HOSPITAL ENGINEERING

June 1978

International Federation Issue

The Journal of the Institute of Hospital Engineering

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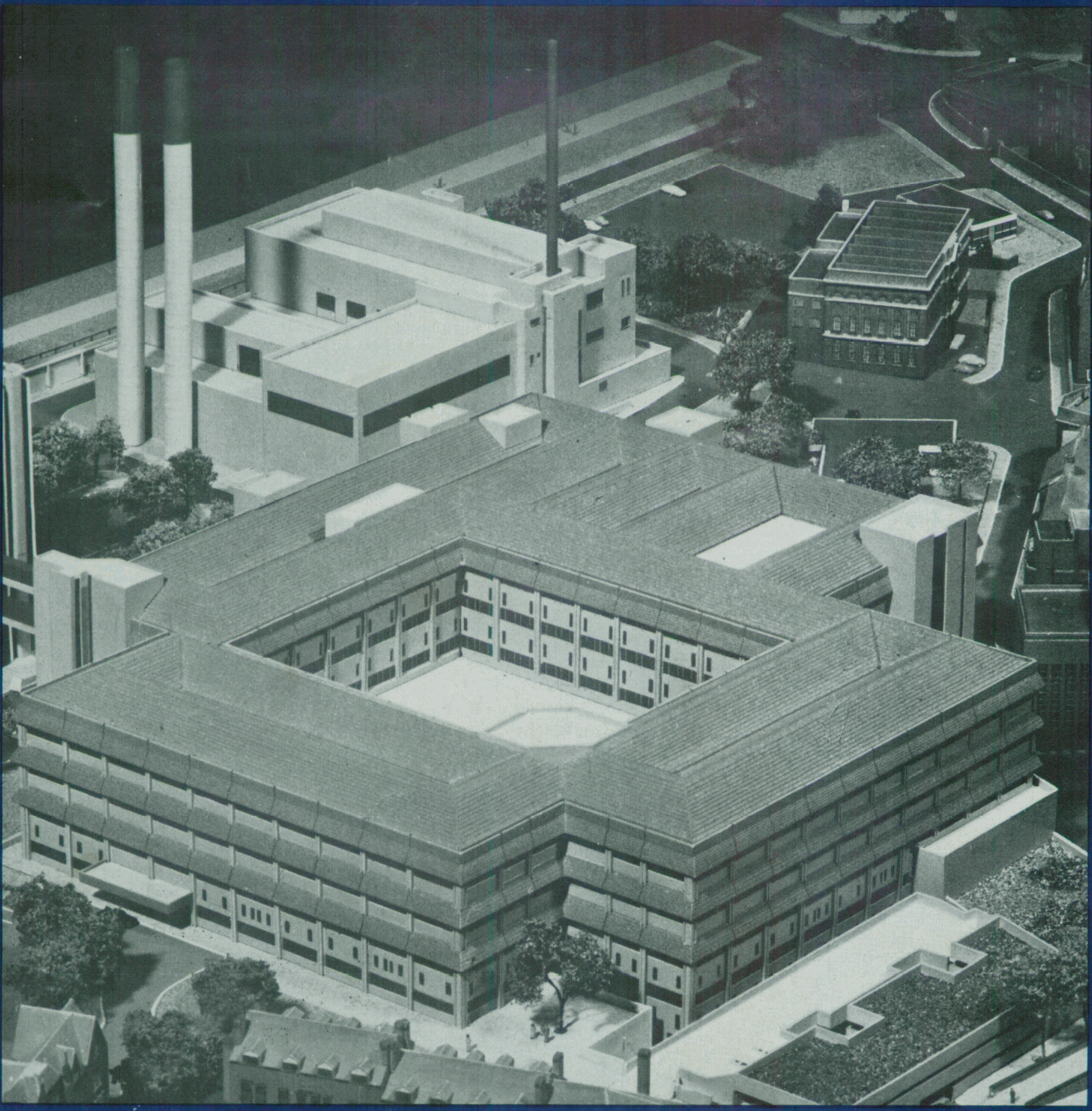

Making best use of the NHS Estate

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Institute News

Annual General Meeting

The Eleventh AGM of the Institute was held at 9.30 am on Friday, April 28, 1978 at the Royal Hotel, Cardiff.

The President, Mr J. R. Harrison, CBE, presided.

The meeting commenced with the President calling on the Secretary to read the Notice convening the meeting.

Council Report and Financial Accounts

The President proposed, W. Carr seconded, 'that with the consent of the meeting the Report of the Auditors be taken as read'. Agreed.

The President proposed, K. J. Eatwell seconded, 'that the Report of Council and the audited Accounts of the Institute for the year ended December 31, 1977, be received and adopted'.

The President invited questions on the Report or the Audited Accounts and there being none, the proposition was put and carried unanimously.

Elections to Council

a. The President reported that in accordance with the Articles of Association, the following members of Council would retire at the conclusion of the Annual General Meeting:
R. G. Freestone, Area Member — East Anglia and East Midlands;
P. Jackson, Area Member — Wales;
D. H. Mellows, Area Member — North West;
B. A. Hermon, General Member;
K. W. Wilson, Nominated Member.

b. The President announced that the following being the sole nominees in their respective categories were elected to Council unopposed:
M. Brooke, Area Member — East Anglia and East Midlands;
E. A. Johnson, Area Member — Wales;
S. Ratcliffe, Nominated Member.

c. The President then called on the Secretary to open the sealed envelope received from the Institute's Auditors, who had conducted the count of the ballots carried out in connection with the elections of a General Member and an Area Member for the NW.

The Secretary read out the Auditor's letter which gave details of the ballots, and votes cast, which revealed that Mr B. A. Hermon had been re-elected General Member and Mr Amos Millington had been elected as Area Member for the North West. The President referred to Mr Hermon continuing to make the most valuable contribution to the affairs of the Institute he had made in the past and offered a welcome to Council to Mr Millington.

Special Business

Special Resolution 1 was then put to the meeting proposed by the President seconded B. A. Hermon, namely:

'That the Institute of Hospital Engineering shall seek Affiliate Membership of the Council of Engineering Institutions'.

The President invited comment or questions and there being none the Resolution was put and carried unanimously.

Special Resolution 2 was then put to the meeting, proposed by the President, seconded K. J. Eatwell, namely:

'That the Articles of Association of the Institute (in this Resolution hereinafter referred to as "the Articles") be altered in the following manner':

1. Article 8 of the Articles shall be deleted and the following substituted therefor:

'Fellows shall be persons elected as such who

a. are not less than twenty-eight years of age; and

b. have an academic qualification acceptable to Council; and

c. have an academic qualification which meets the requirements of the Engineers' Registration Board for registration as a Technician Engineer; and

d. have not less than five years' superior responsibility and experience in hospital engineering, preceded by at least two years' practical training, such responsibility, experience and training being of a nature approved by Council and by the Engineers' Registration Board'.

2. Article 9 of the Articles be deleted and the following substituted therefor:

'Members shall be persons elected as such who

a. are not less than twenty-five years of age; and

b. have an academic qualification acceptable to the Council; and

c. have an academic qualification which meets the requirements of the Engineers' Registration Board for registration as an Engineering Technician; and

d. have not less than two years' experience with an adequate degree of responsibility in hospital engineering, preceded by at least two years' practical engineering training, such experience, responsibility and training being of a nature approved by the Council and by the Engineers' Registration Board'.

3. In Articles 6, 10 and 43 of the Articles the words 'Honorary Members' shall be deleted and the words 'Honorary Fellows' substituted therefor, in Article 19 of the Articles the words 'Honorary Membership' shall be deleted and the words 'Honorary Fellowship' substituted therefor, and in Article 26 of the Articles the words 'Honorary Member' and the initials 'HonMIHospE' shall be deleted and the words 'Honorary Fellow' and the initials 'HonFIHospE' substituted therefor.

The President invited questions and comment.

R. G. Kensett questioned the wisdom of the minimum age of 'Fellows' being set as low as 28 and suggested that at such age it was unlikely that members, or applicants, would have the length or width of experience to warrant election as a Fellow and that this would tend to diminish the standing of that category of membership. Mr. Kensett pointed out, also, that the senior Institutions looked for an age of 35 for election to Fellow.

The President pointed out that the question of the extent of experience and standing of the applicant was carefully covered in Section d of the proposed Clause and suggested that this Section d should allay the fears raised although he agreed that election as Fellow at such an early age was likely to prove the exception rather than the rule.

The Resolution was then put and carried without opposition, and the meeting was formally closed by the President.

New Council Member

Mr M. Brooke has been elected Area Member of Council representing East Anglian and East Midlands Branches.

Mr Brooke was born in Wakefield, Yorkshire, in 1944. He served an apprenticeship with the National Coal

Board and remained with the NCB as an Engineer until 1967. After a brief spell as a Production Engineer with a manufacturing company he entered the Health Service in 1968 as Assistant Engineer with the then Hull 'B' Group HMC. Whilst in Hull he spent a one-year secondment with the Inter Regional Training Scheme for Engineers, and in 1971 was appointed Hospital Engineer with the Ipswich Group of Hospitals.

In April 1975 he obtained his present post of District Works Officer with the Great Yarmouth and Waveney Health District.

Mr Brooke became a Member of the Institute in 1968 and has always participated in Branch activities. He is currently Hon Branch Secretary for the East Anglian Branch.

IHF Conference – Manila
November 1978

The Seventh Regional Conference of the International Hospital Federation is to be held in Manila between November 26-30, 1978, in collaboration with the Philippine Hospital Association.

Topics discussed at the conference under the broad heading of 'Health care in developing countries' will be health care delivery systems, health and hospital facilities planning, hospital fiscal and materials management, education and training programmes of health and hospital personnel in developing countries, all in English.

All participants are expected to come mainly from countries of South East Asia and the Western Pacific, and the conference programme will be directed towards local and regional problems and developments.

Dr J. P. Caedo, IHF Council member, is Co-Chairman of the Conference Organising Committee with Dr C. Cristomo, President of the Philippine Hospital Association. Anyone wanting further details or wishing to present a paper, should write to Dr Caedo or Dr Cristomo at: Secretariat, IHF Regional Conference, 2 Mayon Street (Corner Quezon Boulevard), Quezon City, Metro Manila 3008, Philippines. (Cable address: Phil Hosa).

Spanish Symposium

The Association of Hospital Engineering and Architecture in conjunction with the Association para el Desorrollo Hospitalerio organised a three-day symposium on 'Safety in Hospitals' which took place in Barcelona on March 7-10, 1978.

Papers were presented by Architects and Engineers on various aspects of safety in design and practice including fire risk and prevention, electrical and mechanical safety, the legal implications of safety, and the need for energy conservation without prejudice to safety.

It was agreed that the following recommendations be submitted to the Spanish Hospital Authorities:

To establish in each major hospital a 'Joint Safety Commission' representing both management and staff;
To establish a national/regional coordinating body to monitor the work of local 'Safety Commissions';
To establish a safety training policy for hospital personnel;
and to ensure that adequate funds are available to implement the policies.

New Dutch Journal

We welcome the Dutch Association of Hospital Engineers' new journals which includes in it a translation of our article 'Some Common Mistakes in Planning Intensive Care Units' (*Hospital Engineering* June 1977), some information about *Hospital Engineering* and reports on the fifth International Congress.

The Dutch Association held their annual conference on April 19/20, subjects included safety of hospital electrical installations; safe connection of electronic instruments to patients, and medical technology.

Letter to the Editor

Dear Sir,
An article, 'Common Mistakes in Planning Intensive Care Units' by Professor Hans A. Von Der Mosel, published in your June 1977 issue was seen. Many useful points that are to be considered in the design of Intensive Care Units and the common mistakes can be avoided are illustrated in the above article.

The bad effects when fluorescent tube lights are used in ICUs are mentioned as 'Mistake No. 9' in the above article. In this connection the following views of this office are brought to your notice so that these may be brought to the notice of the author for further clarification.

a. It has been mentioned that the choke emits a magnetic field strong enough to interfere with the working of life-saving equipment. In the intensive care units, fluorescent fittings in which the accessories are housed in a separate metal enclosure are used and no bare choke is used, due to which the magnetic effects are not felt outside the metal casing. Further, it will be appropriate that safeguards against stray magnetic fields must be incorporated in life-saving equipment even for accidental existence of such stray magnetic fields;

b. It is stated that light emitted by fluorescent lamps distorts colour and interferes in distinguishing the colour change in the skin.

Generally in such locations, colour-corrected daylight lamps, which have a spectrum nearer to daylight are used. As such the change in skin colour can be distinguished without any difficulty as is done in daylight. If complete incandescent lighting is resorted to, the skin may look more red and the paleness of the patient may be difficult to recognise for the duty nurse;

c. It has been brought out that the flickering effect of fluorescent lamps may cause tiredness and bring headache to patients. In intensive care units, single tube fluorescent fittings are not used. Generally, twin or more tube fittings are used in which a condenser is provided in the circuit of one of the twin tubes, thereby completely eliminating the flickering lighting in the twin fluorescent fittings.

Yours faithfully,
A. A. AL-ABDULLA
President, State Organisation of Buildings

State Organisation of Buildings
(Designs and Studies Section),
Ministry of Housing and Construction,
Baghdad.

The Institute held a successful one-day symposium on 'Making the Best Use of the NHS Estate' in London on March 15.

The papers given are reproduced below, with first the opening remarks by the Symposium Chairman, Mr T. Nicholls BSc(Eng) MIEE HonMIHospE, Chief Engineer, DHSS.

Making the Best use of the NHS

Estate Management is often considered to be merely a matter of maintaining and operating the health building estate, but this is only one part, although a very important part, of the Works Officer's responsibilities in his management of the health estate. His objectives should be to make the best use of his estate not only in the context of its present use—and this is where effective and economical maintenance and operation comes in — but also in its future role as described in the strategic and operational plans.

