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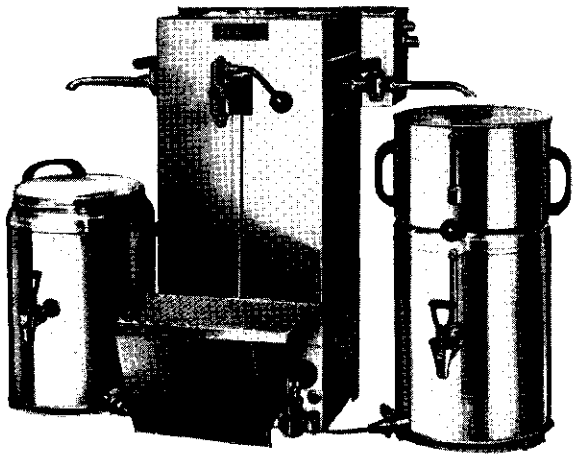

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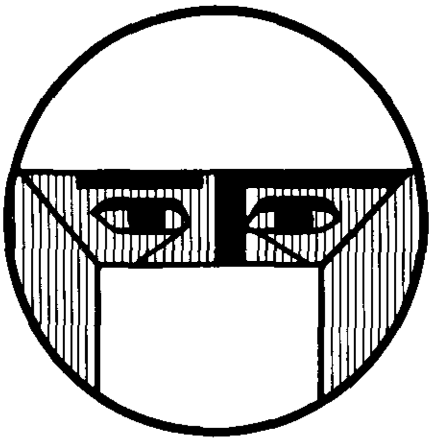

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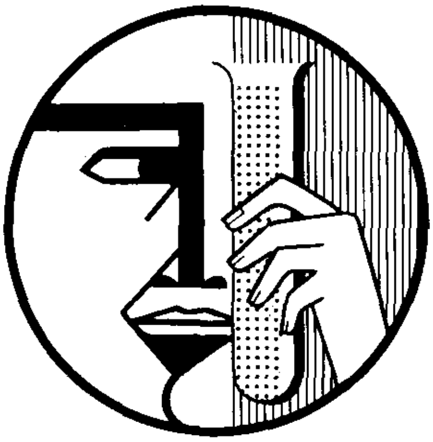

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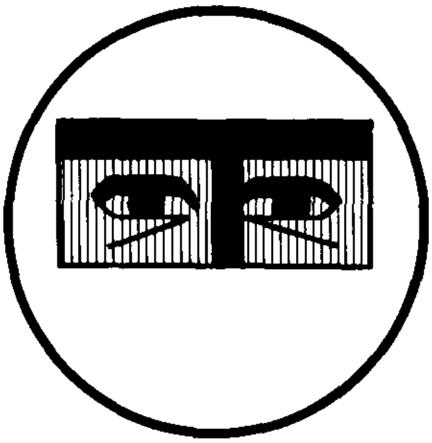

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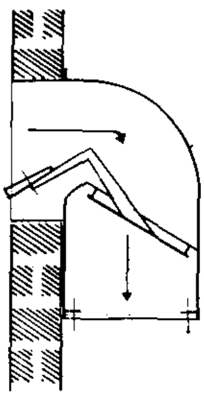

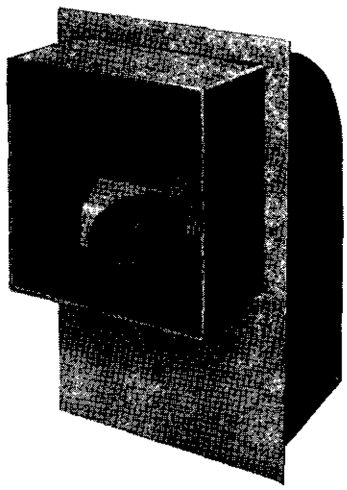

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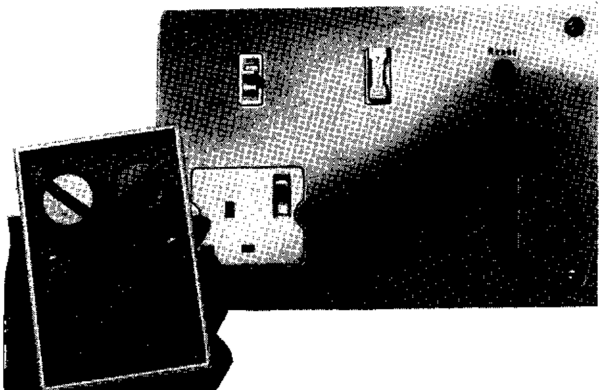

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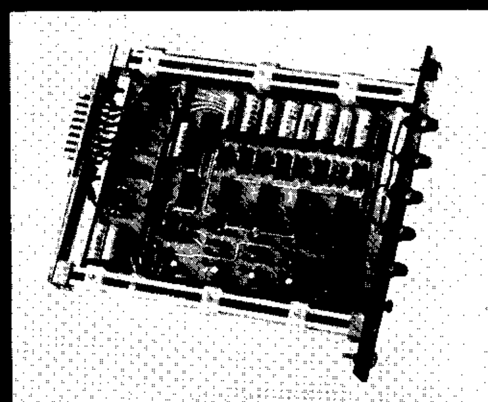

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The Design of Hospital Disposal Chutes

CHUTE USAGE PATTERNS

By GEORGE BAIRD, M.Sc., A.M.I.H.V.E., M.R.S.H.
of the Building Services Research Unit, University of Glasgow

1. Introduction

DESIGNERS or proposers of disposal chutes for hospitals are always asked the following: —

(*a*) What are the risks of air-borne cross-infection due to air being blown out of an open chute entry door, due to the piston effect of a bag of material descending from a higher floor?

(*b*) How much danger is there to personnel loading bags into the chute being struck by a bag of material descending from above?

(*c*) Is there a likelihood of bags colliding and/or jamming in the chute because bags of material have been loaded from two or more entry points at about the same time?

The points raised by these three questions are to some extent inter-related, though simple methods of alleviating some of the dangers suggested do exist. For example, the use of an extract fan, which will dilute the air-borne bacteria in the chute, will go some way towards preventing this means of cross-infection; in other words, any air that does get blown out will be relatively clean. So far as danger to personnel loading bags into the chute is concerned, clearly, the provision of a short connection piece between the entry door and the chute proper should eliminate this fairly completely. The likelihood of bags colliding and/or jamming is a rather more nebulous problem, and is dependent on many factors, but it must be said that our experience during the survey of existing installations did not indicate that it was a serious one.

Much thought has been given, in the design of existing chutes, to methods of preventing two entry doors being opened simultaneously. These range from simple warning lights which come on at every entry point when one door is open, to complex, interlocked double-entry doors. Other methods have also been used or proposed, some of fairly sophisticated design, but in practice, none of these (at least of the ones inspected during the survey) appeared to be particularly successful. Warning bulbs had failed and not been replaced, the complex systems had kept breaking down, and in many cases, entry doors could be opened even when "interlocked."

On the other hand, there were a great number of installations, apparently successful, which were not fitted with any of the above mentioned equipment.

With the generally increasing height of buildings, chute installations will have more entry points than at present. The three questions posed above will be asked again and again, and still more complex entry points will emerge from the drawing boards to be inflicted on the hospital staff. These are likely to be just as costly, expensive to maintain, and of the same doubtful practical value as existing designs.

If as much time and effort had been expended in attempting to answer the fundamental question of the likelihood of coincident usage of more than one chute entry point, rather than on designing entries to prevent an unknown and unquantified risk, then many hospitals could have saved themselves a great deal of money, and planners could have concerned themselves with some of the more basic questions of chute design.

Chute Installation	London Hospital		Middlesex Hospital	Addenbrooke's Hospital
	East Wing	*West Wing*		
No. of Floors served	5	5	6	5
Departments served	300 Surgical	270 Medical	300 General and Theatres	90 Beds and Theatres
Approx. No. of Bags per day	54	36	128	18
Approx. Weight of Bag	50 lbs. and over	50 lbs. and over	20-30 lbs.	23 lbs.
Duration of Usage Tests (days)	12	12	14	8

Table 1. General data of the test chutes.

2. Objectives of the study

The main objective of the study described in this report was to obtain some fundamental information on how chutes were used in the practical hospital situation, and to assess just how much coincident usage of more than one entry point took place.

The method used was simply to monitor the usage of a few existing multi-floor chute installations.

Just about the time this work was being planned, a report was brought to our attention of a similar study which had been carried out at Addenbrooke's Hospital, Cambridge(1). Its purpose was to predict, from a basis of current usage patterns, the likelihood of bags of material jamming and/or colliding in the chute. A computer programme had been evolved for carrying out this prediction, and the opportunity was taken to treat our data in a similar way. Since the results of the Addenbrooke's study have not been made generally known, the more significant data and conclusions will be reported here.

3. Test Technique

Three chute installations were chosen for the study, two at the London Hospital and one at the Middlesex Hospital. Details of the numbers of floors and departments served by the chutes in these hospitals and at Addenbrooke's are given in Table 1.

These chutes were chosen for their size, similarity and geographical proximity to each other. A small microswitch was fitted to each of the chute entry doors and, in each hospital, the switches were wired back to a central multi-pen recorder. The recorders produced a chart trace for each microswitch, which indicated whether the contacts were open or shut (and hence whether the chute entry doors were open or shut). Thus, one could see at a glance whether the doors were open or shut, the length of time they were open, the interval between usages, and whether or not more than one door was open at the same time.

At Addenbrooke's, the times at which the linen bags were loaded into the chute were recorded manually, and the data was presented as total numbers of bags loaded

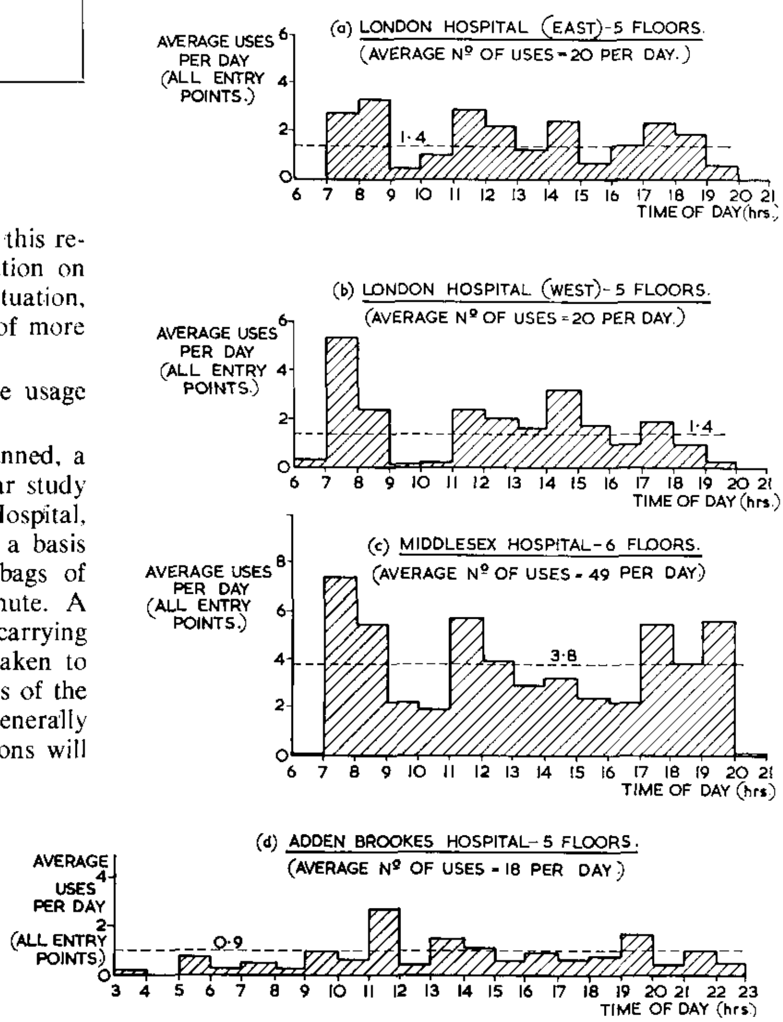

Fig. 1. Daily usage patterns at four chute installations.

during each half-hour period of the day from each department.

Since their chutes were not normally used at night, recording was carried out during the period 6.30 to 20.00 hrs. only, at the London and Middlesex Hospitals. At Addenbrooke's, records were made for the full 24 hours.

4. Daily usage patterns

The average number of uses of each of the chutes are plotted in Figure 1, for each hour of the day. The average number of uses per day is also indicated for each case.

It can be seen that the usage patterns of the two London Hospital chutes and the Middlesex Hospital chute are characterised by three fairly distinct daily peaks. The first of these is in the morning, between 7.00 and 9.00 hrs., the second around the middle of the day, though this one does not attain the size of the first and is spread over a longer period, and the third is towards the end of the day. While it might be expected that the two London Hospital chutes would illustrate a similar pattern, it is interesting to note that the Middlesex Hospital chute is also the same, in spite of having a far larger number of uses. In the case of the Addenbrooke's Hospital chute, the mid-day and evening peaks can also be seen, but there is no early morning peak, no doubt due to the fact that bags are deposited down the chute during the night, instead of being left till the morning, as was apparently the case at the other installations.

From the point of view of equalising the loading on the chute installation one should obviously aim for the same number of uses during every hour of the day. Of the cases considered here, the Addenbrooke's installation gets closest to this ideal (with about three hours per day where the average usage is exceeded, compared to double this figure or more at the other chutes).

Before going into possible reasons for this, consider the data given in Table 2.

Chute Installation	*London Hospital*		*Middlesex Hospital*	*Addenbrooke's Hospital*
	East Wing	*West Wing*		
Approx. No. of Bags/Day	54	36	128	18
Average No. of Uses/Day	20	20	49	18
Approx. Average No. of Bags/Use	2·7	1·8	2·6	1·0

Table 2. Comparison of numbers of bags deposited and uses per day at each chute.

The Addenbrooke's installation was equipped with entry points which allowed only one bag to be deposited at a time. At the others, as can be seen from the table, more than one bag could be deposited during each use of an entry point, and this was very often the case.

It is thought that the principal reason for these two phenomena (i.e. one bag per use and fairly non-peaky usage pattern) was the fact that the Addenbrooke's chute was situated in the sluice room of the ward unit. The other installations were located relatively far from the patient areas or adjacent to the entrance corridor to the wards. In other words, where a journey was involved between storage point and chute entry point, there appeared to be a tendency to wait until more than one bag was full and also till there was additional staff available to transport it (hence the morning peak). Admittedly the Addenbrooke's chute could only handle one bag at a time and, at an average rate of 18 bags per day, was not heavily loaded. However, it seems unlikely that this would account for all the difference. It is still fairly evident that this reduction in peak periods is yet another valid reason for locating the chute in the sluice room. Of course, this has a direct bearing on the main objective of this report since it is at peak periods that coincident usage is most likely to take place.

5. Duration of use of the entry points

Another factor, likely to affect the incidence of coincident usage of more than one entry point, is the length of time which a given entry door remains open. Clearly, the shorter this time, the less likelihood there would be of two or more doors being open simultaneously.

As previously stated, the duration of opening of each entry door was known from the recordings. The frequency of different durations of opening are plotted (for six second intervals) in Figure 2, for the Middlesex and London Hospital chutes. No data was available for the Addenbrooke's installation.

As with the daily usage patterns, the profiles for the duration of use of the entry points were very similar at all three installations. It can be seen that there were two main peaks, the first between 6 and 24 seconds and the second between 30 and 42 seconds. There was a distinct trough between 24 and 30 seconds, only about 5 or 6 per cent of the openings being of that length of time. There was a further minor peak at about the 1 minute mark, and thereafter, the frequency of openings lasting for longer than 1½ minutes or so fell to quite small proportions.

