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CONFIDENTIAL BULLETIN FOR THE USE OF MEMBERS.

EDITORIAL.

The first meeting of the Council for the year 1950 was held at "*The National Hospital*," *Queen Square, London*, W.C.1, Saturday, 4th March, 1950.

The members present were: Mr. J. H. Hargreaves (Chairman), Mr. J. Tomlinson (Vice-Chairman), Mr. R. E. Rogers (Vice-President), Mr. G. Jones (Treasurer), Mr. H. S. Clarke (Hon. Secretary), Messrs. H. A. Adams, A. Macgregor, J. C. Chynoweth, R. G. Rogers, W. G. Owen, A. M. Bain, L. Hunt, W. F. Graham, H. Partington, R. Smith, R. H. Chesney, E. Heald, J. D. Lewes, C. Oliver, F. H. Mills, J. Forsyth, J. W. Brodie, E. D. Yates, J. Green, A. J. Templeman, M. Gray, H. E. Clutterbuck, H. Wright.

Mr. J. Strachan, member of Education Examination Sub-Committee, attended on the invitation of the Chairman.

Before the business of Council commenced Mr. H. Ewart Mitchell, Secretary of the National Hospital, extended a very heart welcome to the Council, and expressed his personal pleasure and the pleasure of his Committee on being able to afford the Council the use of the Boardroom for the purpose of the meeting. The Chairman thanked Mr. Ewart Mietchell most warmly for the excellent arrangements made, and for the very cordial welcome which is always extended to Council whenever they meet at the National Hospital.

The meeting was opened by the Chairman at 11.40 a.m.

The Minutes of the last meeting, held at the Westminster Hospital, on the 3rd December, 1949, were adopted and signed by the Chairman.

This being the first meeting of the year, Council proceeded to elect its Chairman and Vice-Chairman.

Mr. R. E. Rogers, Vice-President, occupied the Chair, and on a unanimous vote Mr. J. H. Hargreaves was re-elected as Chairman for the ensuing year.

The names of Mr. J. Tomlinson and Mr. J. Forsyth were proposed and seconded as candidates for Vice-Chairman. Council decided that a ballot be taken, and Mr. J. Tomlinson was re-elected.

Mr. Hargreaves then took the Chair.

The death of Mr. W. Flack, of Runwell, Essex, was made known to Council, and members stood as a tribute of respect to an old and respected member. Mr. H. Wright informed the meeting that the London Branch had arranged for a floral tribute, and their expressions of sorrow had been conveyed to the family.

Arising out of correspondence received, the Hon. Secretary reported that Messrs. A. Shawcross, W. G. Owen and W. Guthrie had resigned the Hon. Secretaryships of the Cheshire, South Wales, and Edinburgh branches respectively, and it was unanimously agreed that the thanks of Council be recorded in the Minutes. Messrs. W. F. Graham, V. Riley, and S. R. Ross have taken over the respective offices.

Notification from N.A.L.G.O. of the resignation of Mr. Haden Corser, F.R.S.A., Deputy-Secretary, inviting subscriptions to a Testimonial in recognition of his long and outstanding services, was received, and it was agreed that the sum of £5 5s. 0d. be forwarded to the Fund, on behalf of the Institution.

Messrs. C. E. Clayton, J. T. Foulkes, and C. G. Hodges, having retired from Hospital Service, were offered Honorary Membership, with the good wishes of Council for a long and happy retirement.

Mr. E. V. Parton, of Epsom, after a long illness and possible forced retirement, requested advice regarding his position. The Hon. Secretary was instructed to obtain further information pending legal advice.

Applications for membership were approved as follows :—

Members	3
Associate Members	5
Graduate Members	6
Referred back	1

Four applications for transfer to a higher grade of membership were received and approved.

Correspondence from Mr. Sandford, Vice-President, relative to his premium examination, was read by Mr. Tomlinson, and it was agreed that Messrs. Barnetson and Annand be invited to the Annual General Meeting at Harrogate, at the Institution's expense, to receive the awards.

Mr. Tomlinson informed the meeting of the dates of the next examinations, April 11th, 12th, 13th and 14th, the centres being London and Leeds.

(All correspondence relative to the examinations should be forwarded direct to Mr. J. Tomlinson, Group Engineer, St. James' Hospital, Beckett Street, Leeds, 9.)

All Branch Secretaries be asked to bring to the notice of all members the Annual General Meeting to be held at Harrogate, Yorks, on Saturday, September 2nd. Any member requiring accommodation should notify Mr. Thwaites, Ministry of Pensions Hospital, Chapel Allerton, Leeds, 7, at the earliest possible date.

It was unanimously agreed that the President and Vice-Presidents be invited to the Annual General Meeting, as also the Chairman of the Yorkshire Regional Hospital Board.

The Treasurer presented the financial statement to date, and arising from the report of the Financial Sub-Committee, it was resolved that the Hon. Secretary be allowed a sum not exceeding

£30 0s. 0d. to purchase office equipment, together with a Petty Cash account.

The Treasurer drew attention to branches ordering stationery of a special nature, and it was generally agreed that all expenses, other than normal branch expenses, should have the approval of Council. The Treasurer must have the authority of Council to pay accounts.