It may be that under the longer term plans some buildings will not, for example, be required to continue in their present form, hospital departments may be programmed for redevelopment in the same or a different function, or they may be obsolescent. In all cases the Works Officer needs to know of these plans so that he can arrange his works programmes accordingly.

But more important, if service planning decisions of this kind are to take full account of the cost consequences to the health building estate, then the Works Officer should be party to these decisions. He has detailed knowledge of the buildings and services, and this knowledge can ensure that the most economic building options are selected by the planning team during the planning process to satisfy the needs of the service planners.

The NHS planning system embraces all aspects of health care, and the works element is a very small part of the total system. Nevertheless, bad decisions on the use of the estate can have consequences in revenue costs which in time can become very significant.

The NHS planning system is cyclic in operation but it can be considered as comprising three main stages:

1. The service planners determine need;
2. These needs are set against the potentialities of the health estate, and by sampling the various options decisions are taken which, in building terms, should represent the best and most economic solutions to the service planners' requirements;
3. These decisions are implemented by the Works Organisation.

To represent the planning process in this way is, of course, a gross oversimplification, but if the best use is to be made of the health estate then the Works Officer must be able to contribute to stage 2 when decisions are being taken on the ways in which the service needs are to be met by the estate.

To do this properly the Works Officer must have at his finger tips detailed information on the technical and functional capabilities of his buildings, their potential for change and the cost consequences of these changes.

The symposium today is all about the health planning system and the Works Officer's contribution to that system. This is not an easy subject to understand. We have experienced some difficulties ourselves in rationalising the various processes involved in the planning system and the role of the Works Officers. There still remains much to be done. But it is, I believe, extremely important that Works Officers understand the planning system and play their full part in it.

We see this symposium as an opportunity for us to explain our ideas to you and equally for you to give us your views on these very important matters. We realise that this subject is controversial, and, therefore, we shall be surprised, and indeed, disappointed if the papers being presented today do not give rise to lively discussions.

T. NICHOLLS

What is Estate Management

V. SAHAI DipTP ARIBA *Regional Architect, South Western Regional Health Authority*

The title of my paper today, 'What is Estate Management?', would seem to suggest that Estate Management is some new science or field of knowledge, such as Psycho-linguistics or Statistical decision-making. Quite the reverse. Estate Management is, in fact, as old as the history of human settlements; for in a broad sense it is no more than planning one's fixed assets efficiently and economically.

Estate Management has many facets, ranging from matters apertaining to Property Acquisition and Disposal, and Systems of Land Tenure, to a Study of Development Potential, Conservation and much more besides. It would, therefore, be most profitable if I restrict myself in this paper to just three factors. Starting very briefly with the general nature of Estate Management, I shall then attempt to demonstrate (with the help of illustrations) the Health Care Planning Cycle, and finally to show how Estate Management fits in with that Service Planning Cycle.

There are several ways of describing Estate Management, but the most accepted definition is something along the lines of: *The direction and supervision of an interest in land or property with the aim of securing optimum returns.* I hasten to add that those returns may not necessarily be financial, and that they will vary depending on the objectives of the Estate owners. The Health Service, like the universities and schools, provides the nation with a service, as opposed to a developer whose objective is very simple, viz to increase his financial return. Our objectives on the other hand, are less tangible. Furthermore, our objectives tend to be such as can only be achieved over a long span of time, as against the cycle of allocation of resources with which to meet those objectives, which runs from one financial year to the next. This adds to the challenge and makes the problem doubly complex.

The question of time scale is an extremely important one, as one of the pre-requisites of good Estate Management is the ability to keep a long-term aim of things in mind. This is difficult to maintain in a rapidly changing society. There are pressures all round for expediency, whereas those responsible for the Estate must, of necessity, retain a wider and longer perspective. Perhaps it is for this reason that there are so many varying interpretations of Estate Management in the Health Service, or even the need for its application in our work.

This may also be the moment to pause and reflect upon the magnitude of the problem. I do not think that any of us has reasonably accurate figures to indicate the total floor area of buildings for which we are responsible. From the data available, a conservative estimate would put the floor space in even the smallest Region at over one million square metres — and the replacement value of the building and engineering stock in any Region would be well in excess of £300 million at today's prices. That is the magnitude of the problem to which we have to devote our attention.

I mentioned earlier that Estate Management is about the direction and supervision of an interest in land or property; I think it is fair to say that a lot of very valuable ground has already been covered in the Health Service with regard to supervision. I refer, of course, to Estmancode and other related guidance documents. I therefore propose to concentrate on the direction aspect only, which very appropriately leads on to the main part of the Paper, that is, the Service Planning Cycle.

The Planning Cycle

The first thing to be said about planning is that it is not a blueprint in the sense of a building or engineering plan. It is failure to appreciate this point which has led planning into disrepute. Planning is no more than a set of objectives — a statement of intentions, with a rough indication of how to achieve those objectives, and with a time scale attached to it. In this sense, Health Care Planning is more akin to town planning than it is to designing an individual building, with which most Engineers and Architects are clearly accustomed. It is obvious that one cannot forecast future demands with any certainty — nor can one foretell advances in the field of medicine or surgery. That is not to say one should not plan — only that one should recognise the limitations in doing so.

At this point a legitimate question may be put — why this sudden devotion to Planning? Some have said that we got on perfectly well without it before the Re-organisation. It is, therefore, worth reminding ourselves that one of the cornerstones of Re-organisation was, and is, delegation, to enable decisions to be made at local level. Now delegation cannot possibly work unless one sets parameters within which those to whom duties are delegated can operate. For this reason the Management Arrangements in the Grey Book stated:

Decentralisation of decision-making, implicit in the patient-centred approach, can be balanced with the need for national and regional strategic direction only by means of a planning system.

There are two halves to planning — strategic and operational. Strategic is the need to spell out long-term objectives, operational is to set out the methods of attainment. You may say that planning requires a set of bi-focal spectacles, and that the planners must continuously be changing their vision from the top half to the lower half of their glasses. In each case it is essential to remember that planned objectives must be matched against resources available. This makes planning a cyclic process as is shown in *Figure 1*. Planning is a two-fold process in yet another aspect. It emanates on the one hand from the needs arising from the 'grass roots' and on the other hand from the resources availability and from guidelines emanating from the top. In this chart the former is shown on the right hand side and the latter on the left. It begins with the Department making known Governmental policies and issuing guidelines from time to time. The former are instrumental in helping Regions to set their long-term strategic objectives and the latter in formulating operational plans to which I shall return later. I think it would be useful to go into Service Planning matters in a little more detail. Even though these matters may at first appear to have little relevance to our immediate task, they are absolutely imperative to Estate Management. One cannot direct Estate matters unless one fully understands the objectives of Estate owners and users.

So, to come back to strategic planning. This is carried out against the background of policy documents issued from time to time by the Government of the day. In 1976 the then Secretary of State published a consultative document *Priorities for Health and Social Services* and this was followed up by *The Way Forward* last year. These documents have gone much further than anything before them had done in setting out levels of provision 'norm' indicators, manpower and demographic projections, etc. In addition there has been a fundamental change in the financing of Health Service and other Government Departments with the introduction of Cash Limits. Possibly the most important policy document affecting the Health Service which has come out in recent years has been the *Sharing Resources for Health in England*—the RAWP Report, a name which has almost become a verb in initiated circles, synonymous with 'to rob' as far as some Regions are concerned. It is no exaggeration to suggest that the implementation of this Report and the introduction of Cash Limits has had a radical effect on the way we organise our affairs. Previously planning had been very much development orientated, but the introduction of Cash Limits and the implementation of the RAWP Report has made it revenue orientated. This is, in my view, how it should be. I would go a step further and say that we should think in terms of recurring and non-recurring expenditure rather than of revenue and capital. The sooner we begin to think in terms of recurring and non-recurring expenditure, the more cost-effective we will become. As an illustration, resources diverted to more effective use of energy following HN(77)192 is a very good example of sensible Estate Management.

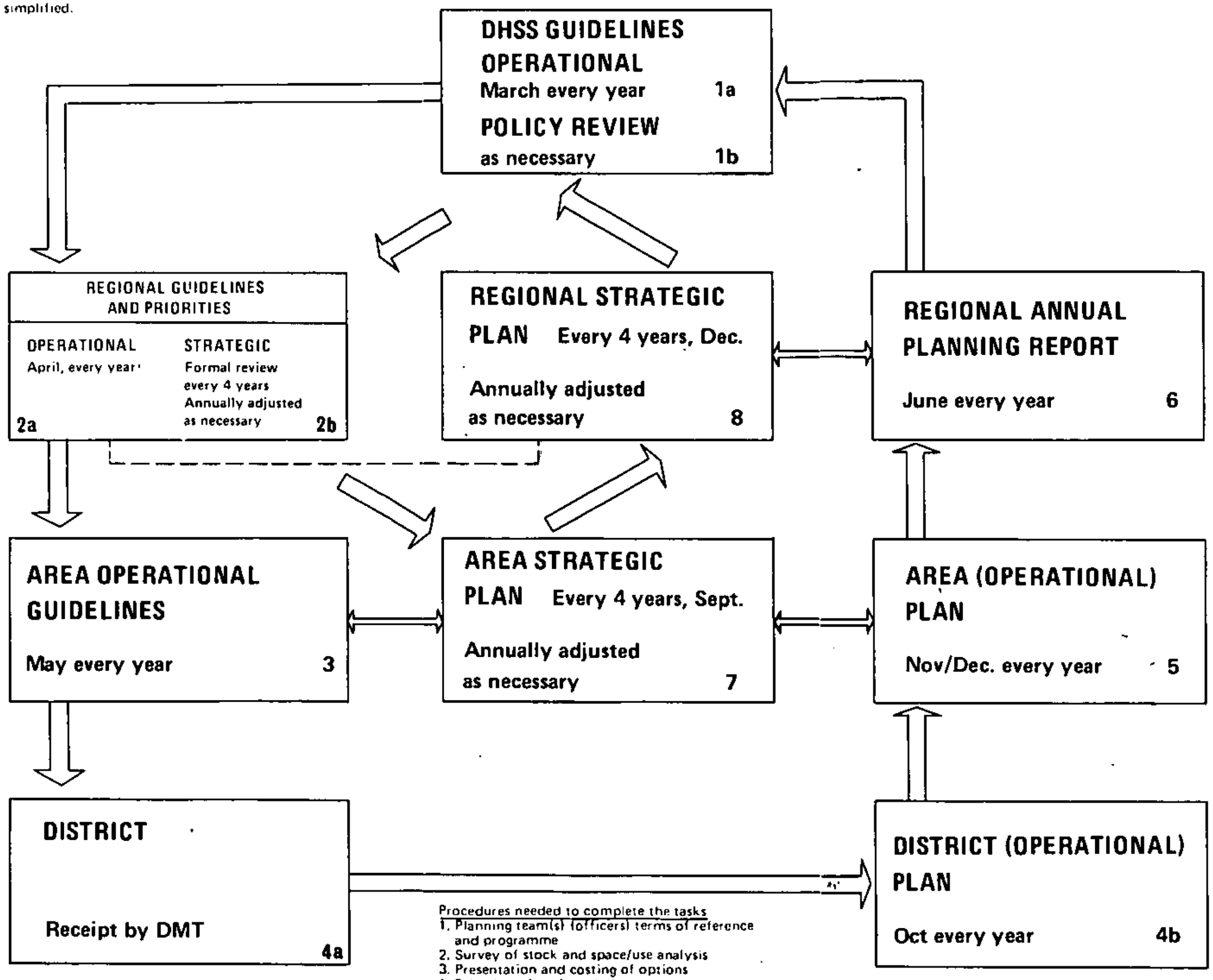
On the basis of such policy documents the Regions prepare the Strategic Plan which has a ten-year horizon. It is the means by which Authorities determine their long-range objectives and priorities for the development of the full range of Health Services and by which they plot the course towards the achievement of those objectives.

The Strategic Plan is formally reviewed every four years in December, though annual adjustments may be necessary from time to time. This possible annual adjustment is a very important part of planning. I reiterate, a strategic plan is not a blueprint of a finite set of objectives: to quote from *The Way Forward* — 'Planning requires regular reviews of all services and resources, not simply deployment of new money'. The point to make particular note of here is the phrase—

GUIDE TO PLANNING SYSTEM CYCLE

NOTE: The annual cycle starting in Box 1 in March is in practice using data from Box 6 in June of the previous year.
- This is in spite of a more recent Area Plan Box 5 having been prepared in November/ December.
- There are thus two separate annual cycles which follow each other.
- When the System has been run-in this may be simplified.

Box 1. Content on services is limited to
Norm indicators
Finance
PESC and Local Authority Plans
Resources
Manpower
Population
Expected influence of new legislations etc.
Policies



Box 2 Regional Guidelines
- Regional Policies & Priorities.
- Resources, Financial allocations and Long Term planning assumptions Manpower Information.
- Specific Area guidance in response to earlier plans
- Special topics e.g. Secure Units.

Box 3 Area (Operational) Guidelines
- Area policies and priorities
- Resource profile: Financial allocations Manpower information
- Target priorities for Client Groups

Box 4 District (DMT) Receipt of Guidelines
- Hospital) To consider
- Health Centres) planning
- G.P.'s) problems
- Remit to Planning Teams and other officers for the preparation of planning needs.

Procedures needed to complete the tasks
1. Planning team(s) (officers) terms of reference and programme
2. Survey of stock and space/use analysis
3. Presentation and costing of options
4. Selection of preferred plan
5. Implement District responsibilities

Box 8 Regional Strategic Plan
This is a 10 year horizon reviewed every 4 years. Periodically adjusted if necessary.

