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Editorial

THE present-day cost of engineering services as a proportion of new hospital building costs is stressed by Mr. D. A. Goldfinch, whose 1960 Chadwick Trust Lecture we are privileged to publish in this issue, and he emphasises the need, when new hospitals are in the planning stage, for this aspect to receive much more careful consideration. The problem must be examined both from the first cost considerations and from the point of view of subsequent economic maintenance. Mr. Goldfinch quotes the capital cost of engineering services today as being some thirty per cent of the whole, and this figure has been endorsed by various authorities including the Department of Industrial and Scientific Research. It was gratifying to learn, therefore, from *Building Research 1959,** the report published by the D.S.I.R. last month, that the Building Research Station is to investigate hospital design and construction, and a programme of research is now being arranged with the Ministry of Health. " This is a field we believe offers much scope for rewarding research " the report says. Ways of providing the services more economically will be studied. Cost studies will also be carried out on recently constructed hospitals to try to identify other parts of the building process where economies might be achieved.

The relative costs of providing housing by three methods—high blocks in city centres, suburban development and new towns—was the subject of a study completed during the year. Dwellings in high blocks cost about two-thirds more than in two-storey buildings and maintenance costs were considerably higher. Suburban development may cost £750,000 for every 10,000 people and some twelve times that figure for a new town of similar capacity. It was concluded, however, that the real cost of new development was less because it had a longer potential life and was cheaper to run. There may be a moral in this when considering hospital building.

Another section of the report draws attention to the lack of a universally agreed code in regard to fire protection in the design and construction of buildings. To quote: " It may well be that the time has come when the whole subject of fire precautions in buildings should be reviewed again in the light of recent experience in this and other countries." The British Standards Institution are, in fact, engaged in preparing a Code of Practice on this subject.

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* Building Research 1959, H.M.S.O., 7s.

Hospital Sanitation

By D. A. GOLDFINCH,
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Changing techniques mean differing requirements. The first cost of engineering services now amounts to one third of the total cost of hospital building. These factors are reviewed together with their effect upon subsequent maintenance costs. We have therefore included this important paper in full.

IMPORTANT medical and technical advances have been made in recent years. Hospital planning has become more and more specialised and, therefore, more and more complicated. It is no longer possible for one single man to master all the different problems, aspects and details, which concern not only the operation and its demands but also the special technical problems which arise when planning a hospital. With this the question arises how best to bring together all the necessary knowledge and experience and to combine them in such a way that it is possible for the hospital architect to find a solution which can materialise in a building serving its purpose in a practical, efficient and economical way.

The only way to gain a satisfactory solution rests in full consultation and collaboration with all those who can assist to delve behind the " causes which affect health," which affect efficiency and accuracy, tenderness and care, skill and a full recovery. In all these, sanitation, whether in the form of safe and efficient drainage and plumbing, sound ventilation, protection from harm in the use of ionising radiations, or the procuring of bacteria free air as the setting for surgical intervention, has a major part to play.

The first cost of the plumbing, mechanical and electrical equipment of a hospital is approximately one-third of the total cost of the building. Moreover, the cost of operating and maintaining this equipment is far greater than it is for all other parts of the building. Consideration should therefore be given to the design and selection of materials for these elements, so that the first cost will be economical, excessive repairs can be eliminated and the cost of labour, fuel and power can be reduced to the minimum. At the same time the plant must be adequate to protect the health and safety of patients and employees and to maintain sanitary conditions in the hospital.

These objectives can only be accomplished by simplifying the design, by using systems of proved merit and by employing only the best materials and equipment. Not only is an over elaborate plant expensive to install, but the increased cost of operation and maintenance is an annual charge for the life of the building.

The architect, hospital staff and hospital consultant plan the various departments of the hospital and specify the clinical equipment required by the doctors, technicians and nurses. However, it is the responsibility of the architect through his consulting engineer to provide heating, sanitary and electrical systems which will guarantee the proper functioning of these departments and their equipment, temperatures best suited for the patients, sanitary conditions and efficient operation of the hospital.

1. Drainage

In selecting the hospital site, consideration should be given to the water supply and sewage disposal. A site near a sewer of ample capacity, with a satisfactory water supply, should be given preference, even if it is more expensive.

Because of the high initial cost and operation cost of sewage treatment plants, connection to an existing sewer system is usually more economical even though lift pumps or long connections are required. When a sewer is available, its elevation and capacity should be determined before the site is selected and, if the site permits, the building should be set at an elevation which will permit gravity drainage to the sewer. Although it is not my intention to refer at length to the more routine external services, there are one or two points that warrant emphasis.

Should it not be possible to drain the basement fixtures by gravity, two systems of drains should be used, one from the basement to the sewage ejectors and one from the upper floors direct to the street sewers. If lift pumps are needed, they should be installed in duplicate to assure uninterrupted service and, if occasional power shutdowns are likely, reliable emergency standby power should be provided for one of the lift pumps.

In providing for the discharge of sewage into an existing system, it should be borne in mind that the concentration of bacteria may be greater than is the normal domestic sewage of the community. If a relatively large hospital discharges sewage into the sewer system of a relatively small community, special treatment of the community sewage may be required.

Chadwick Lecture delivered, under the auspices of the Chadwick Trust, at the R.S.H. Headquarters on 24th March, 1960. Reproduced with the permission of the Royal Society of Health from their Journal, Volume 80, No. 4.

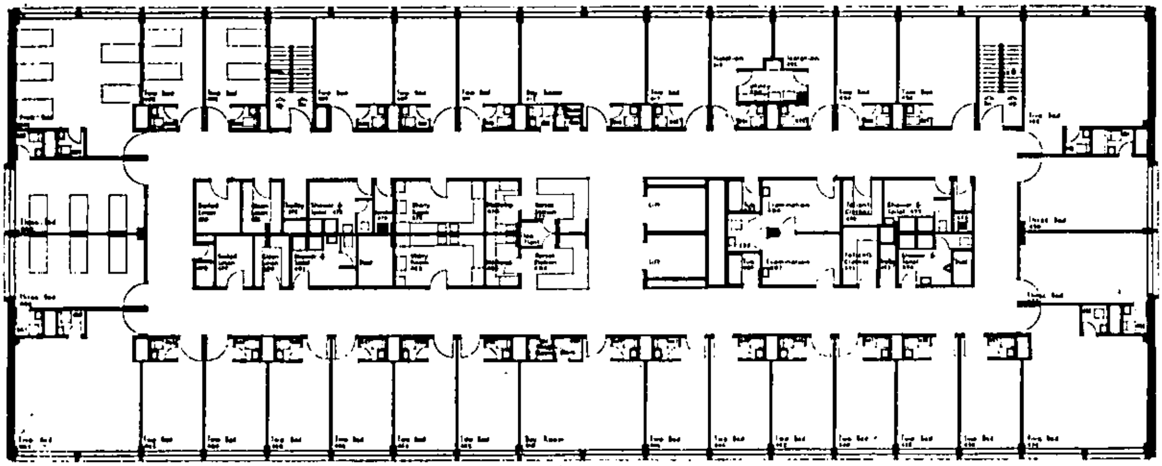


Fig. 1. Plan of ward unit on American race-track principle for hospital at Lakenheath, Suffolk. Designed by D. A. Goldfinch & Partners.

(a) Plumbing Stacks

Space for plumbing stacks should be considered when preliminary plans are being prepared. Chases and shafts for stacks should be run to clear frame and floor beams. Beams should not be located under partitions on which there are plumbing fixtures and should be arranged so as not to interfere with drain lines in false ceilings.

Drain lines and offsets should not be located above kitchens, food preparation areas, storage rooms, water tanks or dispensing areas. Thick partitions and fixings will be required for wastes and soil-stacks, and water pipes should not be located in outside walls. Floor plans, when possible, should be so arranged that plumbing fixtures will be placed one above the other to reduce the number of stacks.

The emphasis placed upon minimal distances to be traversed by medical and nursing staff in the care of the patient have given rise to the general adoption of the race-track plan for ward units in the United States of America and, more recently, consideration to their introduction in this country (Fig. 1).

This type of plan presupposes the acceptance of rooms devoid of natural ventilation or daylight. Where toilet facilities are involved, a stack drainage system in internal ducts becomes essential. For many years, health authorities in this country have looked with suspicion on any internal drainage, especially as regards inspection traps, access bends, manholes, etc., but with the general acceptance of the single stack system for multi-storey flats, its use in hospitals of less than six floors cannot be overlooked.

In 1954, the Royal Society of Health (then Royal Sanitary Institute) arranged for the presentation of a scientific paper on the " Investigation of Single Stack Drainage for Multi-Storey Flats "[1] and subsequent experience has not altered the views then expressed to any major degree. The economy of cost then analysed showed a 50 per cent saving by the single stack over the traditional two-pipe fully ventilated system.

It was noted that single-stack and one-pipe drainage has several advantages over the two-pipe system. The greater total water flow through the stack and drain should help to reduce the chance of stoppages. The absence of a gully makes for more efficient removal of wastes and of detergent foam and eliminates the point at which grease is, perhaps, most likely to collect and form a stoppage. In addition, yards and areas are kept free of the foam that bubbles up through gully gratings. As far as the toxicity of air in drainage pipes is concerned, one of the authors of that scientific paper concluded that the air in a single-stack or one-pipe system is no more harmful than that in a two-pipe system.

The case for single-stack and one-pipe drainage is based, therefore, on efficiency and hygiene, as well as on economy. In the experience of the author, a properly designed system of this type is, to say the least, no less safe and efficient than two-pipe drainage, and it may be more hygienic and more effective in the long run. In 1954, a well-known hospital architect said: " The design of hospitals and health buildings generally called for a great deal of drainage and the economies claimed through the use of the single-stack system offered possibilities of substantial savings."

Soil and waste connections must be sized and pitched to drain freely and prevent back flow to other fixtures and to floor drains. Each fixture must be connected separately, with individual traps.