It was agreed to meet the printing accounts of the London, Lancashire, and Northern Ireland branches.

The Hon. Secretary presented a statement of outstanding subscriptions, when it was agreed to defer any action until the next meeting.

All new members' acceptances to be held over pending payment of entrance fee and first subscription.

The Hon. Secretary of the Benevolent Fund reported on the position to date ; no call on the funds have so far been made.

Mr. R. E. Rogers reported on the work of Whitley Council and informed the meeting that he expected an early notification of the negotiations now completed.

Meetings of Whitley Council are due to commence with special reference to Teaching Hospitals.

The special fees due to Whitley Council are to be £40 per Whitley Council member per year.

Arising out of Resolutions from the branches :—

Provision of Brief Cases to Branch Secretaries.

Resolved that no action be taken.

Members in arrears, enquiries from proposer and seconder.

Resolved that Hon. Secretary refer all matters through Branch Secretaries to the proposer and seconder.

Acknowledgment of correspondence.

Resolved that Hon. Secrearies have post cards printed.

Mr. Arkle's case to Council.

Mr. R. E. Rogers reported on correspondence received which had been shown to Mr. Arkle.

Arising from the resolutions from branches with special reference to the " Rules and Incorporation," it was agreed that these be dealt with by the appropriate committee.

The report of Mr. R. G. Rogers *re* " Rules and Incorporation," Council proceeded to formulate a final draft. After some time it was apparent that a great deal of time would be required to deal with this matter, and it was resolved to hold a special meeting in London on the 25th March, at 11.0 a.m., one member of Council from each branch to form this special sub-committee, who will report on the progress made before the date of next Council can be arranged.

Arising out of A.O.B., Mr. Wright raised the question of guests to Branch Annual Dinners. The General Secretary promised to include the discussion in the agenda of next Council Meeting.

Mr. Gray, of Northern Ireland, gave a report on Northern Ireland progress with regard to salaries and conditions, and it was agreed that Mr. J. Tomlinson go to Northern Ireland to further progress.

It was resolved that the next Council Meeting be held at Newcastle-upon-Tyne.

The Chairman voiced the appreciation of the members at the quality of the hospitality extended by the National Hospital.

The meeting closed at 6.50 p.m.

EDITOR.

STERILISATION IN HOSPITALS, II

By A. F. Dence, M.A. (Oxon.)

In a previous article we discussed some of the problems of sterilisation in hospitals from the point of view of the protection from infection of the personnel and patients in the hospital.

There is, however, another very important angle which scarcely ever receives attention—namely the protection of the public outside the hospital from infections which are inevitably congregated within it.

At first sight this idea may sound ridiculous, but a little thought will show that it is, on the contrary, very far from absurd.

Some time ago, the writer was visiting a well-known South London Tuberculosis Hospital. In course of conversation, the Medical Superintendent was asked the question : " Do you consider that letters and articles handled by patients are infected ? " His reply was in the negative.

I therefore stopped him in the centre of a ward containing some 30 female patients and asked him to observe carefully for five minutes the movements of a patient in a nearby bed.

The patient was a woman about 40 years of age—a chronic T.B. case who had already spent five months in the hospital. She was, in fact, very will, but like so many T.B. patients, did not " feel " very ill. She was writing a letter in pencil on a letter pad. Three times in five minutes she made use of her sputum mug and *immediately passed her right forefinger across her mouth*, after which she took up her pad and continued her letter.

Now, I asked the Superintendent again, is that letter infected ? He replied that it must be. A little imagination only is required to realise what is likely to happen. The letter is received—possibly by a relative—next day. The pages are handled and turned over by the usual process of licking the thumb ; any T.B. bacilli on the pages may therefore be transferred straight into the mouth of the relative.

The letter might be deposited on a kitchen table on which food is subsequently placed. It will probably be kept and handled for some days.

This is infection spread. That particular hospital immediately installed two letter sterilisers, in which all letters written by patients are sterilised "*in their presence*" daily—a process that takes ten minutes, does no damage whatever, costs approximately 2d. per day, and avoids the grievous risk of spreading infection outside the hospital.

Occupational Therapists are employed in most big hospitals now. They teach patients to spend their leisure hours on making various articles—knitting, sewing, embroidery, leather-work, etc., most of which are sent home on application. But normally no attempt is made to sterilise the articles, no matter what the nature of the disease of the maker.

Surely it should be an axiom of all hospitals that no disease germs, isolated in a hospital, should be permitted to escape, to infect a member of the public!

It may be objected that the difficulties and risks are many and insuperable. Visitors are allowed into hospitals and come into close contact with patients, where they may well pick up infection. Indeed they doubtless do so frequently. But is anything done to reduce this risk? I have visited very many hospitals, but have never seen any precautionary measures taken.

One of the chief sources of cross infection—especially in cases of pulmonary diseases—is from coughing, sneezing, and even speaking, so that infectious pathogens are sprayed into the air. These are inhaled by other people—staff, students, visitors, etc., and frequently cause trouble. Any teaching hospital must admit that students constantly acquire illness from contact with patients, and it is a common experience that doctors and nurses do likewise.