Without a more detailed knowledge of how the entry doors were used by personnel loading bags into the chute, it is difficult to give precise reasons for some of these features. However, it would seem reasonable to suggest that the first peak (6-24 seconds) represents the time taken to load a single bag, and the second peak (30-42 seconds) the time to load two bags into the chute. (It is perhaps stretching the data—and one's imagination

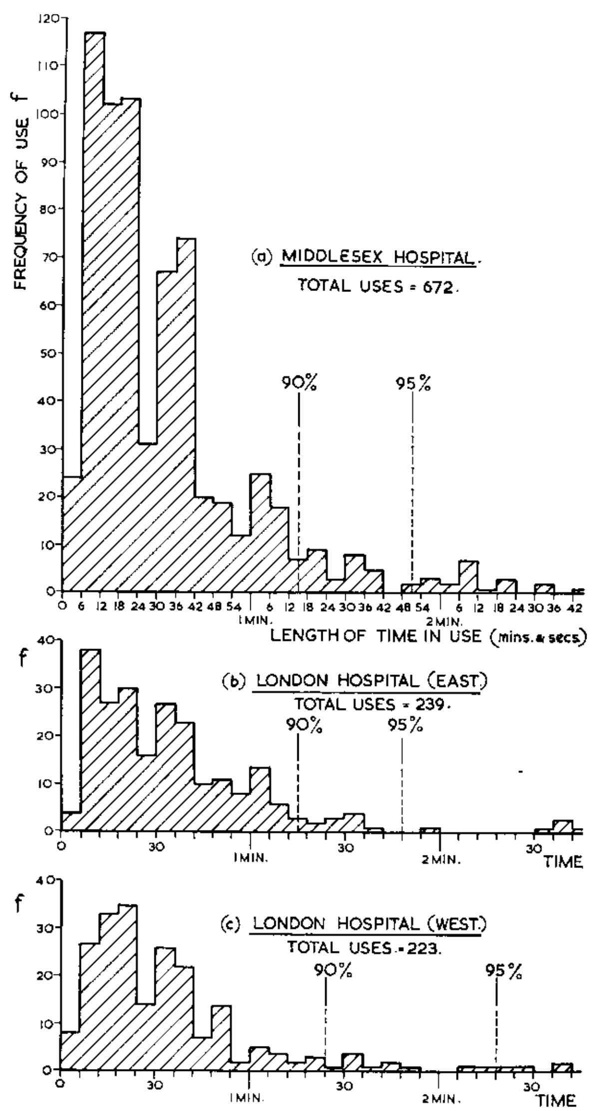

Fig. 2. Length of time in use of the chute entry doors.

—beyond the limits of probability to suggest that the third, smaller peak represents the time taken to load three bags).

Generally speaking, over 90 per cent of the uses took less than about $1\frac{1}{2}$ minutes to complete, and only 5 per cent or so took longer than 2 minutes. About half the uses took less than 30 seconds.

If the chute is designed and located such that it is easy for staff to load each bag as soon as it is full (instead of waiting till several are ready for their journey to a remote entry point), and if one accepts the above premises concerning the peaks of the histogram, then it can be seen that there would be a tendency for loading times to be reduced. Even assuming the 90 per cent figure for the Middlesex Hospital of about $1\frac{1}{4}$ minutes, this would, theoretically, allow up to 48 uses per hour without any overlap. The maximum figure recorded during the Middlesex Hospital morning peak was 18 uses in a one hour period (7.30-8.30 hours), though the average for that particular period was less than 10.

6. Incidence of simultaneous usage

Data was obtained, from the chute usage recordings, concerning the time intervals between usages at different entry points of the installations. This interval was taken as the time between the closing of one entry point, and the opening of another. While these overlapped, that is where two entries were opened simultaneously, the overlap time was noted.

Although the data had been collected for chutes with five entries (the top floor—operating theatres—usage was ignored at the Middlesex Hospital since it was usually much less than the others), random sets were selected to illustrate the likely intervals between usages for 2-floor, 3-floor and 4-floor chutes as well. In addition, the data from the two London Hospital installations were combined to show a possible pattern for 6, 7, 8, 9 and 10-floor chutes.

The results are summarised on Figure 3 where the percentage frequency of coincident usage is plotted against the number of entry points. It will be seen that, in spite of the different amounts of usage, the graphs for all three chutes are practically the same, and only one line has been drawn for the range 2 to 5 entry points. From the graph it can be seen that, for similar usage patterns, one might expect about three per cent of the usages to overlap on a 2-entry chute and about seven per cent for a 5-entry chute.

When the data for the combined London Hospital chutes was plotted it was found that a line of similar gradient could be drawn for the range 6 to 10 entry points. However, this line was slightly lower than the other. There seems no rational reason why it should not continue straight on from the 2 to 5 entry point line—one can only assume, in spite of the efforts made to ensure randomisation, that a biased sample of entry point combinations had been selected.

If one simply extrapolates the 2 to 5 entry point line, then one might expect, for example, about 12 per cent of coincident usage from a 9-entry chute. Generally speaking, the duration of coincident usage was less than half a minute.

It has already been mentioned that a similar study was carried out at Addenbrooke's Hospital, where statistical techniques were used in an attempt to predict the likely numbers of collisions at a proposed new chute installation. In his report, Dawid[1] stated that the two principal factors which affect the rate at which collisions will occur in a chute are the *danger time* and the *traffic intensity*. The danger time was defined as the "critical period during which a bag just entering the main chute is in a position to collide with another bag descending from above" while the traffic intensity was "the average rate at which each entry point is used by the hospital staff." He further stated that "the rate of collision is

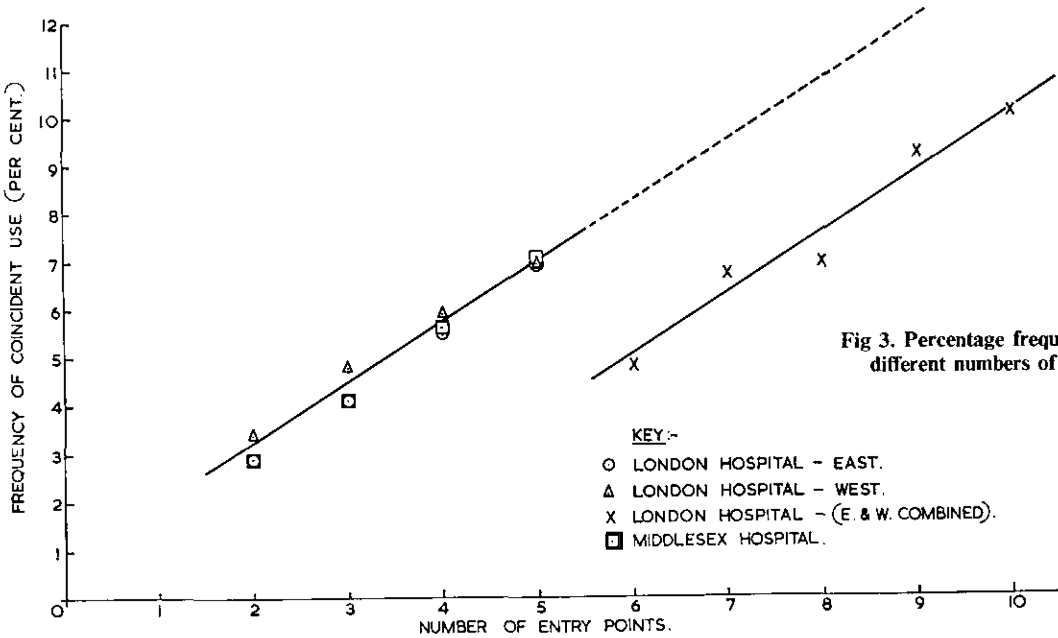

Fig 3. Percentage frequency of coincident use for different numbers of different entry points.

approximately proportional to the danger time, and to the square of the traffic intensity," and took into account the fact that the occurrence of peak periods would increase the likelihood of a jam.

On the basis of the data for the existing chute installation at Addenbrooke's Hospital (which has been presented in this report) and a danger time of half a second, he estimated that for the new installation, which was to comprise two 9-entry and one 7-entry chutes, there would be an average of six collisions per year, with a maximum of eleven in any one year (with 95 per cent probability).

The data from the three chutes tested in this study, as well as the combined figures for the two London Hospital chutes were treated in a similar fashion. The results are given in Table 3 for a range of danger times. These show, for example, in the case of the London Hospital (east) chute with a danger time of 0·5 seconds, that an average collision rate of 1·5 per year is expected and that the rate is unlikely to exceed 2·3 per year over

Chute Installation	*No. of Entries*	*Danger Time (secs.)*	*Numbers of Collisions* — 10 *year period* — *Average per year*	*Numbers of Collisions* — 10 *year period* — *Maximum per year*	*Numbers of Collisions* — *Maximum in any one year*	*Average percentage collisions per year*
London Hospital (East)	5	0·50 0·75 1·00	1·5 2·2 3·0	2·3 3·3 4·2	4 5 6	0·026
London Hospital (West)	5	0·50 0·75 1·00	1·7 2·5 3·3	2·5 3·6 4·7	4 5 7	0·030
Middlesex Hospital	6	0·50 0·75 1·00	5·9 8·8 11·8	7·5 10·9 14·3	10 14 18	0·046
London Hospital (E. and W. combined)	10	0·50 0·75 1·00	6·6 10·0 13·3	8·5 12·4 16·4	11 16 20	0·060

Table 3. Predicted frequency of collisions between bags at the chute installations tested.

a ten year period, although as many as 4 collisions could occur in any one year. The last column of the table expresses the average number of collisions per year (for a danger time of 0·75 seconds) as a percentage of the total number of usages in the same period—in all cases less than one-tenth of one per cent. It is of interest to compare these figures to the corresponding figures for percentage coincident usage.

Although the figures for likely numbers of collisions are fairly small, it should be borne in mind that the method of analysis over-estimates their value. In addition, for a normal size linen bag (not more than about 30 inches long) entering a disposal chute at an angle of 45°, the danger time should not exceed half a second.

Of course, the occurrence of a collision between two bags does not necessarily mean that they will become jammed in the chute. Thus, the rate of jamming should be much less than the figures given in Table 3 for collision rates. Just how much less is difficult to predict from a theoretical point of view, but it must be said that jamming did not occur during any of the present series of tests, and no cases of such an occurrence were reported during our survey of several other existing installations.

7. Conclusions

In the introduction to this report, three questions were posed. In this section, an attempt will be made to answer them.

The first of these questions concerned the risks of airborne cross-infection due to air being blown out of an open chute entry door, due to the piston effect of a bag of material descending from a higher floor. A hypothetical case will now be considered, in an attempt to quantify the likely numbers of bacteria which would be released from the chute into the room.

Assume a 100 ft. high, 2-ft. diameter chute, serving 10 floors with 100 uses per day. We would expect 13 per cent of these to be coincident from Figure 3.

Assume that the linen is bagged and the chute is fitted with an exhaust fan and the median peak bacterial concentration in the air in the chute is 40 bacteria/ft.^{3} (after Michaelsen[2]).

Assume also that half the air volume of the chute would be forced out via an open entry door, the rest being pushed out the exit point, or leaking past the bag—in this case approximately 150ft.^{3} of air.

Hence, 150 (ft.^{3}) x 40 (bacteria per ft.^{3}) = 6,000 bacteria would be released into the room. If the room was 1,000 ft.^{3} in volume this would imply a rise in bacterial contamination of the order of 6 colonies per ft.^{3}, which is fairly small compared with normal background concentrations. Suppose the room had extract ventilation at the rate of 250 ft.^{3}/min., then the bacterial concentration would fall back to its normal level in a few minutes.

This would occur on 13 per cent or less of the chute uses, that is 13 times per day if the chute was used 100 times per day. Since it is as likely for a bag to be dropped from a lower floor, while the entry door at an upper floor is open (which would be of no danger) as vice-versa, then the number of occasions would probably be half of this. In round figures, therefore, one might expect air to be forced into each room of a 10 floor chute about once a day.

To summarise, for a 10 floor chute under the above conditions, one would expect the bacterial contamination in each room with an entry point, to be raised by about 6 bacteria per ft.^{3}, for a few minutes, once a day. The amount which would get into the patient rooms would be negligible compared to the transfer which takes place within and between rooms and wards due to wind and stack effects and natural convection. The above air transfer figures may be compared with the 100 ft.^{3}/min. or so which will flow constantly beneath a closed door due to a pressure difference of one-tenth of an inch W.G.[3] or the 400 ft.^{3}/min. which will be transferred across an open doorway, in both directions, due to a temperature difference of only 5 deg. F.[4]

So far as danger to personnel from descending bags is concerned, there seems little doubt that the provision of an entry connection of about the same length as a full bag will eliminate this problem, without recourse to more complicated procedures.

Experience of existing chutes would suggest that jamming in the main trunking of the chute is virtually a non-occurrence. The statistical analyses also bear this out. Any jamming which has occurred appears to have been for reasons other than those which might be due to the omission of interlocks.

To summarise then, it can be seen that there should be no necessity to fit interlocks or any other complex devices on the entry doors of chutes. In quantitative terms, the dangers against which they are provided are negligible, provided some simple precautions are taken, namely, the use of extract ventilation and the fitting of short entry connections.

Acknowledgements

Grateful thanks must be recorded to the authorities at the London and Middlesex Hospitals, not only for allowing us permission to carry out this study at their chute installations, but also for affording us every possible assistance; to Mr. George Bell who set up our instruments, collected the test data, and assisted with much of the analysis; to the Board of Governors and the Planning Team of the United Cambridge Hospitals for their assistance in making available the results of the study of the Addenbrooke's chute installation; and to Mr. R. G. Carpenter, Department of Human Ecology, University of Cambridge, for running the statistical analysis of our test data.

Thanks are also due to the Western Regional Hospital Board, Scotland, who sponsored the project of which

(Continued on page 44)

Man and the Artificial Atmosphere

By B. KOSTRZ

Creation and control of an artificial atmosphere in the human environment. Physiological influences of various atmospheric factors (air temperature, relative humidity of the air, air movements inside rooms, surface temperatures of walls). Comfort requirement.

AIR conditioning installations are today engineered for many industries, for instance for the textile and foodstuffs industries, for printing establishments, etc. They are also employed in the service of human health (hospitals), to improve the performance of employees (offices) and are known as comfort air conditioning plants.

An artificial atmosphere must be in harmony with the natural temperature regulation of the human organism, for it is not only the heat balance of the body—how much heat it generates and dissipates—that is important for human well-being, but also the question of how this heat is dissipated.

Heat Generation and Temperature Regulation of the Human Organism

Chemical changes taking place during the breakdown of food in the body generate heat, particularly in the muscles and in the internal organs[1]. This heat is carried by the blood stream, i.e. by mainly convective means, to the surface of the skin. Heat transmission through the tissues is restricted by reason of their low thermal conductivity and assumes importance only when the convective transport of heat is seriously reduced.

The temperature in the core of the body—if we consider the body as consisting of an inner core and an outer shell—is approximately 37°C. The body's own control system keeps this temperature nearly constant, and overheating by only as much as 6°C already spells danger to life.

The body temperature depends on the equilibrium between heat generation inside the body and loss of heat to the surroundings. Since temperature fluctuations of over 100°C occur on the surface of the earth, man is forced to use certain aids to his own temperature regulation system, such as clothing, dwellings, heating and air conditioning installations.

The temperature of the body is controlled from a centre in the basal ganglia of the brain. The nerve structures are here in contact with the blood stream from the interior of the body. Their function is that of a temperature sensor: when the blood temperature changes, they initiate various compensating processes through the nervous system in order to restore the core temperature of the body to its normal level.

At the same time changes in the air temperature, which influence the surface temperature of the skin and thus the heat loss from the body, are perceived by temperature-sensitive organs known as thermoreceptors distributed over the whole surface area of the skin. The sensations thus received are passed in the form of nervous impulses to the heat regulation centre in the basal ganglia. At constant temperature about 10 impulses per second are signalled to the brain. When sudden cooling takes place, the impulse frequency may rise to 150 per second. The control organ in the brain functions like a typical proportional regulator; the thermoreceptors, however, behave like proportional-differential regulators, since they respond not only to the temperature deviation but also to the rate at which the temperature changes, The body can detect temperature changes of as little as 0·001 °C/sec.

The organism can influence its body temperature by way of the following adjusting factors:

the heat production of the body;

the thermal conductivity of the 'shell' of the body;

the heat loss by evaporation.

The heat production of the body depends on the kind of work done[2]. Table 1 shows the heat loss corresponding to various activities: the figures lie between about 100 kcal/h for a person seated and at rest and 1,000 kcal/h for a person engaged in an extremely strenuous activity. Heat production in the body is presumably not only influenced by muscular effort but also regulated in part by the internal organs, more heat being produced in cold conditions by an increase in metabolic activity. In a warm environment, on the other hand, the organism seeks to cut down its heat production as far as possible; on hot days we tend to avoid unnecessary movement and easily become sleepy.