Box 6 Progress on Operational Plan towards longer term strategy.

Box 5 Area Operational Plan
Method of attainment of longer term strategy.

Box 4b District Operational Plan. This will indicate a 3 year programme revised each year as follows:-
Year 1 Firm and detailed
Year 2 Proposed
Year 3 Outline

'. . . all services and resources, not simply deployment of new money'. In the days of RCCS monies, planning tended to be very much capital orientated. With only limited resources that is obviously not the most efficient way of fulfilling Service needs. One further point to be made about the Regional Strategic Plan is that it is not formulated by simply a mechanical extrapolation of national levels of provision, etc. Each Region will need to adjust Service 'norms' depending upon its geography and population distribution. Similarly the starting base of provision of services will vary from Region to Region. To give an example from my own Region, the provision for the elderly has been given a very high priority in the Regional Strategic Plan because of the special nature of the population structure within the Region. So the Regional Strategic Plan performs two functions. Firstly, it provides a broad framework within which the Area strategic plans are conceived, taking into account the specific problems and needs of each Area. Secondly, the strategic plan provides the back-cloth against which the operational guidelines can be given to Areas.

So, we now come to operational planning. Just as Government policies form the important link in the strategic planning, in a similar way the Departmental guidelines are the fundamental base to operational planning — in a way they are even more important; because the DHSS operational guidelines which are issued in March every year contain not only matters pertaining to Finance, Manpower Resources, Public Expenditure Summaries, but also take into account Local Authority plans, the expected influence of new legislation, etc.

Following receipt by Region of this information, it provides operational guidelines to Areas in April of every year. Amongst other things these guidelines draw attention to special topics, and take account of, and are a response to, the specific problems highlighted in earlier Area Operational Plans. The Area then issues operational guidelines to the District Management Teams in May every year setting out target priorities for client groups. On receipt of Area guidelines the District Management Teams are then in a position to provide a remit to planning teams and officers concerned with working out problems in connection with Service needs.

This is the point at which you might say real planning begins. The District having been informed of the resources available both in terms of finance and manpower must contain their needs within those resources. The District Plan thus formulated is shown in Box 4b. It is completed by October of each year and is a three-year document. It sets out for the first year firm and detailed intentions, for the second year it puts forward proposals only, and for the third year it is in outline only. The District Operational Plans are then submitted to the Area, which comments upon these documents in the light of guidelines issued earlier and, after adjustments, incorporates them in the Area Operational Plans which are submitted to Region in December each year. The Area Operational Plan is the document which shows how each Area is expecting to achieve the long-term strategic objectives and what progress is being made towards achieving them. In addition it may indicate the impediments to progress in certain sections. On the basis of these Area Operational Plans, the Regions make an annual planning report to the DHSS, thus completing the cycle. The Regional Annual Planning Reports thus incorporate the feedback from the 'grass roots' to the Department. Analysis of the 14 Reports indicates to the Department of Health the extent to which national policies need to be revised and the extent to which the guidelines need to be varied in the succeeding year.

So, to sum up the roles in planning of various tiers of the Service —

The Department
Formulates national policies, makes financial allocations, issues manpower and other guidelines, and checks progress towards long-term objectives from the annual planning reports.

The Region
Interprets national policies in the light of Region's need, produces Regional strategy and approves Area Operational Plans.

The Area
This is the planning authority, which collaborates with Local Government, leading to an integrated Area Operational Plan.

The District
The basic planning unit. It produces the District Operational Plan and is the focus for consultations especially with the Community Health Council.

I hope I have succeeded in explaining the Service planning cycle — the means whereby our objectives and targets are set out for us. It is absolutely vital for satisfactory performance of Estate Management. I also emphasise the point that plans must deal with community needs and not just with buildings for the provision of services.

This brings me to the last part of the Paper — to show how we who are responsible for Estate matters may help to provide appropriate facilities in which health care can be carried out. Estate Planners' main raison d'être is to advise health planners how Service needs may best be met. This is our real function and from this follow two other tasks. We can be in no position to advise unless we know what we have got and what resources are required to keep it going both in capital and operational terms. Furthermore, we must know the potential of what we own. I call the former Estate needs and the latter Estate intelligence. An article by Mr Ceri Davies about the potential of the Estate follows later, so I shall concentrate on Estate needs and optimum ways of meeting the demands of the Service.

Estate Needs

So first the needs of the Estate. In the time that I have I shall only deal with one aspect and that is budgeting for the needs of the Estate. Most other aspects, such as identifying Estate needs etc, will be familiar to you. Estate is a facility required for health care in the same way as drugs, medical equipment and many other facilities. But it differs from these other facilities in one vital way, ie that it cannot be procured 'off the peg'. It has what one may call a planning lag. One of the aspects of planning is to match one's needs against resources available. This requires proper budgeting with both long-term and short-term commitments. It is outside the scope of this Paper to go into the problems of Works staff not being budget holders, but suffice it to say that if you do not get the needs of the Estate budgeted for in the District Plan, then the facilities will suffer.

I submit that one of our aims should be that the Estate does not depreciate unknowingly and unwittingly. We must establish with the service planners what we want to keep. This is not simply a matter of the state of the fabric of building and engineering services; it is frequently a matter of proper location of stock, for which we must seek the advice of Service planners. In this context it is worth remembering that in some Areas it may not be a question of shortage of beds at all. One may have a surplus of beds but those beds may be in the wrong place, or of the wrong speciality, or both.

There should be a planned and programmed obsolescence, not the other way round. This has led us to the present position, in which we are replacing facilities earlier than need be because the older ones have been allowed to run down beyond the point of economic return. There are varying guestimates for backlog maintenance, but all of them run into hundreds of millions of pounds for the whole country. If some of the properties are no longer required, then we should dispose of them, if they are outworn we must replace them, or upgrade them, but simply to allow them to run down if we know that they are required for the Service is unacceptable. We must make a conscious decision about the run-down of properties otherwise there is a great danger of maintenance monies being spent on wrong buildings. These may be buildings the use of which would be better discontinued.

Information needed with regard to the maintenance of buildings which are part of the facilities required for Service needs cannot be looked at in isolation from those needs. In this connection may I also say that I find the Estmancode definition of maintenance too limiting. It says, and I quote: *"To keep or preserve hospital premises to acceptable standards of safety"*. Acceptable to whom? And by what criteria? These are matters which require our attention. Estate is a valuable resource which cannot be replaced or acquired at short notice. It is sometimes claimed that it is currently depreciating at a rate faster than is economic, and I submit that the needs of the Estate are an essential ingredient of the District Budget. As such, the funding for those needs must be fed into the District Plan at the appropriate time. This timescale will vary depending upon the nature of work and amount required to carry out that work. A timescale which may be appropriate for feeding in information for the money required for roof repairs or boiler replacement is obviously different from the procurement of a multi-million pound new development. I shall come back to the different timescales in a minute.

Furthermore — the needs of the Estate are so intertwined with the optimum ways of meeting Service needs that one cannot talk about them separately. In the past it has been assumed too readily that Service needs can only be met by putting up new buildings. There may be other ways of meeting the objective. The solution may not be a building matter at all. It may simply be a case for changing a pattern of use. Provision of sterilising facilities and catering are two obvious examples of problems that may be solved in this way. There are numerous other examples of problems which can be solved by change in organisational arrangements. As far back as March 1975, DHSS issued guidance requiring Authorities to look at total Health Care planning, and not just at isolated expenditures here and there. DS 85/75 drew attention to this aspect by stating: *The purpose of capital expenditure is not only to correct local deficiencies and replace or renovate worn out buildings, but more importantly to redeploy, reorganise and, where necessary, expand services in order to implement policy objectives and at the same time to use resources as efficiently as possible.*

Works professionals have to advise Service planners on the optimum methods for meeting Service needs. This requires presenting properly costed options at the appropriate time and requires ensuring that there is adequate time to examine, analyse and cost the various options. The preferred solutions must be orientated towards organisation and running costs, and this means that it cannot be done by Capital planners in isolation, but that there needs to be a continuous interchange of ideas between Capital planners and Service planners. One of the accusations most frequently made against designers is that new schemes always cost more money to run. This should be a challenge to us to evolve design solutions so as to demolish this myth.

I mentioned earlier about the varying time scales, planning lag and the importance of forward planning and budgeting. I am talking here about the principles of getting Estate monies earmarked in the District Budget, or the Area Capital, or the Regional Capital, which are the only three pockets from which one can get the money you need. With regard to the normal maintenance, I understand the position as being one whereby previous years' expenditure is increased to allow for inflation only. When expenditure for any item may be less than £10,000 it therefore will come out of revenue, second, Maintenance/Upgrading items of expenditure in excess of £10,000 but normally under £50,000 which means that they will come out of Area Capital and third, major investments which usually come out of Regional Capital.

And so to sum-up, planning is an essential tool to enable delegation of decision-making to be practised effectively. In order to avoid a lot of abortive work it must be realistic, by which I mean that the needs must be matched against available resources. This makes planning a cyclic process, with the guidelines and policies emanating from the top and the identification of needs from the 'grass roots'.

Those responsible for the Estate must ensure that they become aware of Service needs whilst they are still in formative stages. The needs of the Estate are an integral part of the District Plan, and must be synchronised with the planning cycle. It is true that health care planning does not begin with a pre-conceived plan — it moves from need to need, from opportunity to opportunity, but the fact that there is neither a finality nor a preconceived blueprint should not mean that it is all haphazard and left to whimsey: that rational considerations and deliberate forethought have not governed every feature of the plan or that a cohesive scheme may not be achieved. Having said this, I would hate to have given an impression that Estate Management is more or less a mechanistic or routine procedure. Far from it. The environment in which health care is carried out and its effect on the wellbeing of all of us, both as individuals and society, cannot be over-emphasised. I say this because I am only too conscious of the fact that in a society where computers are helping us to make value judgements with the aid of mathematical data, factors such as quality of environment, which cannot be quantified, tend to get ignored. In the final analysis, what will matter is whether we have achieved, within the resources given to us, the best possible environment for those under our care. Lest it be said that I am laying too much emphasis on the quality of the Estate, let us remind ourselves that a general improvement of environment, coupled with clean water supply and water borne sanitation, have had a greater influence on improving the health of society than any advances in medicine or nursing.

Making the Best Use of the NHS Estate

Matching the Existing Building Stock to Changing Need

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May I say at the outset that this is a most valuable time to be discussing this important subject. Serious strategic thinking on the development possibilities of the existing Estate, as distinct from the maintenance of that Estate, is just beginning. Some of the ideas and concepts that are now just crystallising are presented here.

The definition of Estate Management used by Mr Sahai in his paper is a useful one, ie "The direction and supervision of an interest in land and property with the aim of securing optimum returns" and I intend to adopt it here. In contrast to a commercial enterprise those 'returns' are, of course, primarily and ultimately measured in the quality (and quantity) of patient care.

The need to have the scope of the subject defined and clarified is of crucial importance, since, historically, 'Estate Management' has tended to cover too wide a range of interpretation. On the one hand it has been used to embrace almost everything including service planning, on the other it has been used as a rather grand title for the maintenance of Engineering and Building fabric of our existing stock. Using the term for the latter activity has its dangers — it infers that the estate is being actively developed and is realising its full potential when clearly it is not, thus lulling us into a sense of false optimism.

That may be one reason why the subject generally has not historically attracted the full range of available creative inputs. It is certainly the case that over the last decade or so essential design skills have been siphoned off into the more spectacular possibilities of designing new, often large, eye-catching building projects — fodder for the glossy magazines! It is some comfort, I suppose, to realise that this obsession with the New struck on a world-wide scale. It is also reassuring to know that again on a world-wide scale that particular pendulum is swinging back. For example, a great deal of very useful work is currently under way in the United States — several University Departments are now active in this area.

To summarise, the aspect of Estate Management that needs particular emphasis now, is that Management at every level in the NHS is made fully aware of the full potential of existing sites and building by developing methods which will help realise that potential.

As with fabric deterioration (which must be halted in these buildings for which a substantial future life can be guaranteed) 'functional obsolescence' is often insidious and gradual. It creeps up until a final straw breaks the organisation. By that time it is usually too late, and a complete redevelopment becomes inescapable. Far greater attention must be given to ways of keeping our stock up-to-date both structurally and organisationally.

The approach is based on two basic assumptions:

a. That, particularly over the last decade, maintenance of the fabric of our health buildings (even for those for which a useful life is guaranteed) has not kept pace with its deterioration, and that the downward trend will continue so long as basic minimum standards or datums (and appropriate methods for monitoring) remain unspecified;

b. That existing buildings have far greater potential for re-use (the term will be defined later) than has hitherto been recognised, indeed they represent a vast largely-untapped National resource.

These two aspects are very much inter-related and although we are concentrating here today on the second, the first continues to require special emphasis, particularly on the much-neglected building side.

The existing stock of buildings in the NHS represents an important national resource that needs to be both conserved and exploited carefully in response to present and future needs. From time to time this estate is supplemented by new buildings provided as and when money becomes available. This is, of course, always the real situation. Grand talk often heard over the last couple of decades about replacing the stock within a generation not only blinded most of us to possibilities inherent in the existing, indeed, it also led positively to the pace at which these buildings deteriorated. "Why spend money on the old when the new is just around the corner?" "Too much spent on the old will delay the new". "The greater the deterioration (both structurally and organisationally) the more obvious is the need for its replacement," and so on.

Thus, as I see it, **our first priority is to change and radically modify attitudes.** The new is not necessarily better than the old, the time scale involved in waiting for the new, together with the inconvenience and disruption costs (including additional running costs), have seldom been taken into account. The basic quality of the old may well be higher than that which can now be afforded — we will see examples of just this later.

Our second priority is to be able to describe **at the appropriate level of information, what we have,** together with a statement of its general condition.