It is, however, perfectly possible to sterilise the air in wards where any such risk of infections occur. The Medical Research Council have recently published (December, 1948) extended research work on the subject of air sterilisation, and in the U.S.A. the undoubted benefits of it are widely recognised.

The simplest and most efficient method, on grounds of expense and maintenance, is a small electrically-operated glycoliser which maintains a constant aerosol (or invisible mist) of Triethylene Glycol in the air. The efficiency of Triethylene Glycol is quite remarkable —airborne haemolytic streptococci being killed in the air in a matter of 2–3 seconds.

The results of three years' research in a children's convalescent hospital in the U.S.A. were as follows :—

In four wards in which a glycoliser was installed, there were 13 cases only of infectious diseases, as against 132 in the control (no glycoliser) wards during a period of three years, while in the same wards only three cases of common cold occurred in the "glycolised" wards as against 79 in the control wards.

Figures such as these are sufficiently impressive to warrant the adoption of such a system as a normal prophylactic effort, which would reduce the risk of infection, not only by the hospital's personnel, but by visitors and even by other patients.

A frequently unsuspected source of cross-infection is nurses' uniforms. During the war, the writer was Chairman of the House Committee of a well-known Chest Hospital. On two occasions serious outbreaks of T.B. occurred among the nurses and junior medical staff—on the second occasion of almost alarming proportions.

At the first outbreak, the diet was suspected of being deficient and of resulting in lowered resistance. But when very shortly afterwards a second and more serious outbreak occurred, a thorough investigation was ordered, which resulted in cultures of Tubercli bacilli being taken from almost every article in the nurses' home. Tables, chairs, crockery, forks, beds—all were infected. The reason was fairly simple.

The nurses were short of uniforms ; they were therefore permitted to go to their meals in the uniforms which they had been wearing while on duty. The fact that the uniforms were heavily contaminated was proved by investigating the contents of the laundry baskets. (The hospital's own laundry had been blitzed and soiled linen and uniforms were sent to an outside laundry in wicker baskets.) Indeed, the wicker baskets were themselves heavily contaminated and cultures were prepared from these.

The trouble was overcome by a simple method. A large chemical vapour process sterilising cabinet containing 12 compartments was installed in the duty room of each ward. When a nurse came off duty, she changed her uniform, placing the contaminated one in her own compartment of the sterilising cabinet. These uniforms were not " dirty " in the accepted sense—but were obviously contaminated from close contact with the patients. When returning to duty she wore the second uniform which was exchanged for the first (now sterile) uniform when she next came off duty. Thus each nurse had two uniforms in constant use, and the actual amount of laundering was not any greater. But she never appeared outside her ward in a contaminated apron.

The outbreak was rapidly controlled by this means.

While it is now proposed to immunise personnel in contact with T.B. patients by the B.C.G. system, which may prove highly effective, there are other infectious diseases which may be spread by the same method and which could easily be controlled by efficient sterilisation.

It is a frequent sight in London to see nurses walking about in uniform. But I often wonder, have they just come off duty, and if so, what type of patient were they tending. Are they, by walking about in a contaminated uniform, spreading disease germs which should be confined within the hospital walls ?

It is impossible to live in a sterile world. Indeed it would be disastrous for the community to endeavour to achieve absolute sterility, for natural immunity would disappear also. But it does seem to be reasonable that a hospital should be as sterile as possible inside, so that cross-infection should be reduced to negligible proportions, and that germs should as far as possible be prevented from leaving a hospital to infect persons outside.

EXPLOSION HAZARDS FROM ELECTRICAL CAUSES IN OPERATING THEATRES

By B. G. PALMER, Esq. (Member).

When an explosion of anaesthetic gases occurs in an operating theatre, the cause is always very difficult to ascertain. Nevertheless, it is a subject which should receive the earnest attention of all concerned. If the Hospital Engineer, all theatre personnel, including the Surgeon, the Anaesthetist and the Theatre Sister and her staff, are all aware of the danger, and have an understanding of its nature, a great stride will have been made towards eliminating the danger.

The magnitude of the explosion may be such that it is accompanied by loss of life, or serious injury, or damage to apparatus, or it may be so slight that it merely evokes an exclamation of surprise.

It is known that the explosion is caused by the accidental ignition of the anaesthetic gases by a spark from some piece of electrical apparatus, or by a spark resulting from a static charge of electricity. It is the cause and prevention of these sparks from static and dynamic electricity that this paper is concerned with; apart from obvious carelessness, such as smoking, naked flames, etc.

One knows, or can find out roughly, how many lives have been lost by these accidents, but it is impossible to find out how many lives have been saved by taking all precautions.

In order that we may appreciate the dangerous nature of the agents used in anaesthesia, let me summarise their properties. It is inhalation agents that we are concerned with, and not the local, spinal or intravenous injections; although, in passing, it might be mentioned that the cleaning of the area with spirit is potentially dangerous.

A very well-known agent is *Ether*. The vapour from this liquid is highly inflammable. It is also heavier than air and consequently tends to form dangerous concentrations on the floor which may reach a height of 2 feet in the vicinity of the operating table.