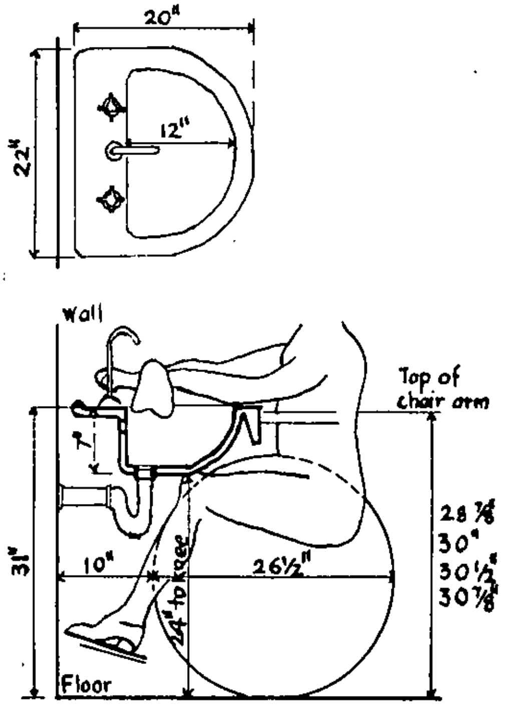


Fig. 2. Lavatory Basin for Wheel-chair Patients.

(*b*) *Risk of Pollution*

The wastes from certain fixtures or devices should discharge into the building drainage system through an air gap (indirect waste). Such an installation is required for utensils used for the cooking or warming of foods and drinks, devices used for warming utensils containing food or drink, machines used for washing dishes and glasses, floor drains in refrigerators, refrigerating machines, ice making machines and storage bins, tanks for storage of drinking water, drinking fountains, sterilisers, disinfectors and stills. Indirect wastes should be properly trapped and vented on the discharge side of the air gap. The air gap, when measured vertically, should be at least twice the diameter of the upper drain connection.

(*c*) *Personal Sanitation*

There are many types of outlet nozzles, water taps and valve controls, but only those applying to hospital use are of interest in the present context. In surgical work or in any other situation where the sterile field of the arms must extend above the elbows, knee-action controls are preferred. Where only the hands need remain sterile, elbow action is sufficient.

While it is desirable to reduce the number of special types of fixtures to a minimum, hospital types are many and varied, depending on their special function. As a prevention of direct cross infection in tuberculosis work, for instance, it has been found desirable for patients to wash themselves in running water. For that reason, the wash basin in such instances has no waste control or plug, but only an open grated waste. Likewise, with tuberculous patients, it is customary to provide separate dental bowls in order to eliminate sputum from the wash basin.

Another example of special fixtures to meet special conditions, is a wash basin designed for use by the chronic sick. Many of these patients are in wheel chairs. This basin enables them to wash themselves while sitting in a wheel chair, because they can get close to the bowl and get their knees under it. To permit these conditions, a fixture was designed to hang a considerable distance from the wall and its front is curved (Fig. 2).

In hospitals, back-siphonage becomes a special problem because there are many situations where the supply outlet is below the polluted, or potentially polluted, level. This is particularly the case where hose extensions are used on post-mortem tables, laboratory sinks, etc. Anti-siphonage precaution should be installed as a protection to the community in all such cases.

The ambulatory chronic sick patient, and the increasing trend toward early ambulation, is reflected in an increased number of toilet and w.c. facilities in closer proximity to the patient's bed. The extra width of w.c. cubicle required for the sani-chair, and for the accompanying toilet attention, must not be overlooked.

A fitting of considerable interest has recently been tested in Germany where sani-toilet facilities for the limbless are provided by means of a fitting having hot and cold mixed cleansing jets and hot air drying incorporated.

2. Structural Implications

The need to convey fluids, wastes, gases, etc., to and from any point of each and every floor level in the hospital building has presented a problem for structural solution.

Detailed consideration has been given by hospital architects and engineers in Belgium to the design of a building structure[2] that would permit of complete internal replanning at any future date, including the resiting of any fittings with connections to the services or drainage. Having decided that an area 60 feet by 40 feet provided the most satisfactory component within which area the whole or sectional part of any hospital department could be planned, the designers provided facilities for ducting of all services to any location.

In the building to accommodate 150 beds, yet capable of expansion to 300, the new hospital at Renaix incorporates three vertical service towers providing both for lifts, staircases and all services

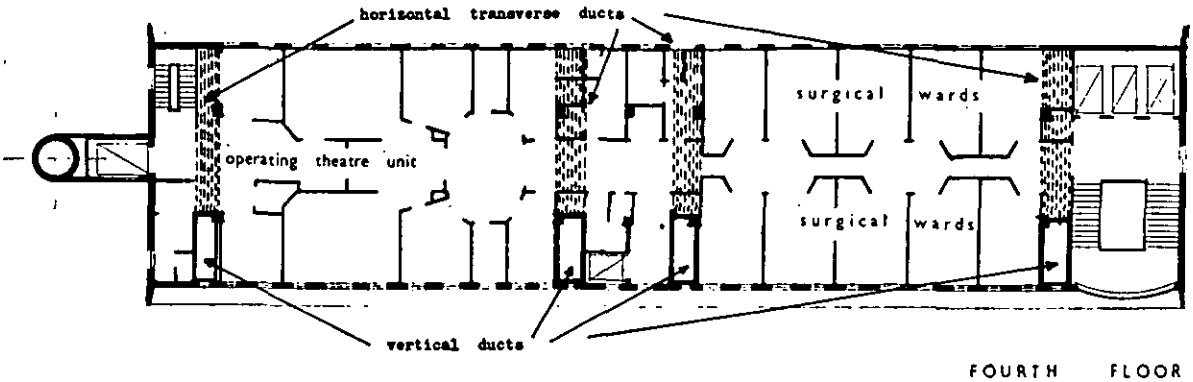
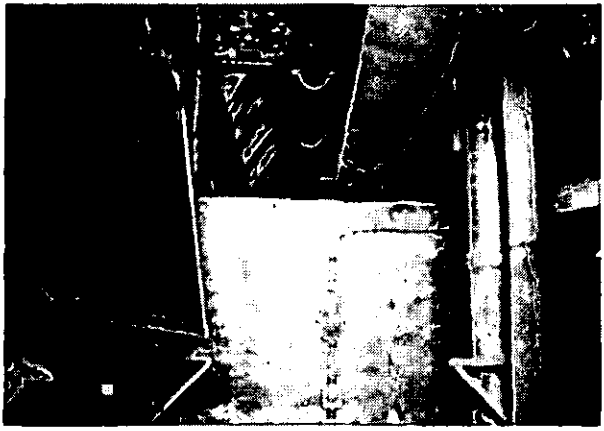


Fig. 3. (Above) Provision of Ducts in New Hospital Buildings at Renaix. (Right) Junction of Horizontal Transverse and Vertical Ducts.



including drainage (Fig. 3). The actual vertical service duct is 11 feet by 2 feet and includes a cat ladder for inspection and repair work. At each floor level there are four cross ducts 5 feet high, providing the points from which the services can run longitudinally throughout the length of the building and under any location on each floor.

The longitudinal runs are led between the prestressed concrete beams which span tower to tower. The advanced use being made of supporting towers of reinforced concrete combined with pre-stressed concrete has in this instance met the building demands of the engineer for full accessibility to all pipes and services. It also meets the wishes of the architect that such services should be hidden from general view and yet complies with the wishes of the medical profession that replanning and resiting of hospital departments, whatever degree of services and sanitation may be required, should be capable of implementation at any future date.

3. Ventilation

The trend in hospital design to accept the utilisation of inner space, devoid of natural light or ventilation, as must inevitably result from the racetrack plan not only presents the plumbing and duct problems already referred to, but necessitates a degree of mechanical ventilation and, in some instances, a wider use of air conditioning.

For many years there has been a natural reluctance on the part of the medical profession, hospital authorities and hospital designers to advocate the installation of warm-air space heating systems. This reluctance has been justifiably based upon the hazards of cross infection and odour nuisance which might result from the general recirculation of air within the hospital. Studies over the years by eminent investigators are quite inconclusive, but there is sufficient evidence to indicate that air-borne infection may constitute a potential hazard. The matter of odour nuisance is well established.

The new impetus which current planning trends have given to the use of air control within the hospital should not result in any relaxation on the part of the air conditioning system designer of all practical safeguards against the hazard of air-borne infection or of odour nuisance. Such precautions in design will result in a system which will supplement such present hospital aseptic techniques as sterilisation, masking, gowning, scrubbing-up, isolation, and any others practised to reduce the hazard of infection.

The field of hospital air conditioning and design presents many problems not encountered in the usual comfort conditioning system. The basic differences result from the restrictions on air movement, ventilation and filtering to control odours and to maintain aseptic conditions, temperatures, and humidities required for certain areas and exactitude in design which will provide positive balancing of the system. This requirement is even more critical in relation to operating theatre conditions, to which I shall refer in more detail later.

The following fundamental information accentuates some of the conditions the designer must bear in mind when planning the system.

(i) The hospital patient, due to his incapacitation or for other reasons, may be susceptible to infections from mild concentrations of pathogens which would have no effect upon a normal healthy individual.

(ii) In general, if outdoor air used for ventilation is taken from above the roof it is comparatively free of pathogenic organisms. Air becomes more contaminated after entering the hospital.

(iii) Recent publications have contained many reports of the emergence of antibiotic-resistant staphylococci and streptococci. These resistant organisms are unduly prevalent in hospitals and are important as infectious agents.

(iv) Pathogenic bacteria and pathogenic viruses are the organisms which make indiscriminate circulation of air a potential hazard. In general, the size characteristics of these organisms should be understood.

Bacteria are generally considered to range in size from approximately 1 micron (about 1/25,000 of an inch) to 10 microns and are visible under the optical microscope. Viruses are ultramicroscopic in size, generally considered ·1 micron and smaller. They are visible under the electron microscope to ·001 micron. They both move through the medium of a conveyor, be it dust particle or droplet.

(v) Bacteria and viruses may be disseminated into the air by sneezing, coughing, and the pronunciation of such consonants as port. These organisms are expelled with moisture from the linings of the nose and throat and are classed according to size as droplets or droplet nuclei. The droplets, being larger, settle very quickly to the floor or other surfaces, where after drying they may become air-borne as dried mucous or as attachments to dust, lint or other materials. Droplet nuclei, being comparatively small, quickly lose moisture and, because of their very slow settling rates, may be considered as suspended in the air until breathed or vented. Bacteria and viruses which have settled out of the air may be reintroduced into the air by traffic over floors and by many housekeeping activities. A brief review of mechanical ventilation under the headings air movement, humidity, ventilation rate and filtering follows.

