to view and then placed on his record. The procedure is painstaking but one must remember the requirement that it should be a **formal verbal recorded warning.**

What is the difference between a formal verbal recorded warning and the written warnings referred to above? The answer is that the former is in the form of a letter or memorandum addressed to the employee, otherwise the format is exactly the same.

When is a warning not a warning?

Just as it is important that the investigation and interview be formally conducted and duly recorded, it is equally important that the warning be just that — a warning. It must be made clear to the employee that if there is another breach of discipline a further warning or dismissal will occur. Cosy chats sprinkled with gentle encouragements such as "let's pull our socks up" or "if this happens again, I don't know what we'll have to do" are not enough. Such an employer can kill himself with his own kindness by wrapping up his warnings to such an extent that the real meaning of his words becomes unclear. In one case, for example, an employee received letters from his superior criticising his work, but at no time was he specifically warned that he would be dismissed and his subsequent dismissal was found to be unfair. Why? — because the basic rules of equity had not been followed.

Be consistent

Equity also demands consistency. It is pointless having a rule which states that persistent lateness will be formally disciplined, if habitual lateness is the norm, and management is aware of this and has never invoked the sanction. Actions in this context speak louder than words — after all, by slack management allowing the practice to evolve it might reasonably be assumed that the rules have been waived. If one has written rules, then apply them firmly and fairly — otherwise one might as well not have them in the first place. Failure to do so effectively destroys the authority of management to manage and the danger is that less acceptable practices may emerge. This is not the fault of the law — it is the fault of management.

Another feature of equity is the notion of job property. If a purchaser of a house moves the boundary fence a few feet to increase the size of his garden, and the owner of the adjoining plot does not complain for a certain number of years then the recalcitrant is deemed to have acquired legal rights over that land. No one told him he could not have it and so he is entitled to regard it as his. In the same way if no one points out to a recalcitrant employee that he should not act in a certain way he is entitled to assume that he may continue to carry out his work as he has been doing. Furthermore, the longer he remains in his job the stronger his right to that job and to that practice. Consequently, in taking the decision to dismiss an employee, length of service becomes a vital factor — and failure to take it into account may render a dismissal unfair.

Where does the blame really lie?

It has not been the purpose of this article to write a detailed legal account of the law of unfair dismissal — only to remove some of the clutter of myth and misconception surrounding these essentially straightforward rules. These rules are merely an application of the basic requirements of justice which are readily recognisable in our everyday life. It must be said that because access to the Industrial Tribunals affords a quick and cheap means of redress for those who allege unfair treatment, the system will be abused by opportunists seeking unjustifiable compensation — but these claims, in the main, will be seen for what they are and dismissed. However, if some of the decisions of the Industrial Tribunal appear to challenge common sense, a thoughtful examination will usually reveal the explanation that some fundamental right has been overlooked. Because the sanctions for being unjust take the apparently daunting form of public examination in an Industrial Tribunal does not alter this fact. The just manager has nothing to fear — it is the unjust who should quake — and what's wrong with that!

For New Entrants

Mr Fletcher is Area Engineer, Cleveland Area Health Authority and has taken a special interest in giving lectures on engineering topics aimed at levels up to and including hospital engineers.

Guidance to Good Boilerhouse Practice and Management

J. R. FLETCHER BA CEng MIMechE MIMarE AMBIM FIHospE

Discussion with junior members of Cleveland's engineering staff has reinforced my belief that the assumption in my paper 'Boiler and Feed Water Treatment' (*Hospital Engineering* April 1977) "that one of the important areas of responsibility where newcomers to the NHS often need the greatest initial guidance remains the boilerhouse" is correct.

I have, therefore, chosen 'Guidance to Good Boilerhouse Practice and Management' as the title of my third paper. All aspects of good boilerhouse practice could not possibly be covered in one relatively short paper. Indeed, a library could be filled with books which have been written on this very important subject. Nevertheless, I hope this paper will assist engineers to understand some of the principles of boilerhouse practice and management and encourage them to expand their knowledge.

I cannot cover in depth all of the many facets of good boilerhouse practice and management. As I shall probably omit sections which some readers would have wished to have discussed, I ask the reader's tolerance in this matter. Perhaps some reader of greater experience will take up the pen and write a further paper.

Boilerhouse practice refers to the operation of the equipment, whilst boilerhouse management is the running and organisation of the system by engineers. Although they could be regarded as two distinct responsibilities, they are so interrelated that one cannot be discussed without the other.

Some engineers may say, "Why should the boilerhouse qualify for special consideration? After all, it is only the application of common-sense combined with knowledge".

This may be true, but the reader has only to reflect on the number of fatal disasters caused by bad boilerhouse practice, and the subsequent introduction of protective legislation to realise that not everyone is blessed with common-sense and the necessary knowledge. Therefore, I consider that guidance and formal rules are necessary for all boilerhouse staff.

A steam boiler may only have a fraction of the potential energy of an oil tank complex, but it must be remembered that the oil tanks are in a relatively stable condition, whereas a steam boiler under pressure is in a dynamic and unstable condition. The sudden release of energy from a boiler steaming at say 10 bar into a confined space, such as a boilerhouse, would be quite devastating.

Working boilers always present a hazard, therefore a flippant approach to boilerhouse practice and management should never be tolerated, and casual and slipshod behaviour by staff must be corrected. Any pressure vessel that contains liquid, gas or a mixture of both at a high temperature and pressure, must be treated with great respect.

All boilerhouse staff must receive adequate training to ensure that they are capable of carrying out their duties in an efficient and safe manner. They need to know all safety procedures, and be educated so that they can understand how and why the plant functions. They should have sufficient knowledge to be capable of recognising when the plant under their control is stable, and when it is unstable and in a dangerous condition. They also have to be aware of what remedial action is required to correct any instability, or how to notify a responsible person.

Stokers are often treated with contempt, frequently by other ancillary workers. This can be corrected if the Hospital Engineer treats the stokers with the respect they deserve. Stoking is a responsible job, which requires the application of knowledge gained through practice and formal training, something which is often not appreciated by other staff. A good stoker can save his wages many times over by intelligent supervision of the boilers and plant under his control.

Training in boilerhouse practice should not solely be for boiler operators. Because of the fall in the number of marine engineers entering the NHS, special training is often required for assistant engineers. Therefore, any training considered should include assistant engineers, tradesmen, boiler operators — indeed anyone involved in the operation and maintenance of boilerhouse plant.

The operational object of boiler plant is to convert heat energy contained in a fuel (coal, gas, oil) into a form which can be conveniently used, eg steam, hot water. For an engineer to control this conversion efficiently, he must have a sound knowledge of the various types of boiler and their suitability for a particular application, the types of fuel available, and the properties of water and the heat content,.or enthalpy of steam.

As the boiler is invariably the heart of the energy system within a hospital, it is the logical place to start boiler-house practice.

Boilers

There are many types of boilers available which have been developed to meet a variety of duties. These can broadly be classified into fire tube, water tube, and hot water boilers. The types of boiler one comes into contact within the NHS is varied, but the most common is the boiler commonly called 'shell boilers', usually of the Economic, Lancashire or Package construction. Therefore, for the purposes of this lecture, I will reserve my comments to these types, with a small comment on monotubes.

The water being contained in a shell or cylinder which has fire tubes passing through it, thereby affecting heat transfer from the hot combustion gases to the surrounding water, shell boilers can be said to combine the functions of (1) pressure vessel (2) energy store (3) combustion appliance (4) heat exchanger or energy transfer unit.

In the NHS the shell boiler is essentially a steam boiler generating steam at approximately 10 bar, although in the past decade there has been a marked tendency to use them as high pressure hot water boilers. Shell boilers have limitations as to the pressure that can be raised, but over the years there has been many innovations to increase their thermal efficiency.

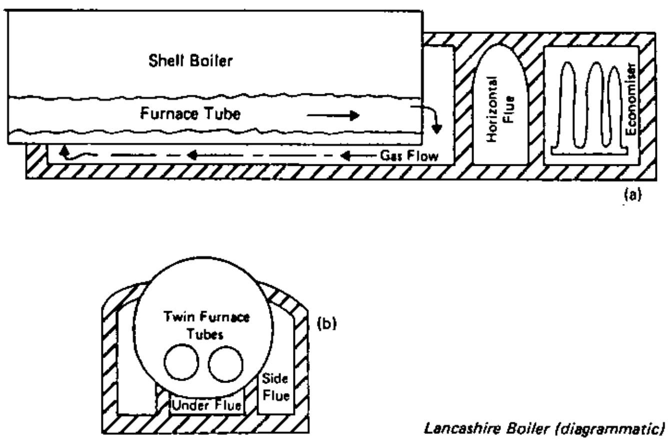
Earlier types of shell boilers are considered uneconomical by present standards. One of the earlier designs was the *Cornish*, of which one still functions within the Cleveland Area, installed in 1916. This type of boiler is basically a single flue fire tube with a thermal efficiency of approximately 65%.

Lancashire Boiler

The Lancashire is a natural development of the Cornish. There are still a great many in use within the NHS. They have produced, and indeed still do, magnificent service.