Other agents and mixtures include *Chloroform*—not inflammable, but not satisfactory as an anaesthetic by modern standards.

Trilene—not inflammable; is safer than Chloroform and Ether, but not as powerful an anaesthetic.

V.A.M.—a highly inflammable mixture of ordinary ether and vinyl-ether.

Cyclo-Propane—possibly the most dangerous, but is a good anaesthetic, being smoother and kinder to the patient. Is expensive, and because of this, is used in the "closed circuit" type of anaesthetic machine. Rubber is porous to this agent.

Ethyl-Chloride—another highly inflammable gas.

Oxygen—this gas is not, in itself, inflammable, but has the property of making other mixtures more dangerous. It is a powerful accelerator of anything burning. Indispensable in Anaesthesia.

Nitrous Oxide—like Oxygen, this gas is not inflammable, but makes anaesthetic mixtures more dangerous.

From these remarks you will see that the safe agents are not good anaesthetics ; consequently there is a tendency to use the best agents for anaesthesia, in spite of the risk involved.

Now let us examine the methods of using these agents. There is the ordinary anaesthetic machine in which the agents are mixed and passed on to the patient who re-breathes part of the mixture, the other part being expelled to atmosphere through the expiratory valve. Bearing mind the subject of this paper, this type of machine is undesirable, as dangerous mixtures are being expelled all the time. Because of this feature in the ordinary anaesthetic machine, the modern " closed circuit " type of machine has been evolved. In this machine, the agents are mixed as before, and fed to the " closed circuit " through 3 or 4 feet of rubber tubing. The Carbon Dioxide absorber is included in the circuit, and, in theory, there should be no leaks. One possible weakness in this type of machine is that should the " closed circuit " receive too much mixture, the increased pressure in the circuit opens the automatic compensator valve and excess gas is expelled to atmosphere.

Both types of machine are liable to certain troubles such as punctures in the rebreathing bag, or in any part of the system of rubber tubing. Leaks may occur through damaged slip joints. The face mask is another point where leaks may occur. Static electricity may be generated by friction in rubber tubes through which dry gas is passing. Tubes containing gas moistened by the patient's breathing are free from this trouble.

The third method is the open mask. This consists of a pad of gauze and cotton wool with a hole in the centre which is placed over the patient's face. A small frame covered with another absorbent pad is placed over the patient's mouth and nose, and ether dripped upon it from a bottle. More ether is used by this method and it all escapes to atmosphere. In the " closed circuit " anaesthetic machine about 6 litres of gas are being pushed around the circuit ; and much of the energy of the patient is used in breathing against disc valves, and overcoming friction of gases in the tubes and soda-lime absorber. Because of this, the open mask is often used in connection with old people and patients with enfeebled breathing. The method is also used for young children because of their feeble respiration.

Ignition of Anaesthetic Mixtures.

The withdrawal of a blanket from a trolley or table ; the friction of clothing against theatre furniture ; the rustling of clothing (particularly silk clothing) when moving about the theatre—all these movements are liable to generate *static electricity*. A dry atmosphere will encourage the generation of static.

Dynamic sparks from faulty electrical apparatus are liable to occur. Then there is the ever-present danger from sparks which occur in the normal working of the apparatus ; such as at the brushgear of motors and rotary converters, switch contacts and voltage regulators. The sparks occurring in connection with the diathermy machine are unavoidable, and will be referred to later.

In connection with static, imagine, for a few minutes, an operating theatre with the well-known terrazo or granolithic flooring. The anaesthetic trolley, instrument trolleys, scialytic lamp, stretcher trolley, operating table, etc., all have trailing chains attached to them, which may, or may not, be efficient. The personnel are all wearing rubber boots and gloves. Now consider the conditions prevailing during an operation. The patient has been laid on a rubber mattress on the operating table by personnel insulated from the floor by their rubber boots. The patient may then be partly covered with rubber macintosh and other sheeting. Note that, should the patient have acquired a charge of static electricity by virtue of dry atmospheric conditions, or by friction in some way or other, he will probably hold the charge for some time.

The surgeon performing the operation is standing in rubber boots and wearing rubber gloves, and probably also wearing a rubber apron which prevents him from coming into contact with the table. The patient may have the rubber facepiece attached, but will still be highly insulated from earth. An actual risk occurs when the anaesthetist, with one hand on his machine, checks the patient's pulse by touching his temple. If the machine is efficiently earthed, there may be a considerable difference of potential between the anaesthetist's hand and the patient's temple. A static spark might result. If the machine offers a fairly high resistance to earth, the static charge may dissipate harmlessly. The word " dissipate " here being used to differentiate between the comparatively slow and harmless discharge of static through high resistance, and the instantaneous discharge in the form of a spark, which occurs when two bodies, having widely differing potentials, come together.

Precautions to Adopt.

It is probable that, under certain conditions, small electrostatic charges are being made, and dissipated all the time. If a similar state of affairs can be obtained in connection with the high

charges of static which we are considering, a considerable degree of safety will have been achieved The present method of earthing the theatre apparatus, and leaving the personnel highly insulated in rubber boots, falls far short of this ideal, in that large differences of potential are created between personnel and apparatus. If means could be found to avoid these high charges altogether, it would be the most satisfactory of all methods.