(a) Air Movement

With the separation of patients, by sub-division of wards, the hazard of direct inhalation of infectious droplets should be reduced and dust, lint and dried mucous may assume more importance as carriers of droplet nuclei. Therefore, the control of air movement is important to avoid the reintroduction into the air of concentrations of pathogens which have settled out of the air on to floors, bedclothing and furniture. Location of air inlets and exhaust of the conditioning system and direction of air flow should be carefully studied, and velocities at floor level should be kept below 50 ft. per minute.

(b) Humidity

Reports of studies of the lethal effect of humidity upon pathogenic organisms are at some variance. It is considered by many, however, that a relative humidity of 50 per cent has the maximum lethal effect upon these organisms. In operating theatre conditions, humidity assumes another degree of importance as a safety factor against anæsthetic explosions by dissipating static electricity.

(c) Ventilation

The reduction of the concentration of pathogens in the air below certain critical levels is very desirable to reduce the incidence of infection. Such dilution is required for certain isolation, treatment and aseptic areas. The removal of contamination by ventilation is based on a simple logarithmic law common to physical and biological processes where the rate of disappearance of a substance at any moment is proportional to the concentration present at that moment. Therefore, each successive air change reduces contaminants in the ratio of $1/e$, that is, $1/2{\cdot}718$.

Assuming that no additional contaminants enter the area during the air change, 63·2 per cent of the original air and contaminants would be removed by one air change. Each successive air change would reduce the remaining contamination in a like amount. However, in practice, contamination must be considered as continuous during periods of use of occupied areas; therefore, reduction of contamination to the vanishing point cannot be obtained. Likewise experiment has shown that the degree of elimination may vary by a variance of the location of intakes, thus a quantitive change of a certain number might produce an effective ventilation rate higher or lower according to the position of inlets.

(d) Filtering

Proper filtering of air used for the ventilation and air conditioning systems of hospitals is of the utmost importance. Filtration is not only an important aseptic technique, but will also reduce housekeeping, painting and redecorating costs which result from dust and soot deposits on wall and ceiling finishes.

4. Air Conditioning in Operating Theatres

The major use of air conditioning in Europe is that of controlling infection rates in operative or surgical cases. In Great Britain the hospital requirement of air conditioning stems from the work of Bourdillon and Colebrook[3] in the field of operating theatre and dressing station contamination and infection. The necessity to secure a solution to post-operation infection and the resultant man-hour losses to industry, as well as the prevention of loss of life in a number of cases, resulted in the Birmingham Regional Hospital Board setting up a research team of surgeons, architects and engineers to study the problem in its widest aspect in relation to operating

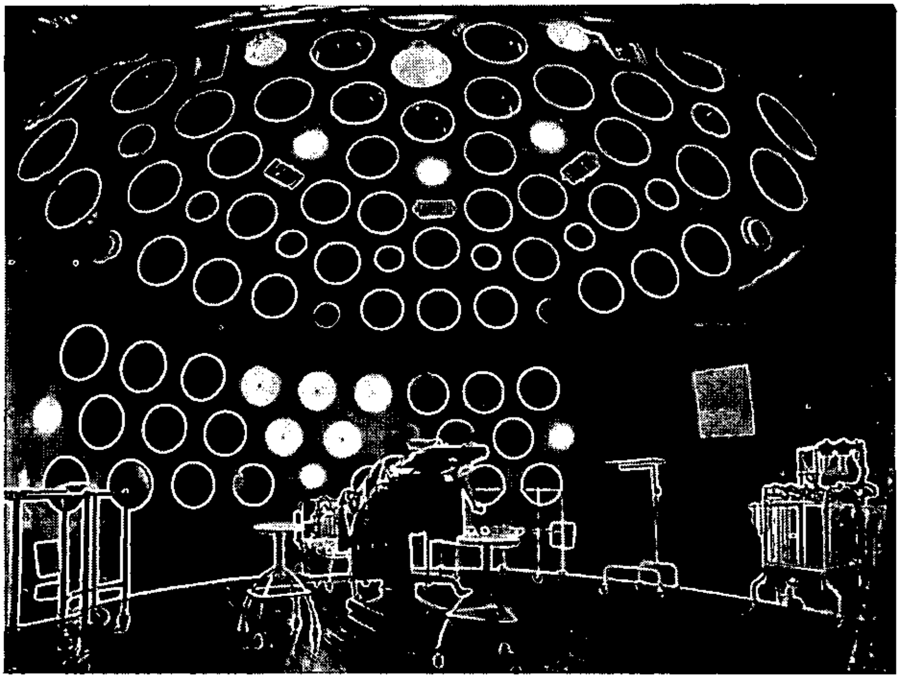


Fig. 4. Interior of mock-up theatre designed for research by Messrs. D. Goldfinch, A. J. Pashler, C. Allderidge and S. Hubbold.

theatre planning. As the architect member and joint leader with a surgeon of that team, it was my privilege to carry through an extensive research programme incorporating the full-scale erection of prototype designs of operating theatre construction, lighting and air-conditioning.

The team began a study of air-borne infection and air-bacteria saturation with the wide experience gained in the internationally-famous Burns Unit, where from 1942 to 1945 Dr. Leonard Colebrook had carried out extensive research. With a knowledge of the work of Dr. F. Masmonteil[4] on " conception moderne des groupes operatoires " and of " Revue sur le probleme de la contamination de l'air des locaux opératoires et sur les divers procédés de stérilisation de l'air " by Drs. Fernand Masmonteil and Marc Fleurot[5], together with an appreciation of the fact that French surgeons, architects, and engineers had given much thought to the problem, the team visited Europe and were afforded every facility to study various examples in France and Belgium.

Being impartial observers of the many varied solutions which had been adopted and were in use, the Birmingham team were able to prepare an extensive report[6]. They reached the conclusion that while in a very advanced stage of evolution, the continental examples did not provide the complete solution to the full problem which had been set by the hospital authority and its surgical advisers. The Research Team were, however, able to build upon the excellent foundations laid by the French and Belgian experiments, and this formed the starting point for the creation of the British solution[7].

A full-size mock-up was subjected to extensive tests and trials, the team having had the benefit of visits by groups of surgeons, anæsthetists, hospital matrons, operating theatre sisters, architects and engineers. Extensive tests to confirm the efficiency of the design have been carried out by the Medical Research Council in collaboration with the Research Team (Fig. 4).

(*a*) *Problems for Solution*

The natural tendency of dust particles contaminated by bacteria is to fall by gravity. It is therefore best to pass the clean air downwards to accelerate this natural fall and then to carry the particles out of the theatre before they are deposited. The patient is lying on a table above floor level, the sterilised operating instruments are on the tables well above floor level. If, therefore, the supply of clean air maintains all contaminated dust at floor level, the operating wound and sterile instruments will not become contaminated by air-borne sources.

If the continuous removal of infective particles of dust by a positive pressure ventilation system of clean air is to be efficient, certain essential requirements in lay-out, design, lighting and ventilation must be met. The ventilation plant, therefore, needs to fulfil certain requirements.

(i) The source of air should be above ground level so as to avoid contamination with street dust.

(ii) The flow of air should be such as to provide about 20 complete changes per hour, although the mode of application can create a wide diversity in the effective ventilation rate.

(iii) Filtration of the incoming air is necessary to remove the soot and any bacterial-carrying particles.

(iv) The temperature and humidity of the incoming air should be automatically controlled both for the comfort of the patient and staff, and to minimise anæsthetic explosion risk. A temperature of about 70°F. and R.H. 65 per cent is satisfactory for these purposes. This should also facilitate the quick drying of the theatre after its physical cleansing between operations.

(v) Since the exhaust air from the theatre is potentially contaminated, it is necessary to remove it to the exterior. This must be done without inducing a negative pressure which would draw in hospital air from the corridors. Similar considerations make air-locks desirable for patients, staff and materials to pass in and out of the air-conditioned section.

(vi) Since preparation work may involve steam sterilisers, etc., separate ventilation of rooms during this work is needed, preferably with an input of the same filtered air as is supplied to the theatre and an independent outlet carrying away the steam-laden air to the exterior. It is important that air potentially contaminated by passage through the theatre should not be supplied to preparation rooms, since this may cause contamination of instruments and equipment to be used for the same or subsequent patients.

Since this method of ventilation is only an additional precaution against operating room infection, the lay-out and design of the theatre suite must be such as to provide the usual aseptic and antiseptic precautions against infection. However, since the emphasis is now on clean air and the prevention of all sources of dust collection, a revision of the detail of lay-out and design is essential, on two counts:

(i) The elimination of all sources of dust collection;

(ii) The ease of maintenance and physical cleansing of all equipment by the normal theatre maintenance staff. In short, the operational efficiency of the theatres must be an easy duty, not a complicated problem.

All equipment hanging from the ceiling must be radically eliminated. The present umbrella-domed high-powered theatre lamp hanging immediately above the operating table is often tilted during an operation. Research shows that this may be as often as four or five occasions. With positive pressure ceiling ventilation of clean air, this could result in the immediate contamination of the operation wound with dust from the top of the lamp.

In addition to the elimination of all hanging equipment, the ceiling, walls, floors, and doors should be so designed as to eliminate dust collection and be capable of being washed down easily. This particularly applies to operating room floors which must also have good and easy drainage.

All equipment—operating and X-ray tables, trolleys, etc.—too big for autoclave sterilisation, should be cleanly designed for ease of washing or spraying with a suitable antiseptic, and be easily wiped down. In some instances consideration is being given to a " pass through " steriliser suitable for an instrument trolley.

All floor furniture not required for a given operation should not be in the actual operating theatre, but for ease of maintenance should be stored in a room closely adjacent to the theatre. For example, two types of operating table are necessary in accident or orthopædic surgery. The more rarely used pure orthopædic table should be stored when not required, not in the operating theatre proper, but in a room closely adjacent to it, so that it can be quickly wheeled in to replace the usual operating table. The storage room or rooms should be capable of housing one operating table and up to four trolleys for instruments.