The health estate is the largest in public ownership. An indication of its size can be gained from the fact that approaching 3,000 hospitals are involved, worth an estimated £10,000m. A very substantial proportion of this accommodation was built before the first world war — some authorities have recently estimated this as over 65%. The scale of change that has taken place in medicine and health care over that period has, of course, been quite revolutionary.

To digress for a few moments, one of our DHSS development projects involved the complete rebuilding of a very typical Victorian 600-bed hospital at Greenwich. It was built in 1840, the year that Dickens wrote the Pickwick Papers. The year that Augustus Northmore Pugin, born in 1812, the English son of a French father, wrote on the first page of his most important book: 'There should be no features about a building which are not necessary for convenience, construction or propriety . . . The smallest detail should serve a purpose and should vary with the material employed'. That was not new, it was the direct continuation of French seventeenth and eighteenth rationalism. Batteaux wrote: **'True architecture is not a spectacle, it is a service** — security, firmness, convenience, propriety'. That year was a whole decade earlier than Pasteur's work on Bacteria. Lister's work on antiseptic surgery followed twenty or so years after that. X-rays and all the other processes that now lie at the very heart of modern medicine were all unknown. Yet, and this is quite remarkable, that building on the whole was still functioning reasonably well — such was the robustness with which the Victorians built, such was the flexibility of plan form and generosity of space, and, above all, the adaptability of its users. If we were attempting this exercise now it would be useful to start by preparing a fully comprehensive upgrading scheme, costing it and comparing it with a complete rebuild. My hunch is that, in this particular instance, we would still have followed the same course because, at that stage in its obsolescence, nothing less than a total rebuild could have provided this particular hospital with the full range of departments in their correct location and at their right size. This, however, is not always the case, and need not have been the case even here if corrective measures had been taken over the years.

Describing the Estate

Describing the stock at just the right level so that its future potential and development possibilities can be identified is a fundamental problem currently being investigated by several groups, and by the Oxford RHA in particular. Their approach is so promising that I will discuss its essential framework in some detail. Essentially it is a macro-information technique, the method concentrates on just those few vital characteristics of a building and its site, a general knowledge of which is vital and holds the key for exploring a range of re-use possibilities.

Information is collected under each of the following four headings: Functional factors, Building state, Dependencies and Land.

Functional factors

These include:

i. **Functional capacity** ie, the number of functional units (or the quantity of function — not necessarily the same thing) a department is potentially capable of delivering.

ii. **Utilisation** ie, the proportion of the potential capaçity which is actually being used.

iii. **Usability** ie, essentially a range of subjective measures involving a range of factors including convenience, departmental relationships, geometry, etc.

iv. **Space Standards** including levels of support provision.

v. **Logistics** identifying organisational bottlenecks against a present and future work load.

Building State

i. The state and condition of the principal following elements, eg:

a. Roof including Perimeter wall;
b. Internal Sub-divisions including finishes and fitted equipment;
c. Structure, including staircases, etc;
d. Services runs and plant;
e. Environmental, including day lighting, ventilation, etc.

We consider the setting of minimum standards or datums for the building fabric in particular so important to the development of the subject as a whole, that a joint NHS/DHSS Working Group (No. 4) is currently engaged in this area.

ii. Fire precaution standards. These will be defined in due course and will follow the joint Home Office/DHSS exercise currently under way.

iii. Energy conservation standards. Its current level and potential for upgrading to meet new levels.

Dependencies

i. **Geographical.** Hospitals are often interdependent for facilities such as laundry, supplies CSSD, etc. This needs to be incorporated into the above analysis forming a network of inter-related buildings and services.

ii. **Building.** The life of one element may critically depend on the satisfactory performance of another, eg, a flat roof.

iii. **Logistical dependences.** The life of the whole organisation may be critically dependent on relieving a bottleneck in the traffic pattern both within the building and externally between buildings. An alternative method of distribution, for example, may well release essential space in what may be a critical area.

Land

Sites can be zoned according to their value:
i. to the NHS, and
ii. for sale and redevelopment.

In this way the opportunity cost of continuing to use particular sites can be assessed. (There may be many good reasons for not selling land even when it may be surplus to requirements, but, nevertheless, the cost of the 'lost' opportunity should be identified and compared with the benefits derived from holding it).

At this very early stage in developing the method, measurements of the various performance standards are necessarily subjective and somewhat crude at the moment, above standard, standard and below standard is used. Although crude, **providing the judgements are generally consistent** a description of the NHS stock along these lines would still be useful in providing pointers to its upgrading and re-use requirements.

Indeed, it has yet to be proved that the extra complication, time (and manpower) spent on a more 'scientific' assessment and measurement would be worth the additional effort. This we shall have to determine.

This approach firmly veers away from the clutter of unnecessary detail. It 'understands' better the real information needs of developing the health estate. Some previous approaches concentrated too heavily on detail, perhaps in the vague hope that the shape and contours of the forest would somehow emerge from counting leaves. It is also less costly than conventional surveys — for example, sixty man days were required to complete a 400-bed District General Hospital. More detailed surveys, usually less useful for development purposes, have been known to require three to four times this effort. The method is susceptible to the application of the computer. Holding information live in a data bank has the additional advantage of examining a whole range of options. Most of the basic programmes are already available for this purpose.

Mr Sahai has underlined the importance of integrating the works effort with the planning cycle. In passing, it is worth emphasising here the crucial need to keep strategic and operational service plans at the **hypothesis level** long enough to allow a creative works profession's input to be made, and ensuring that they do not crystalise into policy before this step has been taken.

The Estate Management Master Plan

Finally, we see these two strands, ie the strategic needs and the future possibilities of the existing stock, coming together and fusing in the form of an Estate Development Master Plan — a familiar concept to those who have been involved in planning new hospitals and an essential procedural stage of Capricode.

This concept as such has not, at least hitherto, been formally applied to the existing hospital. Yet we believe it would be just as useful as a control on the whole range of upgrading, minor extensions, roadwork alterations, etc, which is the normal day-to-day process of the average large District General Hospital together with the constellation of Buildings that comprise the Health Estate at District or Area level as it has undoubtably been when planning entirely new projects.

The Estate Management plan concept is not entirely new even for existing stock. Estmancode required something very similar — 'proposals for the development or rationalisation of the estate and the resources required to bring to the required standard and to maintain to that standard that portion of the estate which will continue in its care'. Hitherto, however, its interpretation has been strictly restricted to the maintenance aspect only. We believe this is a most vital stage and is currently being actively developed by another of the joint Working Groups (No. 2). Eventually, we see three fully compatible and comprehensive plans which will govern the future development of the service at Area level:

The Estate Development Master Plan which should be an integral part of:
The Strategic Plan, and
The Operational Plan.

These can only evolve through an interactive process in which the implications of the service plan for the estate and possible ways of implementing it through changes in the use of the estate are thought through. The service planning itself is then rethought in the light of estate implications.

As we presently conceive it that Estate Development Master Plan, as well as being compatible with the Service Plans, needs to be:

a. **Realistic** particularly in terms of manpower and financial resources;

b. **Flexible** so that it can respond to the many changes that are inherent in any long-term process. It will inevitably need frequent updating and adjustment as the underlying needs of the services become clearer, as technological standards and methods of delivering the service develop, and as lessons are learned from the process of implementing the plan. It is, therefore, never fixed for all time, but updated at appropriate intervals. However, it needs to look ahead and will boldly attempt to set the development proposals within a time scale of, say, ten years;

c. **Multi-professional.** No one discipline alone can undertake the task, it is essentially a team effort;

d. **Economical.** The plan must be based upon the principle of the best value for money both capital and revenue. Some aspects of this will be dealt with in the next paper. Allow me just to emphasise three aspects:

i. That the maximum possible use is made of existing buildings for which a reasonable structural life can be guaranteed, and that proposals to build new buildings are strictly limited to those that are absolutely essential from either an economic or functional point of view;

ii. That in the deployment of facilities the maximum convenience is aimed at particularly for staff movement and supplies traffic;

iii. That the whole pattern of change should be spelt out, identifying the capital and revenue cash-flow implications for all the stages necessary to bring the plan to fruition.

e. **Practical.** The stages, or phases of building, decanting, upgrading, temporary arrangements, etc, necessary in implementing the plan, should be clearly defined together with all consequential resource and financial implications.

This will require information from two principle sources:

i. Strategic and operational planning at Area level;

ii. The wealth of essential functional detail which can only come from District, that is the users themselves. These plans, and indeed the Estate Development Master Plan, should be kept tentative until each have had the opportunity of being influenced by the others;

f. It will also provide the vehicle for the continuous monitoring of the hospital as an organisation functioning within the confines of existing space, layout configuration, internal climate, building envelope and structure. The opportunity presented by this approach, which is positively to control situations in advance of breakdowns with all the relief from the often disastrous consequences 'of the ad hoc solution', should be seized. This surely is of the very essence of Estate Management.

The Tools required

What then are the tools and information necessary for this operation? Primarily, there is the need to develop machinery which will keep the building stock within acceptable operational and structural limits. The traditional method of instituting massive upgradings just occasionally during the lifetime of a building is a traumatic experience for the hospital, and hardly economic in investment terms. Planned preventive maintenance could just as well apply to the organisation as it does at the present to the engineering. This 'machinery' will need to be supported by:

1. A method for describing buildings and land including their condition. One approach, the most encouraging, to date, was described earlier;
2. Guidelines on maximising the use of existing space;
3. Costing tools which will help planning teams to determine whether the cost of upgrading or conversion (including the possible use of temporary facilities) is worth it in terms of the benefit derived;
4. The essential list of Fire and Other Statutory Building Safety Requirements that will need to be met together with guidance on the application and compliance procedures;
5. A method for identifying the key general functional aspects of buildings involved particularly in terms of their logistical requirements — this aspect is absolutely crucial, and I will return to it and enlarge upon it later;
6. Guidelines on the quality of both the internal and external environment that can (and should) be achieved when converting existing buildings

and the spaces between buildings.

It might also be helpful to have available sets of previously worked examples which would set standards of good practice.

Operations Division DHSS will be responsible for this area of work, working with and through the various joint NHS/DHSS Groups, and will shortly be drawing up programmes for them. Planning is not a linear process, rather it is an interactive one, therefore, probably most important of all, the aspect that needs to be stressed is the creation of a climate of multi-professional co-operation and team work. No guidance from the Department can achieve team work, and yet without it no truly creative and imaginative work will emerge. We have in mind the possibility of initiating courses in which a multi-professional team concerned with all aspects of planning the service, including financial, manpower, etc, can work through a planning exercise and produce an Estate Management Master Plan. A parallel to the very successful series held previously for new projects.

The Information required

Finally, before leaving the Estate Development Master Plan it may be useful (as a spur to discussion) to set out the sort of questions the planning team would need to have answered before the process commenced. This list also serves to emphasise the close working relationship that is required between Area and District at this point.

1. Nature, scale and scope of service to be provided;
2. Foreseeable and likely changes in that Service;
3. Relationship of that service to other hospital or community-based service;
4. Whether phasing the service is possible from a functional level;
5. Its initial and ultimate workload, including an estimate of the number of staff and/or patients involved in the service;
6. Whether facilities for teaching or training need to be included;
7. Identify the key functional elements which would substantially affect the planning and environmental design of the department, both within itself and in terms of its siting in context of the Master Plan;
8. Identify the principal operational characteristics of the department and work flow (if appropriate) and major items of equipment which would have a major impact on the design of the building.
9. Identify whether any accommodation can be shared with other departments. This might effect greater overall efficiency resulting in a more compact overall plan and avoid expensive duplication of facilities;
10. Whether there is any special engineering and environmental requirement;
11. Whether there is any special fire condition existing;
12. and list out a tentative and preliminary schedule of accommodation which would be helpful merely as a starting point in preliminary planning discussion.

Conclusion

In conclusion, I return to attitudes. The key to the success of this operation must be the will to make it succeed. I am certainly not arguing that all existing buildings are marvellous, that they are all ripe for conversion, that it is always more economic to re-use rather than build new and so on. We are arguing for an intelligent re-appraisal and re-adjustment of the balance between old and new — a balance which may well have been upset by the 'Build new' and 'Throw away' attitudes of the last two decades. The Economics of Impermanence was always unsatisfactory especially as it found expression in the quality of our recently-built environment — around all of us lies the evidence.

Finally it is our intention to publish information and guidance on this subject within the existing framework of Estmancode. The work outlined here is designed to build upon what already exists. In presenting this today it is entirely appropriate to acknowledge the great deal of useful work in which many of you have participated including the work on EMIS at Northern Region. It is because of thorough, though largely unspectacular, work that we can today look forward positively and with optimism to the next stage, in which the possibilities inherent in the existing Health Estate are realised to a far greater degree than has been the case hitherto.

Making the Best Use of the NHS Estate

Costs Incentives and Restraints

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The title of this paper is 'Costs, Incentives and Constraints' and that is fine if I knew what it meant. Cost constraints I understand, that is the amount of funds you have available. Cost incentives — I am not at all sure. I take it that it is benefits of some kind, but what I am not quite certain. In his paper Mr Sahai has set the Macro scene. My contribution today is at the micro level of investment. Today I want to talk about two ideas that we have that might assist you in assessing the cost implications of using existing buildings stock. Mr Sahai also said that RAWP was, to some people, synonymous with 'rob' — but I prefer to remember the Confucius proverb which goes "If RAWP is inevitable lay back and enjoy it".