Since electro-static charges cannot be prevented, it is the technique at present to adopt means to dissipate these charges as they arise.

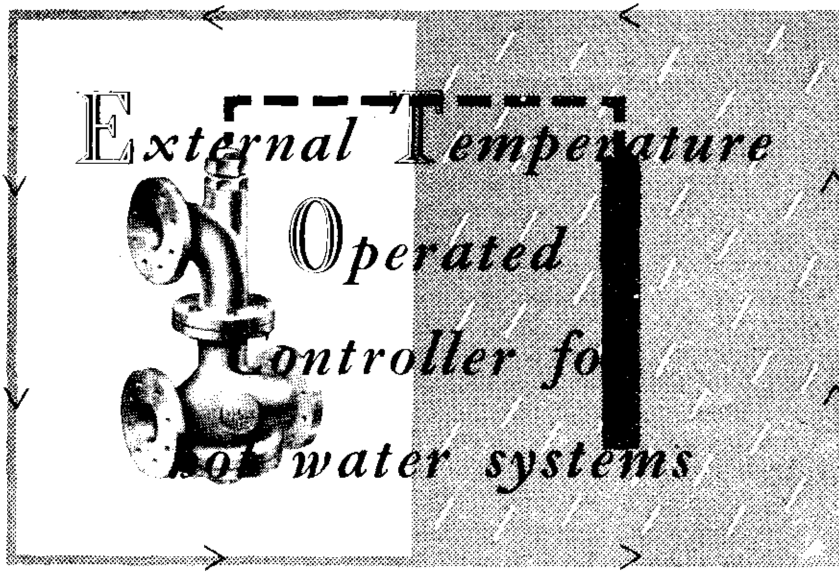
Many of you may be aware of the amount of static electricity that can be generated by swiftly drawing a blanket across the top of a rubber mattress lying on a stretcher trolley. The voltage of this charge may be as much as 30,000 ; and the energy released upon discharge as much as 0.03 joules. Now, while this may be the very maximum possible under suitable conditions, it has been established that about one-sixtieth of this amount is sufficient to ignite an ether vapour-air mixture, even less with oxygen. The earthing of the trolley by trailing chains is not 100% satisfactory, as it has been found in laboratory tests that a trolley so earthed will hold a static charge for several seconds. I, myself, have tested a new anaesthetic machine fitted with chains by the makers, and found the resistance to earth to be " infinity " on a 500-volt megger testing set. A new chain was fitted, and after three months was tested and again found to offer a resistance to earth of " infinity." There is, therefore, a definite danger during the first few seconds while the static voltage is sufficiently high to cause a spark, should suitable conditions occur. It could happen if a blanket was withdrawn from a trolley, and then the trolley wheeled up to the operating table, which might be fully earthed. These two movements might quite conceivably happen within the space of a few seconds.

I have said that, since static charges cannot be avoided, it is the technique at present to provide means to safely dissipate these charges as they occur. Take the case of a stretcher trolley with a capacity of 0.0003 micro-farads, having a static charge of 10,000 volts, and a resistance to earth of 10^{10} ohms. The time taken for this charge to dissipate, or fall to approximately 5% of its initial value, can be calculated from the formula—

$$T = \frac{RC\,(\log V - \log (0.05V)}{0.43}$$

where T = time in seconds, R = resistance in ohms, C = capacity in farads, and V = initial voltage of the charge.

Substituting those values which I gave for the stretcher trolley, you will find that the time taken in this instance is 10 seconds.



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Calculated for a resistance to earth of 100 megohms, the time taken for 10,000 volts to fall to 5% of its value will be 1/10th second.

There is another aspect of the case to bear in mind when considering the advisability of earthing all theatre apparatus to avoid static sparks. If a faulty piece of mains apparatus should accidentally touch a fully-earthed object, a very severe dynamic spark would occur. A rigid system of routine inspection would lessen this danger, but the possibility is still there. To make quite sure that electrical apparatus cannot become " alive," the continuity of the earth lead should be regularly tested by passing a heavy current through it. Mere inspection is not sufficient. On one occasion at my hospital, a certain piece of apparatus was reported giving shocks, and upon examination, the T.R.C. flexible lead appeared to be in perfect conditions at both ends ; but upon stripping back one end it was found that the earth wire had broken first.

From these remarks it will be seen that complete safety from dangerous sparks depends on the upper limit of the time taken for static to dissipate, and the lower limit of the resistance to earth to avoid fuse blowing by faulty electrical mains apparatus. A resistance to earth of between 1 and 100 megohms seems to satisfty these requirements.

In America, where dry climatic conditions have accentuated this problem, various schemes have been tried in an effort to reduce the danger from this insidious cause. One method was the use of what they called an " inter-coupler." This was a device fixed to the ceiling and connected to " earth," and having five chains (or, possibly, flexible leads) suspended from it ; to these were connected the surgeon, the anaesthetist, the patient, the anaesthetic machine and the operating table, the resistance between any one and earth, or between any two bodies being about 1 megohm. Referring to my previous remarks concerning the conditions prevailing during an operating, this, at least, would ensure that *these five* bodies, with fairly large capacities, were all at the same potential. But the device is of doubtful practical value. For one thing, the surgeon may object to being hampered by a metal band round his wrist with a flexible lead connected to it ; also, according to his appreciation or otherwise, of the danger, he may not bother with it. In any case, I submit that danger is still present. While these five bodies are at the same potential, the rest of the personnel and apparatus are still liable to receive static charges of varying degree, depending on their individual capacity, resistance to earth, etc. ; and any one of these coming into contact with the " earthed five " is a potential danger.