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Table 1. Heat loss of a man of medium stature when engaged in various activities (after Missenard)

	kcal/h
Lying	74
Sitting, at rest	96
Standing, at rest	108
Dressing and undressing	118
Standing and doing light work	140
Typing (at speed)	142
Standing doing light work at a counter	150
Bookbinding	155
Doing light work at a bench	215
Carpentering	240
Serving in a restaurant	250
Marching at 5 km/h	270
Dancing or marching at 6·5 km/h	350
Bricklaying, masonry	375
Sawing wood	450
Running at 8·5-9 km/h	580
Maximum effort, according to person and duration	750-1,200

The heat-loss figures for women are 85% of the above
The heat-loss figures for children are 75% of the above

The flow of heat from the core of the body to the surface is proportional to the difference between the core temperature of the body and the surface temperature of the skin and to the thermal conductivity of the shell. It can therefore be influenced by a change in this thermal conductivity. When the surrounding air is cold, the circulation of blood in the skin is throttled by contraction of the blood vessels, and in this way the convective heat transmission and thus the thermal conductivity of the body shell is reduced. Less heat then flows from the interior of the body to the skin, and the surface temperature of the skin falls.

Under warm conditions the opposite takes place: the blood vessels in the skin expand, blood circulation increases and the skin becomes warm: the thermal conductivity of the shell of the body rises. The widening and narrowing of the blood vessels is controlled by the nervous system, which receives its impulses partly from the regulating centre in the brain and partly from the thermoreceptors in the skin.

If the ambient temperature rises above 30°C, the temperature gradient between the core of the body and the surroundings is not sufficient to dissipate enough heat to the outside even when the thermal conductivity of the body shell is at its maximum. Cooling of the skin by evaporation (perspiration) then sets in, thus increasing the temperature gradient between the interior and the surface of the skin.

The heat which the body gives up to its surroundings must thus flow from the interior of the body to the surface of the skin. Here it is eliminated by radiation, convection, conduction and evaporation. The percentages of the total heat loss due to the various mechanisms differ according to the atmospheric conditions, and comfort largely depends on how the body gives up its heat to the surroundings.

Heat Loss of the Human Body

Radiation

Heat loss by radiation is part of a heat exchange process in which there is a flow of heat in both directions, from the body and to the body. Even when the air is cold, there may well be a flow of radiant heat towards the body, for instance in sunshine or in the proximity of warm surfaces (internal blinds).

Heat loss by radiation can be calculated with the equation

$$Q_{rad} = \alpha_{rad} F_{rad} \varphi (t_{sc} - t_{wm})$$

where

Q_{rad} heat loss by radiation (kcal/h)

α_{rad} coefficient of heat transfer for radiation from the clothed human body (kcal/m^{2}h°C)

F_{rad} surface area of body responsible for radiation (m^2)

φ angular ratio of the radiation from the human body to the whole room (irradiation coefficient)

t_{sc} mean surface temperature of the clothed human body (°C)

t_{wm} mean surface temperature of the walls of the room (°C)

Convection and Conduction

Between the surface of the body and the clothing there is an almost motionless layer of air; the flow of heat here mainly takes the form of conduction. The thicker this layer of air, the less the flow of heat; one of the purposes of clothing is in fact to keep this motionless air in its place. The heat loss from the surface of the clothing takes place by convection. For this convective heat loss to the surrounding air we can write:

$$Q_c = \alpha_c F_c (t_{sc} - t_a)$$

where

Q_c heat loss by conduction and convection (kcal/h)

α_c coefficient of heat transfer for convection (kcal/m^{2}h°C)

F_c surface area of clothed human body (m^2)

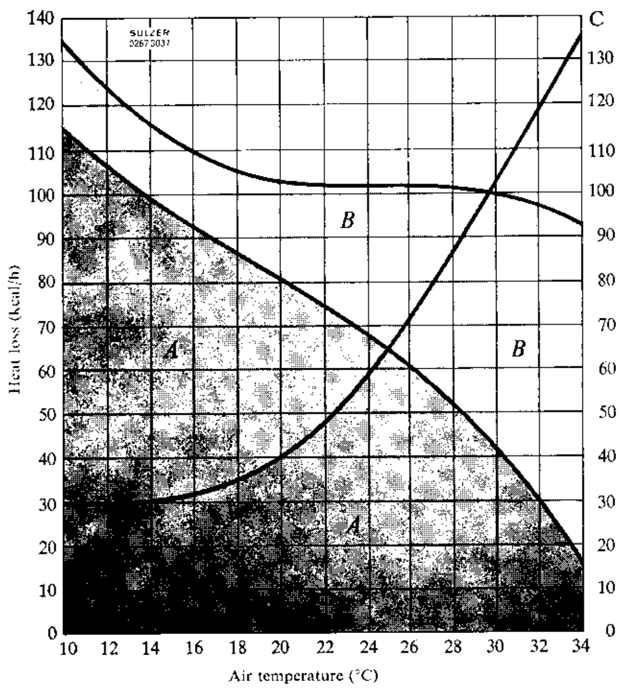
t_{sc} mean surface temperature of clothed human body (°C)

t_a air temperature in room (°C)

Evaporation

Heat loss by evaporation is very effective because water has a high heat of vaporization. Every litre of water (in the form of perspiration) that evaporates on the surface of the skin extracts about 580 kcal from the body. With physiologically ideal evaporation the skin always appears to be dry even though the body eliminates many litres of liquid per day by evaporation. Wetness of the skin is a proof that the process is not taking place fast enough. Visible perspiration is therefore a sign of a build-up of heat in the body.

Heat elimination by water evaporation is the most important form of temperature regulation for the human



A Heat loss by radiation, convection and conduction
B Heat loss by evaporation
C Emission of water vapour

Fig. 1. Heat loss of the human body per hour as a function of air temperature.

body. Open-air workers who are exposed to bright sun and great heat may lose as much as 10 litres of water a day by sweating. This liquid naturally has to be replaced in good time.

Heat losses by evaporation can be calculated as follows:

$$Q_e = rx$$

where

Q_e heat loss by evaporation (kcal/h)

r heat of vaporization of water (kcal/kg)

x water vapour emitted (kg/h)

The amount of water vapour emitted depends on the coefficient of vaporization, on the difference between the vapour pressure at the surface of the skin and that of the room air, and on the clothing.

The coefficient of vaporization depends on the air movement in the room. The vapour pressures are determined by water content and temperature of the skin surface and of the air. The relative humidity of the air is thus not only the determinant of the evaporative process. An important point is that water can evaporate on the skin even at a relative humidity of 100% provided that the vapour pressure above the skin is higher as a result of the high skin temperature (about 36°C) than the vapour pressure of the surrounding air.

Atmospheric conditions are felt to be comfortable when the percentages of the total heat loss due to radiation, convection, conduction and evaporation are in a certain ratio to each other. At 20°C air temperature and 40-60% relative humidity, the thermal comfort is felt to be agreeable for office work when the percentages of the total heat loss are:

Heat loss by radiation	54 kcal/h
Heat loss by convection and conduction	26 kcal/h
Heat loss by evaporation	23 kcal/h
Total heat loss	103 kcal/h

These figures show that of the total heat about half is dissipated by radiation and one quarter each by convection/conduction and by evaporation.

Fig. 1 shows the heat loss per hour (for office work) as a function of the air temperature.

It may be gathered from the equations for the various components of the heat loss that for the human organism thermal comfort depends on the following factors:

1. Air movement in the room: The air movement in the room influences the coefficient of heat transfer for convection, α_c, and the coefficient of vaporization, on which the elimination of water vapour by the human body depends. Since the coefficient of heat transfer for convection is proportional to the air movement, greater air movement is desirable at higher air temperatures.

2. Air temperature: This has a strong influence on the heat loss by convection and evaporation; it is of secondary importance for radiation.

3. Surface temperature of the surrounding walls: Since about half of the heat is given off by radiation, the surface temperature of the walls is one of the most important factors affecting comfort.

4. Clothing: The type of clothing worn is most important. The heat loss by radiation and convection is greater for a man who works in his shirt-sleeves in the office than for one who works in his jacket. There is even a difference between a cotton shirt and one made of synthetic fibres.

5. Work area: It can be gathered from the equation for the heat loss by radiation that this depends on the angular ratio φ between the surface of the human body and the various walls. The nearer the work area is to a cold wall or a window, the greater will be the heat loss of the body through radiation in this direction, since the angular ratio becomes greater[3]. But even in summer a seat in the proximity of internal blinds is less comfortable on a sunny day than a seat, for instance, in the middle of the room, and this in spite of the fact that the air temperature is the same at the two points. For a body near the blinds can give up no heat to them by radiation but will receive radiant heat from them instead.

Comfort

We should perhaps first attempt to define the concept of comfort a little accurately. These are the comments of a doctor on the subject[1]:

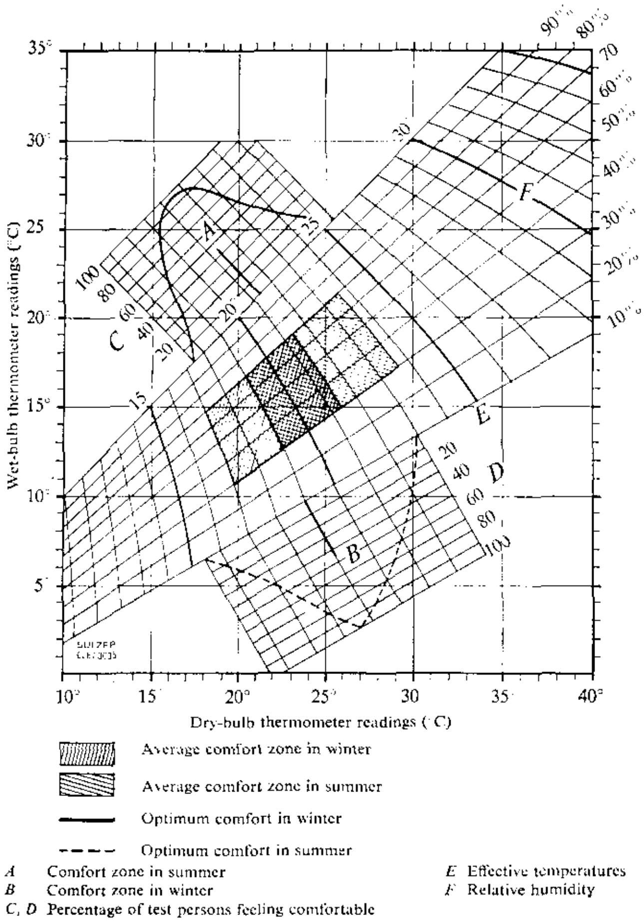


Fig. 2. Comfort zones (Yaglou).

"Comfort, psychologically considered, is a state characterized by agreeable affective responses. If we look closer, however, it proves that the concept of comfort is not at all simple to define. It depends, for instance, on our activity whether we consider given atmospheric conditions to be comfortable or not. The physical facts of our bodily temperature regulation in themselves lead to our preferring a cooler room temperature when engaged in strenuous bodily work than when we are resting. But the atmospheric conditions preferred for intense mental activity are also different from those that suit us best when we want to sit and doze. Cold wakes us up, heat makes us sleepy. A certain number of cold impulses reaching the central nervous system from the skin tend to maintain an alert and active state. Recent psychological experiments have shown that the tendency to boredom (with resulting sleepiness, etc.) due to monotonous work is less marked, and the reactions livelier, when the work is done at a room temperature of 19°C instead of 24°C.

The physiological correlatives of comfort can likewise not be reduced to simple terms. The sense of comfort is an integrative magnitude which many physiological factors must combine to produce. Among them the mean or integral skin temperature takes an important place.

Another important factor is long-term adaptation to given atmospheric conditions, which is known in its general form as acclimatization. The very same atmospheric conditions in a room, for instance, appear to us warmer in winter than in summer."

As gan be gathered from these remarks, 'thermal comfort' can at least be roughly circumscribed, and attempts have already been made to find some yardstick of atmospheric comfort. It is clear that a single factor, such as the room temperature, is not sufficient for this purpose; but complex atmospheric figures or comfort indices can be arrived at by the combination of several factors. The two best-known are shown in Figs. 2 and 3.

Fig. 2 shows the 'effective temperatures' recommended by Houghten and Yaglou[4]. The effective temperature is the temperature which, in a room free from radiation and air movements and at 100% relative humidity, produces the same sense of comfort as the actual temperature at the actual humidity. However, as this figure takes no account of the surface temperature of the walls or of air movements in the room it cannot be regarded as a fully valid measure of comfort.

The radiant temperatures can be taken into account by means of the 'resultant temperatures' of Nielsen and Pedersen[5]. The term 'resultant temperature' is applied to the average of the air temperature t_a and the mean surface temperature of the room surfaces t_{wm}. Fig. 3 is the diagram used for obtaining this temperature. However, no comfort range has been entered in it.

The endeavours made to set up complex atmospheric figures have led to useful partial solutions to the prob-

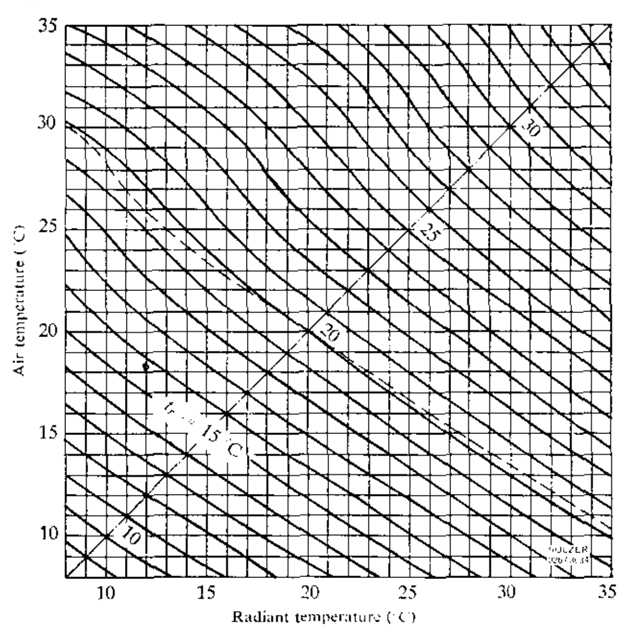


Fig. 3. Diagram for determination of the resultant temperature. The curves connect points of equal resultant temperature.

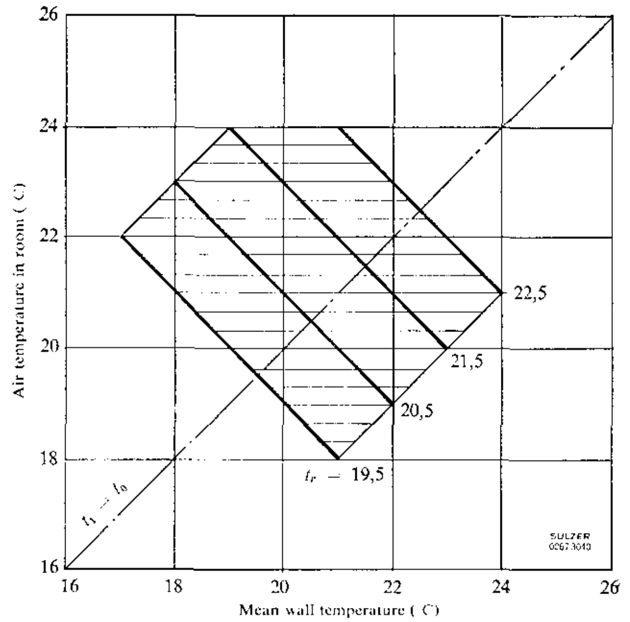


Fig. 4. According to Prof. Grandjean these figures hold good for Switzerland in winter: room with normal windows, relative humidity 40-60%, t_r = resultant temperature.

lem, but it is probably not possible to find a comfort index that holds good under all conditions. It is therefore safest to indicate separately the four most important atmospheric factors in the room in question, viz. air temperature, air humidity, radiant temperature of the surrounding walls and air movement.

In Table 2 the comfortable temperatures and humidities for occupied rooms are given as a function of the outside temperature[6]. As can be gathered, the limits for room temperature are comparatively narrow. A wide range is allowable, however, for the relative humidity, for dry air is not as detrimental to human well-being as is generally assumed. Over-heated air, on the other hand, is a disadvantage, for warm air causes the mucous membranes of the nose to swell as a result of a plenteous blood supply, and breathing is thus obstructed to some extent. The mucous membranes of the respiratory passages also become warm, so that the exhaled vapour cannot condense on them and they dry out. The warmer the air, the more unfavourable is the effect of high relative humidity on comfort. This results from the fact that the evaporation of perspiration from the body, which is the principal method of heat dissipation at high air temperatures, is less effective at higher relative humidities.