The first idea goes under the grand name of 'An Aid to Capital Cost Planning for the Health Estate'. The idea is quite simple — it is to form a matrix of consumption of support services by primary facilities. Primary facilities in the matrix would be the horizontal axis and support services the vertical axis. *Figure 1.* I realise, of course, that we will have to find some other word for primary facilities as this is too closely related to primary care — so it may be that we have to talk about principle facilities — but for today I shall use 'primary facilities'. These are, for example, acute wards, mental illness, geriatric, pædiatric, etc. The support services are such things as operating theatres, X-rays, mortuary, kitchen, dining room, boiler houses and the like. If we could say how much of each of the type of support service went to support the activities contained in a primary facility — eg how much X-ray to acute wards as opposed to mental illness wards etc, then we would have a very good basis of being able to cost out the requirements and the consequences of any given policy (eg nationally, what happens if we require another 10,000 geriatric beds, how much does it cost us?) At least we ought to be able to give first shot figure.

What we have endeavoured to do here is to ask the Doctors and Nurses to fill up the requirements of the support services to the primary facilities relative to the acute bed. In other words if the acute bed uses the main entrance once, how much does a mental illness bed use it? *Figure 2* shows that a mental illness bed uses the main entrance a third of the amount that an acute bed would do, and day ward places, for example, use it 15 times as much as an acute bed.

Having done that, we do a bit of mathematics to proportion the support services out over the primary facilities. *Figure 2* shows the actual costed amount of support services to the primary facilities. For example, you can see that for operating suites — we consider that £1,213 of operating suites is consumed by one acute bed and that only £12 of operating suite is consumed by a geriatric ward bed. Completing the matrix, the cost of all the support services for a particular primary facility is shown to give a total cost for support services related to the Primary facility in question. *Figure 3.* We then add in the function unit cost of the primary facility to give us a total for the primary facility and the support service together and taking 50% for on costs and 13½% for fees. We have the total cost for fees, on costs, primary facilities and support services.

This work on an aid to capital cost planning has been carried out by Surveying Division of DHSS and it is considered that, with development, it could be an invaluable input to the planning system.

How then can we use it? We might, for example, be able to obtain from each district, via the regions, information from every hospital showing primary facilities measured in functional units (that is the top line of the matrix) together with support services also in functional units (that is the first vertical column of the matrix). Then we could produce a series of

Primary Facilities / Support Service	A Acute Ward per Bed	B Mental Illness Ward per Bed	C Geriatric Ward per Bed	D Geriatric day per place	E Maternity Ward per bed	F Maternity Clinic per Dr Session	G A & E per patient per peak 3 hour period	H Day ward per Bed	I O.P.D. per Dr Session	J O.P.D. Fracture and Orthopaedic per Dr Session	K Mental Illness day per place	L Dental per Dental Session
Medical Records 1	SA1= 1	SB1= 0.3	SC1= 0.3	SD1= 4	2	5	2	15	15	1.5	5	2
M/R Staff 2	SA2=1	2	2	3	0.5	1.5	1.5	3	1	1	2	4
Telephones 3	SA3=1	2	1	2	2	1	2	2	2	2	1	4
Operating Suites 4	SA4=1	0.01	0.01	0	0.1	0	2	1	0.01	0.01	0	0.2
X-Ray 5	1	0.1	0.2	0.2	0.2	0.2	20	5	5	100	0.01	2
Pharmaceutical Dept. 6	1	1.5	1	0.5	0.5	0.5	1	1	1	2	1.5	10
Mortuary and PM room 7	1	0.2	3	.01	0.1	0	5	0.01	0	0	0	0
Rehabilitation 8	1	5	0.1	0.1	0	0	1	0.5	0.1	30	1	0
Central Kitchens 9	1	1	1	0.5	1	0.5	0.3	0.5	0.1	0.1	0.5	0.5
Staff Dining Room 10	1	1	1	0.8	1	0.5	0.3	1	1	1	1	0.5
Boiler house and fuel store 11	1	1	1.2	1.2	1.5	2	0.5	1	0.8	0.8	0.8	1
Laundry 12	1	1.5	2	1.5	2	0.05	0.5	1	0.2	0.05	0.5	0.5
Pathology 13	1	0.1	0.5	0.1	2	2	0.8	2	5	1	0	5
HSDU/CSSD 14	1	0.5	0.5	0.05	2	0.05	1.5	1	2	2	0	3
Creche 15	1	1	2	2	1	2	1	2	2	2	1	2
Chapel 16	1	0.8	1	0.1	0.3	0	0.1	0.1	0	0	0.01	0
Occupational Health 17	1	1	0.5	0.5	0.1	0	0	1	0.5	2	1,5	0
Residential 18	1	0.5	0.5	0.33	2	3	0.5	0.33	3	3	0.33	4
Works 19	1	1	1	1	1	1	1	1	1	2	1	4
Education 20	1	1.5	0.5	0.5	1.5	2	1	0.5	2	1	0.5	1
PCMC 21	1	0.5	0.02	0.02	1	1	0.2	0.5	1	2	0	0.05

*Acute category includes children, intensive therapy, special baby care, dental, orthodontic, and C.P. beds.

FIG. 1 'S' values (the amount of each support service required by a functional unit of each primary facility as a proportion of that required by an acute bed). PROVISIONAL

profiles of the hospital in a matrix form. These profiles might be:
1. Profile of the hospital as existing.
2. Profile of the hospital using the existing primary facilities and showing the theoretical support services required.
3. Profile of an 'ideal' hospital required to meet the needs of the particular catchment area under consideration.

From these we could establish (in either functional unit terms or capital cost terms):
1. Under or over provision in existing support services — thus indicating where support services needed amplifying or primary facilities could profitably be extended.
2. Short fall (or over provision) between the existing stock and the stock required to satisfy needs, indicating where services or primary facilities were most urgently needed.

Support Service \ Primary Facilities	A Acute Ward per Bed	B Mental Illness Ward per Bed	C Geriatric Ward per Bed	D Geriatric day per place	E Maternity Ward per bed	F Maternity Clinic per Dr Session	G A & E per patient per peak 3 hour period	H Day ward per Bed	I O.P.D. per Dr Session	J O.P.D. Fracture and Orthopaedic per Dr Session	K Mental Illness day per place	L Dental per Dental Session
Medical Records 1	93	28	28	373	187	467	187	1,400	1,400	140	467	187
M/B Staff 2	93	186	186	279	46	139	139	279	93	93	186	372
Telephones 3	59	118	59	118	118	59	118	118	118	118	59	236
Operating Suites 4	1,213	12	12	–	116	–	2,425	1,213	12	12	–	243
X-Ray 5	45	5	9	9	9	9	915	229	229	4,573	0.53	90
Pharmaceutical Dept. 6	138	206	138	69	69	69	138	138	138	275	206	1.375
Mortuary and PM room 7	40	8	120	0.40	4	–	201	0.40	–	–	–	–
Rehabilitation 8	179	894	18	18	–	–	179	89	18	5,362	179	–
Central kitchens	369	369	369	184	369	184	111	184	37	37	184	184
Staff Dining room 9	92	92	92	74	92	46	28	92	92	92	92	46
Boiler house and fuel store 10	232	232	278	278	348	464	116	232	185	185	185	232
Laundry 11	401	601	802	601	802	20	200	401	80	20	200	200
Pathology 12	337	34	169	34	675	675	270	675	1,688	337	–	1,688
HSDU/CSSD 13	212	106	106	11	419	11	307	212	419	419	–	642
Creche 14	35	35	70	70	35	70	35	70	70	70	35	70
Chapel 15	40	32	40	4	12	–	4	4	–	–	0.42	–
Occupational Health 16	27	27	13	13	3	–	–	27	13	55	41	–
Residential 17	929	464	464	307	1,858	1,787	464	307	2,787	2,787	307	3,716
Works 18	75	75	75	75	75	75	75	75	75	149	75	298
Education 19	122	183	61	61	183	244	122	61	244	122	61	122
PCMC 20	114	58	2	2	114	114	23	58	144	228	–	6
ToTal Cost 21	4,845	3,765	3,111	2,580	5,534	5,433	6,057	5,864	7,812	15,074	2,278	9,707

*Acute category includes children, intensive therapy, special baby care, dental, orthodontic, and C.P. beds. PROVISIONAL

FIG. 2 The cost of the supporting services for one functional unit of each type of primary facility.

Cost	A Acute Ward per Bed	B Mental Illness Ward per Bed	C Geriatric Ward per Bed	D Geriatric day per place	E Maternity Ward per bed	F Maternity Clinic per Dr Session	G A & E per patient per peak 3 hour period	H Day ward per Bed	I O.P.D. per Dr Session	J O.P.D. Fracture and Orthopaedic per Dr Session	K Mental Illness day per place	L Dental per Dental Session
Total support service cost	4,845	3,765	3,111	2,580	5,534	5,433	6,057	5,864	7,812	15,074	2,278	9,707
Primary facility cost	5,428	5,083	5,054	2,680	12,067	11,700	2,152	11,767	2,655	2,667	2,438	1,778
Total cost	10,273	8,848	8,165	5,260	17,601	17,133	8,209	17,631	10,467	17,741	4,716	11,485
+ 50% ca–costs	15,410	13,272	12,243	7,890	26,402	25,700	12,314	26,447	15,701	26,612	7,074	17,228
+ 13.5% fees etc,	17,490	15,064	13,901	8,955	29,966	29,170	13,976	30,017	17,821	30,205	8,029	19,554

FIG. 3 TABLE 1 Summary of results for the 12 primary facilities PROVISIONAL

These profiles, of course, could be aggregated to any degree that we thought desirable. For example — hospital, district, area, regional or national level. The work carried out on an aid to capital cost planning would need to be extended. So far it only covers DGHs but there is no reason why it could not cover community hospitals also. These are also certain aspects that will have to be thought out — such as how do we cater for group facilities? How do we treat regional specialties and the like? What do we do about health centres? These are points of issue that we are currently considering.

Now I realise, of course, that this only covers the hospital stock in quantative terms — it has not brought in any question of quality. The question of quality, I feel, can be brought in at local level, for I find that the local Works Staff know a great deal about their hospitals. It may not be on paper, they may not have their Estate Records up to date, but they have a very good knowledge of their estate. For example, you could give us, hospital by hospital, a purely functional unit number count, which I maintain would be well-known, either by your administrator or the secretariat at the hospital. We could return to you for each hospital what a purely theoretical quantative analysis suggested each ought to have in the way of support services and, in the ideal situation, the primary facilities and support services required. We could aggregate those, as I said before, either at district, area or regional level, and this could give us a reasonable idea of what was wanted in quantity terms. You could then, with your local knowledge of the state of the hospitals, say "oh, it is all very well you including hospital X in your analysis, but it is a really clapped-out hospital, it's entirely in the wrong place, there is not much we can do with it," and our reply would be "fine, let's take it out and see what happens." You could, from your knowledge of the quality of stock, identify reasons why you are departing from this notional plan. Nevertheless it will give you a very good idea of what was required in your district, area or region, in the way of primary facilities and support services, together with a very good indication of the cost of provision, admittedly in new terms. It would also indicate at individual hospital level where you could profitably increase primary facilities because you have a surplus of support service, and also the converse — where you would need to increase the support service in order to get a more viable unit and possibly to increase through-put and to reduce running costs or length of stay.

So that is the idea in a nutshell, very simplistic, yet I believe, could be very worthwhile. What does it do?

1. It allows the total cost implications of a national building programme for any particular primary facility to be estimated. (For example, an extra 10,000 geriatric beds distributed around the country).
2. It improves the efficiency with which a capital cost plan for a hospital is established. An estimate of the expected costs of a hospital could be based on the primary facilities proposed for the hospital. The support services aspect of the hospital would not need to be sized or costed at the initial planning stage.
3. It allows the improvement in any one particular type of primary facility in an area or district to be planned in the most economical way, taking due account of any surplus support services existing in each hospital within that area or district.
4. It forms a basis of a capital cost comparison of revision of health care in two or more hospitals, even when the primary facilities of the hospitals are different.
5. It enables you, the district, the area or the region, to concentrate on the quality side of the equation, having got a purely mechanical means for the quantity provision. (It is so much easier, for example, when you have a report in front of you, to criticise that report rather than to start to write the report from scratch). This, if you like, is a report on the quantity side and you can overlay that report with the considerations thrown up by the quality, location, change of use requirements, etc, and so give you a very strong indication where to deploy your resources to the best effect.

Well that is one idea. The second idea is simplistic also. It is a method of how to judge the degree of upgrading we should aim for which gives the best return for the money available.

When a need for provision of health care is identified it is incumbent upon us, especially in these days of stringent capital rationing, to provide for that need in the most economical way. As far as health building is concerned there are several options open to us — for example, to provide a new building, provide a short-life building, lease an existing building, upgrade an existing building, reorganise space within an existing building — and I suppose we have the option of doing nothing. If, after taking all considerations into account such as capital cost, running cost, location, disruption, decanting, life of the option, time required to execute the option, etc, etc, we come to the conclusion that the only available option still open to us is upgrading. How do we assess the economical degree of upgrading we should be aiming for?

It is obviously a complex and detailed task to produce documentation on upgrading design that can be used to determine what the likely costs of the upgraded scheme will be. There is also the risk that a designed upgrading scheme could be rejected because the estimate indicated that it could not be achieved within an acceptable cost limit. It would be useful, therefore, to have a method of quickly estimating the cost of different standards of upgrading and their relative benefits. This method would be used to assess and select the optimum level of upgrading and thereby reduce, and with luck, eliminate abortive design work.

Let me present one method of assessment that might be used. The initial selection procedure will start with determining specific levels or categories of upgrading. For convenience I have assumed three levels, that is: minor, intermediate, and major. These categories, let us say, can be described as

Minor upgrading
Redecoration
New floor covering
Minor repairs
Rewiring
New bed-head services.

Intermediate upgrading
All the minor upgrading requirements plus
New fittings
Layouts amended
M & E services part renewed.

Major upgrading
All of intermediate upgrading requirements plus
Substantial structural alterations
New layouts
New partitions
New sanitary arrangements and fittings
Nurses' call system
Complete renewal of environmental services.