Therefore, to carry this method to its logical conclusion, all portable apparatus and personnel in the theatre should be connected to this central point. When one considers the multifarious articles in use during an operation, conditions resembling a maypole would be obtained, to say nothing of having to disconnect and reconnect oneself upon leaving and re-entering the theatre. In most theatres the operating table, while not a fixture, does, nevertheless, stand permanently in the centre of the floor. It may be that, in some hospitals, advantage has been taken of this to fully earth the table to a point in the floor beneath. This is definitely inadvisable unless everything is similarly fully earthed.

So, we see that the policy of connecting everything directly to earth is not practical. The partial earthing of apparatus with trailing chains, while leaving the personnel highly insulated in rubber boots, is not satisfactory. Indeed, it is not a wholehearted attempt to solve the problem.

It seems to me that a good case can be put forward for the use of conductive rubber. Ordinary rubber is not only the chief cause of static being generated, but is the means of keeping charged bodies electrically separated. It is used for numerous purposes in operating theatres. The rubber mattress keeps the patient insulated from the stretcher trolley and operating table. He is still highly insulated when connected to the anaesthetic machine by a rubber tube. The surgeon and personnel all wear rubber gloves and boots. If the instrument trolleys have removable shelves, they are probably insulated by small rubber pads for the purpose of silence. All-metal trolleys with fixed shelves are to be recommended for theatre use. The buckets in the bucket trolleys may be insulated by rubber bands. All portable apparatus on wheels is bound to be fitted with rubber castor wheels.

Because of its suitability for so many purposes, rubber is used a great deal in operating theatres ; and if this material could be made conductive, the probability of static charges reaching dangerous proportions would be practically eliminated. The conductivity of the rubber need not be of a very high order. From my previous remarks, a resistance to earth of between 1 and 100 megohms is satisfactory for the purpose.

With the conductive rubber castor wheels. The practice of fixing only one on each trolley is to be deprecated, as, should this particular wheel not be touching the floor, because of distortion of the trolley frame, or other reasons, contact with earth is lost. Therefore, all four castors should be fitted with conductive rubber wheels. The four parallel paths to earth are not likely to reduce the resistance below the 1 megohm mark.

A patient lying on a mattress on a trolley is insulated from earth by two resistances in series (the mattress and the trolley tyres), but by virtue of the large area of contact with the mattress, and the four points of contact with the floor, the total resistance would be well below the maximum of 100 megohms. Other situations may occur in which series resistances are involved, but if conductive rubber is substituted for all ordinary rubber, the resistance to earth, or between any two charged bodies, is not likely to exceed that required to quickly and safely equalise any static potential which may arise.

The floor, if it is granolithic or terrazo, is sufficiently conductive, and need not be rendered with conductive rubber. The method of manufacturing conductive rubber by the addition of very finely divided carbon, makes it, unavoidably, black in colour. Partial use of conductive rubber in a theatre will only aggravate the danger by allowing the creation of a condition of contrasting static voltages. Articles fitted or made with conductive rubber will be near earth potential, while articles fitted with ordinary rubber cán receive and hold high static charges.

Air Conditioning.

There is another element besides rubber which can, by its condition, either lessen or increase the danger from static electricity. It is the atmosphere. If this be too dry, it will encourage the generation of static. If it be still, it will allow dangerous concentrations of explosive mixture to accumulate. Therefore, a properly conditioned supply of air is most necessary.

The generally accepted rate of change of 10 changes per hour, relative humidity of 65%, and temperature of 70° F. to 75° F. are all satisfactory, but I should like to make a few observations regarding the method of obtaining these conditions. In planning a new theatre, special consideration should be given to the position of inlet and extraction fans. The inlet fan should be at floor level on one side of the theatre. But in deciding the best position for the extraction fan, consideration must be given to the special problem of a concentration of heavy vapour in the middle of the floor. The best scheme for dealing with this is low-level cross ventilation, and I suggest that extraction could take place at two points. One at floor level opposite the inlet fan. This, by creating a horizontal movement of air across the theatre at low level, would effectively prevent anaesthetic mixtures from collecting on the floor. The other fans could be fixed near the ceiling in order to extract the stale air in the usual way.