In order to avoid dust-collecting surfaces it was decided that theatre lighting must be from outside the room itself, and this presented difficulties associated with flexibility of light source and intensity of illumination in the field of the operation. A number of different lighting systems in use in England and on the Continent were studied to find an answer to the problem, and in all the cases examined there was thought to be either insufficient flexibility or else a lower illumination value than that provided by the conventional Scialytic operating theatre light fitting suspended over the operating table.

It was finally decided to construct the major portion of the roof and walls of the theatre as a true sphere having as its focal centre a point 9 in. above the surface of the operating table. This arrangement would permit the installation of a large number of specially designed prefocused lighting reflectors, each with heat filter, in the dome of the theatre, capable of selection in groups to suit the surgeon's needs.

Tests in a full-scale model of such a theatre showed a satisfactory degree of flexibility coupled with an illumination value, at the focal point, of 4,400 lumens/sq. ft. with a group of six fittings simultaneously in use. General lighting was obtained by a number of diffusing fittings dispersed in the ceiling of the dome but external to it. Six of these fittings, each with a 200-watt general-purpose lamp, were found to give a level of illumination at the working plane of 32 lumens/sq. ft.

This system of lighting with a magnetic switch control panel was subsequently taken into production by the G.E.C. Ltd., whose illuminating engineers, C. Allderidge and S. Hubbold, had been actively engaged with the research team, and the system was installed in the Neurosurgical Unit at Western General Hospital, Edinburgh[8], where the Professor of Neurosurgery, and the architect, J. Holt, realised the potentialities of the Birmingham experiment.

The term "air-conditioning" should cover the complete control of the air state within the rooms concerned, and this entails:

(i) filtration for bacteriological purity;

(ii) control of dry-bulb temperature;

(iii) control of wet-bulb temperature;

(iv) control of air movement.

A degree of bacteriological purity and some control of air movement and dry-bulb temperature is obtainable with many conventional theatre plants; but complete control of wet-bulb temperature and consequently the relative humidity is obtainable only with refrigeration plant or drying agents, which considerably increases the capital cost of engineering work associated with air treatment.

There are few plants in existence in Britain or on the Continent which give complete control, but surgeons are becoming increasingly aware of the advantages of such control, particularly where lengthy operations are involved and where the comfort of the staff contributes to the success of such operations. A team of 12 persons may be working within a theatre and themselves contribute to a rise in dry-bulb temperature and relative humidity. Heat gain from these 12 may be in the order of 4,000 B.t.u./h and moisture gain of 1·3 lb/h. These gains, coupled with high external wet-and-dry-bulb temperatures during summer months in temperate zones and at all times in tropical and sub-tropical climates, do in the author's opinion fully justify the inclusion of refrigeration in the air-conditioning plant to give automatic control of the air state.

In addition to the need to introduce clean filtered air from outside, and to automatically control constant wet- and dry-bulb temperatures in the theatre, it is essential to prevent the ingress of contaminated air from rooms surrounding the operating theatre. To this end, a positive air pressure should be maintained within the theatre itself.

Experience has shown that conventional air-conditioning plant, having separate air inlet and extract fans, cannot be relied upon to maintain a positive pressure within the operating theatre, even when fans of a larger inlet capacity than extract are allowed. Variation in filter resistance, fan-belt slip, wind effect, etc. may influence the performance of the inlet system and may seriously reduce the designed level of positive pressure and indeed may reverse it, with consequent potential risk of contamination of the theatre atmosphere.

Extensive experiments with a full-scale theatre model of the domed-roof type have shown it is possible to build up an air pressure within the theatre and to maintain it with a specified rate of air change when all openings to other rooms are closed. To achieve this without induced extraction by fans, the air-inlet system has to be designed to maintain, on the type of room tested, an air flow with a room pressure equivalent to 0·04 in. to 0·1 in. water gauge. The pressure range was found to be fairly critical, as regulation below 0·04 in. was difficult to maintain and above 0·1 in. the effect of air pressure on the opening and shutting of doors became unpleasant.

In order to prevent, if possible, the movement of bacteria colonies from one part of the theatre to another, turbulent air movement should be minimised.

The movement of bacteria within the theatre assumes considerable importance as a source of infection at the operating table. It is probably true to say that the less the number of air changes in the theatre the more serious is the risk of infection from this source.

Bacteria are released by movement of theatre staff, from clothes, dressings, the mouth, nose and from dust present within the theatre. The stirring action of movement transmits such bacteria to all parts of a room with turbulent air velocities in the order of 20–60 ft/min. With any type of control of direction of air flow within a room it should be appreciated that unless velocity in the desired direction exceeds, say, 50–60 ft/min. these turbulent stirrings by movement of personnel cannot be prevented from distributing any bacteria present throughout the room.

If, as was the case in the model experimental theatre in question, a downward direction of air flow from ceiling to floor be selected, then, to maintain uniform downward piston-like motion of air at a velocity of 50 ft/min. would require some 200 air changes per hour—clearly an impracticable figure. It was realised, therefore, that air turbulence from movement of personnel would have to be tolerated. After considerable experiment a rate of 20 air changes per hour was selected as giving reasonable controlled downward air movement and rapid clearance of the theatre of contamination.

The curves prepared by Dr. E. J. L. Lowbury, after tests in the model theatre with a "slit" sampler at Birmingham, show the effect of clearance of bacteria released over the operating table with and without the ventilating plant running. Four minutes after peak contamination with concentration dropped, with ventilation on, to the low level of ten colonies/cu. ft. Without ventilation, after 30 minutes, the concentration was still above 40 colonies/cu. ft. (Fig. 5).

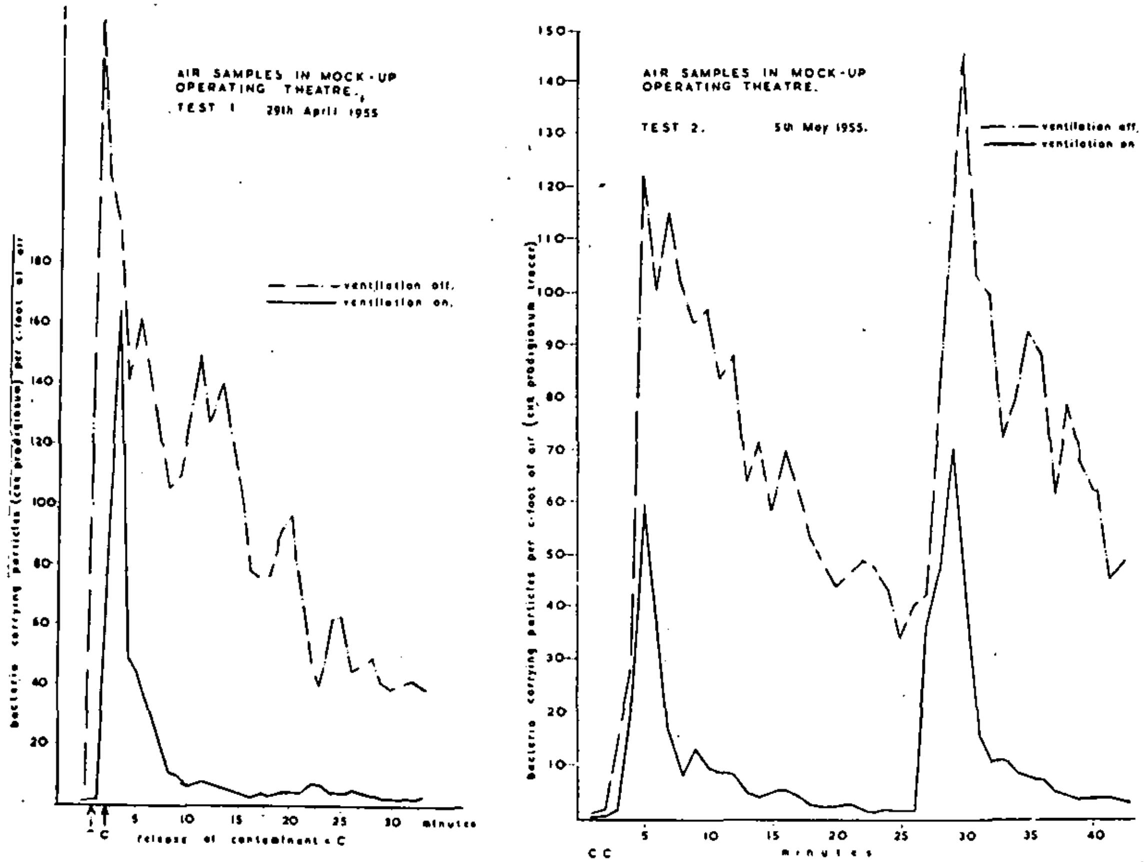


Fig. 5. Air Samples Taken in Model Operating Theatre.

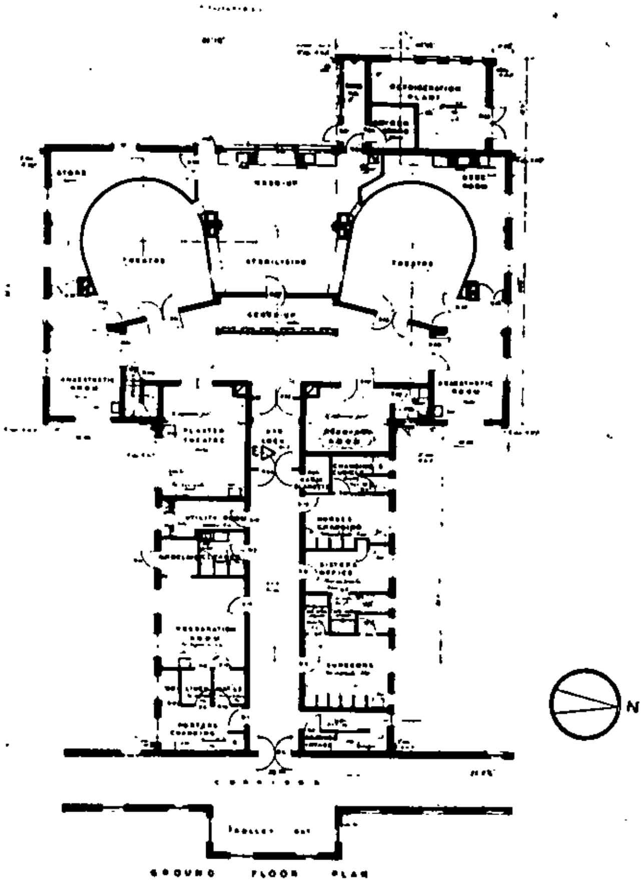
To maintain a positive air pressure within the theatre, to prevent the ingress of airborne contamination from surrounding rooms, steps must be taken to provide clearly defined clean and dirty areas, with some form of air-lock to prevent direct opening of dirty areas to the theatres or sterilising rooms. The method decided upon by the Birmingham team, with which the author has worked, is to maintain an intermediate air pressure zone for anæsthetic room, sterilising room, access lobby and scrub-up area serving the theatre, with dirty areas such as the sluice room, access corridors and changing rooms, etc., at a normal atmospheric pressure. Where the sluice room communicates with the theatre for receiving dirty instruments and soiled dressings provision is made for double air-lock hatches through which no air flow from sluice room to theatre is possible.