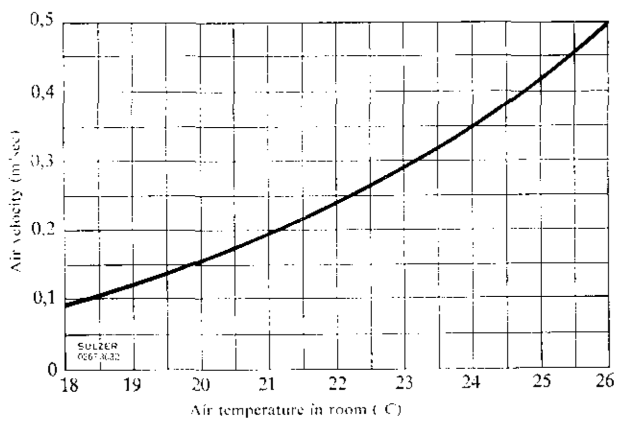


Fig. 5. Admissible air velocity in the direction of seated persons as a function of air temperature in the room (DIN 1960).

Table 2. Comfortable temperatures and humidities for occupied rooms

Outside temperature (°C)	20	22	24	26	28	30	32
Room temperature (°C)	22	22	22	23	24	25	26
Relative humidity (%)	(35) 40	—	—	—	—	—	55 (60)

Since the diagram for the determination of the resultant temperature (Fig. 3) indicates no comfort range and radiation from the walls can only be compensated in a restricted range by the air temperature, we give in Fig. 4 the values recommended by Prof. Grandjean[7].

In addition to the air temperature, the air movement in the room must be taken into account in any comfort assessment. Air movements increase the heat loss of the body, and are felt particularly by persons who work in a seated position. Complaints are often made about 'draughts' when the body is in fact giving up too much heat by radiation towards cold windows or walls.

Most hygienists indicate an air velocity of 0·2 m/sec as the admissible maximum for air movements in offices. In Switzerland the view is sometimes taken that this figure is too high and that air movements must be below 0·1 m/sec if they are not to disturb the room occupants. Air movements, however, are technically unavoidable where air conditioning is employed, and it is then advisable for reasons of comfort not to exceed the values shown in Fig. 5.

Air Conditioning Systems

The complicated processes involved in the body's own temperature regulation and the manifold influences of atmospheric conditions on human comfort show very clearly that an installation designed to create and maintain an artificial atmosphere must satisfy exacting requirements if the room occupants are to be comfortable at their work and are not to suffer any impairment of their efficiency. Air conditioning engineers have therefore developed various types of air conditioning systems. These can only be successful in practice, however, if they are planned from the first in close cooperation between architect and air conditioning engineer. The requirements that must be fulfilled by a good air conditioning plant should be known to all involved in the construction work and should be duly taken into account.

The Heating and Air Conditioning Division of Sulzer Brothers Ltd. has been engaged for many years in the investigation of the problems connected with the

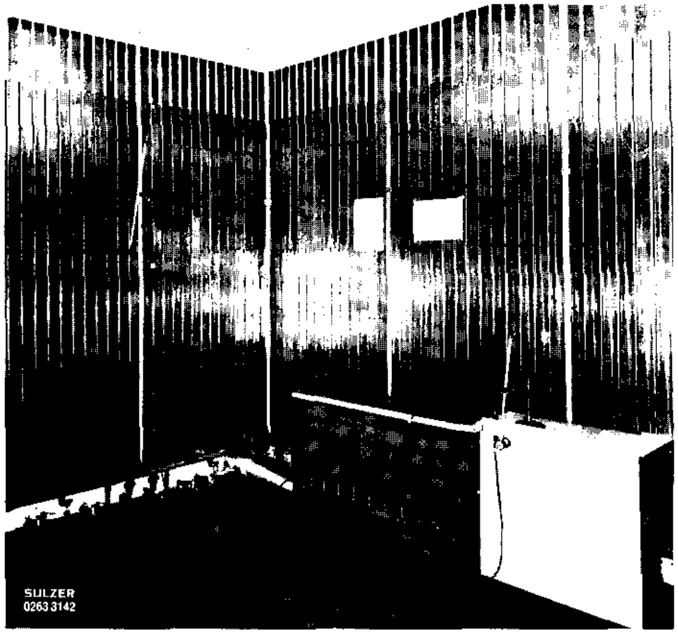


Fig. 6. Test room for investigating radiation problems.

creation and control of an artificial atmosphere, whatever the air conditioning system used to obtain it. Special rooms are available for research into basic questions and for testing plant components before an actual installation is carried out.

One room is equipped, for instance, for research into radiation phenomena (Fig. 6). The inside walls of this room consist of 15 plate-type radiators which can be heated or cooled independently. This enables the temperatures of outside and inside walls or of windows to be simulated.

Air movements are measured in a special airflow

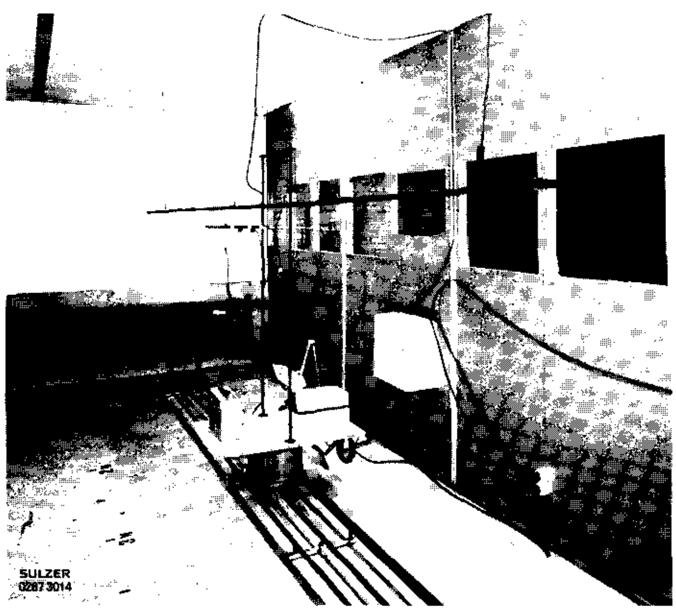


Fig. 7. Airflow chamber for measuring air movements.

Fig. 8. Outside wall of measuring room.

chamber (Fig. 7). The movements produced by all types of air inlets employed in the various air conditioning systems can here be investigated at any desired point. One end wall of the room is made up of flat heating or cooling elements so that window temperatures in winter or surface temperatures of internal blinds in spring, summer or autumn can be simulated. The air velocity is measured with an electronic instrument mounted on a carriage that can be remote-controlled from outside the room. Air movements of less than 0·1 m/sec can be accurately measured, since all outside influences are eliminated.

The flow pattern is made visible by intermittent smoke injection (isothermally) and is observed from outside through the windows.

Fig. 8 shows the outer wall of the airflow chamber with the observation windows. The scale of the airflow measuring instrument appears on the television screen.

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Looking in at Keele from the outside

By T. A. JONES,

Regional Training Officer, Liverpool Regional Hospital Board

WHAT goes on at Keele? Come to think of it, where is Keele? Perhaps it would be more logical if the answer to the second question came first. Keele is the University of Keele in North Staffordshire, one of the new post-war universities built on the "campus" principle on an estate of some 630 acres, two miles west of Newcastle-under-Lyme on the main road to Crewe and Chester. Its central situation and its proximity to the M6 Motorway and Crewe British Rail station made it an almost ideal venue for the annual courses of a week's duration for Group and Hospital Engineers on the one hand and Assistant Engineers on the other.

The Keele courses for Hospital Engineers have been in existence since 1964 with the exception of 1965 when a course for Group and Hospital Engineers was held at the University of Nottingham. The fact that these annual courses, held usually in July and September, have now become a regular feature of the engineer's calendar is the direct result of maximum co-operation between the Department of Health and Social Security, The Scottish Home and Health Department and The Institute of Hospital Engineering. Such a healthy "marriage" has extended its field of co-operation so that the courses are tutored by members of Regional Hospital Board engineering staffs and members of Regional Hospital Board training staffs. The needs of the proper development of engineers are thus met both from the point of view of further education and from the practical application of new engineering techniques in an ever-changing technological world.

Each year a "Course Committee" assembles to thrash out the course content for courses to be held at Keele in the ensuing months of July and September. The overriding principle occupying the minds of the course committee is that there must be a positive emphasis on management skills in all syllabuses, so to this end the content of each course is arranged on the basis of there being 60% management and 40% pure engineering techniques. Once the course committee has decided on the precise content for each course the Institute then brings together the course tutors for a briefing meeting. So engineers and training officers get together a few months before the July course to thrash out "who does what." This settled, the Institute of Hospital Engineering makes itself responsible for the entire administration, including handling the all-important task of accepting nominations for the Courses.

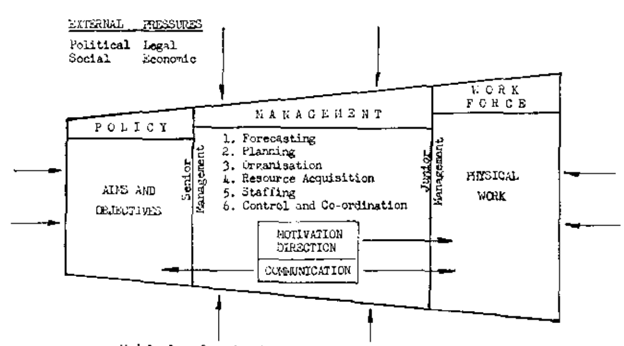
Student Participation

The very thought of "going back to school" is enough to put anybody off attending any type of course. The tutorial staff are mindful of the fact that many engineers have been away from the actual learning situation for a very long time, consequently they aim at maximum participation on the part of course members. Formal lectures are reduced to an absolute minimum. It is true to claim, therefore, that course members spend the greater part of the time in discussion groups. Such discussion and study-group sessions are given to the main course theme, that is, management topics. Management is an ACTIVITY. To this end discussion groups work to the positive aim of presenting a "Course Council" on the final day of the course. Each study group, therefore, presents its findings on the particular subjects which they have been asked to discuss at the Course Council. Each group (there being usually eight groups) occupies the row of "hot seats" facing the remainder of the course to present its findings. This presentation takes ten minutes and a further ten minutes is allowed for the answering of questions put to them from the floor of the house. Groups are properly structured with a chairman and secretary; expertise being shared throughout the group.

Management Content

It would be quite impossible to discuss the whole management concept in the space of a one-week course, consequently a thorough investigation of selected management topics is felt to be more desirable than a quick flick through the whole management process. The tutorial staff are agreed that in the pursuit of management

THE ROLE OF MANAGEMENT IN AN ORGANISATION



Model of an Organisation - showing The Role of Management knowledge the role of management in an organisation should be studied to a common denominator and to this end the management chart on page 37 is adhered to by all groups in discussion. The acceptance of a common management chart by the tutorial staff ensures that all groups are "on net" at the final course council and safeguards the disadvantages of any one group discussing management in complete isolation.

Technical Content

The technical content of the Group and Hospital Engineer Course is presented in the more orthodox manner of set lectures, films, etc. than is the case with the study of the management area.

For the Assistant Engineers, the programme includes a carefully planned visit to a hospital and a follow-up session which enables course members to present their questions, observations and criticisms to those associated with the hospital visited.

Fig. 1. Course Council in Session.

The engineering staffs of the hospital, Hospital Management Committee and Regional Hospital Board concerned join the Course, at Keele, to discuss the visit beforehand, are available on site during the visit and at the follow-up session which is conducted in the free atmosphere of the lecture theatre at the University.

The subjects selected for groups to discuss at the Course Council on the final day of the Course are related to this visit.

The Domestic Scene at Keele

It is customary for the University authorities to allocate the Students' Union building to the Institute for the whole period of each course. What is the ballroom of the Union becomes the main lecture theatre for the courses and discussion rooms are adjacent to the main lecture theatre. Course members and tutorial staff are

Fig. 2. Group Chairman reporting for his Group.

accommodated in the delightful halls of residence quite near the Students' Union. Each member has his own single study-bedroom and the usual domestic facilities are supplied—towels, soaps, etc. Each residential hall has its own kitchen wherein members may make early morning tea (known as "gunfire" to the older hands), late night coffee and what have you. Main meals are taken in the University dining room located in Keele Hall; usually breakfast and lunch are obtained on the cafeteria system whilst the evening meal is provided by means of waitress service. The Students' Union houses a shop and a bar where members may slake their thirst after the day's toil. Many and varied are the problems of engineers at the bar! One is never sure that these problems are fully resolved under these circumstances but nevertheless it is good to give them ventilation in such convivial surroundings.

Each Course includes a special Dinner to which guest speakers are invited. *(Continued on page 48)*

Fig. 3. Another Group Chairman reports for his Group.

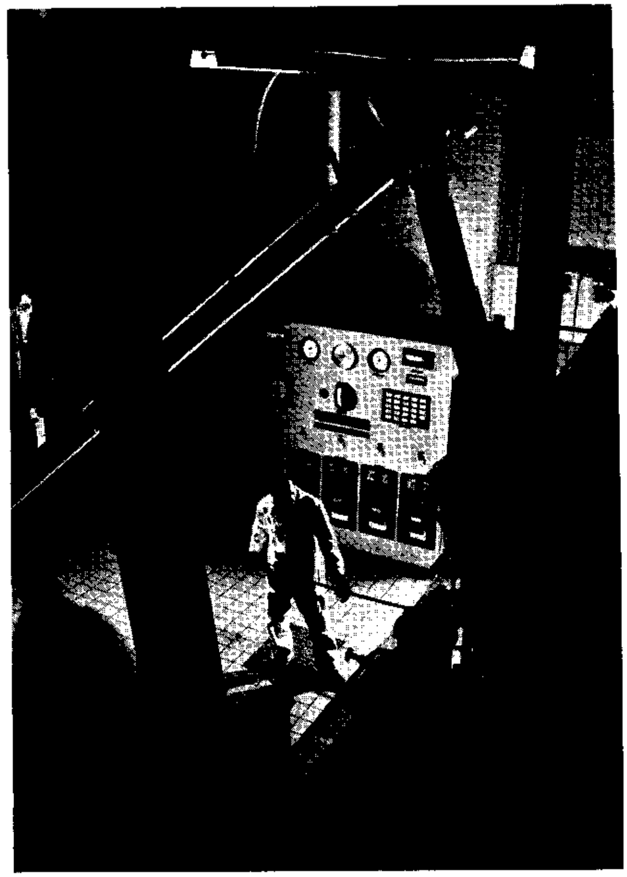
NEW BOILER HOUSE OPENED AT FRIERN

JANUARY 30TH saw the official opening by Mr. Maurice Hackett, O.B.E., Chairman of the North West Metropolitan Regional Hospital Board, of the new Boiler House at Friern, a 2,282 bed psychiatric hospital, which comes under the New Southgate Hospital Management Committee. The new steam plant has been sized to meet also the demands of Halliwick Hospital which is on an adjoining site.

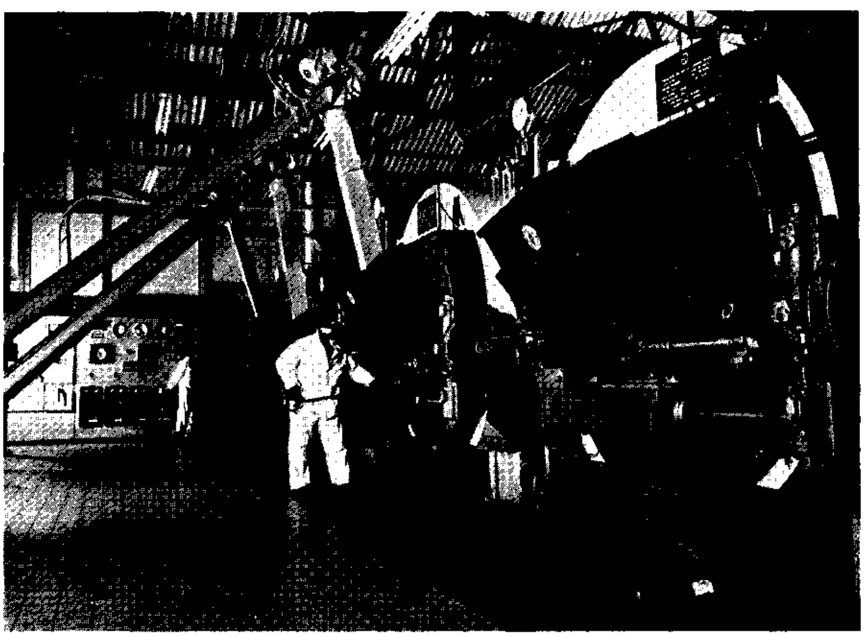
The original boiler plants, serving Friern Hospital only, comprised three separate units, one of three and two of two 7,000 lb/hr. Lancashire boiler installations which were all installed in the late nineteenth century. They were hand-fired, manually controlled, working at low thermal efficiency and requiring a large labour force. Steam distribution was to a central service at 50 lb/sq. in.