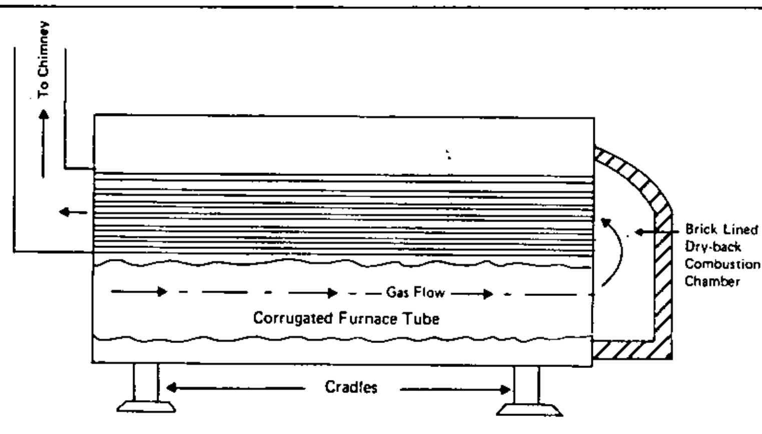
Although they are of a large and bulky construction, and of moderate heating surface, they do provide a large steam and water reservoir. Unfortunately, the quality of steam is 'very wet'. They have a slow response to load changes, but are able to supply sudden demands for steam at the expense of the pressure energy, due to the large water capacity within the boiler. Their construction is of twin fire tubes running the full length of the boiler, the hot gases are returned through external brick flues under the boiler to the front, then divided and directed along the sides of the boiler. Provision is required for expansion of the boiler shell within the brickwork.

Figure 1.



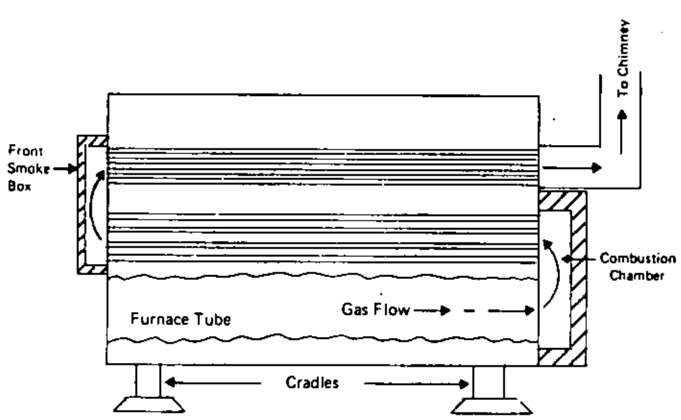
Lancashire Boiler (diagrammatic)

Figure 2.



Two-Pass Economic Boiler (diagrammatic)

Figure 3.



Three-Pass Economic Boiler (diagrammatic)

Due to the large mass of water within the boiler, circulation is poor and raising steam from cold is a lengthy procedure. The simplicity of design and robust construction allows the Lancashire to operate with low maintenance costs. Thermal efficiency is approximately 67% without economisers and 75% with economisers. (See *Figure 1.*)

Economic Boilers

These are a further progression where all gas passes are within the boiler, usually of two, three, or four pass, and can be either wet or dry back construction. (See *Figures 2, 3, 4 & 5.*)

The 'dry back' construction has a tendency to cause fire brick problems at the back end of the boiler, hence the development of the 'wet back'.

They are of relatively low volume with a small steam and water capacity. Due to their large heating surface they have a rapid response to load changes.

Limitations of pressure and evaporation are approximately 15 bar and 8,000 kilowatts per hour. They are much more compact than Lancashires, with greater proportional heating surfaces providing quick raising of steam. With the use of circulators and steam injectors, steam pressure may be raised in approximately three to four hours.

Thermal efficiency is dependent upon type of fuel used, but can be as high as 85%.

The first 'fire tube' boilers were introduced in approximately 1910 and proved to be a technological breakthrough in boiler design.

Package Boilers

These are a special application of the multi-tube boiler of a compact construction. When clean they have a high thermal efficiency, but due to the mass of tubes contained in a relatively small space they present cleaning problems which often leads to a reduction in efficiency. They require a close control of feed water treatment to prevent the build-up of scale on the water side of tubes, etc. The inaccessibility of the internal heating surfaces creates a cleaning problem, and chemical cleaning or the use of high pressure jets is often required.

Due to their construction, they are delivered to site complete with ancillary equipment, and only require connecting to the steam, water, fuel, electricity and blowdown lines, to be ready for service. They also require

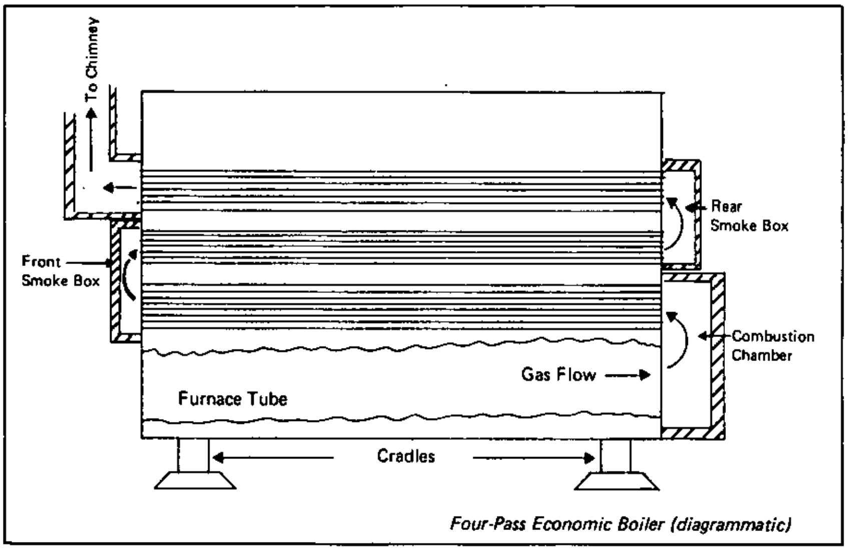
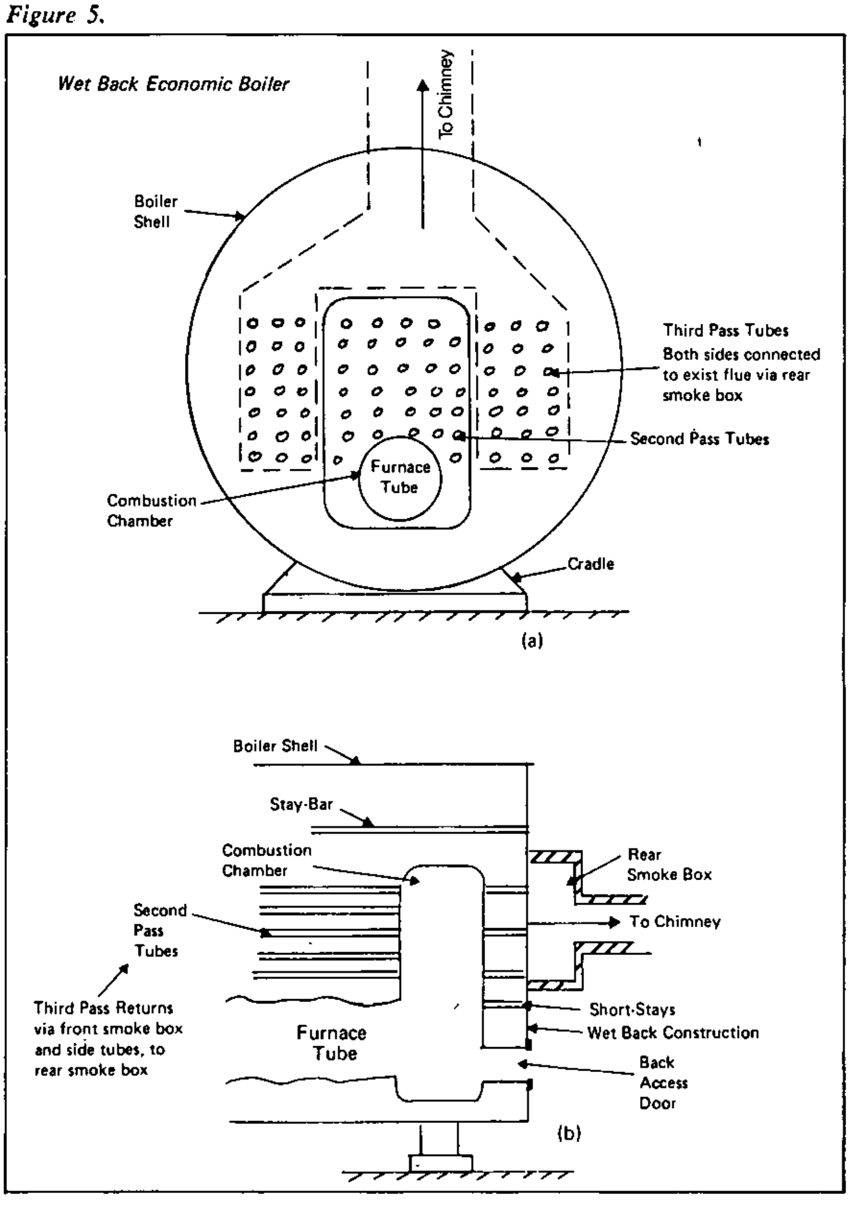


Figure 4.

Figure 5.



a relatively small operating space. Their compact package design makes them an admirable boiler for installation where speed is of the essence and for emergency use.

Mono-tube Boilers

These are a fairly recent innovation and consist of a continuous tube. Feed water enters the tube under pressure and leaves as steam, all evaporation occurring at the end of the tube. Capacity approximately 10 bar. 3,000 kilowatt/hour. They are of a low output capacity, and due to the evaporation occurring at the end of the tube, a heavy build-up of solids can occur resulting in tube blockagé. Only 75% of the water entering is converted into steam, 25% is recirculated. This 25% is heavy with dissolved solids and passes into a separator tube. The water passes through a cleaner and then recirculates.