In practice, with an air pressure in the theatre equivalent to 0·08 in. W.G. the intermediate pressure zone would be stabilised at 0·04 in. W.G., the sluice rooms being at atmospheric pressure.

To minimise the possibility of transfer of sources of contamination from the intermediate zone to the theatre on door opening, it is further considered necessary to maintain approximately the same ambient temperature throughout the pressurised zones. Even with a higher air pressure in the theatre and consequent outflow of air on door opening, the thermal currents which can circulate with different room temperatures constitute a cross-infection risk—a fact commented upon by R. Bourdillon in his paper "Infection of Clean Surgical Wounds" in 1951.

To avoid the adverse effect of cold walls upon air movement in the theatre it is convenient to arrange the planning in such a way that the room has the minimum of external wall construction and, where such walls are essential, to ensure that they are well insulated against thermal loss. Preferably the room should, from this aspect, have only internal walls and be entirely surrounded by other rooms warmed to a temperature close to that of the theatre itself.

The desirable relationship between the various special service areas within an operating theatre suite, and their close link with air conditioning, heating and lighting requirements, are shown in a sketch design by the author to provide a twin-operating theatre suite (Fig. 6).



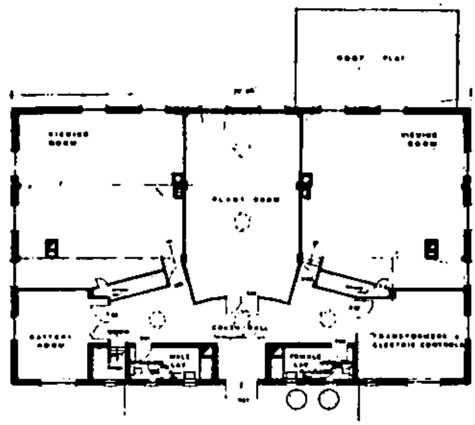


Fig. 6. Sketch Design for Twin Operating Theatre Suite Incorporating Results of Theatre Research, by D. A. Goldfinch.

5. Sterilising Procedures

Within the last decade serious concern has been expressed regarding the deficiencies in hospital sterilising technique. Prof. Howie of the Department of Bacteriology of Glasgow University has been in the vanguard of research.

Procedure previously considered acceptable have been condemned and the British Standards Institute has endeavoured to create a specification for high pressure high vacuum autoclave sterilisers. In America the sterilisation of dressings and instruments in package form has long been accepted, but old methods prevail over here and drums are still packed and used.

The subject of sterilisation would justify a series of papers and only the briefest reference can be made on this occasion, but it must be clearly accepted as an essential part of hospital sanitation, and indeed one of the greatest importance in preventing loss of life.

The time has come when all instruments used in an operating theatre should be sterilised in a high pressure steriliser. The days have gone when one could be content with boiling instruments before an operation. Instruments could be sterilised for the same time and pressure as for dressings, but as they dry quickly, the drying period could be considerably reduced. Instruments should never be sterilised at the same time as dressings, as the steam might condense on the metal.

If a vacuum of 28 in. or 29 in. were used, a very high temperature could be obtained in a short time, i.e., 135°C. (275°F.) at a pressure of 30 to 32 lbs. If this temperature were held for three to four minutes adequate sterilisation should be obtained. Thereafter, the drying process could be quite short, again using a high vacuum—28 in. or 29 in. By using this procedure, it should be possible to attain adequate temperatures in about three minutes, to sterilise in three to four minutes and to dry in one to two minutes. The whole process could thus be shortened considerably and it should be possible to sterilise the instruments just before an operation in a high pressure autoclave.

Bowls could be sterilised in the same way as instruments with a high vacuum and high temperature, or they could be sterilised in the usual way at 121°C. in the ordinary type of autoclave.

It is now essential that water, saline, etc., of guaranteed sterility should be available in operating theatres. These fluids can be obtained by the use of high pressure sterilisers working at 121°C. (250°F.) at 15 lb. The fluid is adequately sterilised, but there

The volume of work carried out under the supervision of the Maintenance Department has continued to increase, as measured in terms of finance, but it is interesting to note that there has been some small saving in the cost of fuel and power, etc.

SALFORD HOSPITAL MANAGEMENT COMMITTEE

The report of the Management Committee this year is issued in the shorter form without the separate reports in respect of the various group services and individual hospitals.

Work on up-grading at Hope Hospital has continued throughout the year. Two wards have been up-graded and Capital Works expenditure has included the provision of a diet kitchen and a staff canteen, and the extensions to the operating theatres were commenced.

The installation of oil-fired boiler plant at Salford Royal Hospital was completed during the year and it was estimated that £1,200 a year would be the resultant saving on fuel costs. It was unfortunate that this saving would be off-set for the time being by the increased cost at Ladywell Hospital arising from the use of coke in the main boilers to reduce smoke emission.

The Regional Board had approved in principal the conversion of "E" Block at Ladywell Hospital to provide accommodation for geriatric patients including suitable facilities for day patients. This was an important development in the area in the improvement in the geriatric services.

Other work has included the provision of a Dental Health Unit, improvements to the V.D. Block and adaptations and up-grading of the mortuary at Ladywell Hospital. The scheme for the development of the Group Central Laundry at Hope Hospital had been approved by the Ministry and it was hoped to begin work during the ensuing year.

The year marked the tenth anniversary of the inception of the Health Service and it was noted that the net annual cost of running the hospitals in the Group had risen from some £865,000 in the 1949/1950 period to £1,396,000 in the 1957/1958 period.

BOOTH HALL AND MONSALL H.M.C.

The report covering the period 1956/1958 is the latest issued by Booth Hall and Monsall H.M.C. and the year 1958 also marked the 50th anniversary of Booth Hall Hospital. The Manchester Corporation, by whom the hospital was administered prior to 1948, decided to hold a civic reception at the Town Hall to mark the occasion.

At Booth Hall Hospital an important development has been the setting up, on Ward 4, of a Department of Electro-Encephalography. Further improvements have been made in the main operating theatre by the addition of an anaesthetic room and an extension to the sterilising room.

The Management Committee, after much consideration, decided to close the Monsall Hospital Laundry and to concentrate the laundry work at Booth Hall, for which purpose the Booth Hall Laundry was to be enlarged. The Monsall Laundry was very old and unsatisfactory, whereas the Booth Hall Laundry was comparatively modern. Extensive additions to the Booth Hall laundry building and equipment have enabled an efficient centralisation plan to be brought into operation.

Replacements of major items of equipment have included a new Lancashire boiler, improvements to heating in both nurses' homes, renewal of the stores' refrigeration plant, replacements of laundry machinery to the tune of one callendar drying machine, a washing machine and a twin-rapid press, and the renewal of the piped oxygen supply. At the Monsall Hospital development has continued at a slower rate on account of the decline for demand for beds for infectious diseases. The development, however, of empty wards has continued, five having been modernised and re-equipped during this period. In addition to the above, the sluice rooms on Ward 18 were enlarged and modernised in 1958, and Ward 23 was brought into use at the request of the Regional Board for one of the mass miniature radiography units. The Committee say that the heating of the wards and departments at Monsall has for many years presented an administrative problem because there are close on 40 hot water and heating boilers and a staff of six boiler men working round the clock is required to keep them in operation. In an attempt to resolve this problem a small private scheme was tried out in Wards 1 and 2 at the beginning of 1957 with gas-fired boilers. The obvious advantages were the saving of wages and the disappearance of unsightly coke dumps in the hospital grounds. A main disadvantage proved to be that of expense and, for this reason, the pilot scheme was abandoned early in 1958 and it now appears probable that this problem will remain with the Committee for some years to come. However, economisers have been installed on several of the boiler units and it is hoped shortly to have these fitments on all boilers.

During 1957 arrangements were made with the Chief Fire Officer of the Manchester Corporation for the thorough inspection and re-siting, where required, of fire fighting equipment.

Correspondence

7th September, 1960.

The Editor.

DEAR SIR,

The Practical Aspects of the High Pressure, High Vacuum Sterilisers used in Hospitals

In reply to Mr. E. R. F. Lee's letter to our JOURNAL, I should like to say that I agree with everything he writes, but the whole point of my article was to the effect that jackets are unnecessary on sterilisers and that, therefore, most certainly hydraulic tests are unnecessary and probably drilling tests as well.

I stated that jackets are expensive to construct, and troublesome. With correct steriliser design they are useless appendages—away with them!

Yours faithfully,

A. M. JONES,

Superintendent Engineer.

Portsmouth Group Hospital Management Committee,
Management Committee Offices,
St. Mary's Hospital, Milton Road, Portsmouth.

The First Carousel in a British Hospital Laundry

THE first Carousel Contraflow Washing Unit to be used in a British hospital has been installed by Baker Perkins Ltd. in the West Cumberland Hospital, Whitehaven.

Many of these fully-automatic machines are already in use in commercial laundries in Britain. Each machine consists of ten individual end-loading washers of equal size, arranged in a circle. They are connected in such a way that a continuously-flowing stream of water is passed from one machine to another. The entire unit revolves automatically—each washer stopping at each " station " to allow a different part of the washing process to take place.