The plurality of subsidiary heating means, including individual gas-fired heaters and other forms of energy consumption, installed in the remoter parts of the hospital made it necessary to burn five grades of coal and coke as well as oil, gas and electricity. From a re-appraisal of the present situation, the North West Regional Board deduced that a centralised Boiler House with separate calorifier stations on site would simplify fuel requirements and show considerable reduction in operation costs.

The new installation has been built on the site of one of the existing boiler houses and embodies latest solid fuel burning practices, combustion being controlled automatically matching the fluctuating steam requirements of the hospital. The bunker arrangement, with a total capacity of 12 tons, is such that they can be recharged by mechanical shovel. Supply to the boilers is by Hodgkinson Bennis 6 in. screw type elevators feeding the unit's hoppers. Ash removal is through the front end of each boiler.

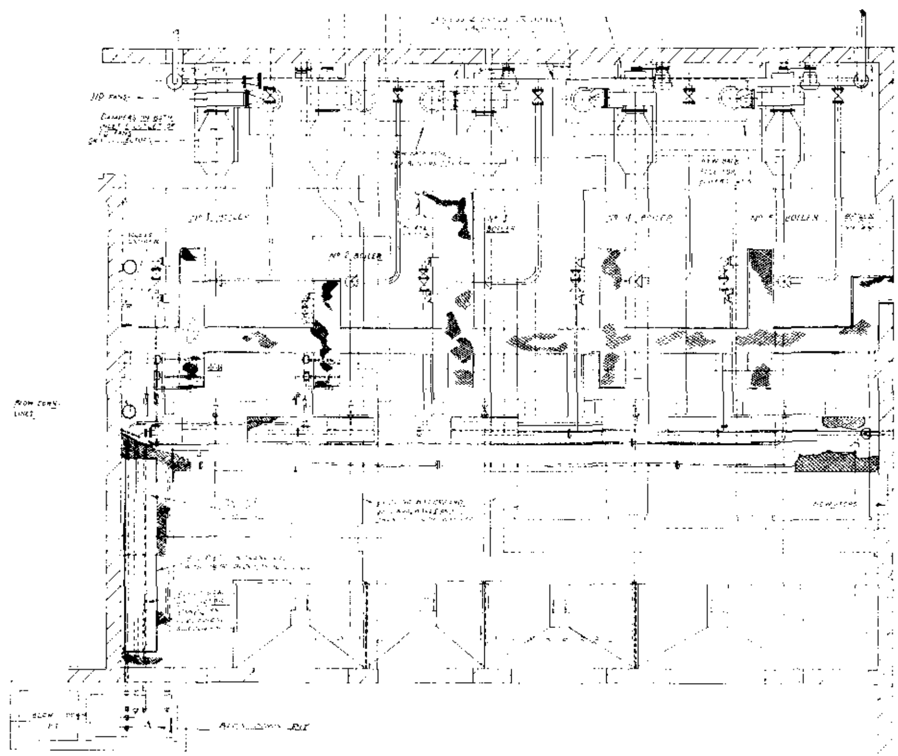


Above: The Control Panel from an unusual angle. This incorporates an audible alarm and visible indicator system for fault finding use should these occur.



Left: Four of the five new Boilers can be seen from the firing end in this photograph.

The five new boilers were manufactured by Edwin Danks & Co. (Oldbury) Ltd. and are of the three pass dry back Economic type; four of 10,000 lb/hr. capacity and



This plan view shows the layout of the new Boiler House at Friern Hospital.

one smaller unit of 4,000 lb/hr. capacity. The number of boilers required to serve the present normal working load is four, and the installation is designed for one boiler ordinarily to remain at rest. Each of the units is fired by a Hodgkinson Bennis low ram stoker with Unitherm automatic controls. These operate in conjunction with a cyclic time switch and single speed A.C. motor.

The new boilers are designed for 150 p.s.i. ultimate working pressure, though the existing steam distribution system can accept a maximum of 100 p.s.i. This situation will pertain until the requisite new pressure-reducing valves have been installed. The various working pressures, such as 100 p.s.i. for calorifiers, 20 p.s.i. for certain catering equipment and various other pressure requirements, will be satisfied by pressure-reducing valves.

A novel system of fault finding is incorporated; in the event of failure of a major item of equipment, an audible alarm is set off and the fault is indicated on the instrument panel.

Davidson Sirocco induced draught fans and collectors are fitted to the boilers. Each stoker is fitted with over-grate steam jets and has its own independent controller on the main control panel. Draught control is achieved by a swivel blade damper in the I.D. fan duct. Feed water is regulated by Ronald Trist modulating controllers. Each boiler is fitted with CO_2 indicators and there is a smoke density recorder.

Raw water is taken from a 300 ft. well on site and fed to the reaction tank, through the hospital service mains. Well water is drawn at an average rate of some 13,000 gallons per hour for periods of approximately 18 hours.

The water supply to the boiler has to be maintained to an exceptional standard of purity to eliminate the formation of scale or corrosion within the boilers. For this purpose there is a special lime soda water softening and conditioning plant installed in the pump room, adjacent to the boiler house. This equipment has been jointly manufactured by Messrs. Becco Engineering & Chemical Company and Messrs. Dearborn & Pittam Ltd. Feed delivery to the boilers is by three six-stage G. & J. Weir EF2 electro feeders delivering to a 6 in. main.

The building associated with the new plant is of necessity a simple structure, consisting partly of asbestos cement cladding on a steel frame, the existing roofs being removed and replaced by a new roof in one clear span and a new floor level under the whole structure established.

The ground under the new boiler house and pump room was found to be unsuitable for normal foundations and some 38 piles were bored. The boring of some of these piles close to a working boiler caused no little anxiety. In addition, there was some 30 feet of underground flue work to link the new system with the existing stack.

Because at all times during the building of the plant an adequate supply of steam for the hospital had to be maintained, a very careful phasing of the building and engineering work was essential and the greatest co-operation being given and received by the Regional Architect, the Regional Engineer, the hospital staff and the contractors, made it all possible. The engineering contractor responsible for the installation was Messrs. Regional Heating Limited, the building contractor Messrs. H. E. Winskell & Sons and the consulting structural engineers Messrs. C. J. Pell & Partner.

The whole project, which has taken some three years to complete at a total cost of £123,000, was under the direction of the Engineer to the North West Metropolitan R.H.B., R. C. Hodge, C.Eng., M.I.Mech.E.

Problems of Planned Maintenance

A Conference on the Problems of Planned Maintenance, sponsored by the King's Fund, was held at The Hospital Centre, London on January 8th under the Chairmanship of Mr. M. C. Hardie, M.A., F.H.A., Director of the Fund.

Six Papers were read to open the proceedings and these were followed by a discussion session with the conference members split into a number of groups. The proceedings are reported below.

THE NATIONAL COST OF MAINTENANCE

By M. V. JARMAN, A.M.I.C.E., M.I. Mech. E., A.R.I.W.E., Works Manager, Engineering Components Ltd.

The National Plan of 1964 contained not only estimated growth rates for the various sectors of public and private industry, about which there has been so much discussion, but also a factual evaluation of existing outputs, investments and expenditures.

A study of the Plan reveals one fact of prime importance—the tremendous size of the maintenance problem in the National economy.

The Plan generally considered industries in both public and private sectors as separate vertically—integrated industries; that is to say, it considered the expenditure, output and growth rates independently for each of the manufacturing industries, the distributing industry, public authorities, nationalised industries, Government departments, etc.

If we now, however, consider the horizontal integration of like expenditures within these industries a different picture emerges.

In particular, if we integrate the expenditures in each and every industry on the maintenance and running costs of the nation's buildings and machinery the following facts emerge:—

1. The maintenance of buildings (included incidentally in the vertical consideration of the Construction Industry) was calculated to cost the nation £1,400 million per annum.
2. The maintenance of plant and equipment, not specifically evaluated or separately mentioned in the Plan, I would estimate to cost somewhere between £1,500 and £2,000 million per annum.
3. The output of the Energy Producing Industry was valued at over £3,000 million per annum, i.e. the value of electricity and gas produced from power and gas stations plus the value of coal and gas supplied direct to the remainder of industry. This output is, of course, equal to the input to 'Energy Consumer Industry'.

The sum total of those three factors indicated that the nation is spending over £6,000 million per annum on the running costs of its assets of buildings, plant and equipment; or something like 20 per cent of the Gross National Product.

Furthermore, the nation is spending about the same sum in increasing these assets by constructing new buildings and civil works, and installing new plant and equipment.

These are vast sums of money on which attention must be focused if we are to relate successfully the future standards and maintenance costs of the nation's assets, and avoid a legacy of excessive maintenance requirements from cut-price construction.

If there are any who doubt the real importance of this matter let them reflect on this fact—that by the year 2000 we shall have built as many houses as you see standing today—and the same thought may apply to hospitals.

National progress in the field of maintenance has been limited in the past by several factors.

1. Lack of appreciation of its importance by the Directing Authorities, whether public, private, or central government; who have tended to look upon its cost as an objectionable millstone and yet, with apparent delight, as a prunable expense in times of adversity.

The financial bogey has, I feel, been one of the major causes of slow progress in this field. For example, one factor which has weighed against a proper consideration of maintenance in the past by public authorities and by central government has, in my opinion, been the lack of capital and revenue accounts in the Treasury, which possesses only a cash flow account. This results in a lack of due consideration to the running cost commitment that must follow capital commitment.

Capital commitment should never, in my view, be approved unless the subsequent running costs have been taken into account, and this applies to all Directing Authorities, public and private.

For example, the cost of heating new buildings with large areas of glass and insufficient insulation—a problem, incidentally, now under review by the Committee on Building Maintenance.

There have therefore been two financial brakes impeding the correct treatment of maintenance; reduced capital expenditures on projects, resulting in additional maintenance requirements at a later date; and the pruning of the maintenance budgets themselves.

Both represent a set-back to the conservation of the property involved, and can only too often be seen as a repudiation of the responsibility of the owning or directing authority.

I would like to raise one further point here on the financing of national authorities, who are unable to raise money privately as local authorities do, through the instrument of loan sanction.

If we consider an item of plant renewal, such as boiler plant, where the savings can more than offset the loan repayments and can yield a direct cash saving on completion of the loan repayment, it seems a pity that lack of cash flow prevents such a worthwhile investment. It may be difficult indeed to argue the case for a new boiler plant against a new operating theatre and perhaps the method of financing could bear examination and discussion.

2. Lack of attention to this subject by the major professional engineering institutions and the R.I.B.A.

A study of the published papers will show an utter lack of interest in this subject in the past by the major institutions, although I must add that the R.I.B.A. is now taking an active interest in the subject of maintenance.

This is truly an appalling state of affairs when you consider that the annual cost of maintaining the nation's assets is no less than the annual cost of constructing new ones.

3. Lastly, there is the assumed lack of status or glamour for the maintenance manager, which will only be rectified as the importance of the subject itself becomes more widely recognised.

The national picture is improving however.

The Committee on Building Maintenance was appointed in August 1965 under the chairmanship of the Parliamentary Secretary to the Ministry of Public Building and Works, to review the problems involved in building maintenance and make recommendations. Progress was difficult in the early days but this month we publish the Interim Report of the Committee, to which I will refer later. The very work of the Ministry secretariat has taken the discussion of the subject far and wide into other Ministries and national bodies. and into national conferences, and I feel that the seeds of a more satisfactory treatment of the subject have been sown.

In the field of mechanical engineering a working party has been set up by the Ministry of Technology and perhaps, in due course, a Committee of some description will be set up following the same principles as the Committee on Building Maintenance.

The third cornerstone of the eternal maintenance triangle—utilisation of fuel, equal in annual expenditure to the sum of the costs of building and plant maintenance, has as yet unfortunately received no similar attention from the Government. Suffice to say here that I did submit a report on this matter some two years ago through the Committee on Building Maintenance and am still pressing the case for its consideration.

I would like to say just a few words about the Interim Report of the Committee on Building Maintenance, which you can shortly read for yourselves, but which may be of interest at today's conference.

Four areas of analysis have been defined:

The context of maintenance, and the attitude of the community towards it; including consideration of statistics, tax reliefs, statute laws, training, and the relationship between capital and running costs using discounting techniques.

The causes of maintenance, and the relationship between design and maintenance; the criteria of good design, construction and material life, and the recording of maintenance data.

The management of maintenance, from large property owners to individual householders; planning of maintenance, cost control, and status of managers.

The execution of maintenance, by direct and contract labour; productivity and incentive bonus schemes, training in management and for craftsmen, and equipment utilisation.

On some topics papers are in preparation, and on other topics working parties have been set up, and studies have been commissioned at various universities; with a view to the preparation and publishing of further and more detailed reports over the next two years.

I would like to close now by submitting a new year thought to Directing Authorities at large on this problem of maintenance. Maintenance requires a firm policy to be supported by the Directing Authority, backed up by adequate financing planned for some years ahead and related realistically to the increasing assets of the Authority, not dogged by the diverting of funds from the prunable maintenance budgets.

In an era of increasing attention to maintenance, Directing Authorities would, I feel, be well advised to pay due attention to this problem, and finance and manage this area effectively if they are to avoid any loss of autonomy which they enjoy at the present time.

PLANNING FOR PROBLEMS OF PLANNED MAINTENANCE IN EXISTING PREMISES

By P. M. HENDERSON, A.M.I.Plant E.,
Group Engineer, Redhill and Netherne HMC

An inspection of the most recent returns in Hospital Service Engineering No. 8 shows that after six years since being recommended in the Tyler Report only some 6% of the total hospitals in England and Wales have been able to introduce a system of planned preventive maintenance.

It has been hinted that planned preventive maintenance should now be introduced as a statutory requirement, that it should begin before the hospital is opened and continue to operate on a planned basis throughout the entire life of the building, to have as its objective to ensure the uninterrupted performance of the entire physical plant and equipment for the maximum possible life at the lowest possible expense. This of course is the ideal, and, in practice, for the existing hospital something less may have to suffice, although in fact many of the items listed in the ideal programme can be used.

My earlier experience of planned preventive maintenance was in industry and this experience I found invaluable when I became associated with the development and subsequent introduction of what is known as the Scottish system within the two HMC's to which I was Group Engineer at that time. The results were completely ideal and the scheme from every viewpoint an unqualified success. There is of course a choice of several systems of planned preventive maintenance available and the working mechanics of any of the schemes are relatively simple to grasp and their logical introduction a matter of application rather than inspiration.

Three years ago I moved to my present post, an amalgamated group of 14 hospitals with a complement in excess of 3,000 beds embracing acute and psychiatric disciplines each with their particular engineering requirements. With 14 hospitals and only four hospital engineers the hospitals were allocated into four sub-groups so that every hospital could have the advantage of responsible engineering supervision and advice, bearing in mind that the responsibility for securing at all times the proper economic safe operation and condition of all electrical and mechanical equipment, thereby providing a direct service to the hospital patient and staff, is a function of Engineering Management.

Now, introducing problems of planned maintenance within these existing hospital premises presented many problems. Personnel were untrained and just not motivated for prevention. Equipment had already been damaged, wear had already taken a serious toll. Operational failures and necessary repairs consumed too much of the available personnel and skills. Many Group Engineers have had to grapple with similar situations but, when it is spiced by a recent and locally unwanted amalgamation with personnel problems at both staff and other levels and completely devoid of any logical pattern of management, then the score becomes really interesting.

Planning in these circumstances must be built around considerations of not only what is to be done but how it is to be done. This requires an intimate study of methods and their implementation, based on availability of management/supervisory and trades skills.

After an initial inspection of the hospitals and an examination of existing practices, I advised the Hospital Management Committee that the only way to be able to introduce planned preventive maintenance was to free the direct labour force from all such exercises as minor developments, ward upgradings, etc., many of which were in any event patently uneconomic. Consideration was also given to which type of specialist contracts should be allowed to continue.