FIG. 4

Preliminary Estimates for 3 Levels of Upgrading — Sheet No. 1

RHA: Norlands — Existing No. of Beds: 30
Hospital: Princess Royal — Existing Floor Area: 1040m^2
Department: Ward "A" — Date 5.6.78

Building Elements To Be Costed	Minor Upgrading (1)		Intermediate Upgrading (2)		Major Upgrading (3)	
	Proposed Work	Cost £	Proposed Work	Cost £	Proposed Work	Cost £
Foundations	—	—	—	—	Concrete Founds to Extension	800
External Walls	—	—	—	—	Walls to Extension	1,800
Roof	—	—	—	—	New flat roof to Extension	1,400
Floor	—	—	—	—	Concrete floor to Extension	400
External Doors and Windows	New fire escape door	100	New fire escape door	100	Fire escape door and SW single glazed windows	1,300
Partitions	New partitions and Glazed Screens	1,000	New partitions and Glazed Screens	1,000	Bk. & Blk. partitions & glazed screens	1,500
Internal Doors	New doors complete	500	New Doors complete	700	New Doors Complete	1,000
Wall Finishes	Renew complete	700	Renew complete	800	Renew complete	1,300
Floor Finishes	Renew Complete	1,000	Renew Complete	1,300	Renew complete	1,700
Ceiling Finishes	Acoustic Tiles in Dayroom	400	Acoustic Tiles in Dayroom and Corridor	500	Acoustic Tiles in Dayroom, Corridor and Circulation Areas	800
Decoration	Decorate throughout	400	Decorate throughout	500	Decorate throughout	600
Fittings and Built-in Furniture	New Cupds, Shelves, Desks, curtain rails	1,000	Ditto and Patients Wardrobes	1,600	All as (2)	2,400
External Plumbing	New RWPs	300	New RWPs and to Extension	400	All as (2) and CI Drains	600
Sanitary Fittings and Wastes	New Fittings	1,200	New Fittings	1,300	New Fittings	1,800

Preliminary Estimates for 3 Levels of Upgrading — Sheet No. 2

RHA: Norlands — Existing No. of Beds : 30
Hospital: Princess Royal — Existing Floor Area : 1040m^2
Department: Ward "A" — Date: 5.6.78

Building Elements To Be Costed	Minor Upgrading (1)		Intermediate Upgrading (2)		Major Upgrading (3)	
	Proposed Work	Cost £	Proposed Work	Cost £	Proposed Work	Cost £
Hot and Cold Water Services	New supplies and over flows	700	All as (1)	800	All as (1)	1,600
Heating System	5 additional rads.	300	9 additional rads.	400	Renew complete	2,700
Medical Gases	—	—	Local oxygen supply	300	Local oxygen supply	500
Electrical engineering	Renew complete	2,000	Renew complete	2,100	Renew complete and additional clock and X-ray points	2,800
Fixed Equipment	New kitchen equip.	500	All as (1)	500	All as (1)	500
Nurse call System	—	—	—	—	—	—
Lifts	—	—	—	—	—	—
Drainage	—	—	—	—	—	—
Alterations and Extensions	New cols and Beams New disposal room	2,000	Extension to dayroom and disposal room	2,600	New cols and beams (Extension m.s.)	500
Demolitions	Partitions TD and stripped for services	300	All as (1)	300	All as (1)	400
Other						
Other						
Sub-Total		12,400		15,200		26,400
Preliminaries and Contingencies	15% on sub-total	1,860		2,280		3,960
Sub-Total		14,260		17,480		30,360
Professional Fees	18% on sub-total	2,567		3,146		5,465
TOTAL COST		16,827		20,626		35,825

FIG. 5

FIG. 6

Preliminary Estimates for 3 Levels of Upgrading — Sheet No. 3

RHA: Norlands — Existing No. of Beds = 30
Hospital: Princess Royal — Existing Floor Area = 1040m² — Date 5/6/78
Department: Ward "A"

Functional Aspects to be Assesed	Weighting Factor	Assessed Improvement of Functional Aspects								
		Minor Upgrading (1)			Intermediate Upgrading (2)			Major Upgrading (3)		
		Proposed changes	%	Wgtd %	Proposed Changes	%	Wgtd %	Proposed Changes	%	Wgtd %
Patient Comfort	0.9	New decorations finishes & fittings	20	18	As (1) & patients wardrobes & extention to dayroom & acoustic celing	60	54	As (2) & acoustic tiles generally	70	63
Visual contact	0.5	Glazed screens	30	15	Glazed screens	30	15	Improved layoutq	50	25
Safety	0.8	Fire escape door	20	16	Fire escape door	20	16	Fire escape door	20	16
Hygiene	1.0	New wall, floor & ceiling finishes & decorations.	60	60	All as (1)	60	60	All as (1)	60	60
Sanitary Facilities	0.7	New fittings	70	49	New fittings	70	49	New toilet extension	80	56
Privacy	0.5	New screens and curtains	20	10	New screens, Ptns and curtains	30	15	New layout	40	20
Layout	0.4	New disposal room	20	8	New disposal room	20	8	New layout	30	12
Communications	0.5	No change	—	—	No change	—	—	New layout	20	10
No. of Beds	0.7	25 Beds	-15	-11	26 Beds	-10	-7	28 Beds	-5	-4
Staff workload	0.3	5 fewer beds 42 more m² area	30	9	4 fewer beds 22.3 more m² area	20	6	2 fewer beds 577 more m² area	10	3
Services	0.8	Part heating new elec part San fittings	50	40	All as (1)	50	40	Complete renewal	80	64
Report writing	0.2	New nurses station	20	4	New nurses station	20	4	New nurses station	20	4
Cleaning	0.4	New finishes complete	60	24	All as (1)	60	24	All as (1)	60	24
Storage	0.5	No change	—	—	New wardrobes for patients	50	25	All as (2)	50	25
TOTAL IMPROVEMENT			385	242		480	309		585	378

FIG. 7

Preliminary Estimates for 3 Levels of Upgrading — Sheet No.4

RHA: Norlands — Existing No. of Beds = 30
Hospital: Princess Royal — Existing floor area = 1040m² — Date 5/6/78
Department: Ward "A"

Summary	Minor Upgrading (1)	Intermediate Upgrading (2)	Major Upgrading (3)
1 Total Cost	£16,827	£20,626	£35,825
2 Increased cost and % over previous category	–	£3,799 (22.6%)	£15,199 (73.7%)
3 Total improvement over existing weighted %	242	309	378
4 % Increased improvement over previous category	–	27.7%	22.3%
5 Proposed number of beds	25	26	28
6 £ cost/bed	£673	£793	£1,279
7 Proposed floor area	1082m²	1263m²	1617m²
8 £ cost/m²	£15.55/m²	£16.33/m²	£22.16/m²
9 Proposed cost allowance for upgrading = £25,000			
10 Total Cost / Total Improvement	£16,827 / 242 = £69.53/Unit of Improvement	£20,626 / 309 = £66.75/ Unit of Improvement	£35,825 / 378 = £94.78/Unit of Improvement

Assessed Optimum level of upgrading = Intermediate Upgrading

The number of categories can be adjusted as required. A large number will increase the paper work, but this should have the advantage of being more sensitive in gauging the relative benefits to be gained from additional expenditure.

For each upgrading category an outline sketch plan could be produced showing the work required. This will be related to the particular building elements involved and briefly described. Normal estimating techniques will be used to cost proposed work. The intention is to produce quickly a range of relative cost between the categories. The cost of each category will be summed, and also expressed, as £s per square metre and £s per functional unit, to facilitate comparison. The 'marginal' increase in cost of each higher category will be given as a percentage of the cost of the previous category.

In addition to the costing of each category an assessment must be made of the improvement produced in the functional aspects and performance of the department by each upgrading category. These assessments will need to be made by medical or nursing personnel, and will be subjective judgements based on their experience and knowledge. The range of improvements for each category will be given as a percentage. For each category a percentage improvement will be given of the proposed upgrading over the existing situation. These improvements will be weighted in order that the relative importance of each functional aspect, for example — patient comfort, hygiene, layout, privacy, storage, etc, can be gauged and a true picture of the overall improvement produced.

It should clearly be understood that the description and figures given in *Figures 4, 5, 6 and 7* have no factual basis. Their relevance is limited to providing an indication of how the schedules might be produced. The actual work descriptions and costs will be inserted by the work personnel. The functional aspects, weighting factors, proposed changes and assessed improvements will be inserted by the medical or other relevant personnel.

The intention is to produce quickly for each level of upgrading a total cost and a total improvement by comparing these costs and improvements and the levels that show the least cost per unit of improvement is presumed the most satisfactory (ie, it provides the greatest value for money). I said that it presumes to be the most satisfactory because this is not necessarily the case, for we do not know how to value one per-centage improvement in facilities in money terms, but at least it will give a very strong indication of the best value for money. It is, of course, accepted that the levels of satisfaction are subjective and difficult to evaluate. It is, however, suggested that the probability of reaching the right decision is greatly increased by this comparative technique.

Biomedical Engineering in Developing Countries

Three Years Experience in Nigeria

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The need for the profession of biomedical engineering was recognised first in the USA some 15 years ago, although the profession had established itself long before this time. Since its recognition as a much-needed and useful profession, biomedical engineering has made fast progress throughout almost all developed countries and can be credited with much of the progress of modern medicine.

Developing countries, however, have failed so far to recognise the need for biomedical engineers, although there, especially, the need for this profession is likely to be much greater than elsewhere. While in developed countries the predominant objective of biomedical engineering has been — and still is — the development of new, highly sophisticated equipment for research, diagnosis and therapy, this field of science faces much more basic, though certainly not less interesting, objectives in developing countries. There, basic commodities like a reliable supply of electricity, water, reliable communication systems, etc, as well as trained and experienced technical manpower and the availability of spare parts are still, to a large degree, non-existent. An entirely different approach to biomedical engineering and highly specialised skills is, therefore, necessary to perform successfully as a biomedical engineer in developing countries.

In the following we will try to outline some of the major problems facing a biomedical engineer there, and we will try to suggest how he can find solutions to these problems.

Supply of Electrical Energy

While in developed countries a reliable and stable supply of electrical energy is the rule, electrical supply is one of the major problems in most developing countries. In Nigeria, total power failures, often lasting for several hours, are an almost daily experience. Supply voltage and frequency deviations of up to 45% and more from standard nominal are not uncommon.

Grounding of electrical systems is, as a rule, neither properly understood nor properly handled, and often gives, above all, quite considerable difficulties due to soil conditions and the tropical climate. Often, outdated electrical supply and distribution systems, poor line separation through substations, poorly installed and maintained distribution systems, lack of well established and enforced installation codes and standards, often complete lack of inspection of new installations, are contributing factors for these conditions. To illustrate the above the following:

Measurements in the College of Medicine of the University of Lagos, carried out with recording voltmeters over periods of two to three weeks continuously, indicated that the supply voltage, which is nominally 240 Volts in Nigeria, could vary, within minutes, between 193 Volts and 312 Volts with occasional short peaks of up to 400 Volts and a duration of 10 microseconds to 25 milliseconds. Line frequency, which is in Nigeria nominally 50 Hertz, was measured with storage oscilloscopes and indicated variations between 43 and 66 Hertz, although these variations were not so frequent. After power failures, the returning electrical energy was, for a short moment, at about 300 to 340 Volts, sometimes higher.

It is quite obvious that the conditions described above caused substantial damage to our medical and research equipment, usually burning out first components in pre-amplifiers and power supplies, or electrical light bulbs in microscope illumination stages and photometers. Conventional line voltage stabilisation by means of voltage stabilisers or constant voltage transformers did not provide sufficient stabilisation. We have tested many such instruments for which manufacturers claimed they would do the job and found them insufficient. These instruments usually operate at a limit of stabilisation of $\pm$ 10 to 20% variations, while we had to deal with variations in excess of 35%. Stabilisers with better than 20% correction, in turn, had usually longer reaction times (usually 1% per microsecond) and could not cope with the sometimes extremely fast and high transients.

In addition, the many and unpredictable power failures made it almost impossible for a researcher to carry out his experimental work economically and successfully, and, therefore, many frustrated researchers eventually gave up their experimental work altogether. With these constant interruptions, reliable and reproducible results became almost impossible.

Further, damage to equipment caused by the conditions described could render equipment inoperable for quite long periods of time, sometimes for more than a year, since spare parts were locally unavailable and had to be ordered from abroad, an extremely time-consuming task in a country like Nigeria which does not have a freely convertible national currency and with constant port congestion.

We were faced with the task of finding a suitable (and economic) solution to these problems and considered the following two possibilities:

a. to generate our own electrical energy, or

b. to work from batteries.

Both these solutions have advantages and disadvantages, as we will outline in the following:

Generation of Electrical Energy

Generating our own electrical energy with generators was probably the most obvious and most simple solution. However, it had its definite difficulties. In Nigeria, NEPA, the Nigerian Electrical Power Authority, permits self-generation of electrical energy only during power failures (emergency generators), or in areas within the country to which they do not yet provide electrical energy. Excepted are Government institutions such as Universities, Federal Research Institutions, etc. This leaves private and industrial institutions deprived of this possibility. Although we were primarily concerned with our own Government owned institution, we felt nevertheless obliged to provide solutions to non-Government institutions, for Universities are financed from public funds and, therefore, are rightly expected also to provide services to the public.

There was another serious reason why we considered this solution was not the best one. Electrical generators need regular maintenance, which is difficult to provide in a country with technical manpower shortage. Also, electrical generators have component failures and breakages, particularly due to high humidity, dust, sand, etc. Supplying spare parts for such generators was as problematic as supplying spare parts for our equipment. A broken-down generator, therefore, could be out of service for very long periods of time. Further, generators are quite expensive, and the provision of spare generators had its definite financial limitations.