A steam accumulator is often incorporated to provide a limited steam reserve. This type of boiler is extremely useful where a constant steam supply is not needed, but where steam may be needed quickly. Steam *can be raised in as little as two* minutes from the feed water entering the tube.

Some Definitions

Volatile Matter
Tarry gaseous matter consisting of hydrocarbons, gases driven off when coal of a certain type is first heated or carbonised on a hot fuel bed.

Moisture Content
Can refer to both the surface moisture obtained from the atmosphere or storage and the inherent moisture characteristic of the fuel.

Fixed Carbon Content
Residue after moisture, ash content and volatile matter have been removed.

Ash Content
Incombustible substance present in the fuel.

Caking Power
Extent to which a coal is capable of forming a coherent coke.

Friability
A fuel is said to be friable when it breaks down into small particles when exposed to atmospheric conditions over long periods of time.

Ignition Temperature
Temperature above which combustion of fuel takes place when mixed with oxygen.

Flashpoint Temperature
Indicates the lowest temperature at which inflammable vapour is given off in sufficient quantities to be ignited when in contact with a naked flame.

Viscosity
Resistance between successive layers of a moving fluid.

Specific Gravity
Ratio of weight of a given volume of a substance to the weight of an equal volume of fresh water.

Calorific Value
Calorific value of a fuel is the quantity of heat released on the complete combustion of unit weight of the fuel.

Gross Calorific Value
Includes the heat given up in the reaction to supply the latent heat of vaporisation to the water which forms part of the products of combustion.

Net Calorific Value
The gross value minus the latent heat referred to. The greater the amount of hydrogen in the fuel the greater the difference between the two valves.

Enthalpy
The total heat, is the sum of the sensible and latent heats.

Sensible Heat
Heat given to a body to change its temperature without changing its state.

Latent Heat
The heat given to a body to change its state without changing its temperature, eg latent heat of evaporation.

Saturation Temperature
The temperature at which steam is formed from water and varies with the pressure, eg the saturation temperature of steam at atmospheric pressure is 100°C.

Wet Steam
Steam containing small globules of moisture carried over from the boiler or caused by partial condensation.

Dryness Fraction
An inverse ratio of the amount of water contained in steam. Dry saturated steam has a dryness fraction of 1, whereas steam containing 10% moisture will have a dryness fraction of 0.9.

Combustion
Occurs when inflammable matter combines with oxygen at a temperature above the ignition temperature of that matter and produces heat.

Forced Draught
Achieved by forcing air for combustion through the front of the boiler and mixing with the fuel to achieve a high rate of burning.

Induced Draught
Achieved by inducing a flow of air through the boiler by means of an *extract fan mounted between the end* of the flue gas passage at the rear of the boiler.

Smuts
A smut is an acid agglomorate of oil and carbon particles resulting from a combination of total stack solids and low temperature corrosion products. If the temperature of the flue system falls below the acid dewpoint, a damp acidic film is formed on the walls of the chimney in loose layers. These layers break away by changes in gas patterns and thus carried out of the chimney. They create a public nuisance and can cause considerable damage to surrounding surfaces.

Economiser
A heat exchanger in the form of a *bank of tubes inserted in the exhaust* flue gases to raise the temperature of the feed water before injection into the boiler. Water temperature kept approximately 15°C below saturation temperature to prevent formation of steam within the economiser.

Superheater
A heat exchanger inserted in the flue gases where steam is heated out of contact with the boiler water where its temperature is raised, thereby increasing the sensible heat content, whilst the latent heat remains constant.

Fusible Plug
These are fitted in the crown of the furnace of shell boilers with solid fuel burners. The plug is of metal with a low melting point. If water level falls, undue heating of furnace crown melts the plug. Escaping water extinguishes the fire. They should be changed every two years as the fusible material can

change its metallic structure through constant exposure to heat, plus there is a tendency for scale to form over the fusible plug on the water side thus reducing its effectiveness.

Fuels and their Combustion

Fuel is any substance that will burn easily in combination with oxygen. The type of fuel used in the NHS is invariably:—
Solid Fuel — coal or coal derivatives;
Liquid Fuel — light and heavy fuel oil;
Gaseous Fuel — town gas or natural gas.

Fuels generally fall into one of three classes, solid, liquid or gaseous, and due to their different characteristics the combustion methods employed vary, and must be considered for each individual type of fuel. The type of fuel chosen will depend upon several factors:—
(a) cost and availability of fuel in the long term;
(b) type and size of boilerplant;
(c) availability of operating staff;
(d) environmental problems associated with the location of the boilerplant.
(e) operational and maintenance characteristics of the boiler burner;
— to name but a few.

Irrespective of the fuel chosen, there are several fundamental requirements wh'ch must be fulfilled. Adequate air must be supplied at the right time and then thoroughly mixed with the fuel to provide the necessary oxygen for complete combustion. The temperature of the combustion gases must be maintained at, or above, the ignition temperature until after ccmbustion is complete.

Solid Fuel

Coal is the most important of the natural fuels available in this country, and is the principal solid fuel used in the NHS. There are several types of coal available, lignite and brown coals, bituminous, anthracite and semi-anthracite. The type of coal burnt in the NHS is invariably of the bituminous variety.

Coal, as mined, varies both in size and quality and contains a considerable amount of impurities (dirt, shale, etc). It has to be cleaned and graded before it is ready for the commercial market. Coal chosen for a particular burner must only be chosen after full consultation with the National Coal Board and the burner manufacturer.

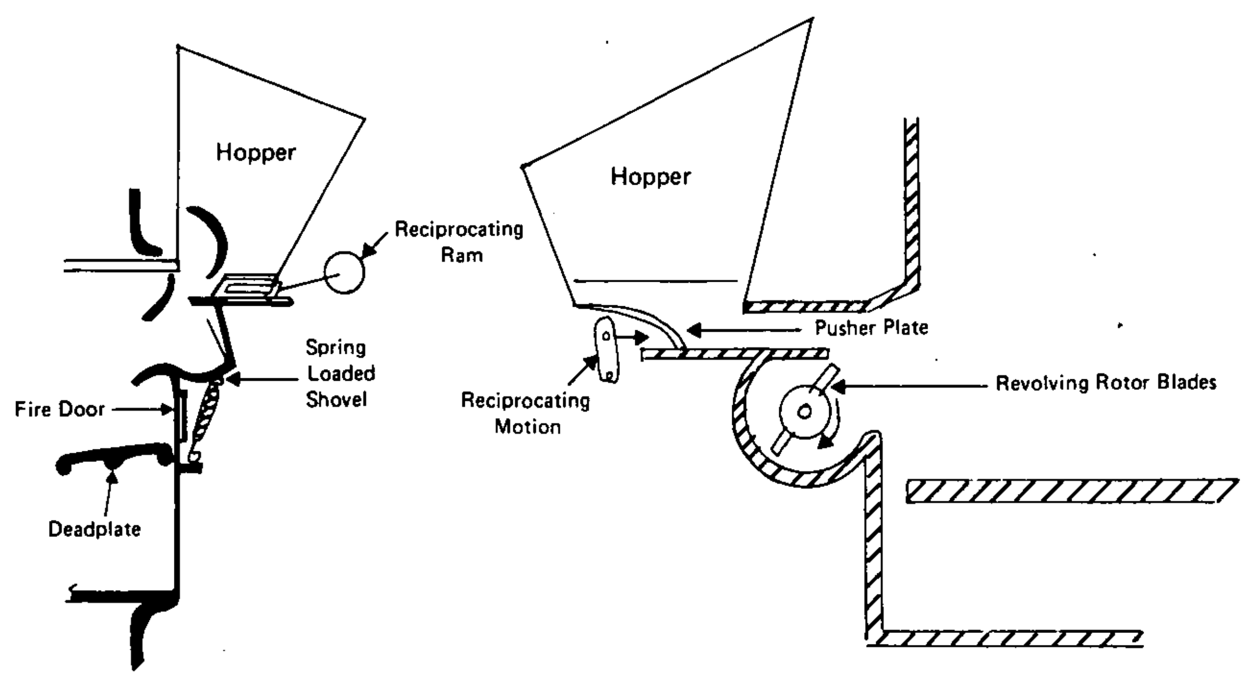
The type of coal available varies throughout the country. What is suitable for cokers may not be suitable for a chain-grate stoker. The bulk storage of coal can create the possibility of spontaneous combustion. Raw coal tends to absorb oxygen, and in the process emits heat, which unless allowed to disperse, gives rise to an increase in temperature which may result in spontaneous combustion. Therefore, all coal storage heaps must be well ventilated. Coal does offer a large storage facility (space permitting) and so offsets minor delivery problems.

Coal is burnt in a boiler furnace by hand-firing or by mechanical stoker. Hand-firing is only suitable for smaller plants which would not warrant the expense of installing a mechanical stoker. Hand-firing is an erratic and inefficient way of burning fuel (and is greatly dependent upon the skill of the stoker). With the increasing cost of fuel and labour it is being phased out rapidly, and I will not discuss it further.

The limitations of hand-firing can be overcome by the use of mechanical stokers, whereby a continuous or regular feed of fuel is maintained. without the admission of excessive quantities of cold air. Due to the better air/fuel ratio, higher thermal efficiencies can be achieved, particularly when lower grade fuel is burnt. Due to the reduction in manual labour, one operator can look after several boilers and devote more time to obtaining improved combustion efficiency. Mechanical stokers allow larger grate areas to be used, thus increasing the evaporate capacity of a boiler.