In order to break quickly the circle of direct labour engaged on contract work, term contracts for electrical and mechanical services were prepared and let on a long term basis of three years. This has since proved to be a much better way to meet the minor capital developments such as ward upgradings, etc., which can so easily foul up a basic maintenance workload. Jobs are now completed to programme and everyone appears satisfied with the arrangement.

Up to this point I had been actively communicating with the hospital engineers and appeared to have their promise of co-operation in preparing the planning stages. This, however, was not to be so easy and, though I kept in close pursuit, little progress was made over the next three months. I then called a further meeting in which I outlined what the requirements to be met over the next three months were to be and gave a clear understanding that those who were not willing should make other preparations.

The effect of this was to have three out of four systems substantially set out in the period allowed. The fourth engineer went on extended sick leave. On the completion of the planning stage, one of the three remaining resigned. I have not had a full establishment from that time on and the management supervisory structure has at times been sorely stressed.

During this period we recruited a young Assistant Engineer who in eight short weeks carried out and introduced planned preventive maintenance to an 1,800 psychiatric hospital together with six smaller cottage hospitals.

At this stage we now had a scheme, a workload, a task force but no money. The next step was to persuade the Treasurer that men, materials and money went together and for the first time the hospital engineers had an allocation based on their own summary of requirements with which to purchase the spares and materials necessary to support the labour in the field. The budget was a modest one but gave to the engineer a new found sense of responsibility and they now keenly scrutinise every item of expenditure. It has had the added advantage that in bringing them into contact with a budget allocation they began to notice just what maintenance did cost and to see how finance can control so much of our development. Concurrent with the planning stage it is necessary to gather together such items as, equipment specifications, manufacturers' maintenance instructions, layout and installed drawings, and to have these marked up and confirmed for easy reference. It is also extremely important to ensure that the correct tools are available, especially test equipment for electrical safety—velometers, hygrometers, etc., for testing theatre ventilation. Opportunities must be taken to send all levels of staff on suitable courses to improve their knowledge and versatility.

As we moved towards the target date of the new financial year opportunities were taken to have talks with as many heads of departments as were willing to listen. These meetings were attended by the Hospital Secretaries, Matrons, Theatre Superintendents, Ward Sisters, etc. Real and imaginary fears had to be dealt with. Patience, tolerance and understanding must be shown even though there may be difficulties in getting your point of view across, and always leaving the opportunity for the individual to discuss personal problems. It is very important to explain the chain of responsibility in relation to engineering services for confused responsibilities tend to create unsatisfactory relationships. It is also most important to explain fully to the trades staff what these moves are all about and what their part in this exercise is to be. It has been my experience this far that the introduction of planned preventive maintenance is viewed by the tradesman as a form of work study to squeeze more from his working day and restrict his earning potential as well as his future security. Of course this is a form of work study and, though it will take some time to produce results recognisable for analysis purposes, this will eventually prove a sound basis for productivity working and an increase in earning capacity. Good communication cannot be adequately stressed for much is dependent on a high level of co-operation and goodwill on all sides.

Finally, there are in my opinion two important musts. First, the hospital engineer must be given the basic facilities of reasonable office accommodation together with a supporting technical management structure to match the supervisory requirements, and backed up by necessary clerical assistance where job costing is to be carried out.

Secondly, both the Group Engineer and the Hospital Engineers must be regarded as managers of their departments. I say to you now that it is the responsibility of the Hospital Management Committee through the Chief Administrator to assist the Engineer to progress in this field, to give the Engineer his full place in the management team, to inspire dedication and loyalty through the principle of job satisfaction, because personal satisfaction can achieve much without cash reward or costs.

It is now some 2½ years since we started out and I have found nothing to shake my belief in the total value of planned preventive maintenance. Progress has been erratic due, in the main, to extended vacancies in the management team; the rewards, however, can make the effort well worth while, for example:—

(1) You are able within limits to balance out the

workload to match the available man hours existing.

(2) Without further trouble the daily, weekly, monthly, etc., workload is planned in advance.

(3) The increase in plant efficiency and productivity is alone well rewarding.

(4) The responsibility of the tradesmen in signing for work done is a marked deterrent to sloppy workmanship, and zero defect techniques should be encouraged.

(5) Optimum times will be established for repetitive job working.

(6) The correct level of maintenance can be tailored if a record system similar to that employed in the Scottish system is adopted.

(7) Figures relating to job analysis and productivity working can be realistically assessed.

(8) A feedback of type faults in various classes of plant can be filtered through to the design engineers to enable them to improve on future design aspects.

(Proceedings to be continued)

B.S.I. News

REFRIGERATORS FOR STORAGE OF BLOOD

In response to requests from a number of organizations including the National Blood Transfusion Service, Medical Research Council, Ministry of Health and the Hospital Equipment Standards Advisory Committee (OC/IS), B.S.I. has prepared a British Standard specification for blood storage refrigerators.

B.S. 4376 : 1968 *Electrically operated blood storage refrigerators* applies to units for use in temperate and/or in tropical climates which are intended for the preservation of whole blood, fluid blood plasma and fractions at a temperature of 4°C. to 6°C. (39°F. to 43°F.). The standard covers all sizes of refrigerators, both "reach-in" types and "walk-in" types, prescribing requirement for construction, materials and finish, equipment, controls and instruments.

It specifies certain performance tests to be carried out on self-contained refrigerators and the design conditions for on-site erected, sectional construction refrigerators.

PROGRESS IN METRICATION: CEMENT MAKERS' FEDERATION

The Cement Makers' Federation announces that the makers will change to the use of metric weights and decimal currency simultaneously on 1st January, 1971. From that date all their deliveries will be in metric tonnes or 50 kg. bags, and invoices will be made out in decimal currency.

No deliveries will be made in imperial weights after 31st December, 1970, and none will be made in metric weights before 1st January, 1971. In this way it is hoped to avoid the confusion that might result from the use of both weights concurrently. The makers hope that this arrangement will be convenient to all their customers.

PVC COLD WATER PIPE

The revision of BS 3505 *Unplasticized PVC pipe for cold water services (metric units)* includes a number of important innovations and amendments.

The amendments include effect on water, dimensional stability on heating, resistance to acetone and resistance to impact.

New features include the addition of a further class of pipe for higher pressures and the extension to include pipes up to 24 inch nominal size. The first table now specifies dimensions in accordance with BS 3867 *Dimensions of pipes of plastics materials (outside diameters).*

Opportunity has been taken to express dimensions in metric units, but it has been decided to continue to designate the *nominal* size of pipes in inches because it is thought that some confusion might be caused if these were changed to metric units at this stage. Maximum sustained working pressures and stress levels are specified.

No type designation is included in the title of this revision to indicate the recommended maximum working stress for the material because two different stress ratings are covered. A stress of 123 bars (1780 lbf/in²) has been used for calculating the minimum wall thicknesses of pipes of nominal size 8 inch and larger, and one of 110 bars (1590 lbf/in²) for pipes of nominal size 7 inch and smaller. The use of two different stress ratings in this way provides greater robustness in handling for the smaller sizes, but it is emphasized that only one type of PVC is used for the manufacture of both the larger and smaller sizes of pipe.

The standard includes requirements for the material (including use of re-work material and softening point under load), classification and dimensions (including tolerances on outside diameter and on length), appearance, heat reversion, resistance to acetone and to sulphuric acid, opacity, effect on water, impact strength at 20°C and at 0°C, short-term and long-term hydraulic tests, sampling, marking, stocking and transport.

Methods of test are given in appendices, including one for the determination of organotin as tin in aqueous solution to be used in conjunction with the requirement for effect on water.

A BS Code of Practice is being prepared to assist users in assessing the suitability of plastics pipes for particular purposes and to ensure their proper application.

(Continued from page 30)

this report is part. Opinions expressed are not necessarily those of the Board, or of the University of Glasgow.

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On the Market

A review of new equipment and materials and their development

NEW IMPROVED ROBUR PALLET TRUCK

A new Robur hand pallet truck has been introduced by **W. C. Youngman Ltd.,** Manor Royal, Crawley, Sussex. Available as two basic models of 3,300 lbs. and 5,500 lbs. capacities, the truck features a new simplified control method with improved hydraulic system designed to minimise maintenance.

Height of lift is from a minimum of 3$\frac{3}{8}$ in. to 8 in., power for the hydraulic lifting cylinder being provided by a ram pump fitted with non-lubricating bearings and operated by the steering handle through an eccentric cam. Both pump and cylinder are pressure-sealed against leakage under maximum load.

Finger-tip release for stepless lowering is through a steel rod passing within the steering handle shaft to connect with the hydraulic valve through a roller chain.

The truck body is of all-welded construction with forks of pressed steel. All main operating components are mounted on a ball-bearing swivelling base.

Widths over the forks are 20$\frac{1}{2}$ in. or 27 in., lengths are from 36 in. to 72 in. Wheels and fork rollers are equipped with double, fully enclosed, ball bearings, and may be supplied in steel, solid rubber, nylon or polyurethane. For increased stability over irregular floor surfaces, tandem rollers may be fitted, while other optional extras include stillage frame attachments. The Robur range also includes models designed for cold storage working. Prices of basic models are £60 and £65 delivered U.K.

VACUUM CLEANER FOR WET OR DRY OPERATIONS

The new Dustbane PC 2 (69), from **New Romney Manufacturing Co. Ltd.,** of North Street, New Romney, Kent, is an industrial vacuum cleaner which will be particularly useful in any situation where water must be frequently picked up.

It has triple filtration—a special polythene exhaust filter in the motor head to compliment the dual, acid-resistant, flameproofed primary and secondary filters.

Other features include heavy-duty switches, plastic bumper equipped dolly and a "locked-on" paint finish. It is easily stripped down for servicing. It is, of course, equally efficient for dry operations as for wet.

It has a 1·25 horse-power by-pass motor, an amp rating of 3·25A, and a maximum wattage input of 750W. Waterlift with closed orifice is 76″ (1,930 mm.). Airflow (two filters) is 81 c.f.m. (2·29 cu. m./min.). It weighs 64 lb. (20 kg.). It is priced at £86 15s. 0d.

AIR CONDITIONING UNIT

Humidair Consultants Ltd. announce their appointment as distributors for the Humidaire Air Conditioning Unit, British designed and built specifically for close control conditions. The unit, which cools, heats, dehumidifies and has a pan type humidifier, also incorporates inbuilt controls, thus providing a compact unit which can be used either with an air cooled or water cooled remote condenser. It has a range of 30,000–50,000 b.t.u./hr. and is fitted with a plenum discharge or can be used with a ducted system. The Electric Heater Battery is 16 kW. arranged in 4 kW. steps. Filters are synthetic fibre media having an efficiency of 96% down to 5 microns. The unit is only 18″ deep × 45″ wide × 70″ high and can be used in multiples by the use of a control console which also allows for future units to be added. Standard finish is hammer blue stove enamel.

Further information from 63 Wiltshire Close, London, S.W.3.

NEW SELF-CONTAINED EMERGENCY LIGHTING UNIT

Security Lighting Ltd., Radiant Works, Imperial Way, Croydon Airport, Croydon, have introduced a new range of self-contained emergency lighting units for installation wherever fire regulations require security lighting arrangements. Models are available to meet the special requirements of G.L.C. Regulations. The new emergency lighting units, each of which operates entirely automatically and independently, enable complete systems to be installed in small and large premises at very low cost. Models are available from £18 each.

All models in the "Securi-Light W" series are designed to be connected through a local mains supply, such as an ordinary socket-outlet. The lighting is activated instantaneously as soon as any kind of a supply failure occurs. Energy is provided by a self-contained 12 V. battery. This is an hermetically sealed, nickel cadmium unit. No maintenance is required. Alternative capacities are available to provide either 30–40 minutes duration or 60–80 minutes duration when fully charged.

A transistor inverter and charger with a double wound mains transformer is incorporated and the lighting unit recharges itself after use. The unit's fluorescent tube is controlled by no-relay solid-state switching for instant, trouble-free starting.

A feature of the new designs is their compactness and neat appearance. All models measure only 14$\frac{1}{2}$″ × 4″ × 3$\frac{1}{2}$″ and the whole base area is covered by a simply styled opal diffuser. The base unit is a weatherproof diecasting, secured against unauthorised interference. It can be mounted vertically or horizontally.

INSTANT WATERPROOFING

Emergency waterproofing of roof leaks can be effected under the most adverse conditions with a new product from **Membrano Molecular Membrane Ltd.,** of Claro Road, Harrogate, Yorkshire. Known as Membrano Rapid, this new development can be applied, during rain, when the snow is lying on the surface or even under frosty conditions and will seal the leaking area instantly.

The first step is to clean away as much dirt, moss, lichens etc., as practicable from the defective area. When the surface is wet or damp, the Rapid Surface Conditioner should be liberally applied with a sponge swab and immediately followed with a layer of Membrano Rapid. To give the repair added strength, Reinforcing Tape should be stippled in and more Membrano Rapid applied to thoroughly saturate the tape. This product can be used to waterproof leaks in all types of roof—slate, tile, asbestos cement, galvanised iron, lead, asphalt, etc. A useful specification sheet is available, clearly showing the application techniques.

Further details available from: Membrano Molecular Membrane Ltd., Claro Road, Harrogate, Yorkshire.

Notes for Members

Mr. J. L. Bluff

We regret to announce the death, on 23rd November, 1968, of Mr. Joseph Leonard Bluff.

Mr. Bluff served an apprenticeship with Messrs. Beeson & Sons of Rickmansworth, after which he remained with the firm for a further seven years. He was appointed Engineer-in-Charge at Mount Vernon Hospital, Northwood in 1939, and continued responsible for the engineering services to the Harefield and Northwood Group until his death in post. He was elected a member of the Institute in 1961.

COMPANIONS OF THE INSTITUTE

The Members below were elected Companions of the Institute of Hospital Engineering in 1968.

H. A. Adams, M.B.E.
F. J. Chance
Gwilym Jones
R. G. Rogers

INSTITUTE CONFERENCE DINNER

As previously announced, the Institute will hold a special Conference Dinner during the International Hospital Equipment, Medical Engineering and Services Exhibition.

The Dinner will be held at the Rembrandt Hotel, Thurloe Place, Knightsbridge, S.W.7 on Tuesday, 3rd June. Guests will include the Chief Engineer, Department of Health and Social Security and Mr. R. Gresham Cooke, C.B.E., M.P., Chairman of the Standing Conference, National Qualification and Title.

Attendance at the Dinner will be restricted in no way and it is hoped that the function will attract a large number of members, ladies and guests.

Application for tickets for, and enquiries regarding, the Dinner should be addressed to: The Secretary, The Institute of Hospital Engineering, 20, Landport Terrace, Southsea, Hampshire.

KING EDWARD'S HOSPITAL FUND FOR LONDON

Following discussions an "Engineering Panel" has been set up whose duty it will be to act in an advisory capacity to the King's Fund College of Hospital Management. The Panel's terms of reference are: —

"To consider the place and development of engineering services in hospitals, particularly with regard to their direction by engineers forming part of the management team; to consider and advise on training arrangements (apart from professional training) of hospital engineers; and to advise the King's Fund College of Hospital Management on any aspects of the operation of engineering services in hospitals on which advice is sought on where the Engineering Panel feel it should be given."

The members of the panel are: —

D. Ayres. Regional Engineer, Wessex Regional Hospital Board. *Vice-Chairman.*

M. J. Burke. Assistant Regional Engineer, East Anglian Regional Hospital Board.

K. J. Eatwell. Regional Engineer, South West Metropolitan Regional Hospital Board. *Chairman.*

B. A. Hermon. Deputy Regional Engineer, Birmingham Regional Hospital Board.

B. P. Holloway. Chief Engineer, St. Thomas' Hospital. London.

F. H. Kirton. Deputy Regional Engineer, Newcastle Regional Hospital Board.

D. H. Mellows. Group Engineer, Wigan and Leigh Hospital Management Committee.

WELSH BRANCH

The Welsh Branch held a meeting at the Temple of Peace and Health, Cardiff, on 16th November, 1968.

Before introducing Mr. H. F. H. Dolling as the speaker the Chairman welcomed Mr. Griffiths, of E. Griffiths and Son, and several new members who were attending a Branch Meeting for the first time.

Study Tour of Hospitals in Switzerland

Mr. Dolling opened his talk with a brief explanation of the International Hospital Federation which organises a tour of hospitals in a particular country on a two yearly basis. In 1968 it had been the turn of Switzerland to act as hosts for the international tour. The touring party consisted of 250 members from all parts of the world where hospital development was taking place. The touring party was conveyed to hospitals throughout Switzerland in seven coaches.