At the unloading and re-loading station the operator removes the cleaned items and places them on a conveyor. He then fills the empty washer with soiled goods. There is an automatic device for time-setting—any time from two to ten minutes can be selected on the degree of soiling.

As the machine travels in a clockwise direction, the water passes through each washer in an anti-clockwise direction. A continuous flow of clean, cold water is fed into the system at the *last* rinsing stage. The water is at its dirtiest at the first washing stage and is then discharged.

Each operation in the washing stage is carried out by simple automatic control. Soap, alkali, sour-blue, bleach and so on are added automatically at the appropriate point. The continuous flow of the system keeps the liquid suds working back through several phases, thus utilising the still active detergents in the preliminary washer. In this way a great saving in supplies is achieved.

Low pressure steam (10 lb./sq. in.) is adequate and is injected directly at station 5, the boiling stage in the process. Here, the temperature is raised to boiling point. This heat is, of course, absorbed by both the water and the work. As the machine moves to the next stage, the heat contained in the clothes is sufficient to raise the temperature of the water to 170° F. to provide a hot rinse. Meanwhile, the water which has been heated by the steam flows to its next stage to give the work there a 170° hot wash. This explains why the machine is so economical of steam—for as the water enters station 5 (boiling stage) it is already at 170° and the steam has only to raise it to boiling point.

Although the process would appear to be complicated, the design of the Carousel is surprisingly simple. There are no flexible hoses and the other devices for feeding materials. Stationary pipes dispense soap, alkali, bleach, sour-blue and any other materials. Steam is fed in through a ring main. The only pipework required is for steam and cold water to the machine and for connecting the solution tanks to the unit. It is claimed that saving over service pipework required for ten conventional washing machines is dramatic.

Since the Carousel is controlled completely and automatically, the operator need not move from the unloading and loading station: work is brought to him at pre-determined regular intervals. On the three smaller sizes the operator also has time to load and unload the extractors. On the larger sizes this is done by a conveyor and a hydro attendant.

This automatic machine, with its loading and unloading station, at one point, allows the wash-house layout to be simplified. The position for soiled work reception can be fixed and the hydros can be located near the washer. This means that wet work trucks are unnecessary. Floor space occupied is normally less than required for over ten end-loading washers giving the same output.

The Hospital Aspect

In bacteriological tests carried out in a hospital laundry to determine the effectiveness of the Carousel washing method, a test sample of water was taken from the discharge connection of each individual washer during normal laundry operations. Tests were undertaken in the normal bacteriological manner, by mixing an agar jelly at an incubating temperature of 37° C. for a period of 48 hours, after which the bacteria were counted.

The washing consisted of articles usually dealt with in the hospital laundry, including articles from the sick wards. To determine the variations in bacteria infection, it was deemed necessary to make a series of tests (seven in all) and to make these tests with washing of various degrees of soiling.

In the table below each individual machine in the Carousel is numbered from 1 to 10. Machine No. 1 is the one in which loading and unloading takes place. The water taken from this machine is not in the continuously flowing stream but is discharged at the end of the washing process.

Machine No. 2 is in the continuous stream. Steam is added at stage No. 5 and a continuous stream of cold, soft water enters at stage 9. The last rinsing stage is at Machine No. 10 to which a hard water supply is taken. This machine, as already explained, is not in the continuous flow circuit.

The highest temperature (185°–195° F.) prevailed at Machine No. 5. The temperature in machines Nos. 4 and 6 was some 50° F. lower. In machines 2 and 9 an average temperature of about 85° F. was registered. After the last rinse with hard water, the temperature was about 72° F. The controlled steam supply maintained the highest temperature very evenly.

For the purpose of the test the unit was set so that the various washing operations in each machine lasted 5 minutes. The bacteriological samples were taken from each individual machine one minute before the end of each period.

These are the results obtained from a series of tests:—

No. of Machine	*Number of Bacteria per ·061 cu. ins.*		
	Average	*Highest*	*Lowest*
1	8,362,200	20,000,000	5,000
2	10,176,800	20,400,000	4,000
3	6,681,800	18,000,000	0
4	3,520,040	16,000,000	0
5	0	0	0
6	0	0	0
7	0	1	0
8	1	2	0
9	4	14	0
10	4	12	0

The figures in this table show that the greatest amount of dirt is removed in machines 1 and 2. In this, there is an advantage in that the independent water supply to machine No. 1 loosens and disposes of the greatest proportion of the dirt and likewise of bacteria.

In the machines which follow, the number of bacteria drops substantially to be reliably eliminated when heat is applied at machine No. 5 (as all the tests show).

The results in the other machines were equally satisfactory. The small number of bacteria observed at times in machines 9 and 10 is due simply to the fact that a few heat resisting spore formations grew during fostering by agar action. This must be expected with all washing methods as comparison tests with other machines have proved this.

The difference in results was very apparent according to the type of washing dealt with. With slightly soiled articles (bed linen) the number of bacteria registered in stage No. 1 was very small, numbering 6,000, while general articles gave over 6,000,000 bacteria. Very soiled articles such as handkerchiefs gave 15 to 20,000,000 bacteria per ·061 cu. ins.

The apparatus was fully described and illustrated in our April 1959 issue.

INTERNATIONAL HOSPITAL EQUIPMENT AND MEDICAL SERVICES EXHIBITION

The third International Hospital Equipment and Medical Services Exhibition will be held at Olympia from May 15th to 20th, 1961. On this occasion it will be in the Grand Hall which, to meet the greatly increased demand, will provide stand space amounting to 65,000 sq. ft. The demand for space has exceeded all previous requirements and within eight weeks from the time that bookings had commenced over 50,000 sq. ft. of space had been sold.

At the time this information was issued 110 exhibitors had reserved accommodation and this has resulted in the Organisers opening negotiations for a further extension to provide yet another 25,000 sq. ft.

The exhibition is sponsored by the Institute of Hospital Administrators and *The Hospital* and has the full support of the Institution of Hospital Engineers and this JOURNAL.

Conferences and lecture sessions will be arranged during the course of the exhibition as before by various professional bodies, and the Institution hopes to arrange a series of lectures on May 17th, 18th and 19th, with the A.G.M. on the 20th.

£1·2 m. GRANT FOR UGANDA'S NEW TEACHING HOSPITAL

A grant of £1,229,062 for the new General Teaching Hospital at Mulago, Uganda, has been made under the Colonial Development and Welfare Acts, representing three-quarters of the estimated cost of the second phase of construction.

Mulago General Teaching Hospital is being built by the Protectorate Government (to replace one established in 1913) at an estimated cost of £2.3 m., of which more than £1½ m. will be provided from Colonial Development and Welfare Funds. When completed, by March 1964, it will be the largest medical unit in Uganda, with 758 beds, together with wards for 132 paying patients. All the local specialist services will be based on it and, in association with Makerere College Medical School, it will be the main teaching hospital for the whole of British East Africa.

CHELTENHAM HOSPITAL EXTENSIONS

Cheltenham General Hospital is to have additions and alterations to its Casualty and Out-Patients Department costing just under £75,000.

The sum of £74,562 has been authorised by the South-Western Regional Hospital Board in Bristol in awarding a contract for that amount to Ford & Weston Ltd., Imperial Square, Cheltenham, and Derby.

The Cheltenham firm of architects, Messrs. Healing & Overbury, will be in charge of the design.

B.S.I. News

Abstracts of information supplied by the British Standards Instiituton

SAFE OIL HEATERS

The eagerly-awaited new British Standard for oil heaters (B.S. 3300) was published in April. It is a comprehensive technical specification which covers all kinds of domestic paraffin appliances including the radiant drip-feed heaters which have been under severe attack recently. In this British Standard, manufacturers have the technical guidance they need to produce heaters with a very high safety factor. It is expected that all heaters made from now on will comply with B.S. 3300.

The new standard supersedes the one issued in 1953 as B.S. 2049, Part 1. Its publication, so rapidly on the heels of the recent D.S.I.R. report on oil heaters, represents the determined efforts of the British Standards Institution, heater manufacturers, Government departments and safety interests to get out a new, safe specification in the shortest time possible.

17 m.p.h. draught test

The main feature of the new British Standard is the inclusion of a really severe draught test.

Tests will have to be made by manufacturers—with the aid of a wind-tunnel—to ensure that heaters will not create a fire hazard even when exposed to draughts up to as strong as 26 feet a second, that is 17 to 18 m.p.h.

This figure was recommended by the D.S.I.R. in its recent report.

Other safety features

The standard also includes a requirement to limit as much as practicable the hazard which might result should an appliance be knocked over. Makers are called upon to overturn lighted heaters and then, scientifically, to measure the degree of burning that occurs—if any.

The fuel tanks of radiant heaters must be made of corrosion-resistant materials because a fuel tank that corrodes is a potential fire risk.

The standard lays down that all heaters must include some provision for fixing them to the floor or wall to prevent overturning.

Other amendments have been made to bring this new standard fully up-to-date and to make oil appliances generally more efficient and safer.

Labelling

The standard says that a *permanent* label fixed to each heater shall give the manufacturer's name or trade mark and the number of the British Standard (B.S. 3300). The label will also warn against carrying a heater when alight, on the need for adequate ventilation, on protection from draughts, against the use of petrol, and against placing the appliance where it can be knocked over.

British Standard 3300 : 1960 is entitled *Kerosine (paraffin) unflued space heaters, cooking and boiling appliances for domestic use.* It was prepared by a widely representative committee which included: Chief Fire Officers' Association, Consumer Advisory Council, Council of British Manufacturers of Petroleum Equipment, D.S.I.R.—Joint Fire Research Organization, Fire Officers' Committee, the Fire Protection Association, Home Office, Institute of Petroleum, Institution of Fire Engineers, Ministry of Education, Ministry of Power, National Federation of Ironmongers, Oil Appliance Manufacturers' Association, Oil Companies Materials Association and the Women's Advisory Committee of B.S.I.

I.E.C. PUBLICATION

I.E.C. Publication 34-1: Recommendations for rotating electrical machinery (excluding machines for traction vehicles). (Sixth edition)

The sixth edition of I.E.C. Publication 34-1, which has just been issued, supersedes the fifth edition published in 1953.