A good mechanical stoker should have the following desirable features:

Figure 6.



Sprinkler Stokers

1. It should be fed by mechanical means;
2. It should be capable of efficiently burning fuels of varying quality, smokelessly and maintaining an even fire bed;
3. It should be self cleaning, and the ash and clinker discharged should contain the minimum of combustible matter;
4. It should be capable of ready adjustment to suit variations in load demand;
5. Maintenance costs should be low and the necessary replacements should be readily available;
6. It should be possible to observe the condition of the fire bed without opening doors and so introducing excess quantities of cold air.

Mechanical stokers can be 'overfed' where the fuel is fed on to the bed or of the 'underfeed' type, where the fuel is fed underneath the bed.

Overfed types can be subdivided into Sprinkler, Coking and Chain-Grate Stokers.

Sprinkler Stokers

Sprinkler Stokers are virtually mechanical shovels which project the raw fuel from the hopper into the combustion chamber (see *Figure 6*). The feed hopper delivers the fuel on to a pusher plate which can be adjusted to deliver the desired quantity of fuel to the shovel or the rotary distributor. Thickness of fire bed varies between 50 mm and 100 mm. The shovel may have a horizontal action, or be of the radial or swinging shovel type. The shovel imitates the hand-firing spreading method, and the coal is thrown to different parts of the bed in turn. The rotary distributor spreads the coal continuously and evenly over the whole grate area. These stokers have a quick response to steam demand, but have a tendency to form smoke particularly if the air/fuel ratio is not carefully controlled. Primary air is supplied by means of a forced draught fan, being introduced through the grate bars. This has the effect of protecting the bars from overheating.

Coking Stokers

The coal is fed from the hopper and is pushed into the top coking or distributing plate by means of a ram whose stoke can be adjusted to give the desired rate of feed. (See *Figure 7*).

The volatiles of the fuel on the coking plate are distilled off by the heat in the combustion chamber, and are burnt as they pass over the hot fuel bed. Fresh coal is fed onto the coking plate, and the coked coal is pushed off the plate onto the grate, where due to the reciprocating movement of the fire bars it is gradually worked along the grate until it finally passes over the end of the grate as ash.

The stoker is as responsive as the Sprinkler type to variations in steam demand, and reduces smoke and grit emission. The draught required is greater than that required for the Sprinkler due to the greater thickness of the fire bed, usually about 30 mm at front, tapering towards the rear of the grate.

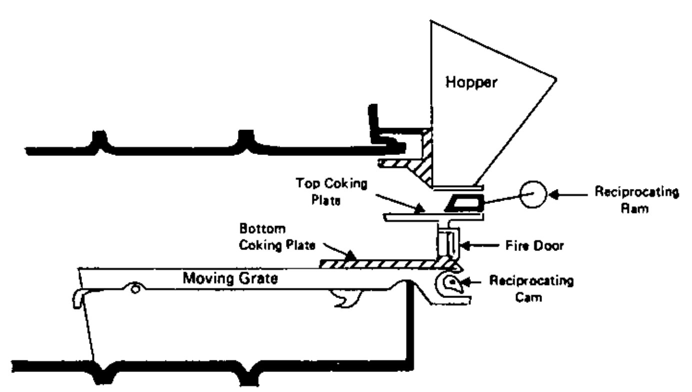
Chain Grate Stoker

Sometimes known as the travelling grate, this stoker enables fuel to be fed into the furnace continuously (see *Figure 8*). The fuel is fed from a suitably designed hopper to the front end of the stoker in a uniform layer over the full width of the grate. The fuel bed thickness being regulated by the position of the firing door or guillotine situated between the hopper and the combustion zone. Average bed thickness is approximately 100 mm. The boiler load and class of fuel determine the speed of the chain grate. As the fuel passes to the back of the furnace, the fuel is coked and the volatiles are burnt above the fuel bed. The grate speed and draught must be adjusted so that all volatiles are burnt, and the residual coke is burnt out as it reaches the ash plate. Balanced draught achieves the best rate of combustion, a forced draught fan supplies primary and secondary air for combustion purposes, an induced draught fan draws away the gases through the boiler system to the flues. The choice of coal is important, small coal and coal with low ash content and fusion temperature should be avoided. Coal with a moisture content and an ash content of approximately 7% is recommended, this reduces clinkering and helps to protect the grate. The incorrect choice of fuel will cause repeated breakdowns due to linkage breakage. Ash is extracted automatically from the furnace.

Pulverised Fuel Firing

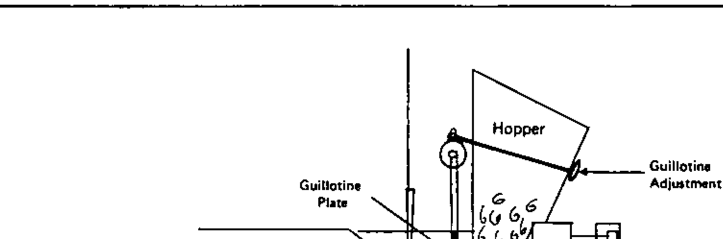
This type of firing has widespread

Figure 7.



Coking Stoker

Figure 8.



Chain-Grate Stoker

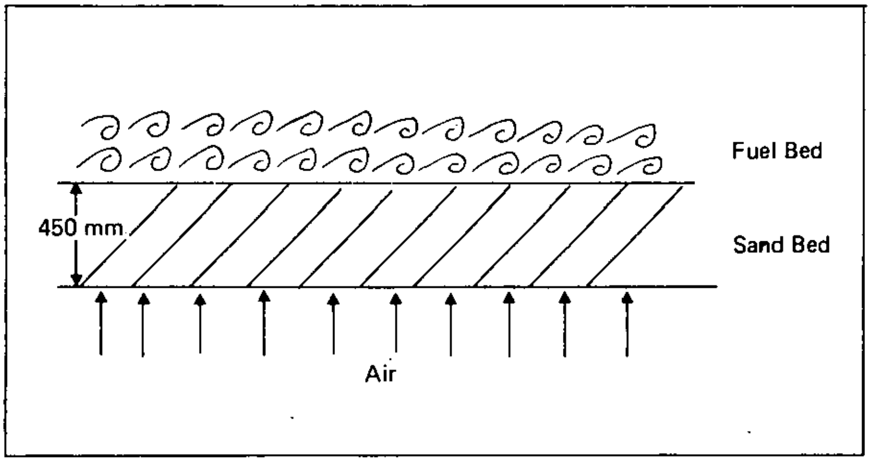


Figure 9.

usage in large boilerplants, particularly by the CEGB, but I am only aware of one instance of it having been installed in the NHS. The distinct advantage of this type of firing is that it permits the efficient combustion of cheap low-grade coal. The fuel is ground or pulverised to a flour-like consistency, and the fuel is then blown into the combustion chamber and burnt in suspension. Intimate mixing of the fuel and air is obtained using very little excess air and a high efficiency comparable with liquid fuel burners can be achieved. Unfortunately, the cost of the extensive plant required for pulverising the fuel is high, and is usually only justified on plants which have a fairly constant steam load in excess of 50.000 kg/hour. There are two main systems of pulverised coal firing: —

(a) The unit system, consisting of a pulverising mill unit feeding direct to the burners of a single burner;

(b) The bin and feeder system, where the raw coal is pulverised and transported to a central bunker, from which feeders distribute the fuel to a number of boilers.

One of the major drawbacks in the use of pulverised fuel in smoke-tube boilers is the high carry-over of grit and ash, which can quickly cause blockages in the tubes. There is also considerable wear and tear of the refractory lining, particularly in the vicinity of the burners. As with gas and oil burners, a purging cycle is required to clear the combustion spaces of inflammable gases before the burner is ignited.

Fluidised Beds

This concept of burning fuel is in its infancy, particularly in the NHS. I am not aware of any boilerplants which are in operation using fluidised beds (see *Figure 9*), but I believe experimental plant is in use, using hospital waste as the fuel.

High pressure air is introduced under the sand bed, which is thus aerated. The emitting air mixes with the fuel and keeps it in a fluid state, promoting efficient combustion. The heavy residuals gravitate through the sand bed for extraction to waste. This type of combustion is not very flexible, and will have to be used where a constant base load exists.

Combining the fluidised bed combustion with a quick rise steam load boiler, such as a liquid fuel burner monotube boiler, to cope with steam peaks could have possibilities.

Finally, it can be said that coal is a plentiful fuel, rich in energy, which is easily obtained, easy to burn and store, and is currently the cheapest form of fuel available. Unfortunately, it has several unattractive features. It requires a lot of mechanical equipment for handling and burning, which invariably involves a lot of maintenance. The storage and handling of coal and subsequent removal of ash waste, etc, is not very satisfactory in a hospital. The consistency and characteristics of coal varies enormously throughout the country, and trouble is often experienced with burners due to the NCB changing the fuel supply from colliery to colliery. Calorific values can vary from 8,000 to 14,000 Btu's/lb, and Ash content from 3% to 30%.

Liquid Fuel

Liquid fuel is a fossil fuel, but unlike coal is the result of a manufacturing process, and as such the quality of the oil can be controlled within closely defined limits. The various classes of oil are shown at foot of page.

Up until the recent astronomical rises in oil prices, it could be said that oil was the most favoured fuel when choosing for a new installation. It is still the fuel used in the majority of hospital boilers. The type of fuel oil used depends upon the size and usage of the boilerplant. On boilers of a relatively small capacity, or for part-time use, the lighter oils are used because of the ability to burn the fuel without attendant ancillary equipment such as heated storage tanks and pipework, recirculation pipework, and heaters to raise the temperature of the oil before combustion is possible.