In many theatres the only attempt at a conditioned supply of air is in the use of a filter of fine cloth, fixed, for the convenience of regular changing, on the inside of the inlet fan. I would suggest that louvres, fitted to this fan to assist in deflecting the air a little

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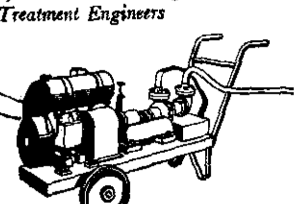

169 Piccadilly, London, W.1. *Telephone: REGent 4521* further across the floor than would otherwise be the case, would help in dispersing the heavy vapour on the floor. Humidification will vary with the conditions existing outside. Again, if no heated air is supplied, the fan is not used at all in cold weather. In some theatres, this contingency is provided for by ventilators, complete with gauze filters, fitted behind the hot water radiators. But in winter months, with the heat from these radiators, and the running of the high level extraction fan only, it is probable that air admitted through these ventilators rises quickly and is exhausted to atmosphere without helping in any way to disperse the heavy vapour on the floor. The gauze filters on the extraction fans also serve to prevent the spread of possibly burning ether-vapour ignited by the fan motor brushes after the style of the Davy safety lamp for miners. The gauze should, therefore, be a fine wire gauze, and not a cloth one.

In some hospitals, with, possibly, only one theatre, sterilizing is carried out in the theatre itself. In this case, humidity is considerably assisted by steam liberated from the sterilizers. In the case of a suite of theatres, with a central sterilizing room, a large volume of warm, humid air is expelled to atmosphere *via* specially constructed hoods, ducting and exhaust fan. Is there not scope for ingenuity here in using this for warming and humidifying the theatre in winter time?

Dynamic Sparks.

These may occur at a large number of points in the theatre, and the power of the apparatus concerned may range from 2,000 watts down to the smallest scopes consuming about 1 watt or even less.

Consider lighting switches and switch-sockets. Although the possibility of a spark from these switches being the cause of an explosion, is remote, the Home Office, nevertheless, recommend that they be of the sparkless or flameproof type. Switch-sockets should be interlocking as well as sparkless. Where 5 amp. and 15 amp. switch-sockets are on different circuits in the same theatre, care should be taken to see that they are connected to the same phase of the supply; otherwise, should certain faults develop, a short circuit may occur between two phases. As the voltage in this instance might be over 400, the spark at the point of contact would be severe.

If the lighting is fluorescent, it might be connected to two or three different phases of the supply in order to avoid the stroboscopic effect. The fact that extra phases of the supply have been brought into the theatre for this purpose, is not regarded as dangerous, as no portable apparatus is involved.

With regard to the switch-socket outlets ; as an additional precaution, these could be supplied with a low-voltage earth-free alternating current from the secondary of a step-down transformer. If this system is adopted, there are a few points to be borne in mind. All theatre apparatus must be designed for a suitable low voltage, and will therefore not be useable elsewhere in the hospital. The low-voltage switch-sockets must, therefore, be of type which is non-interchangeable with mains voltage switch-sockets. At the same time, it may be necessary on occasion, to use some piece of special mains apparatus in the theatre. For this reason it may be advisable to retain, say, one mains voltage switch-socket in each theatre.

While on the subject of switch-sockets, there is one more point I should like to mention. Referring again to the recognised position of the operating table in the centre of the theatre. Possibly, in some theatres, there may be small, fixed pedestal or plinth beneath the table with one or two mains voltage plug points fitted. If these are inter-locking and sparkless, and in good condition, they should be safe. But in view of the explosive mixture which collects around this point, these switches should receive special maintenance attention. A much safer position for them is overhead, fixed within reach of a person of average height.

Apparatus.

It is useless going to the trouble of making mains switches and switch-socket safe when portable apparatus is used with ordinary switches on it. The apparatus is taken much nearer to the danger zone, and if the switches on it are used, the whole object of the sparkless switches on the wall is totally defeated. In my opinion the whole question of safety in operating theatres is very closely connected with the design and use of electrical apparatus, and electrical men of the Engineer's staff should make it their business to become familiar with all aspects of the problem.

The type of sparks most difficult to deal with are those produced by the diathermy machine. Here is a machine which accomplishes its purpose by actually passing a current through the patient. Power taken from the mains may be in the region of 1,000 to 1,500 watts. Control of the primary current is effected by a specially constructed gas-proof foot-switch. The secondary current is earth-free. One pole is connected to the patient by a comparatively large electrode fixed to a convenient part of the body (usually the thigh), but depending chiefly upon the site of the operation. This electrode is called the " indifferent " electrode, and is a lead plate measuring about 8 ins. x 6 ins. Its object is to provide a return path for the current used for cauterising. Therefore it should collect the current from the patient with the least possible effect upon the skin. To accomplish this, a thick pad of absorbent material (about 2 ins. larger all round than the electrode) soaked in a 15% to 20% warm salt solution, is interposed between the electrode and the patient. This ensures even contact with the skin, and reduces current approximately 70 square inches.

The other pole is connected to the needle electrode, and the spot where this needle touches the patient is where sparking occurs. One precaution that the surgeon might adopt is to see that the needle is in contact with the tissue before switching on, and to switch off before removing the needle. But as sparking occurs all the time the needle is being used, it is doubtful if there is much to be gained by this precaution.

The makers of diathermy machines issue instructions that explosive anaesthetics must not be used. At the present stage of development these sparks appear to be unavoidable ; and if dangerous agents must be used, I should like to stress the importance of efficient ventilation. Regarding the machine itself, it should be kept as far away from the danger zone as possible ; especially if it is of the spark gap type. Diathermy machines are obtainable with the spark gaps enclosed in a gas-tight chamber.