The recommendations given in I.E.C. Publication 34-1 apply to rotating electrical machines without limitation of output or voltage, with the exception of the machines for traction vehicles covered by I.E.C. Publications 48, 101 and 102.

Publication 34-1 contains the following sections:

> Scope, definitions, rating, service conditions, temperature-rise, dielectric tests, excess current and excess torque, commutation test, tolerances, rating plates.

The sections on scope, service conditions, dielectric tests, excess current and excess torque, commutation tests and tolerances, remain technically unchanged with respect to the fifth edition. Some changes have been introduced into the sections on definitions, ratings and rating plates, but the most important changes are in respect of temperature-rise, which latter section has been extended to include the new classes of insulating materials embraced by I.E.C. Publication 85.

Methods of measuring the efficiency of rotating machines are given separately in I.E.C. Publication 34-2.

The corresponding British Standards are:

B.S. 170	Electrical performance of fractional horse-power electric motors and generators with class A insulation.
B.S. 2613	The electrical performance of rotating electrical machinery.

Copies of the above publication may be obtained from the B.S.I. Sales Branch, 2, Park Street, London, W.1, price 18/– each, plus 1/– postage.

MODULAR CO-ORDINATION

International study group being set up

Building experts from 15 countries who for the past six years have been studying modular co-ordination—that is co-ordination of dimensions in building—under the auspices of the European Productivity Agency (E.P.A.), met recently at British Standards House to wind up their work and discuss plans for the future.

The 15 countries taking part in this E.P.A. project published their first report (which contained data and experience from each of the participating countries) in 1956. At the recent meeting in London, delegates examined the second and final report covering phase two of the E.P.A. exercise which involved the construction of experimental buildings to test the theories of modular dimensional co-ordination in actual practice.

This report, shortly to be published, reaffirms that substantial advantages in the building industry and for international trade in building components would be achieved if a general system of dimensional co-ordination in building could be rapidly introduced.

Although the E.P.A. project is now formally completed, the group of experts participating have decided to continue and follow up this important work by constituting themselves as an international study group.

On the Market

A review of new equipment and materials and their development

MAZDA °KOLOR-RITE FLUORESCENT LAMP

A new **Mazda** fluorescent lamp is announced which is said to give the nearest light to daylight yet achieved by lamp makers.

A.E.I. lamp designers describe the light given by the lamp to be in the noon sunlight region.

Available as a 5 ft. 80-watt lamp with B.C. or Bi-pin cap and 4 ft. 40-watt lamp with Bi-pin cap only, the °Kolor-rite lamp has an estimated life of 5,000 hours with an average output of 2,560 and 1,360 lumens respectively. The price for the 80-watt tube is 14s. 8d. (including tax) and for the 40-watt tube 12s. 11d. (including tax).

Light from the first tubular fluorescent lamp was nearer to daylight than that from the light bulb, but was criticised as being cold and unflattering. The various " white lights " which have been introduced since are better, but have usually been designed to meet criticisms rather than to produce an exact copy of natural light. Typical results of this method were the pink fluorescent lamps produced in response to early criticisms.

NEW PORTABLE " DEMINROLIT "

The Mark 6 Portable " Deminrolit " designed and manufactured by **The Permutit Company Ltd.** is designed to convert up to 12 gallons hourly of clean cold water into demineralised water having a conductivity of less than 1·0 reciprocal megohm per centimetre: the quality of water produced by the Unit conforms to the " Purified Water " standard of the British Pharmacopœia, 1958.

The new Portable " Deminrolit " is a mixed bed ion exchanger. The ion exchange materials used are " Zeo-Karb 225 " and " De-Acidite FF ": these are manufactured by Permutit at their Chemical Production Division in South Wales.

The unit is designed for simple and reliable regeneration on the spot. A conductivity tester is fitted which continuously monitors treated water quality. Constructed as a free-standing unit of robust, non-corrodible construction throughout, the Mark 6 Portable " Deminrolit " is suitable for workshop as well as laboratory conditions. No plumbing is necessary, the unit being simply connected by flexible hose. This is an addition to the existing range of Portable " Deminrolit " Units. For greater outputs of very pure water, Permutit design and manufacture industrial plants for dealing with practically any quantity of water.

EXTRUDED FIRE HOSE

Formica Ltd. have now produced an extruded fire hose for which exceptional lightness and flexibility is claimed, yet which is tougher than many of the traditional types in use. The special process of extrusion forces flexible P.V.C. around and through a tough "Terylene" sleeve. One homogeneous material is the result, which meets the British Home Office Specification.

Salient qualities of the hose are said to be its easy tolerance of pressure; the impossibility of pinholing; its rapid drying speed, permitting almost instant use in successive emergencies; its ease of cleaning—no scrubbing—just a wipe down; its visibility at night—the brilliant yellow colour never fades; its high resistance to abrasion; its simple, on-the-spot repairability in cases of violent accident; the ease with which it can be handled and the unobtrusive way it folds and compactly stores.

Supplied in standard lengths of 75 ft., the hose is offered initially in two sizes, 2½ in. and 2¾ in. bore, and is economically priced at 5s. 0d. and 5s. 6d. per foot respectively.

UNBREAKABLE NEW NYLON INTERLOCKING CABLE TERMINALS

British Central Electrical Co. Ltd. have introduced a range of Nylon Insulated, Interlocking Cable Terminals in five sizes with six types in each size. Shrouded in nylon, with robust, brass inserts, they are designed to be shock, heat, moisture, oil and acid resisting.

Securing the cable is achieved by a " U "-shaped cable clamp. A permanent pressure is maintained on the cable connections—even when the cables have " settled," thus ensuring permanent low-resistance connections.

Positive, vibration proof, vice locking of the cable is effected by means of a captive, special lockwasher, under the head of the cable clamping screw.

A shroud which surrounds the two halves of the terminal, envelopes them and prevents any " spreading" taking place. This shroud is a captive part of the cable clamping " U " screw clamp. Cables do not have to be cut, as the clamping screw can be completely removed so as to allow the cable to be laid in the terminal. A nylon cap, coloured for phase identification, is available to insulate the terminal completely.

Prices range from 15s. per dozen for the smallest to 69s. for the largest, insulated cap extra.

Ideal for use as line taps, busbar connecting devices or with trunking systems, switch and fuse-gear applications, etc. Further details from 6 and 8, Rosebery Avenue, London, E.C.1.

A DIVAN WITH STORAGE SPACE

Designed primarily for use in nurses' homes, students' hostels, etc., the Holdalot ottoman costs little more than a normal divan bed.

It consists of a spring interior mattress on a sprung base. The lid of the base lifts to provide a storage space for personal belongings, clothing, books, uniform, etc. Alternatively, for bed-sitting rooms, the Holdalot can be supplied with mattress and base covered in moquette or other covering appropriate to a settee, and the storage space is then used to accommodate bed clothes.

Made by **Rest Assured Ltd.** of Northampton, the Holdalot is available either 2 ft. 6 ins. or 3 ft. wide. Total height is 22½ inches. Length is 6 ft. 3 ins. Storage capacity is 8·05 cu. ft. in the 2 ft. 6 ins. size and 9·76 cu. ft. in the 3 ft. size. The ottoman is fitted with castors.

Price, depending on the quality of the mattress, type of covering chosen and size, is from around £20 (retail).

NEW SOLVENTLESS EPOXIDE COATING SYSTEM

The paint industry has had several years experience of solvent-thinned epoxide paints for protecting metal surfaces against corrosion. While these paints impart the necessary chemical protection required for industrial corrosion resistant finishes, in common with any solvent-based system they do not have sufficient film thickness to resist mechanical damage and, in most cases, several coats of epoxide paint are required.

It is with this problem in mind that **Bakelite Ltd.** has developed a solventless liquid epoxide resin/hardener system which will provide a coating of up to 0·010–0·015 in. thick in one application, thereby eliminating the need for multiple coats. Such coatings are claimed to be ideally suited for application to structure steel work, most metals, wood and concrete.

In this system, in which pigments can also be incorporated, the hardener cures the epoxide resin under widely varying conditions of temperature and humidity to give hard, tough and chemically resistant films. The thickness of such films can also be varied by incorporating differing amounts of filler into the resin/hardener mix.

Another important feature of the system is that, by careful formulation, minimum drainage of films on vertical surfaces has been achieved. Flow-out is said to be excellent and the films will harden overnight under normal ambient conditions.

Full details are contained in Advance Information Sheet E.37. Copies are available, free, from **Bakelite Ltd.**, 12-18, Grosvenor Gardens, London, S.W.1.

EXTENSION TO RANGE OF "SAFRAN" CCE HOT WATER CIRCULATORS

The extension to the range of the three existing sizes (1½-in., 2-in. and 3-in.) of these Fullway-Direct-in-Pipeline circulators has been made possible by the adaptation of the "Safrax" circulator body. The basic design is generally the same as the existing CCE pattern but the branch connections are fitted with unions screwed internally and the impeller is retained by a nut. The screwed connections are for sizes ¾-in., 1-in., 1¼-in. and 1½-in. These additional sizes are fitted with ⅛ b.h.p. sleeve bearing motors running at 1,430 r.p.m. and suitable for either 230/250 volts single phase or 400/440 volts 3-phase electric supply.

The ¾-in. and 1-in. sizes are for duties up to 12 g.p.m., 1¼-in. and 1½-in. for duties up to 16 g.p.m. The 3-flanged models provide duties up to 110 g.p.m.

The suitability of the smaller sizes for Domestic Hot Water supply systems will be appreciated as these, as well as the larger sizes, are available in all gun-metal construction when required. Further details from **Saunders Valve Co. Ltd.**, Safran Pump Division, Drayton Street, Wolverhampton.

NEW CLEANING AID

A new multi-purpose disposable wiper suitable for a wide range of uses has been introduced.

Called Kimwipes, they are made of soft, strong, highly absorbent cellulose and are particularly useful for wiping and cleaning jobs where liquids, light oils, grease and dirt are involved.

Due to its creped construction and comformability, the wiper is said to pick up dust and dirt particles much better than cloth.