The heavy oils, particularly 3,500 secs, are used on larger plant, where the consumption warrants the additional expenditure required to install the ancillary equipment mentioned above.

The cost of oil varies inversely to the viscosity, ie the higher the viscosity the cheaper the oil.

35 sec oil requires no preheating before atomisation,
200 sec oil may require it, while
3,500 sec oil does require it
to lower viscosity of oil to approximately 100 to 150 seconds.

Liquid oil is a fuel which is easily delivered and stored. Storage capacity for a minimum of three weeks' consumption should be provided. Storage facilities must comply with current regulations with reference to siting, type of storage, drainage, venting, filling facilities, fire precautions, etc.

The majority of oil burners in use within the NHS are one of the following types:

1. Pressure jet burners;
2. Air/Steam assisted pressure jet;
3. Spinning cup burners;
4. Vaporizing burners.

Heavy fuel oil	—	3,500 secs	Redwood No 1
Medium fuel oil	—	950 secs	Redwood No 1
Light fuel oil	—	200 secs	Redwood No 1
Gas oil	—	35 secs	Redwood No 1
Diesel oil / Distillates, etc		not used as boiler fuel	

Pressure Jet Burners

Atomisation of the fuel is brought about by pressurising mechanically, and then converting the pressure energy into velocity energy by passing the oil through an orifice or nozzle. Pressure varies between 12 bar and 30 bar. The oil issues forth from the nozzle in the form of a fine spray in the shape of a hollow cone. The air required for combustion plays no part in the atomisation of the oil and has to be introduced with sufficient velocity to penetrate the cone, and so mix thoroughly with the atomised oil. After the air and oil-mix ignition is achieved by means of an electric spark supplied by a pair of electrodes.

Pressure jet burners are the most common of oil burners used on fully automatic boilers, having a good turn-down ratio of 3 : 1.

They are simple in action, easy to maintain, and, providing the nozzle is kept clean, are very reliable.

Air/Steam Assisted Pressure Jet Burners

Similar in concept to the pressure jet, except that atomisation does not depend upon the oil pressure but upon the velocity of the assisting medium, which can be low-pressure compressed air or steam, approximately 1.5 bar. Velocity of air breaks down and atomises the oil.

Rotary or Spinning Cup Burners

These burners achieve atomisation by mechanical means, using a combination of low pressure air and a spinning cup shaped like a truncated hollow cone, and usually having a serrated edge on the large diameter. The cone can be rotated either mechanically, or pneumatically, ie incoming air strikes fins on the outside of the cup causing the cup to spin like a turbine. Oil is fed onto the inner surface of the cup, and centrifugal force propels the oil along the cup until it is finally whirled off the serrated edge, thereby affecting primary atomisation. Atomisation is completed by mixing with the incoming air.

These burners provide a simple but effective means of atomisation, suitable for a range of oils. The spinning cup is readily interchangeable.

Maximum viscosity for this type of burner is 400 seconds Redwood No 1 which means heavier oils require preheating. The spinning cup rotates at approximately 5,000 rpm, for efficient atomisation it is essential to have an evenly distributed film of oil on the cup.

Oil too thick on the cup causes slip between the layers of oil, causing uneven atomisation. Conversely too little oil causes erratic atomisation. These burners produce good atomisation providing the cup is kept clean and well maintained. Cups with an imperfect serrated edge should be discarded. These are suitable for fully automatic plant, and they provide a good turn down ratio.

Vaporizing Burners

Invariably used on low output boilers, eg domestic use. Oil is heated in order to vaporize at correct temperature, and the resulting vapour is mixed with the correct amount of air to produce combustion. The air balance is important to prevent undue carbon build-up and is introduced by either natural or forced draught. These are suitable only for low viscosity fuels.

Gaseous Fuels

Since the advent of North Sea gas (natural gas) the use of gas within the NHS has increased. Natural gas is approximately 93% pure methane, which requires no special provision for combustion. It has a high calorific value controlled by Act of Parliament, low flame speed and is already at an inflammable temperature. Natural gas, being lighter than air, will collect at high level. Boilerhouses using this fuel must therefore be well ventilated to avoid dangerous concentrations.

As a fuel it is not as economical as coal or heavy fuel oil, but competes favourably with lighter oils. As a fuel it is easily distributed, but offers no reserve storage capacity, therefore an alternative means of combustion is required for emergency purposes, particularly when the gas is supplied on an interruptible tariff basis.

Hence the introduction of dual fuel burners into the NHS, whereby natural gas is used as the principal fuel. The secondary fuel is usually 35 sec oil which gives a reserve storage capacity for emergency use.

Before considering the use of natural gas as a boiler fuel, engineers are advised to discuss the proposal with the relevant local gas board, who will provide all the necessary advice to ensure that current regulations are followed.

Natural gas provides a low maintenance fuel, much favoured by engineers, with a relatively high efficiency. The lack of sulphur within the fuel ensures a clean flue gas. The relatively high hydrogen content of the fuel produces relatively high stack losses and a low net CV.

General Principles of Combustion

The heat required for the generation of steam in a boiler is obtained from the combination of fuel in a part of the boiler known as the furnace, and from the hot gases produced by the combustion as they flow over the boiler heating surfaces on their way to the exhaust flue. Combustion is the rapid chemical union of the elements of carbon and hydrogen etc in the fuel with the oxygen gas from the air. During this process heat is produced. Student readers are advised to work out from first principles how much heat can be generated from the complete combustion of one unit of coal, heavy oil, and natural gas. The procedure can be obtained from any textbook on 'the principles of heat'. Another way of expressing the heating value of a fuel is quoting the 'evaporative value'. This is the quantity of water at 100°C which can be converted into steam at the same temperature by the complete combustion of one unit of fuel.

The primary object of accelerated combustion is to burn more fuel per unit area of grate, or liquid and gaseous fuel per unit volume of combustion space. Hence the use of forced draught and/or induced draught fans.

It is not intended to go into the basic principles of combustion, as the majority of readers will have studied, or will be studying, the subject in depth while gaining the necessary academic qualifications for promotion within the NHS. Suffice it to say, that everyone involved with the supervision of a boilerplant should have enough knowledge to establish quickly that good combustion is taking place. Any engineers of experience can quickly assess the approximate efficiency of his boilerplant by checking the CO_2 and temperature readings, and by flame inspection. With practice and experience, one develops a 'nose' for these things with surprising accuracy. The readings expected will of course vary depending upon the fuel used. If the new entrant does not know what are the correct readings, then I suggest that he asks for guidance from his supervisor. Who knows, he may get quite a surprise if he asks several different people!

Formation of Steam

Heat is a form of energy, and the transfer of heat from one body to a second body increases the heat content, or enthalpy, of the second body.

There are three distinct stages in converting water to steam:

Stage 1
Sufficient heat is added to the water to raise the temperature to the saturation temperature corresponding with the pressure (sensible heat).

Stage 2
Further heat is added to boiling water under constant pressure, which causes a change in state from water to steam without any change in temperature (latent heat). When all water present is converted into steam, it is referred to as dry steam, not practical in the presence of water as water globules will be entrained in the steam.

Stage 3
Almost dry steam can then be taken from the boiler and passed through a superheater where further heat is added at constant pressure. The steam is completely dried, and then raised to the desired degree of superheat (sensible heat).

The total enthalpy is dependent upon the quality of the steam produced and the pressure condition. The student reader is advised to calculate the enthalpy of steam for various pressures and then to check his results against a set of steam tables.

Atmospheric Pollution

The Clean Air Act 1956 has considerably reduced the level of atmospheric pollution. A Hospital Engineer should ensure that all boilers under his control do not add to atmospheric pollution and that they meet current requirements. Smoke can consist of unburnt gases such as carbon monoxide, hydrogen, methane, sulphur, etc, and is usually a sign of inefficient combustion. Although some smoke must be expected during 'flashing-up' periods, etc, constant or repeated smoke emission must not be tolerated.

Atmospheric Pollution can be greatly reduced if:

1. Sufficient time is allowed for combustion to be completed within the combustion chamber;
2. The combustion chamber temperature is sufficiently high to ensure ignition of the fuel and volatiles;
3. There is sufficient air to ensure an intimate mix with the fuel in order that combustion may be completed.

Where grit persists as a nuisance, a grit arrestor must be fitted on the boiler exhaust flue. The height of a chimney influences the extent of the nuisance. A low chimney localises the settling of particles whilst a tall chimney will distribute and dilute any pollution over a much wider area. The Clean Air Act 1956 is a comprehensive document which Hospital Engineers should study (fundamentals only), particularly with regard to furnaces, density meters, height of chimneys, and smoke control areas. Approval of new furnace and boiler installations must be obtained from the Local Authority. Therefore it is advisable to consult with the Local Authority concerned at the design stage of a contract. Installations within a smoke-controlled zone must burn an authorised fuel.

Boilerhouse chimneys should be fitted with an instrument suitable for the detection, measurement and recording of smoke. An audible alarm should be fitted which operates automatically when the density of smoke exceeds a pre-determined obscuration level. The alarm and recorder is normally activated by a photo-electric cell projector and receiver placed across the base of the chimney or flue connection to the chimney. Suction assists in keeping the projector and receiver lenses clean by causing a small stream of air to flow into the housing via air orifices. Smoke density is recorded on Ringelman charts, which are calibrated from white to black in six shades numbered 0-5. The lenses of the projector and receiver must be cleaned regularly to prevent false readings.