Operation from Batteries

For this type of operation, we have found a solution which worked satisfactorily for us, at least as low power consuming equipment was concerned. We have experimented with a system consisting of two banks of 12 Volt heavy-duty automotive batteries. While the one bank was supplying electrical energy, the other bank was charging from line supply. As soon as the energy from the first bank dropped below a predetermined energy level, a relay automatically switched this bank to charging and the other bank to supplying. From the battery supply, the 12 Volt DC was inverted to AC (chopped square wave) and fed into a step-up transformer. The 240 Volts AC thus obtained energised our equipment. The result was a very stable supply voltage, having the additional advantage that in case of power failure, we still had some time left to continue the use of our electrical and electronic equipment. Maintenance of batteries, inverter and transformer caused no major problems.

Although the method described might not be the best possible solution, it has worked for us satisfactorily. In future years, energy obtained from solar cells, atomic batteries, etc, may provide better alternatives. Our solution has merely been described as an example as to what can be done in a given situation.

Any system which may be considered must, however, fulfil the following conditions:

a. it must be capable of delivering a stable output voltage and frequency;

b. it must be free of interference;

c. it must be easily maintainable and require only a bare minimum of spare parts, which must be easily available, and;

d. it must be economically feasible.

As mentioned above, electrical grounding is a very special problem, particularly in tropical countries. Most developing countries have inherited their technical systems from their former colonial period and have not updated them since. This is particularly true in countries where native technical manpower is still scarce. The reasons for and principles of grounding are quite often not properly understood, and the particular problems of grounding systems in medical care institutions in view of micro-shock-hazards and interference-elimination are usually completely unknown.

In Nigeria we have observed that water and waste water lines use quite frequently plastic and ceramic pipes. So grounding through the water lines was not possible. Due to the poor electrical conductivity of sand, the

generally used 'Ground Rod' did not provide the same reliable grounding as it would in the moist soil in Europe or the USA. We used in Nigeria 'Chemical Grounding' with good results. A ceramic pipe approximately 2 metres long with a diameter of 12 cm was vertically buried in the ground so that about 10 cm of its length remained above ground in order to avoid surface sand falling into the pipe. In the centre of this pipe, a copper grounding rod approximately 3 metres long was inserted so far that its upper end was about level with the outer end of the pipe. The space between the rod and the inner surface of the pipe was filled with calcium chloride. We selected this chemical since it is not poisonous and would, in small quantities, not alter the taste of the ground water. Initially, about 10 litres of water were poured on the surface of the calcium chloride filling. After this, the humidity of the air will keep on to resolve some of the chemical inside the pipe. The resolved chemical, which is a good electrical conductor, seeps through the sandy soil to the groundwater level, thereby creating a good grounding pathway. Every six months (in some areas more often), the loss of chemical must be replenished.

Measurements between the system described and a steel pipe which was, in effect, driven all the way down to the groundwater level, indicated a constant ground path resistance of 12 Ohms, while the resistance between the steel pipe and conventional ground rods measured 2724 Ohms during the dry season (Harmattan) and 27 Ohms during the rainy season. The system described worked well. Other methods may be possible. This is probably one area for further research for a biomedical engineer working in a developing country, for the conditions in Nigeria may not necessarily equal the conditions in other tropical countries. Again, we have described this particular problem in more detail to illustrate the general problems of working in developing countries.

Technical Manpower

One of the most serious problems facing a biomedical engineer, and for that matter probably any professional working in a developing country, is the lack of reliable, skilled and experienced technical manpower. It begins with the user of medical and research equipment, who, usually only has a vague idea of how to use a given piece of equipment properly and, as a rule, does not bother to read the instruction manual which, in most cases, is anyway written in a way almost impossible to understand. The result is usually a large amount of damaged equipment. This damage, in contrast to that caused by environmental conditions as described above, is avoidable if proper instruction is given to the user, which in turn would be one of the assignments of the biomedical engineer.

Equipment damaged by means as just described, combined with damage due to an unstable electricity supply, the, in most cases, complete lack of preventive maintenance, and the relatively fast deterioration of equipment caused by the conditions of tropical climate (humidity, heat, dust, etc) causes an unusual amount of repair work, for which neither well-trained technical manpower nor necessary spare parts are easily obtainable.

Establishing internal training programmes does not usually give good results for the following reasons:

a. They do not give a diploma to the trainee after he has completed the programme, and, therefore, do not offer him better career prospects, which, in turn, eliminates the challenge for him. He will still participate, but with little enthusiasm and effort;

b. Quite often, as soon as a technician has obtained special training for a given purpose, he regards himself as such a highly trained specialist that he is no longer willing to do the job for which he was trained, but rather wants to be supervising others. This is particularly true for technicians who were sent abroad to obtain factory training as field service men;

c. Those with University training in technical fields usually have good theoretical knowledge but little practical experience as to how to apply their knowledge to practical problems. Since they have usually a higher degree, they feel quite often that it would be below their academic standing to accept practical instruction in manual work.

The few highly skilled and experienced technicians one might find in such a country, have usually acquired their skills and knowledge through apprenticeship and years of practical work rather than through a school. They do not, as a rule, have the necessary paper qualifications to obtain positions according to their capability, and which offer them an attractive salary and career prospects. Thus disillusioned, they will not perform to their full ability.

Here, the only possible solution would be a complete re-thinking by the responsible authorities, but how to get them to do so? Introduction of 'Equal Opportunity Employment' schemes, where practical experience, knowledge and skill can, to some extent, replace paper qualifications in a career programme, could probably work well. One has, however, to be aware of the fact, that particularly in developing countries, status is very important, and those with academic degrees, who have established their status, will not easily be prepared to let non-degree holders obtain the same status.

Technical schools and universities, particularly in developing countries, should tailor their technical curricula to applied sciences rather than to theoretical sciences, with a major portion of student work being practical courses rather than theoretical lectures. The high cost of such programmes, however, will be a prohibitive factor for many developing countries. We would like to suggest that Governments of developed countries, offering scholarships to students of developing countries, should be more aware of the real needs of these countries, and should select students and fields of study accordingly in order to help them really develop towards independence and self-sufficiency. Technical and financial assistance to Universities in developing countries should primarily concern applied sciences and technology. It must also be recognised that teachers sent to developing countries will soon find themselves trapped in an established, often highly inefficient, teaching system, and are, as aliens only in the country for a relatively short period, usually not in a position to change things for the better. Many of these teachers have, in the past, left in frustration. Being an instructor or teacher in a developing country, no matter at which academic level, requires very special knowledge and skills and an enormous amount of idealism which only few of those accepting such appointments have.

A biomedical engineer accepting a position in a developing country must be prepared, at least for some years, to do almost everything himself, even if it is work which is way below his own professional status. He will occasionally find some good technical assistance, but this is the exception rather than the rule. His goal must be to create good technical manpower, and he will only then be successful if he appreciates fully the problems the country is really facing, and all the difficulties of the people he will have to deal with. However, if he returns home and has completed his assignment successfully, this will be more rewarding to him than anything else.

Equipment

The newcomer to a developing country which has financial resources will be surprised with the amount of medical and research equipment he will be confronted with, some of it quite modern and sophisticated. It is understandable that developing countries strive hard to catch up with scientific and technological development of highly developed countries. However, it is usually not considered that reliable commodities such as electricity, water, gas, communications, etc are basic requirements for the proper operation of sophisticated scientific equipment. If they are missing — and in many developing countries they are — the best of such equipment will be useless.

Lack of good technical manpower is another factor contributing largely to the problem of modern medical care in such countries. They are usually far away from the manufacturer of equipment or his technical representative, and the manufacturer is also often not aware of the specific environmental requirements for his equipment in such countries. In addition to this, there are, quite often, reckless businessmen selling out-dated equipment in bad condition to such countries, equipment for which spare parts are no longer available. For such equipment, which quite often could not be sold any longer in well developed countries, unbelievable prices are charged. Obviously, few of these 'businessmen' appear to be aware of the extremely bad long-range consequences in public relations between the selling and the buying country.

The fact that most developing countries do not have national testing laboratories, as Underwriters Laboratories in USA and the VDE in Germany, which control the quality of imported technical goods, makes it easy for such unscrupulous businessmen to import equipment of questionable quality for good profits. Any biomedical engineer working in a developing country should, also in his own interest, try to establish some sort of quality control facility within his institution, and should advise his superiors and colleagues of delivery of poor quality equipment. Otherwise he will be blamed for the poor performance of such equipment. Still better would be if he manages to gain sufficient confidence among his colleagues that he would be consulted on the selection of new equipment before a firm order is placed. Thus the purchase of low-quality equipment could be reduced if not totally eliminated. Standardisation within the institution of as low as possible a number of different brands of equipment would make maintenance and repair procedures much easier, and would permit the stocking of sufficient amounts of spare parts at a reasonable cost.

All this, however, will require much persuasion, convincing, patience and hard work. Presently, for instance, one may find in one small laboratory several pieces of equipment all doing the same but all from different manufacturers, because every academician or technician returning from his training abroad will likely insist on the same type of equipment which he had used abroad, without regard of what is already available. With such an array of different makes of the same type of equipment, spare parts storage becomes financially impossible, and repair and maintenance will be cumbersome, particularly if native personnel have to be trained. This situation is not, by the way, characteristic only of developing countries, for the authors have seen this in European and American institutions as well.

Repair of any kind of equipment can be a serious problem, since even the most simple small standard components, like resistors, etc, which at home are at any time available for pennies in the nearby radio store, may not be available in the country at all. If ordered from abroad, it may be months, if not years, until they arrive. In Nigeria there is also the problem that the national currency was not freely convertible. All purchases for foreign currency had to be approved by the Central Bank. The usual method of purchase after such approval was by irrevocable letter of credit, which, in turn, usually could not be obtained for purchases amounting to less than US $2,000. It was not unusual that we had to produce a small resistor ourselves by coating a piece of cardboard with several layers of graphite from a pencil until we obtained the approximately correct value of resistance, or that we had to turn out a certain screw or other piece of hardware on the lathe, because it was not available. A certain amount of ingenuity is, therefore, one of the foremost requirements for a biomedical engineer intending to work in developing countries. The word 'impossible' should not be found in his dictionary. He must be prepared to teach basic instrumentation to instrument users and basic instrument principles and repair and maintenance procedures to his technical staff, using clear and simple terminology, and he must be everywhere at anytime to help, explain, and eventually do things himself where necessary.

General

After having discussed some of the professional aspects, it may be appropriate to make a few remarks on the general situation for one who is willing to work in a developing country.

Many of us have experienced administrative 'red tape' at home. If you cannot cope with it, stay where you are, for it is worse in developing countries. There are many reasons for it. The most simple one is that cumbersome administrative procedures were introduced into these countries by their former colonials rulers long ago, and they are still used in much the same way. But 'red tape' can also be used as a weapon. It is used by small administrative officials to demonstrate their power, or to delay the progress of someone not liked, etc. It can be extremely frustrating, and one has to learn to cope.

Communication is another frustrating subject. It can happen that a letter from your home country will reach your developing country within two to three days, but it will not reach you yourself for another two weeks.

Telegrams, telex and urgent letters may not reach you any faster than ordinary letters. The telephone on your desk may be a nice piece of decoration which never works, or which rings constantly for wrong connections. A short distance trip of a few miles with the car might, despite good roads, take you several hours because of traffic congestions.

Environmental conditions may be another source of trouble. Although in most of these countries modern buildings are air-conditioned, this does not help much if the electrical power fails, which is quite a common thing in Nigeria. If this happens, electrical insulation in some equipment starts breaking down within hours because of fungal or bacteriological activity, meter dials and hands begin to rust and get stuck, etc. It should be stressed at this point, that only 'tropicalised' equipment should be purchased for such countries, but during our three years in Nigeria we have not seen one piece of equipment so prepared.

Preventive maintenance is more important in tropical developing countries than anywhere else in the world. Dust, sand, heat, humidity, careless handling, etc, make this equipment age faster there than normal. Unfortunately lack of technical manpower, essential spare parts, etc, usually makes this impossible.

We have tried to outline some of the problems facing a biomedical engineer in developing countries. It is not our intention to frighten away such colleagues contemplating the possibility of accepting a position there. On the contrary, we feel that in those countries, biomedical engineering is probably more challenging and satisfying than anywhere else. But anyone intending to accept such a job should be fully aware of what he has to expect. We also hope that responsible Government agencies, equipment manufacturers and vendors who are concerned about their good reputation may find some points of interest.

Finally, we sincerely hope that the Governments of developing countries, and organisations interested in assisting such countries in their health care planning, may realise the importance of biomedical engineering for developing countries, and will provide the necessary assistance to establish this profession where it is probably needed most.

Product News

NW Thames' Low-Cost System to Reduce Theatre Pollution

Engineers of North West Thames Regional Health Authority, working with a consultant anæsthetist, have designed a system for reducing anæsthetic gas pollution in operating theatres which offers significant initial cost savings.

The system can be added to most existing theatre air extracts and will cope with a peak flow rate of 130 litres per minute. It is called the Assisted-Passive System, incorporating an Air Break AETU (Anæsthetic Exhaust Terminal Unit).

Manufacture of the system and installation in a typical existing theatre will cost around £100.

The Air Break AETU provides direct connection through a special expiratory valve on the anæsthetic face mask into the theatre extract. The connection is through flexible piping to a wall or ceiling pendant incorporating the Air Break AETU, then by fixed tubing to the extract duct. The break is a fail-safe device allowing the patient to continue breathing normally if the mechanical ventilation system should stop. In a theatre or anæsthetic room with recirculatory ventilation an AETU venting direct to the atmosphere would be used.