Mr. Dolling then dealt with a brief history of Switzerland in order to give a background to the development of the hospitals. Switzerland had suffered a stormy history up till about 200 years ago, since when she has always resolved to remain neutral in spite of wars around all her frontiers. She had now become a centre of World Health and World Finance.

Switzerland is a country of 16,000 sq. miles and a population of 4,000,000. It is a democratic nation divided into 25 small states called Cantons. There are four official languages, German, French, Italian and Romansch which is derived from ancient Latin.

The Federal Government is responsible for the health of the Nation, but each Canton, which has its own legislative power, is responsible for the provision of hospitals.

Each Canton may hold its own referendum to decide important issues. The male population therefore actually vote as to the building of a hospital in a particular canton. Referendums regarding the provision of hospitals have always produced a favourable result.

The fact that the Cantons are responsible for the building of hospitals, and absence of federal planning, has resulted in many varied designs in hospitals with a very wide range of services provided.

The engineering services include oil fired boilers using oil pumped by pipeline from the Italian seaboard; steam and hot water brought from neighbouring Waste Disposal Factories; and hot water supplied from hot water springs.

The electricity in Switzerland is usually produced at hydro-electric plants and brought in by the hospitals.

The money for building and running hospitals is provided from a number of sources including rates and taxes, a complex insurance scheme and from people who can afford to pay for their treatment, but nobody goes without treatment because they cannot afford to pay.

The number of hospitals in the country allows for approximately one bed per 100 population.

Mr. Dolling continued his talk by showing an extensive series of slides illustrating external views of new hospitals, including landscaping and panoramic views taken from the top of multistorey hospitals. The internal shots included Operating Theatres, Theatre Sterilizing Units, Dining Rooms, Kitchens, Laundries, Hydrotherapy pools, Calorifier rooms and Control Switch rooms.

The Chairman announced that both Mr. Coy and Mr. Davies had retired from the hospital service and on behalf of the Branch wished them a very happy and long retirement.

MID-SCOTLAND BRANCH

The Mid-Scotland Branch held a meeting on 23rd November at the Aberdeen Royal Infirmary, when Mr. W. Runcie conducted members on a most interesting tour of the operating theatres and wards contained in phase I of the hospitals' new development programme.

The Branch will hold its Annual General Meeting in Aberdeen in March.

YORKSHIRE BRANCH

A meeting of the Yorkshire Branch was held at Leeds General Infirmary on 2nd November, 1968 when papers entitled "Closed Circuit Television Systems" and "The Distribution of Television Signals" were given by C. W. Oakley, M.S.R.E., A.M.I.W.M.

On 14th December, the Branch Meeting was held at St. James Hospital, Leeds and, on this occasion, an 8 mm. sound film entitled "The History of the Reciprocating Engine" was shown. Both the film, and the commentary, were produced by the Branch Vice-Chairman, J. Deen. The film proved to be a most interesting one and it is hoped to publish the accompanying notes in this Journal.

The Branch Annual Dinner and Dance proved a success, once more. Among the principal guests were Mr. W. Bowring, Secretary to the Leeds Regional Hospital Board and Mr. W. C. Jeffries and Mr. A. R. White, Regional Engineers to the Sheffield and Leeds Regional Hospital Boards respectively.

The provisional programme for the first part of 1969 includes the following:

February 15th: Storthes Hall Hospital, Kirkburton, Nr. Huddersfield. "The Demolition and Rebuilding of a Hospital Chimney" by J. Black.

March 15th: High Royds Hospital, Menston, Ilkley. Annual General Meeting.

April 12th: Middlewood Hospital, Sheffield. "Management" by W. C. Jeffries, Regional Engineer, Sheffield Regional Hospital Board.

WEST OF ENGLAND BRANCH

A meeting of the West of England Branch was held at Manor Park Hospital, Bristol.

The Chairman welcomed Messrs. G. Cooper, Hearton and Astley of Dorman & Smith Ltd.

Mr. Fry expressed his regrets to Mr. Cooper for the appalling weather and the small number present, particularly after the visitors had themselves come so far in the freezing fog.

Mr. Cooper commenced his lecture by explaining the construction of the Loadmaster Miniature Circuit Breakers, which comprises of thermal overload and magnetic short circuit tripping devices, and their advantages over the hydraulic type of circuit breaker. By the aid of graphs the over-current and short circuit protection was clearly shown compared with the rewirable and H.R.C. fuses. Discrimination and back up protection was explained and illustrated by sketches of actual installations using M.C.B.'s and moulded C.B. on F/S as back up fuses, thereby getting the best of both worlds. Stress was also made on the savings on cable by using the above system in a correct manner. He stated that circuit breakers should not generally be used to provide back up protection to other circuit breakers.

Owing to the gathering fog the speaker was apprehensive about the return journey to Birmingham and foreclosed his lecture after a few questions were answered.

The Chairman ended the discussion and thanked the speaker and his colleagues for their excellent effort under such very adverse conditions.

MIDLAND BRANCH

About 30 members attended the meeting on Saturday, 4th January, at Good Hope Hospital, Sutton Coldfield, where Mr. E. Bampton gave a talk on "Direct Labour versus Contract," which was followed by a very useful discussion. The programme also included a film by John Laing Ltd. entitled "Building as a Team" which illustrated the way in which a number of experts in different disciplines can be welded together to form a team to achieve an objective.

The Branch Annual General Meeting will be held at East Birmingham Hospital on Saturday, 1st March. The meeting will be preceded at 2.15 p.m. by a paper entitled "Gas from the Desert and North Sea" by D. Scott Wilson, M.B.E., A.R.I.C., C.Eng., M.I.Gas.E., Scientific Officer of the Gas Council. Visitors will be welcome to listen to the paper.

A cheese and wine party will be held at Bromsgrove on the evening of 14th March, 1969. Members will be given further details in February.

EAST ANGLIAN BRANCH

A well supported meeting of the East Anglian Branch was held at St. Mary's Hospital, Bury St. Edmunds on Saturday, 11th January, under the Chairmanship of Mr. H. Holtz.

Mr. J. E. Furness, Secretary of The Institute, attended the meeting and outlined the progress and achievements during the last year and spoke, too, of certain coming events.

Mr. M. J. Burke, who is a Member of the King Edward's Hospital Fund College of Hospital Management "Engineering Panel", also attended the meeting and told something of the work of this "Engineering Panel."

(*Continued from page 38*)

Course Membership

The courses are available to all engineers irrespective of whether or not they be members of the Institute of Hospital Engineering. It is pleasing to know that these courses are subscribed to in numbers of 100 and upwards. Because of the progressive nature of these Courses, Engineers are encouraged to attend on more than one occasion; such is the value of these excellent courses, provided by the maximum co-operation of all concerned in the planning and execution, that they are fast becoming an accepted part of engineering education in the hospital service. Now that you know what goes on at Keele, go and savour the benefits that may be had from learning through participation because this is undoubtedly *your* course in every sense of the word.

Index to Advertisers

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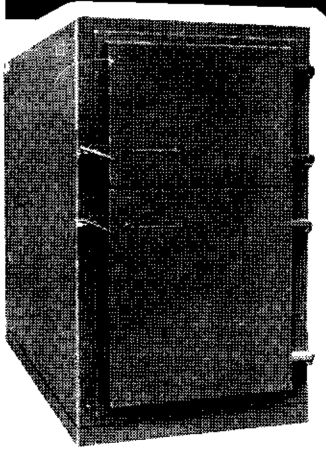

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NATIONAL HEALTH SERVICE

OPPORTUNITIES IN HOSPITAL ENGINEERING

Training posts within the areas of the Leeds, Birmingham and Sheffield Regional Hospital Boards are offered to suitably qualified and experienced candidates between 28 and 45 years of age who are interested in careers as ENGINEERS in the Hospital Service.

The scheme will consist of approximately one year's intensive theoretical and management training at residential training colleges, supplemented by practical training at selected training hospitals, if possible within the Region of the candidate's own choice. The scheme will be open to men who have completed a recognised apprenticeship in mechanical or electrical engineering or have otherwise acquired a thorough practical training and experience in the management of mechanical and electrical engineering plant similar to that of modern hospitals and who have obtained, or expect to obtain within the next 12 months:

(a) *Higher* National Certificate or Higher National Diploma in Mechanical Engineering, with endorsements in Industrial Organisation and Management and the Principles of Electricity or Electro-Technology, if this was not taken as a subject of the course, OR

(b) Higher National Certificate or Higher National Diploma in Electrical Engineering with endorsements in Industrial Organisation and Management and including (at SIII or O2 levels or with endorsements in) Applied Heat and Applied Mechanics, provided he has suitable practical experience in Mechanical Engineering, OR

(c) Equivalent qualifications approved by the Department of Health and Social Security.

Salary during training will be at the rate £1,260 per annum and, on completion of training, candidates will be offered permanent, superannuable posts at hospitals within the three Regions, with salaries ranging up to £2,430 per annum, plus special responsibility allowances where applicable.

Interviews will be held during March 1969 and training will commence in June 1969.

Further details of the training scheme and the appropriate application form may be obtained from the Secretary, Leeds Regional Hospital Board, Park Parade, Harrogate. Closing date for both internal and external candidates is 28th February, 1969.

SITUATIONS VACANT

THE HOSPITAL FOR SICK CHILDREN, GREAT ORMOND STREET, LONDON, W.C.1.

HOSPITAL ENGINEER required to be directly responsible to the Group Engineer for maintenance of all Engineering services at Great Ormond Street and its country branch hospital.

Qualifications should include an appropriate City and Guilds Certificate, O.N.C., or equivalent. A flat can be made available locally at a reasonable rental, if required.

Salary scale £1,292-£1,500 p.a. plus £75 L.W.

Applications, giving the names of two referees, should be sent to the House Governor by 4th March, 1969.

EAST BIRMINGHAM HOSPITAL MANAGEMENT COMMITTEE

ASSISTANT ENGINEER

Assistant Engineer required at East Birmingham Hospital to assist the Hospital Engineer in the management and organisation of engineering services, operation and maintenance. Responsibilities involve electrical and mechanical services and the control of Planned Maintenance. Applicants must possess an O.N.C. or O.N.D. in electrical or mechanical engineering or an approved equivalent qualification. Salary commencing £975 p.a. rising to £1,270 p.a. A house may be available to a married applicant at a moderate rental. Apply in writing, stating age, experience and qualifications, with names and addresses of two referees, to the Group Engineer, East Birmingham Hospital Management Committee, Group Administrative Offices, 45, Bordesley Green East, Birmingham, 9.

HOSPITAL ENGINEER
TOOTING BEC HOSPITAL, S.W.17
(1,800 beds)

Whitley Council Conditions of Service. Salary scale £1,510-£1,745. H.N.C. (Mech.E.) or equivalent required. Application forms from Group Secretary, Battersea, Putney & Tooting Group Hospital Management Committee, Tooting Bec Hospital, Tooting Bec Road, London, S.W.17, to be returned not later than 1st March, 1969.

BOSTON GROUP HOSPITAL MANAGEMENT COMMITTEE

Applications are invited for the post of Assistant Engineer, to assist in the operation and maintenance of the engineering services in this Group.

Applicants should have completed an apprenticeship in mechanical or electrical engineering, and should hold an Ordinary National Certificate or an equivalent qualification.

The applicant appointed will be based in Boston.

The salary will be within the range £975-£1,270 per annum.

Applicants not holding the requisite qualifications may be considered but their salary will be abated £100 per annum.

Applications should be forwarded immediately to the Group Engineer, Boston Group Hospital Management Committee, Sibsey Road, Boston, Lincs.

WALTON HOSPITAL, LIVERPOOL, L9 1AE

Applications are invited for the post of HOSPITAL ENGINEER at this large acute general hospital (1,048 beds) which is being redeveloped as a District General Hospital and would give excellent experience to an enthusiastic engineer.

The engineer appointed will be responsible to the Group Engineer for the operation and maintenance of all engineering services and should have wide experience with mechanical and electrical engineering plant and services. Applicants must have completed an apprenticeship in mechanical or electrical engineering and possess either:—

(a) H.N.C. or H.N.D. in mechanical engineering with electrical endorsements at "S.III" or "O.2" level.

(b) H.N.C. or H.N.D. in electrical engineering with endorsements in thermodynamics and applied mechanics at "S.III" or "O.2" level.

An additional endorsement in "Industrial Organisation and Management" would be an advantage.

Salary Scale: £1,470 to £1,705 per annum by five annual increments, includes special responsibility payment of £100.

A job description is available on request. Applications stating age, qualifications, experience and names of two referees to be sent to the Group Secretary, North Liverpool Hospital Management Committee, Walton Hospital, Liverpool, L9 1AE not later than 3rd March, 1969.

DEPUTY GROUP ENGINEER

Doncaster Hospital Group Management Committee invite applications from men able to act for the Group Engineer over the whole range of his duties.

Applicants for this progressive post should have wide experience in the management of mechanical and electrical plant together with HNC or HND in Electrical Engineering with endorsements in Industrial Organisation and Management and including (at S3 or O2 level, or with endorsement in) Applied Heat and Applied Mechanics.

Salary on a scale up to £1,605 plus £100 special responsibility allowance. Temporary rented accommodation is available.

Full particulars will be sent to applicants. Please write, within seven days of the appearance of this advertisement, giving details of age, qualifications and experience, and the names and addresses of two (one technical) referees, to: The Group Secretary, Doncaster Royal Infirmary, Doncaster.

PETERBOROUGH AND STAMFORD HOSPITAL MANAGEMENT COMMITTEE

Stamford and Rutland Hospital

HOSPITAL ENGINEER required, to be directly responsible to the Group Engineer for the maintenance of all engineering services at the following:

Stamford and Rutland Hospital, Stamford

St. George's Hospital, Stamford

Group Central Laundry, Stamford

Bourne Chest Hospital, Bourne

Bourne Butterfield Hospital, Bourne.

Applicants must have acquired a thorough practical training appropriate to the responsibilities and duties of the post and must hold one of the following qualifications, or an approved equivalent:—

(1) Higher National Certificate or Higher National Diploma in Mechanical Engineering with endorsement in Industrial Organisation and Management and Principles of Electricity or Electro-Technology, if this was not taken as a subject of the course.

(2) Higher National Certificate or Higher National Diploma in Electrical Engineering, with endorsements in Industrial Organisation and Management and including (at S.III or O.2 level, or with endorsement in) Applied Heat and Applied Mechanics, provided he has suitable experience in Mechanical Engineering.

(3) City and Guilds Mechanical Engineering Technicians Full Technological Certificate (Part III) which must include Plant Maintenance and Works Service.

National Health Service Whitley Council Conditions of Service; present salary scale £1,270 to £1,500 p.a. Special responsibility allowance will be paid.

Applications stating age, qualifications and experience, together with the names of three referees, to be sent to the Group Secretary, Peterborough and Stamford Hospital Management Committee, Peterborough District Hospital, Peterborough.

HEREFORDSHIRE HOSPITAL MANAGEMENT COMMITTEE
DEPUTY GROUP ENGINEER

Applications are invited for this newly created post. The person appointed will be required to deputise over the whole range of duties of the Group Engineer and will, in the first instance, be based at the General Hospital, Hereford.

The Group Engineer is also responsible for building maintenance.

Applicants must be qualified in accordance with the requirements prescribed by the Department of Health and Social Security.

Housing accommodation may be available.

Salary scale £1,370-£1,605 per annum, plus special responsibility allowance of £75 per annum.

Applications, stating age, experience and qualifications, together with the names of three referees, to be sent to the Group Secretary, Herefordshire Hospital Management Committee, Victoria House, Eign Street, Hereford, not later than 1st March, 1969.

LUTON AND HITCHIN GROUP HOSPITAL MANAGEMENT COMMITTEE

Applications are invited for the appointment of HOSPITAL ENGINEER to be responsible to the Group Engineer for the engineering services of St. Mary's Grove Road Annexe and Harpenden Memorial Hospitals.

Salary scale £1,270 to £1,500 plus a units responsibility allowance of £25 per annum.

Applicants must have completed an apprenticeship in Mechanical or Electrical Engineering or have otherwise acquired a thorough practical training as appropriate to the duties and responsibilities of the post. Applicants must be in possession of H.N.C. or H.N.D. in Mechanical or Electrical Engineering with endorsement or an equivalent qualification approved by the Ministry of Health. They should also have a sound knowledge of the efficient operation of mechanical fired steam boiler plants and a wide experience of mechanical or electrical services, preferably in the Hospital Service.