Boiler Efficiency and Testing

Although daily monitoring of boiler efficiency is usually maintained through the recording and assessing of oil consumption, steam evaporation, CO_2, ambient, feed water, and flue gas temperatures, periodic tests are still required to assess the true boiler efficiency, and to check on the accuracy of the boilerhouse instruments. Efficiency tests should be carried out when steady full load conditions are available. It is essential that accurate instruments are used to measure fuel and water consumptions. All readings should be recorded for comparison with previous tests, particularly the original efficiency tests. For comparison purposes, boiler outputs are usually expressed in kilowatts per hour expressed from and at 100°C at atmospheric pressure.

The following information should be recorded for boiler efficiency tests:

1. Date and length of tests, frequency of observations;
2. Barometer reading and boilerhouse temperature;
3. Type and quantity of fuel used;
4. Calorific value of fuel (analysis if possible);
5. Flue gas temperature;
6. Flue gas analysis;
7. Draught readings;
8. Ash quantity and amount of unburnt fuel (if solid fuel);
9. Quantity of water evaporated;
10. Temperature of feed water;
11. Steam pressure and condition, ie dryness fraction and temperature.

Tests should be for a minimum of 6-8 hours, readings should be taken at regular intervals during the test, and should be taken by a responsible person.

The gross CV should be used in the formulae below.

The main losses of heat in boiler installations are:

a. unburnt fuel in liquid or solid state;
b. unburnt fuel in gaseous and smokey state;
c. heat loss in flue gases;
d. radiation and conduction.

The first two losses can be eliminated almost completely by the use of the correct method of burning the fuel. The loss of heat in the flue gases can be reduced by using an economiser or air preheater, although care must be taken not to lower the flue gas temperature below the dewpoint temperature.

Assuming that the insulation of the boilerplant is in the optimum condition, the heat losses by radiation and conduction are approximately a

$$\text{Boiler Thermal Efficiency} = \frac{\text{Heat Output}}{\text{Heat Input}} \times 100$$

$$= \frac{\text{Heat Used to Produce Steam}}{\text{Heat provided by Fuel}} \times 100$$

AREA HEALTH AUTHORITY .... HOSPITAL .... Date:..............................

BOILER & CALORIFIER PLANT LOG SHEET

TIME	STEAM CONS			BOILERS						FEED WATER					FUEL			
	Total Steam	Laundry Steam	Boiler in Use	Pressure	Exit Draught Press	Fuel Temp.	Combustion Chamber Temp.	Exit Flue Temp.	Exit Gas C.O.2.	Pump in Use	Pump Press	Boiler Inlet Temp.	Flow Meter Reading	Make-Up Meter Reading	Flow Meter Reading	Return Meter Reading	Flow Temp	Return Temp.
	kg/hr	kg/hr		bar	m.bar	°C	°C	°C	%		bar	°C	°C	Litres	Litres	Litres	°C	°C
To suit local conditions																		

TIME	HEATING SYSTEM						DOMESTIC HOT WATER						DOMESTIC COLD WATER		
	Pump in Use	Cal. in Use	Cal. Temp.	Flow Temp.	Return Temp.	Flow Press	Pump in Use	Pump Press	Cal. in Use	Cal. Temp.	Flow Temp.	Return Temp.	Pump in Use	Pump Press	Meter Reading
			°C	°C	°C	bar		bar	°C	°C	°C			bar	Litres
To suit local conditions															

AIR	
Ambient	Boiler Front
°C	°C

TIME	OIL STORAGE TANKS			
	Tank No.	Contents	Oil Flow Temp.	Oil Rev. Temp.
		Litres	°C	°C
	1			
	2			
	3			

	CHEMICAL TREATMENT
TIME	DETAILS OF CHEMICALS ADDED
	DETAILS OF BLOWDOWN

STANDARD DAILY BOILER DUTIES		REMARKS
Water Gauges Tested		
Test High, Low, Extra Low Water Alarms		
Test Flame Failure P.E. Cell		
Test Low Steam Pressure Alarm		
Clean Burner Nozzle		
Changeover & Clean Oil Fuel Filter on Pump Unit		
Test Fire Circuit Alarm		
Remove Alarms Checked		
Signature of Tester		
OPERATORS REMARKS		Signature
CHECKED BY: Signature ....Engineer		

Figure 10.

constant, although it is accepted that there is a small seasonal change in the boilerhouse air temperature. Therefore a quick check of a boiler efficiency can be obtained by checking the variable factor in the flue gas loss by use of the 'Siegert Formulae' which is:

$$\text{Dry Flue Gas Loss} = \frac{K(t_1 - t_2)}{CO_2 \text{ reading}}$$

where K = 0.56 for heavy fuel oil
= 0.38 for natural gas
= 0.63 for bituminous coal
t_1 = flue gas temperature
t_2 = combustion air temperature
CO_2 = % CO_2 in flue gas taken at same position as t_1.

Hospital Engineers are recommended to carry out this simple but quick method of checking boiler efficiencies at least once per week as a monitoring role on energy consumption.

Records

An essential part of good boilerhouse practice is the recording of essential readings within an official log book once per working shift. The use of loose leaf records should be discouraged. Log books should preferably be hard-backed, signed and inspected daily by a nominated engineer. Operators should be informed as to the importance of taking readings at the stated times, and instructed as to the correct procedure for filling in the official log book, and for drawing the attention of the following shift operator to any irregularities in the system. Wherever possible, automatic recorders should be installed to reduce human error and to provide a factual record. Recording instruments are advisable for steam evaporation, CO_2, exit flue temperature and back-end temperature, feed water temperature, gaseous fuel and smoke density.

It is advisable that all log books within a District or Area are similar. This makes it easier for operators to understand and for supervisors to read. A suggested log sheet for steam boilers is shown on *Figure 10*. Obviously the log sheet will have to be modified to suit individual needs, and the restricted space of A4 prevents the optimum layout, but any boilerhouse log book should contain sufficient information to ensure that the operator(s) are performing their duties, and that sufficient information is being recorded to enable the Hospital Engineer to monitor the performance of the plant effectively.

Boiler Inspections

Due to the inherent potential danger in a pressurised boiler, periodic inspection by a competent person is required by law. To ensure the safe operation of a boiler, the following fittings must be attached to each boiler:

1. a suitable safety valve to prevent the boiler being worked beyond its designed working pressure;
2. a suitable stop valve fitted between the boiler and the steam main;
3. a suitable steam pressure gauge calibrated in appropriate units and with the maximum permissible working pressure distinctively marked thereon;
4. a water level indicator;
5. a suitable means of attaching a test pressure gauge;
6. a fusible plug or an efficient low water level alarm device;
7. a distinctive number easily visible if the boiler is one of two or more boilers.

The above fittings are mandatory.

Other fittings are obviously necessary before the boiler is operable, eg feed check valves, auxiliary steam stop valve, air vent, manholes top and bottom, blow down valve, boiler water sampling cock, high level alarm, etc.

New entrants are advised to write down on a piece of paper all of the fittings or mountings there are on their boilers, and then to go and check if they are correct.

For liquid and gaseous fuels, the low level alarm should include a flame cut-out device, and on automatic boilers an extra low level alarm and flame cut-out device is required. The extra low level cut-out incorporates a lock out device which requires manual resetting.

Inspections of boilers must be carried out by a competent and qualified person once every 14 months, and after any extensive repairs.

Every facility should be given to the inspector (usually an insurance technical inspector) to enable a thorough internal and external boiler examination and subsequent operating examination under normal working pressure to be completed quickly, and with the minimum of inconvenience to both parties.

Hospital Engineers should ensure that the boiler for inspection should be cleaned, descaled and all fittings opened up for inspection as required, so that the inspector can complete his duties with minimum fuss.

Full co-operation in the preparation and carrying out of these periodic tests is to the Hospital Engineer's advantage.

Conclusion

I now come to the most difficult part of this paper, knowing how to end it! Boilerhouse practice and management is such a large and important subject that I am beginning to feel as if I have stepped onto a treadwheel which refuses to stop. I realise that there are many items which I have not covered, eg 'Commissioning of Boilers' is a subject on its own, but this, I feel, is covered admirably in HTM 26, a copy of which should be in every Hospital Engineer's possession. Boiler ancillary equipment is another — perhaps someone will produce a paper.

I can only hope that this relatively short paper will assist new entrants in their understanding of boilers, etc, and encourage senior staff to ensure that adequate training facilities are available for operators and supervisors. I hope also that it will reduce some of the complacency that exists with regard to boilerhouses.

Hospital Engineers should constantly be examining their procedures to see if they require improving, or indeed, that they are being followed. I have walked into more than one boilerhouse to see evidence of manhole doors having been incorrectly fitted, filthy sight glasses where it is almost impossible to establish the water level, steam leaks which have obviously been blowing for a considerable period of time, instruments showing optimum temperatures and CO_2 readings, only to find on examination they have been preset and then disconnected (needless to say *not* in Cleveland).

Gentlemen who are we kidding! I repeat what I said at the beginning of this paper, the boilerhouse is no place for complacency and irresponsible behaviour. It should be the Hospital Engineer's showroom, and often where he is first judged by his superiors and visitors. An untidy and dirty boilerhouse usually reflects a poor standard of engineering throughout the hospital.

Where does a large percentage of the engineering budget get consumed, *in the boilerhouse*, therefore, gentlemen if we cannot get this part of our responsibilities right, there is not much hope for the rest!