Where the essential requirement of a cleaning or wiping application is the complete elimination of dust and fluff Kimwipes are superior and more economical than white linen rags.

The wipers, which measure 17¼ in. by 10 in., are packed 100 to a self-dispensing carton. They are interleaved. Cost per carton works out at 2s. 6¾d. to 2s.10d. depending on quantity ordered.

Kimwipes are manufactured by **Kimberly-Clark Ltd.**, Larkfield, Maidstone, Kent.

Notes for Members

News of I.H.E. activities, etc., and items of interest from Branches

OBITUARY

Mr. W. S. Newton

We regret to announce the death of Mr. William Stanley Newton of " Deneside," Wooley Sanatorium, Hexham, Northumberland.

Mr. Newton served an apprenticeship with British Electrical Repairs Ltd. In 1930 he was appointed Assistant Engineer at High Team Institution, Gateshead, and in 1938, Chief Engineer at Wooley Sanatorium. He retained this post until his death.

Mr. Newton was elected an Associate Member of the Institution in 1946.

PROCEEDINGS OF THE INSTITUTION

The following applications for membership of the Institution have been approved:—

Member

John Thomas Alcock, Northern Ireland Branch.
Donald Amos Hall Black, London Branch.
Ivor Leonard Boulter, Welsh Branch.
William Arthur Bryars, Lancashire Branch.
J. Constable, Midlands Branch.
Kenneth J. Eatwell, London Branch.
Hugh George Fairhead, London Branch.
Francis Franchetti, East Midlands Branch.
Roy Kitson, East Midlands Branch.
James Esler McAllister, Northern Ireland Branch.
Harry Eric Oakes, London Branch.
Jack David Owen, West of England Branch.
John Reilly, North-East Branch.
Robert Smith, London Branch.
Samuel Sutherland, Lancashire Branch.
William David Trotter, Northern Ireland Branch.
David A. L. Whitehead, London Branch.
Kenneth Wallace Wilson, East Midlands Branch.

Oversea Member

Gerald Thomas Foley, Broken Hill, N. Rhodesia.

Associate Member

Fred. Freeman, Yorkshire Branch.
Bernard Patrick Smith, London Branch.
Donald Smith, Yorkshire Branch.
Archibald Stanley Wright, Welsh Branch.

Student

Roger George Taylor, Midlands Branch.

Transfer to Full Membership

Irwin Benson, Yorkshire Branch.
John Black, Midlands Branch.
Albert Eric Harwood, London Branch.
William Percy Lawrence, London Branch.
Alfred Bertram Proctor, Welsh Branch.

Transfer to Associate Membership

Claudius Bromley Tronlin, Southern Branch.

As all except the most recently elected members will know, it is our policy to devote the greater part of this section to Branch activities. Unfortunately information from some regions has for long been conspicuous by its absence, whilst from others in the past it has been seriously delayed. As the result of Council's action this position will automatically be remedied and, within the last week or two, a greater stream of information has begun to come in from all quarters.

We therefore look forward, in the next issue, to passing Branch news on on a more topical basis. We are making use of this occasion to include what was previously to hand.

LONDON BRANCH

At the London Branch Meeting held in June, Mr. J. R. Foulgham, of Manlove, Alliott & Co., gave a paper covering the general aspects of flatwork ironing. He had intended dealing with the history of flatwork ironing machines but, in view of an article by him on this subject having been published in the May issue of the JOURNAL, he extended the range of his talk to include the present-day application of these machines when used with automatic folding and feeding equipment.

His talk was preceded by two short films.

In response to a request from Council, the present remuneration problems were subsequently discussed at great length and recommendations drafted in regard to representation and future policy.

The May meeting was devoted to business but a period of time was set aside to allow members to raise matters upon which they needed advice. The result of this was very worth while and led to discussion on such items as the temporary loaning of steam plant during major conversion programmes and the working of the 42-hour week award to artisan staff.

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LANCASHIRE BRANCH

A special meeting of the Branch was held at Prestwick Hospital on June 24th. It was called to discuss and agree the official attitude of the Branch in regard to various matters arising from the A.G.M. which would be debated at a special meeting of Council to be held in July.

The agreed views were subsequently submitted to Council.

WEST OF ENGLAND BRANCH

The June Meeting of the Branch was held on the 25th at Wonford Hospital, Exeter.

Mr. H. A. Adams gave, at the request of members, a report on the Four-Branch Meeting at Oxford and coupled this with his Council Report, as there was a good deal in common in regard to subject matter. Mr. Adams covered routine business matters of a kind already referred to in these pages concerning principally the topics discussed at the A.G.M. He also referred to a training scheme upon which a committee of Council was working for the training of future hospital engineers.

At the conclusion of official business, a discussion took place on high vacuum autoclaves and their maintenance, in view of the fact that some manufacturers had arranged maintenance contracts. It was decided to suggest that the guidance of the Regional Engineer be sought.

A meeting was held on July 23rd at Glenside Hospital, Bristol (formerly Bristol Mental Hospital).

Arising from the previous meeting—Autoclaves and their maintenance—the Chairman said that he had attended a meeting at the Bristol Royal Infirmary on sterilising at which the lectures and demonstrations were of the highest order. Unfortunately the meeting had been badly publicised and few engineers knew of it. It was decided to approach the Regional Board to see if the arrangements could be repeated.

The Meeting agreed to ask the Regional Board to repeat the previous year's syllabus of eight lectures as an Artisan Course, the lectures to be divided equally between engineering and building subjects. The following lectures were suggested:—

(1) Modern trends in sterilising, autoclaves and maintenance.

(2) Laundry maintenance and automation in the Laundry.

(3) Gas and electric welding.

(4) Control valves and reducing valves maintenance.

(5) Prevention of damp in buildings, and damp courses.

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WEST BROMWICH AND DISTRICT HOSPITALS MANAGEMENT COMMITTEE

HALLAM HOSPITAL (428 beds)

SENIOR ENGINEER REQUIRED generally to assist the Superintendent Engineer and to be mainly responsible for the engineering and maintenance services at the above Hospital. Candidates must have completed an apprenticeship or a thorough practical training and be able to efficiently supervise steam boiler and laundry plants, electrical services, and should possess one of the following qualifications or equivalent:—

Ministry of Transport and Civil Aviation 2nd Class Certificate of Competency in Marine Engineering.

Ministry of Transport and Civil Aviation Certificate of Service as 2nd Class Engineer.

Ordinary National Certificate in Mechanical Engineering, including Heat Engines, endorsed in Principles of Electricity.

Ordinary National Certificate in Electrical Engineering, with endorsement in Applied Mechanics and Heat Engines.

Engineers at present in Health Service posts with the necessary Service qualifications are eligible to apply.

Whitley Council conditions—salary scale £715 × 25 (2) × 30 (3)—£855 p.a. maximum.

Applications with full particulars of age, qualifications and experience, together with the names and addresses of three referees, to be sent to the undersigned.

J. O. ROBINS, Group Secretary.

West Bromwich and District Hospitals Management Committee,
West Bromwich and District General Hospital,
Edward Street, West Bromwich.

BURNLEY AND DISTRICT HOSPITAL MANAGEMENT COMMITTEE

SUPERINTENDENT ENGINEER

Applications are invited for the position of Superintendent Engineer, who will be responsible for the satisfactory operation, maintenance and co-ordination of the engineering services and activities, both mechanical and electrical, of the Group of Hospitals; the supervision of engineering maintenance works, and the keeping of all necessary records, etc.

Applicants should be qualified in accordance with the Ministry of Health requirements.

Salary £1,070 × £30 (2) × £35 (3)—£1,235.

Applications, giving details of qualifications and experience, together with the names and addresses of two referees, should be received by the Group Secretary, Burnley General Hospital, not later than the 31st October, 1960.

CHELMSFORD HOSPITAL MANAGEMENT COMMITTEE

SENIOR ENGINEER required for St. John's Hospital, Wood Street, Chelmsford. Salary £715—£855. The post is superannuable. The person appointed will be responsible to the Superintendent Engineer for the maintenance and operation of mechanical and electrical services, care of fabric and control of engineering and building staff, plant and equipment.

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(6) Internal and external plumbing.

(7) Erection of scaffolding.

(8) Factory acts applied to Building Trades in Hospitals.

The Chairman was asked if any information was available regarding Civil Defence. He replied that he had received a circular and that there was a course in Bristol. He would give further details at the next meeting.

One member, who had been on a N.I.F.E.S. course in North Wales, said that it was excellent, and anyone going there would derive a great deal of knowledge. They were only run once a year.

N.I.F.E.S. were carrying out efficiency tests in certain hospitals and members were advised that, when this was done, they should ensure that it was under normal operating conditions over a period, day and night, and with a similar fuel to that normally used.

JOINT MEETING IN THE NORTH

A meeting of the Yorkshire, East Midlands and Lancashire Branches was held at Middlewood Hospital, Sheffield, on May 14th. This, of course, preceded the A.G.M. and therefore business was predominantly concerned with matters relating thereto.

Many points were discussed and suggestions made but it was the overriding view that, in relation to the complexities of modern hospital engineering responsibilities, the financial reward was indeed poor. It was also felt strongly that the Report YB/57 had not been used as the basis for negotiations as members had been led to believe. The Meeting drafted a resolution to Council.

During an interlude, Mr. M. J. Sewell, Vice-Chairman of Sheffield H.M.C., addressed members, his subject being "The Place of the Hospital Engineer in the Health Service." He referred to the upgrading of old hospital buildings and paid tribute to the ability and ingenuity of the engineer in this difficult field. Costs, he said, were mounting, but records showed that the funds now available to hospitals were proportionately less in this country than anywhere else in the world.

NEW PUBLICATIONS

Negretti & Zambra have recently issued three new publications. These are:

(1) R30/2E dealing with Electric Switch and Contact Automatic Controllers and Alarm Mechanisms.

(2) A/19. Integrating Indicator (Type I.R.) for use with N & Z Aircraft Fuel Flowmeter.

(3) F25/S. Spanish version of our general catalogue—this is the sixteenth version of our Overseas Catalogue.

Copies of these catalogues are available on application from Negretti & Zambra Ltd., 122, Regent Street, London, W.1.