Application giving age, qualifications, apprenticeship, present employment and experience with the names and addresses of two referees to be sent to Group Secretary, Luton and Hitchin Group H.M.C., St. Mary's Hospital, LUTON, Beds.

BURNLEY AND DISTRICT HOSPITAL MANAGEMENT COMMITTEE

GROUP ENGINEERING SERVICES

ASSISTANT ENGINEER required to assist the Group Engineer in the maintenance of the electrical services at the Burnley General Hospital.

Candidates must have completed an apprenticeship in electrical engineering or acquired a thorough practical training in hospital or similar electrical services and hold the Ordinary National Certificate in Electrical Engineering or an equivalent qualification approved by the Department of Health and Social Security.

Salary—£975 rising to £1,270 per annum (additional increments above the minimum may be awarded for relevent experience). Persons not holding the qualification recognised may be subject to an abatement in salary.

Hours—Normally 38 per week.

Applications giving details of age, training and experience, together with the names and addresses of two referees, to the Group Secretary, Burnley General Hospital, by 25th February, 1969.

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CIRCULATING PUMPS and Steam Turbines. Complete units, electric and steam, spares and service. TURNEY TURBINES Ltd., 67, Station Road, Harrow. Tel.: 1355 and 3349.


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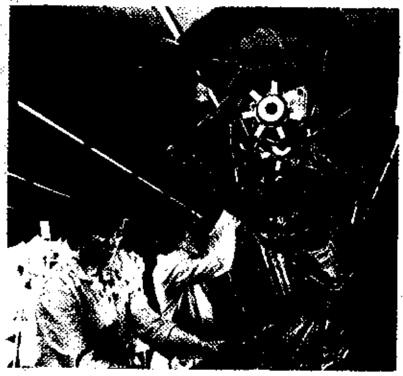
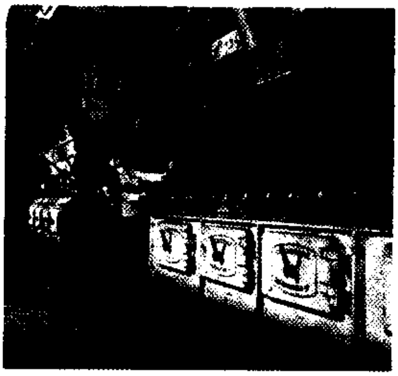


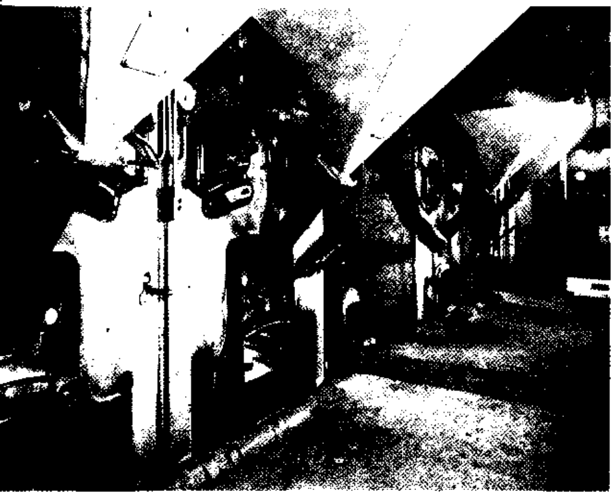
Hank to cone winding of yarn at Billingham.

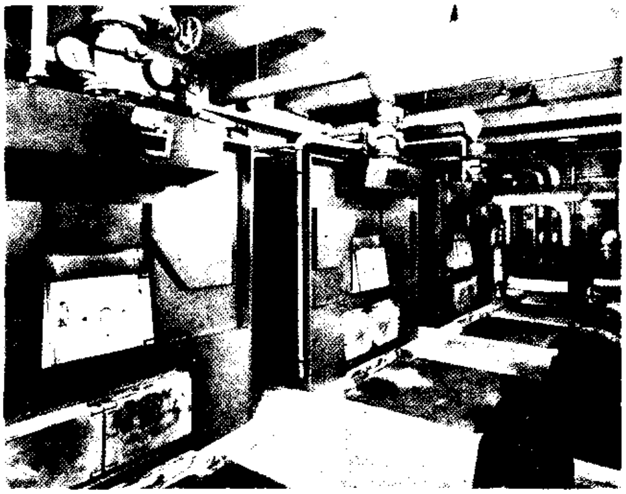


Interior of boilerhouse at Darlington.

Balling of hand knitting yarn at Darlington.

A long-term investment in power.





The Earleymil System of Combustion — Automated, Efficient, and Highly Versatile.

Earleymil is essentially a fuel and labour saving system for the production of heat, versatile enough for use with domestic and industrial sectional boilers, and also in the horticultural and malting industries. Its low installation and running costs have been proved in many installations.

The basic conception is very simple.

A hopper above the boiler holds enough fuel for 8-24 hours' combustion – or more, according to heat demanded of the boiler. From the hopper, fuel is automatically fed through to the fire box, where an ingenious and foolproof system ensures that absolute combustion takes place leaving only a small quantity of clinker for removal. This and the re-filling of the hopper take only a few minutes a day.

For boiler-houses with three or more boilers, Earleymil have developed an automatic system for delivering fuel to the hopper and this provides a further valuable saving in labour costs.

'Ideal Standard' No. 7 series 'Vanguard' boilers

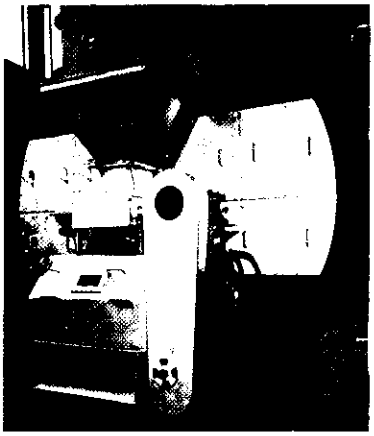
As buildings grow taller, methods of heating them become a problem. This is because the higher pressures involved limit the choice of boilers and the metal from which they are made. 'Ideal Standard' have a new solution to this problem which apart from withstanding these pressures, offers improvements in total installation costs and resistance to corrosion. This new metal is Spheroidal Graphite cast-iron.

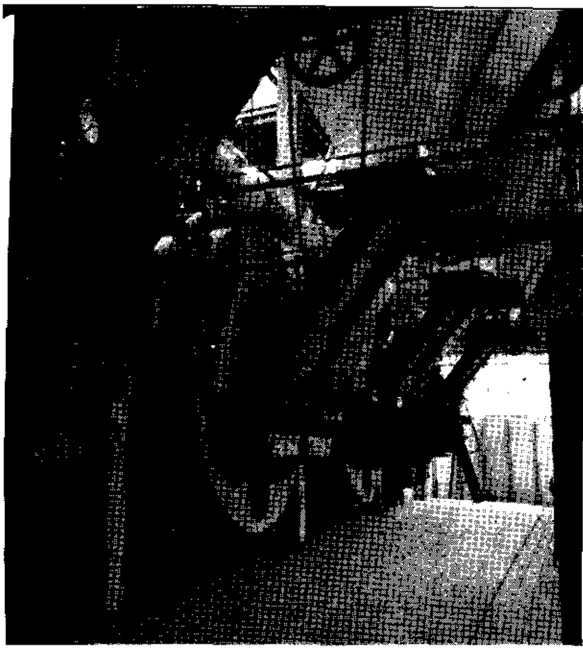
Using new high efficiency sections, 'Vanguard' boilers are easy to install, especially where access to the boiler house is restricted. The boilers are made in sizes ranging from 2,480,000 to 3,894,000 Btu/h, and a mechanical stoker of the underfeed type is recommended.

'Ideal Standard' also produce a 'Vanguard' range in grey cast-iron suitable for buildings of average height. Like all modern coal-fired installations, 'Vanguard' boilers are highly automated and economical in capital outlay and operation.

The Oldbury Spreader Stoker, made by Edwin Danks & Company (Oldbury) Limited, is a natural development of the conventional chain grate stoker. It is designed to burn a wide range of fuels, some of which may be unsuitable for the conventional chain grate stoker, with the minimum of clinker and offers the further advantage of automatically discharging ash.

By using the automatic fuel handling "Oldbury" traversing screw elevator, the only manual work required is to empty the ash container. The spreader stoker conforms to the Clean Air Act since particular attention has been paid in its design to the control of smoke and grit emission.





CASE HISTORY No. 9

AT CAMBRIDGE: coal keeps down hospitals' fuel costs.

Post-war expansion and improvement of patient, laundry and engineering services at the Fulbourn *Hospital, Cambridge* – coupled with the erection of the new Ida Darwin psychiatric hospital on an adjacent site – resulted in the opening, in September 1966, of a completely rebuilt and re-equipped, coal-fired boilerhouse. This replaced the earlier, decentralised coal-and-oil-fired boilers which had become inadequate.

At the same time, a new central calorifier chamber to service the improved space heating and hot water systems – an 80 ft. high cold water storage tower, a centralised range of engineers' workshops, stores and offices, a new incinerator and bin cleansing building, have all been provided.

The four new, coal-fired boilers are of three-pass, wet-back, Economic type – manufactured by John Thompson (Wolverhampton) Ltd., and each rated at 13,000 lb/h. Mechanical firing is by low-ram coking stokers and each boiler is fitted with induced draught fans, grit arrestors, and complete instrumentation.

The coal is transferred mechanically by elevator and conveyor from ground-level storage to overhead bunkers, from which it is fed, under automatic controls geared to the required steam output, to each boiler firing mechanism. Ash removal has also been automated, the ash being moved from boilers *to an outside silo by submerged conveyor* and automatically-operated hoist.

Fulbourn's up-to-date coal-firing equipment permits the burning of a cheap grade of fuel, while plant attention is minimised by the installation of modern coal and ash handling methods, and fully automatic controls.

CASE HISTORY No. 45

AT BOURNE: Coal the best treatment for hospital heating.

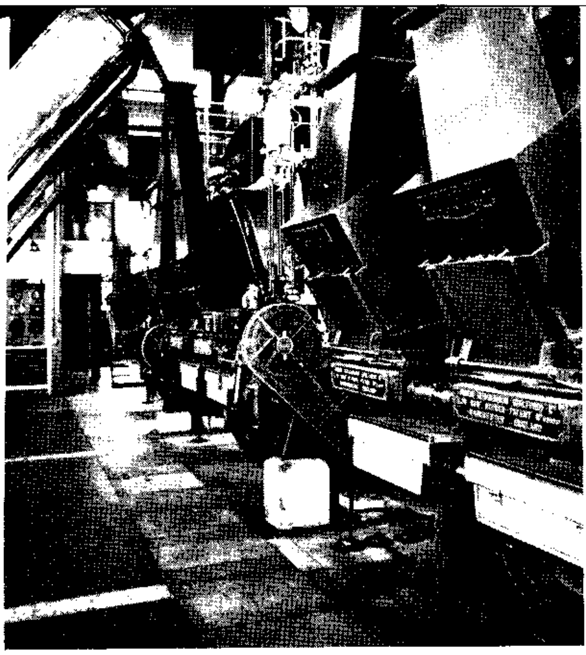
A new boiler was installed and commissioned by the Sheffield Regional Hospital Board at St. Peters Hospital, Bourne, Lincs. in 1965 following consultations with the N.C.B. technical services branch. This replaced an *existing steam installation*, for having closed the hospital laundry, steam was no longer required.

Three new low-pressure hot water boilers were installed, two Potterton MEG cast iron sectional boilers type MU7-KR7 each rated at 1,240,000 Btu/h, and one Potterton MEG type MU5-KR4 rated at 720,000 Btu/h.

These boilers, under normal conditions, are capable of operating efficiency at excess of 75% – giving great economy in fuel consumption. All three units are fired by a Riley 'Direkto' bunker type underfeed mechanical stoker, and the coal (washed singles) is delivered *pneumatically into the fifty-ton bunker*, cutting labour costs considerably.

For economy and efficiency, the Sheffield Regional Hospital Board have discovered that they were right to choose coal for St. Peters, where – as with many consumers large and small – it will continue to be used for years to come.

See back page for latest developments in automated coal-burning equipment.



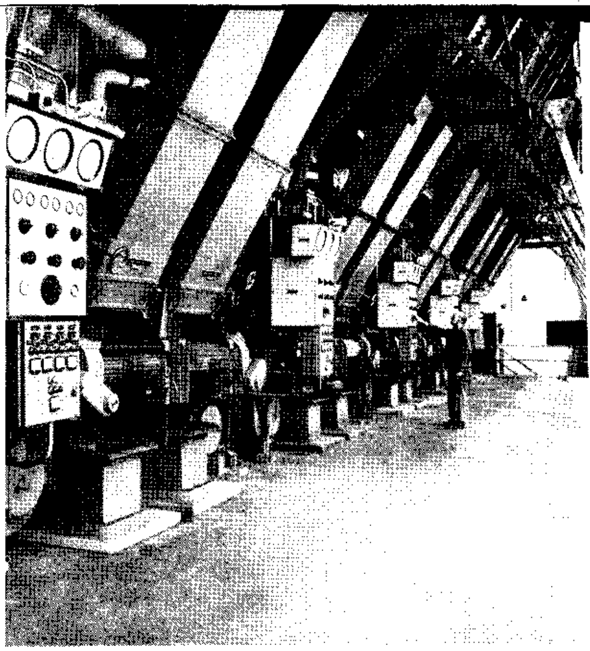
CASE HISTORY No. 150

AT HOLMES CHAPEL: hospital chooses coal for cleanliness.

Cranage Hall Mental Hospital has grown steadily in recent years. A new villa, laundry, kitchens, an audiology unit and a children's autistic unit, have brought the number of beds to a total of 574. Plans are already in hand for a further expansion costing £1,250,000.

To meet the increasing demand on hot water, steam and space heating, a new boilerhouse was built and equipped with the latest automatic solid-fuel plant. With its own eating quarters, washrooms, showers and toilets, it is an outstanding example of the cleanliness that can be achieved with modern coal-fired equipment.

The steam-raising plant centres around three Ruston & Hornsby horizontal Thermax boilers, two rated at 10,000 lb/h and one at 5,000 lb/h, operating at a pressure of 100 lb/in^2. Firing is by Hodgkinson low-ram coking stokers, and fuel is mechanically elevated from the 27-ton bunker to the stokers. A compact instrument room gives the one attendant per shift a quick visual picture, and complete control of steam-raising consumption and demand throughout the entire hospital. Cranage Hall is a clear demonstration of the cleanliness, economy and efficiency with which modern solid fuel equipment can serve a hospital.



CASE HISTORY No. 20

AT CARDIFF: Coal included in plans for new hospital.

The University Hospital of Wales (the largest hospital development in the country) now being built at Cardiff, is expected to be completed by January, 1971. The project includes Medical, Dental and ancillary training schools. There will be some 800 beds and accomodation for 800 resident staff and students.

The boiler plant is already completed and consists of six 16,000 lb/hr Ruston & Hornsby Wet Back Economic Boilers working at 140 p.s.i., fired by local Washed Smalls on John Thompson chain grate stokers. The coal is mechanically handled, after being tipped by lorry into the boot of the inclined belt conveyor, and distributed by conveyor belt to the storage bunkers. Ashes are disposed of by means of a submerged conveyor belt to a bunker and from there they are removed by contract.

The boiler plant will serve the whole project – economically, cleanly and efficiently.

H

The 1970s start here: in these pages you will read how people responsible for heat and power are basing their long-term plans on coal.

Coal is the one fuel that can offer you a guaranteed supply coupled with stable prices – prices as low as Britain's most dynamic industry can hold them.

We know you have individual heat and power problems – and we shall be glad to help you solve these. But, in broad terms, it always comes down to this: you can go confidently into the 1970's with coal from a modern, automated pit, used with modern, automated coal-burning equipment.

Let's talk it over. As you can see from the case-histories here, there are three basic problems which can be solved by modern automated coal-burning equipment. How to spend less on fuel. And how to cut down on both labour and maintenance costs.

You are probably looking for the answer to at least one of these problems. Coal-firing can provide it – but exactly how depends very much on your special requirements. This is why we should be glad to arrange for an NCB representative to visit you and discuss your problems.

This service is entirely free. For details and for any other information on modern coal-burning techniques please write or 'phone your nearest NCB Regional Sales Office.

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