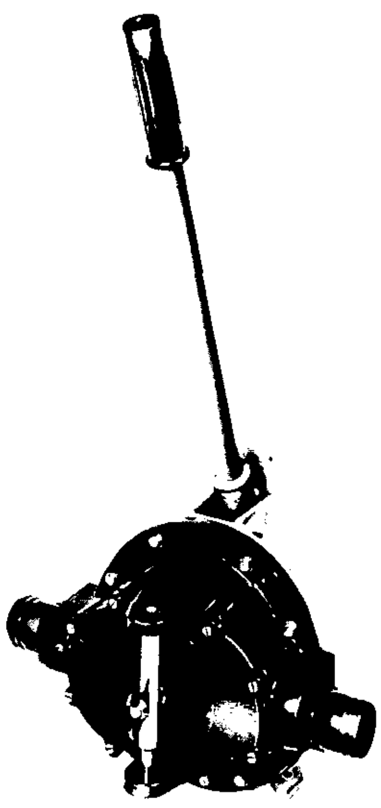
Product News

New uPVC Hand Pump

A new uPVC hand pump is according to the manufacturers capable of delivering 85 litres per minute at one stroke per second. It is self-priming, easily maintained, transfers liquids containing solids and can be mounted in any position. This pump is suitable for emptying carboys and sumps, etc, and can handle a wide range of aggressive chemicals. Weighing approximately 2.5 kg, it has a maximum delivery of 4 m head and a maximum suction of 2.5 m head. The list price is approximately £35 plus VAT.

Full details are contained in a leaflet available direct from: George Fischer Sales Limited, Eagle Wharf Road, London N1 7EE. Tel. 01-253 1044.

The new uPVC hand pump.



Automatic Dispenser

Kardex Systems are giving working demonstrations of their successful Pharmatriever — the automated labour-saving device for the dispensary which is rapidly becoming standard equipment for enterprising pharmacists.

In place of the traditional pharmacy with shelves, cupboards and drawers taking every available inch of wall space, Kardex Pharmatriever condenses the whole dispensing stock into a single unit occupying about 4 × 8 feet of floor area and standing some 7-8 feet high. Electric power delivers the appropriate material to hand in a few seconds, always at a comfortable working height.

Manual labour of dispensing is significantly reduced, maintain Parmatriever users. They also indicate that a greater number of prescriptions can be dealt with in a day with less fatigue, and that stock control is improved.

Pharmatrievers are now in profitable use. They can be found in use in single unit 'High Street' retail chemists, multiple unit high-turnover concerns, and there is an increasing number of hospital installations.

Enquiries to: Kardex Systems (UK) Ltd, 2 Dyers Buildings, Holborn, London EC1N 2JT. Tel: 01-405 3434.

New Electric Sensor

A new electronic sensor can be used for detecting when the filter of Erlab portable fume cabinets has reached saturation point. Erlab is well-known for their fume hoods which eliminate toxic gas by filtration. The electronic sensor can indicate if the wrong filter is being used for that particular gas or chemical.

Full technical data is available from: Bigneat Limited, 64 Solent Road, Havant, Hants PO9 1JH. Tel. 0705 476831.

Encapsulated Magnetic Pump for Corrosive Fluids

The new high energy material Hera, which gives twice the power of conventional ceramic magnets, has been incorporated into Totton's latest design, enabling them to improve the gap tolerance between the two magnets which operate each encapsulated magnetic pump. The most significant advance is that the EMP equipment will have only polypropylene and alumina ceramic spindles in contact with fluids. Therefore the pumps can handle sulphuric, hydrochloric and other highly aggressive acids.

EMP range technical details are available on request from John Grindley, Totton Electrical Sales Ltd, Southampton Road, Cadnam, Southampton. Tel: Cadnam 3136.

Services Brochure

'Planning for the Future' is the title of a technical publication for hospital planners, architects and doctors. The brochure describes the products, services and planning facilities available from Operating Theatre Planning Division of Eschmann Bros & Walsh Ltd.

The brochure is available free from Eschmann Bros. & Walsh Limited, Operating Theatre Planning Division, 24 Church Street, Shoreham-by-Sea, West Sussex BN4 5EB.

US National Fire Codes

The 1979 edition of the National Fire Codes, published annually by the National Fire Protection Association (NFPA) is the largest in its long history. This sixteen-volume set of Codes contains 12,635 pages. The National Fire Codes consist of the complete text of the current edition of each of the 238 official NFPA documents.

NFPA standards and codes are 'consensus' documents, developed by some 150 Technical Committees of the Association on which nearly 2,400 experts serve voluntarily. The National Fire Codes are widely adopted at federal, state and local levels as public ordinances and regulations, and are used extensively on a voluntary basis by commerce and industry. The Codes are useful for everyone concerned with fire protection, prevention and suppression in residential, industrial, commercial and institutional properties.

Price of the complete set of 1979 National Fire Codes (Catalogue No FC-Set) is US $95; individual volumes are US $10 each.

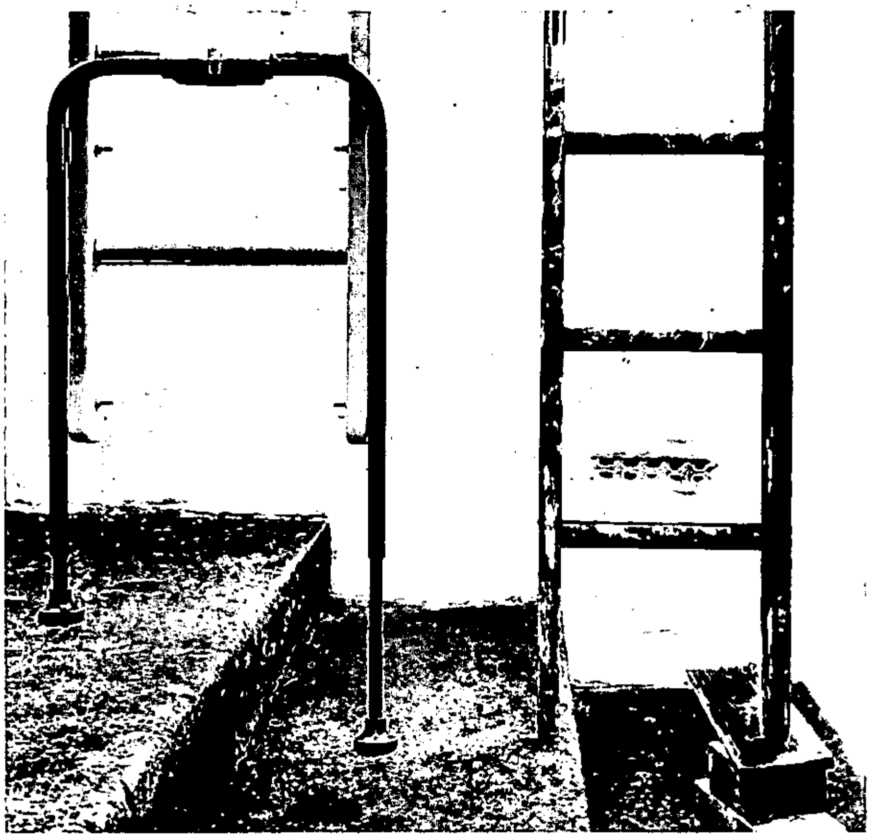
Inquiries and orders should be addressed to the NFPA Publications Sales Department, 470 Atlantic Ave, Boston, MA 02210 USA. Tel. NFPA Sales at (617) 426-2525.

Balancing Device for Ladder Users

Levelmatic is a simple device which, when bolted to the bottom of a ladder, is stated to adjust the length of its legs to compensate for uneven or sloping ground, steps or stairs. The legs of the unit are telescopic and interconnected — as one leg goes up the other goes down. The legs are connected by a 'ball chain' made up of a number of steel balls threaded onto a stainless steel cable which passes through a tubular guide linking the legs. When a Levelmatic equipped ladder is placed in position the legs adjust to suit the ground and are automatically locked by the weight of the ladder. When the ladder is lifted, the lock releases and the legs become free to adjust to the ground conditions at the next site.

The manufacturers claim it takes about twenty minutes to fit and is maintenance free. Once fitted, it is automatic and requires no action by the ladder user. The cost is around £20.

Further information is available from: Levelmatic Ltd, 29 Alexander Street, London W2 5NU. Tel. 01-221 6565.



The Levelmatic in action.

Quick-Reference Performance Guide for Axial Fan Selection

A quick-reference selection guide to axial flow fans has been produced by Thelcastle Ltd to assist fan users in making the right choice for a particular application. This new guide offers a comparison of the specifications and performance ratings for direct-driven and belt-driven units.

Copies of the new axial flow fan selection guide are obtainable, free of charge, from Thelcastle Ltd, P. V. Works, Montonfields Road, Monton, Eccles, Manchester M30 8AW. Tel. 061-788 0345.

Smoke Alarm Unit

A new smoke alarm unit, manufactured by Photain Controls Ltd, will when fitted to the output duct of a boiler or onto a chimney monitor the products of combustion being emitted to atmosphere and provide a visual and audible signal when these exceed a safe limit. The unit is designed with solid state components and the manufacturers claim it will have years of life with negligible maintenance. The principle of operation is based on a solid state light emitting diode (LED) mounted in a robust east aluminium housing fitted on one side of the duct or chimney and a photocell in similar housing fitted on the opposite side. Both the LED and photocell are connected to a control unit which can be mounted remotely.