The AETU has been designed by Mr. Raymond Hodge, NW Thames regional engineer, Mr. Frank White, assistant regional engineer, Mr. Tony Lamberti, principal assistant engineer and Dr. Juan Gil-Rodriguez, consultant anæsthetist at St. Mary's Hospital, Paddington.

About 300 Air Break AETUs will be needed for theatres in North West Thames. Design information on the system is being sent to all other health authorities.

Although the DHSS says no safe level of anæsthetic gas pollution can be defined, research in America has suggested that, for nitrous oxide, 20 ppm is acceptable. On test at the Building Services Research and Information Association, the Air Break AETU air leakage was less than 1 ppm.

Victor Ripley, Regional Press and PR Officer, 01-262 8011, ext. 324.

Synthetic Voice Speeds Contact at St Thomas'

To speed communication within the St Thomas' Hospital complex in London and ease congestion on the busy hospital switchboard, a 'synthetic voice' pocket paging system is now in operation — the first of its kind in this country.

The new 'Access 100' paging system, designed to handle a high volume of traffic and using an electronic voice synthesiser to indicate the origin of calls, has been installed by Multitone Electric Company.

Before the system was installed at St Thomas', the hospital switchboard was handling an average of over 3,000 paging calls a day. The hospital needed a full-time operator to handle the paging.

Now, to page someone, the caller does not need to go through the switchboard. All he or she does is dial an 'access number' on the internal telephone to gain entry to the paging terminal. The caller then dials the digits of the person to be altered, followed immediately by four message digits indicating the telephone extension to be called back. After being alerted by a call signal, the recipient then hears the digits of the dialled message in a synthesised voice.

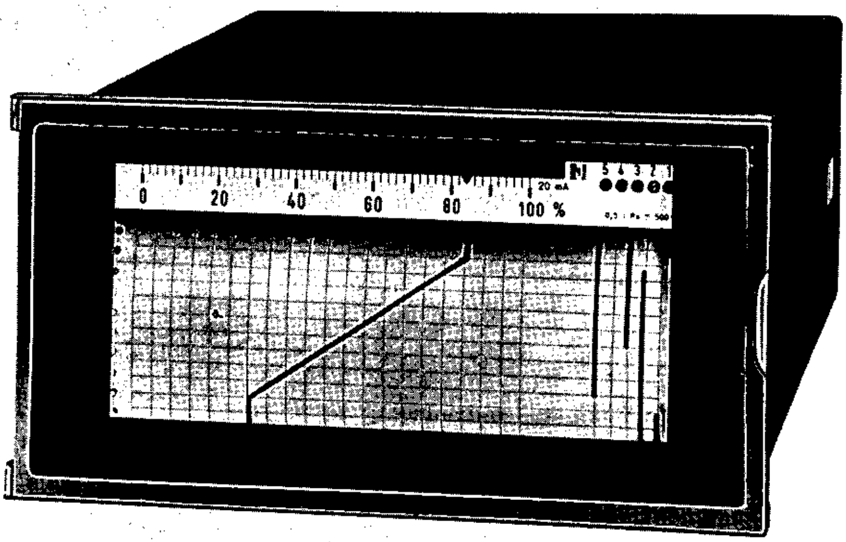
Paging can still be done via the switchboard, as well as crash calls and major disaster calls, when several people are alerted simultaneously. Outside callers also have to go through the switchboard, but the total level of operator-handled traffic has eased considerably.

Further information on the Access 100 system is available from Multitone Electric Company, 6-28 Underwood Street, London N1 7JT. Telephone: 01-253 7611.

New Electronic Programmer

Crompton Parkinson Ltd, a Hawker Siddeley company, is introducing an elctronic programming station which is new to the British market. This will be marketed in this country by Crompton Electronics of High Wycombe who recently became the sole UK agent for the Joens range of control and process instrumentation. It operates either as a conventional set-point programmer, as a time-based programme station or in a sequential event programming mode.

The new unit provides an adjustable, switched programme duration from two minutes up to 32 days. The opto-electronic sensing head enables the desired programme to be quickly



Crompton Parkinson's electronic programmer.

drawn on quick-change cassettes for speed of replacement. Other features include a linear-motor powered plotter giving repeatability and high resolution.

The output from the unit is 0 to 20 mA dc or 4 to 20 mA dc into 500 ohms. Up to five optional sequential on/off relay-switched functions are available with contact ratings up to 3 A at a maximum of 220 V ac. The overall size of the unit is 192mm wide, 96mm high and 337mm deep.

Colin Ashmore, Crompton Parkinson Ltd, 50/52 Marefair, Northampton NN1 1NY. Tel. Northampton 30201.

Plug-in Bathrooms

A new 'instant' bathroom which come ready to plug in as an integral component into any new building project is now available. Built by Feal of Italy and marketed in Britain by Makoni Establishment, the bathroom block is a basic steel frame, tiled and fitted in ceramics, aluminium and stainless steel at an ex-works cost of between £700 and £1,100.

Delivered in batches of up to seven a time by container trailer, the 950 kilogram units can be crane-hoisted into position and the existing pipework, ducting and electrical systems are then connected.

The Feal bathroom unit is available for inspection at Makoni Establishment's London Depot.

For further information please contact: Dr Adriano Passoni, Makoni Establishment, 71 Selbourne Road, London N14 7DE. Tel. 01-886 6463.

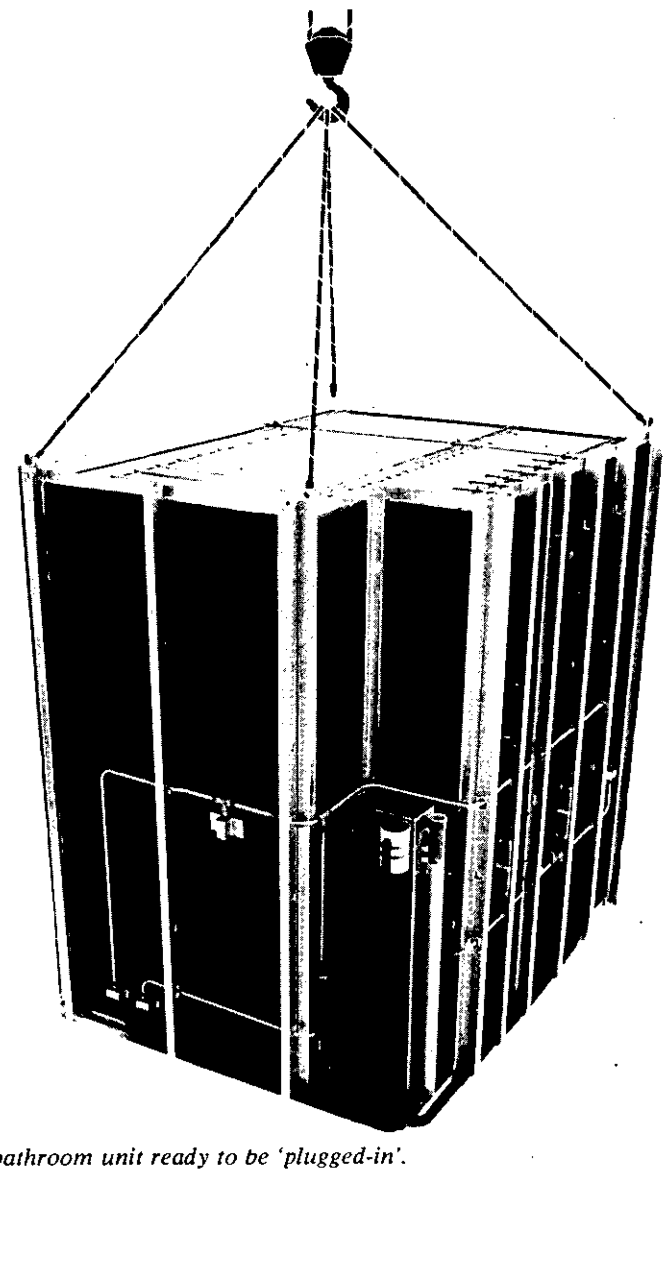
TM3 Gas Differentiator

Developed by DI Special Products Ltd, the TM3 brings a new clarity to correct indication of the medical gases nitrous oxide and oxygen.

Each of the gases produce a positive meter indication of gas type. The instrument is robust and compact, it is simple to operate, battery-powered, requires minimal maintenance, and is priced at £90.

The instrument has been evaluated by BOC Ltd and a report is now available. Also a paper by anæsthetists at Westminster Hospital was recently published in the publication *Anæsthesia.*

Detection Instruments Special Products Ltd, 3 Rectory Road, Wokingham, Berks RG11 1DJ. Telephone: Wokingham 787016.



A Feal bathroom unit ready to be 'plugged-in'.

Classified Advertisements

APPOINTMENTS AND SITUATIONS VACANT

LANCASHIRE AREA HEALTH AUTHORITY — LANCASTER DISTRICT
Lancaster Moor and Ridge Lea Hospitals

Hospital Engineer

To be responsible for the effective operation and maintenance of all Engineering Services at the above hospitals.

Applicants should have sound experience in Mechanical/Electrical Engineering, and managerial ability in this field.

Minimum qualifications:
- Must be time-served Engineers in either Mechanical or Electrical Engineering.
- Hold HNC/HND in Mechanical or Electrical Engineering with appropriate endorsements or acceptable equivalent.

Salary Scale: £4,497 to £5,073 per annum, plus responsibility allowance of £183.

Closing date for applications: June 30, 1978.

Application forms and job description available from the District Personnel Officer, Lancaster Moor Hospital, Lancaster. Ref: HE1.

Lancashire Area Health Authority

LANCASTER DISTRICT

KING'S HEALTH DISTRICT (Teaching)

ASSISTANT ENGINEERS

Salary: £4,242-£4,731 inclusive

The minimum requirement for these posts is an ONC in Electrical / Mechanical Engineering or equivalent qualifications. The jobs offer excellent training opportunities and full support given for further studies. Previous experience of maintenance engineering (mechanical / electrical) preferable.

Application form and job description available for the above posts from Nigel Sewell, Assistant Administrator, Dulwich Hospital, East Dulwich Grove, London SE22 8PT. Telephone: 01-693 3377, ext 3209.

Qualified Engineer

Salary £4,950-£5,529

required to take responsibility for the mechanical and electrical services and the buildings at the Dental Estimates Board's offices in Eastbourne.

Applicants must have at least HNC in mechanical or electrical engineering or an acceptable alternative and have had wide practical training and experience, including maintenance of air conditioning plant.

This is a permanent and pensionable appointment in the National Health Service with good conditions of service. The person appointed may receive assistance with removal expenses.

Further details and an application form are obtainable from The Establishment Officer, Dental Estimates Board, Eastbourne, East Sussex BN20 8AD (telephone: 0323 25552, extension 27).

Index to Advertisers

THE ROYAL MASONIC HOSPITAL
Ravenscourt Park, London W6 0TN

Deputy Chief Engineer

Required to assist the Chief Engineer in this private 270-bedded hospital. Major redevelopments are at present taking place. A planned preventive maintenance scheme is being implemented.

Applicants should have completed an apprenticeship in mechanical or electrical engineering and hold HNC or equivalent approved qualification and be experienced in the management of mechanical and electrical plant.

Experience in control of maintenance staff and programming maintenance work would be an advantage.

New salary scale £5,342 to £5,917 per annum inclusive.

Accommodation at moderate rental available if required.

Application form and job description from Director of Support Services at above address, telephone number 01-748 4611.

Closing date: 14 days from the date of this advertisement.

THE MIDDLESEX HOSPITAL
Mortimer Street, London W1

HOSPITAL ENGINEER

Due to promotion in this Central London Teaching Hospital, a vacancy exists for the Hospital Engineer. The person appointed will be responsible to the District Engineer and form part of the Works Management team maintaining the services and assisting with some of the upgrading projects currently being carried out. He/she will also be responsible for co-ordinating a large direct labour force and will be supported by three assistant engineers.

Candidates should hold the Higher National Certificate in Electrical or Mechanical Engineering or a recognised equivalent qualification.

Salary scale £5,034-£5,610 inclusive of all supplements and allowances. Accommodation can be made available if required.

Application forms can be obtained from, and informal discussion may be held with, John Richards, District Engineer, The Middlesex Hospital, Mortimer Street, London W1N 8AA. Telephone: 01-636 8333, ext 7577.

Closing date: June 19, 1978.

LANCASHIRE AREA HEALTH AUTHORITY
Blackpool Health District
DISTRICT WORKS DEPARTMENT

ASSISTANT ENGINEER

The successful applicant will be a member of a design team involved in the production of specification and drawings for minor capital and major maintenance schemes within this Health District. The post offers excellent experience in the design and implementation of schemes to completion.

Applicants should have served an apprenticeship or have obtained a thorough practical training in electrical or mechanical engineering, and possess an ONC in Engineering or equivalent qualification.

Salary scale £3,888, rising to a maximum of £4,377.

Application forms and job description available from the District Personnel Officer, District Offices, Victoria Hospital, Whinney Heys Road, Blackpool FY3 8NR. Telephone: Blackpool 34151, ext 206.

Closing date for receipt of applications: July 12, 1978.

To place an advertisement in the next issue of **HOSPITAL ENGINEERING**, appearing on **August 4, 1978**, please contact: **EARLSPORT PUBLICATIONS**, 17 St. Swithin's Lane, London EC4, 01-623 2235/8, by **July 24**, latest.

Closing Dates

Recruitment advertisers are requested to set closing dates no earlier than three weeks after publication date of the Journal.

Monthly publications do not receive preferential treatment by the Post Office and circulation lists in hospitals also delay receipt of the Journal by many potential applicants.

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INSTITUTE NEWS

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ROYAL COMMISSION ON THE HEALTH SERVICE

PRODUCT NEWS