In addition to providing protection against prosecution under the Clean Air Act, 1956, the manufacturers consider this unit ensures greater operating efficiency of the boiler by bringing the attention of the operator to the waste of fuel which is incurred when excess products of combustion are being emitted to atmosphere. The price is £100 per set (plus VAT in UK) and delivery is estimated at 3/4 weeks.

For further information, please contact: Photain Controls Ltd, Unit 18, Hangar No. 3, The Aerodrome, Ford, Nr. Arundel, West Sussex BN18 0BE. Tel: Littlehampton 21531.

New Gould Advance 15 MHz Oscilloscope

Including many features normally found only on the more highly-priced oscilloscopes, the Gould Advance OS255 incorporates a large 10 × 8 cm rectangular cathode ray tube and a control layout designed for easy use. Open-plan circuit-board layout and a low component count enhance reliability and simplify maintenance.

A wide range of measurement facilities is provided. The vertical amplifiers feature 2 mV/cm sensitivity, sum/difference and X-Y modes with channel 2 inversion. Horizontal sweep rates are adjustable over 18 ranges from 0.5 μs/cm to 0.2 s/cm, with a X5 expansion giving a fastest sweep rate of 100 ns/cm with no loss of accuracy. A calibrator output (1 V-1 kHz), ramp output, and DC coupled Z mod input are incorporated.

Comprehensive triggering features are included. Positive or negative slope selection is available, and triggering can be AC/DC or from a television signal, with active sync separation. Line or frame for television applications is selected automatically by the timebase control.

The OS255 measures 140 mm high × 305 mm wide × 460 mm deep, and weighs approximately 6 kg. The instrument carries a two-year guarantee.

Details are obtainable from: Gould Instruments Division, Roebuck Road, Hainault, Essex. Tel: 01-500 1000.

Classified Advertisements

APPOINTMENTS AND SITUATIONS VACANT

DEVON AREA HEALTH AUTHORITY
TORBAY HEALTH DISTRICT

ENERGY CONSERVATION OFFICER

(ENGINEER GRADE)

Applications are invited from suitably qualified and experienced persons for the above post. Applicants will be accountable to the District Engineer for the evaluation of all energy requirements in the District.

The work entails the investigation and implementation of schemes and measures for the control and utilisation of all energy resources and the development of statistics and management information.

PLANNER MANAGER — ENGINEER

(ENGINEER GRADE)

Applications are invited from suitably qualified persons for the above post in the Technical Services Section of the District Works Department. He/she will manage the Planning Office, comprising three Planner Estimators engaged in the District Works Incentive Bonus scheme, and would be responsible to the District Engineer for the implementation and organisation of the Health and Safety Act, Hazard Notices, Work Safety Committees, and Permit to Work Systems.

Applicants for both posts must hold an ONC in electrical or mechanical engineering or equivalent together with appropriate endorsements as laid down in the Professional and Technical Staffs B Council Handbook.

Salary scale: £4,497 to £5,073 plus bonus allowance.

Application form and job description for both posts available from Mr D. J. Chappell, District Engineer, Torbay Health District, Torbay Hospital, Torquay.

Dartford and Gravesham Health District

Kent Area Health Authority

Senior Engineer

£4,938 - £5,718 + London Weighting

Engineer (2 posts)

£4,497 - £5,073 + London Weighting

The posts are attached to the District Works Department but will involve working in the four sectors.

Duties will include both maintenance and project work and applicants should have a broad engineering background (both mechanical and electrical) and possess the qualifications as laid down in PTB 9/78 — HNC in Mechanical or Electrical Engineering or C&G 293, 255 Part 3 or Full Cert No. 57 or 281.

Previous training must include an Apprenticeship and for the senior post an appropriate management qualification.

The District Headquarters are situated at Darenth Park Hospital in a pleasant position overlooking the Darenth Valley.

For informal discussion please contact the District Engineer Mr R. D. Rose (Telephone: Dartford 29326 Ext 271).

Application forms and job descriptions are available from the District Personnel Officer, District Headquarters, Darenth Park Hospital, Dartford, Kent.

Closing date for completed applications May 18, 1979. All post are open to both men and women.

Engineering and Building Officers

Norwich Health District

The complex buildings, plant, services and equipment of the Health Service Estate demand commitment, versatility and ingenuity on the part of the Engineering and Building Officers charged with the responsibility for its maintenance and development.

We offer the opportunity for the practical professional to make a real contribution to health care.

Engineering Officers' posts are available for men and women at St Michael's Hospital, Aylsham, and the following Norwich Hospitals, Hellesdon, St Andrew's and Norfolk and Norwich where the vacancy for a Building Officer exists.

Salary

for all posts: £4,497 - £5,073 (New entrants to the Health Service will commence at the minimum of scale).

Qualifications

Appropriate ONC or City and Guilds (Part II) Certificate, or equivalent, are the minimal qualifications required.

Enquiries

Informal enquiries may be made to Mr L. G. Banks, District Engineer, for Engineering Posts, or Mr C. D. Gower, District Building Officer, for Building Posts on Norwich (0603) 29717.

Application forms may be obtained from Mr F. D. Blackburn, District Works Officer, 201 Bowthorpe Road, Norwich, to be returned within 10 days of advertisement.

Board of Governors — St. Peter's Hospitals

GROUP ENGINEER

(0-12 points)

Salary scale: £4,743 pa - £5,229 pa plus £354 London Weighting.

Responsible for the efficient management of the engineering and building services of this group of four, post-graduate teaching hospitals.

Applicants must have suitable experience, hold an HNC in Mechanical, Electrical, or Electrical and Electronic Engineering, a higher qualification, or an acceptable alternate qualification, and have completed an apprenticeship in mechanical or electrical engineering.

Application forms and job descriptions are available from the Personnel Officer, St Philip's Hospital, Sheffield Street, London WC2A 2EX. Tel: 01-242 9831 Ext 37.

Closing date: May 25, 1979.

AREA WORKS ORGANISATION

Sterilizer and Specialist Services Engineer

Salary scale: £5,328 - £6,309 pa

Applications are invited from suitably qualified and experienced applicants for the above post in the Area Works Organisation based in Cambridge.

Duties of the post will cover a wide range of activities connected with the testing, evaluation and commissioning of sterilizers, medical gas systems and other specialist hospital services.

Applicants should be qualified to at least HNC level in Mechanical, Electrical or Electrical and Electronic Engineering.

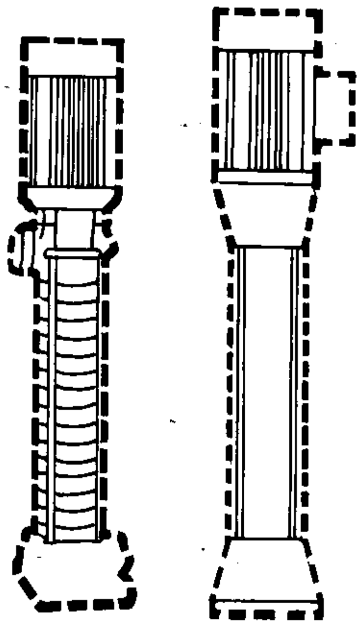
Application forms and job descriptions may be obtained from the Area Personnel Officer, Cambridgeshire Area Health Authority (Teaching), Purbeck House, Purbeck Road, Cambridge CB2 2PF. Telephone: Cambridge 42841 Ext 234.

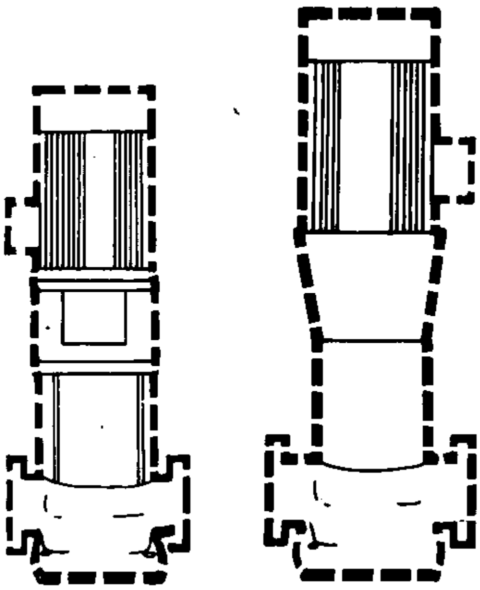
Closing date for receipt of applications is May 30, 1979.

CAHA

CAMBRIDGESHIRE AREA HEALTH AUTHORITY **(TEACHING)**

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





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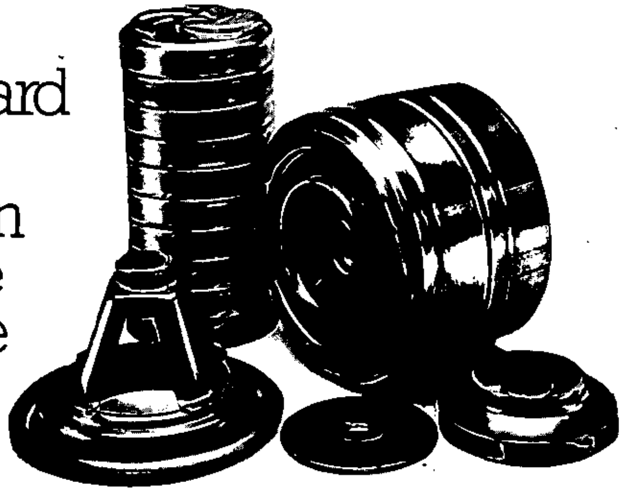

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