Other apparatus used in theatre include small electric sterilizers for special instruments, scialytic lamps, and X-ray tubes. These should receive special maintenance, and, where possible, sparkless and interlocking switches fitted, plug and socket connectors eliminated, and generally be modified to ensure that the circuit cannot be broken except by a properly designed switch.

Finally, there is the low-powered battery or transformer operated apparatus. The fact that this is earth-free is by no means a guarantee of its safety.

Following are some notes and particulars of portable apparatus used in operating theatres :—

Electric drill and saw—

1/12 h.p. motor with foot-operated switch and speed regulator. Volts 230, amps. 0.5 = 115 watts.

If motor should be stalled, power controlled by foot-switch would be considerably increased.

Cauterised Points—

Hollow needles with wire-wound elements in series with a mains resistance.

Power consumed by largest needle : 50 volts x 0.775 amps. = 38.75 watts.

Voltage drop across resistance = 180.

Total power controlled by small switch on the needle = 0.775 x (180 + 50) = 178.25 watts.

The hot needles (even below red heat) are dangerous when ether vapour is about ; but a power approaching 200 watts is far too much to be controlled by a small instrument switch.

Trans-illuminator—

An instrument for providing low voltage, earth-free alternating current for lights and cauterising, comprising a rotary converter, transformer, and panel for switches, regulating switches and terminals.

Power consumed by converter only : 0.2 amps. x 230 volts = 46 watts.

Power consumed by converter and transformer : 0.4 amps. x 230 volts = 92 watts.

Power consumed by converter, transformer and cautery : 0.6 amps x 230 volts = 138 watts.

These powers are controlled by small panel-mounting toggle switches.

Power consumed by 1 light (on transformer secondary : 0.25 amps. x 12 volts = 3 watts.

Power consumed by hot-wire cautery : 15 amps. x 1.5 volts = 22.5 watts.

In addition to the danger from the hot-wire, there is the danger from the small switch included in the instrument. When switching off, the spark is quite visible in daylight.

Portable electro-cadiograph—

Power in galvanometer and patient circuit is negligible.

Power consumed by lamp : 1.8 amps. x 12 volts = 21.6 watts.

Gastrscope—

0.25 amps. x 9 volts = 2.25 watts.

Cystoscopes, Sigmoidoscopes, Laryngoscopes, etc.—

Where these 'scopes are used in conjunction with a regulating resistance, the power controlled by the switch is—

Voltage across resistance and lamp x current, which might be anything up to 3 or 4 watts.

With regard to the switches in the mains circuit of the above instruments, it should not be difficult for instrument makers to incorporate sparkless switches in their apparatus.

The battery-operated 'scopes may have coupling connectors on the instruments or in the leads ; there may be pin or spade tags on the leads for connection to the battery or transformer terminals ; or, possibly, a 2-pin plug with no interlocking mechanism. There may be a voltage regulating resistance with an " off " position. Dynamic sparks can occur at any one of these points. Although there is not so much energy in these sparks, they can occur in the danger zone, and caution should be observed when using these instruments to see that they are switched on before being taken to the operation table, and removed from the danger zone before being switched off. It seems to me that all these connections could be eliminated, and, say, one specially designed connector fitted, which should be the only possible point at which the circuit could be broken.

It should not be forgotten that a short circuit in battery-operated apparatus can cause currents in the order of 15 or 20 amps., and that there is no protection against this possibility. The ordinary open type, copper wire fuse is useless in this situation, because (1) it operates only *after* the " short " has occurred, and (2) the actual fusing of the wire, and spark at the moment of breaking the circuit defeats its own object. Point No. 1 also applies to mercury overload cutouts.

Finally, I must mention one or two more points which are, perhaps, somewhat less closely connected with this subject. Most theatres have an emergency lighting installation for the operating table ; but in order to maintain the smooth progress of an operation during a mains breakdown, emergency lighting installations should be capable of maintaining the whole of the theatre suite at the full level of the artificial illumination ; and, of course, it should be automatic in action. If, and when, the lights fuse, it is, to say the least of it, somewhat disconcerting, and it is apt to detract the attention of the personnel from the numerous precautions they should observe regarding electrical apparatus. To conform with Home Office recommendations, all switchgear, relays, etc., in connection with emergency lighting installations should be of the sparkless or flameproof type. This is particularly important on portable scialytic lamps.

THE UNITED CARDIFF HOSPITALS

Applications are invited for the post of Group Engineer/Clerk of Works to the United Cardiff Hospitals. Candidates should have served an apprenticeship in mechanical engineering and should possess a qualification at least up to the standard of the Higher National Diploma or Certificate in Mechanical Engineering. They should have a sound knowledge of the principles and practice of the efficient operating of institutional boiler plants and possess wide electrical experience and a good knowledge of building construction. Duties will include responsibility for the operation and maintenance of engineering services generally at the various hospitals of the group and for the maintenance of the buildings. The salary for the post will be (temporarily) £580 x 20—£680 per annum, but this is subject to review when National Scales are agreed for Group Engineer/Clerk of Works of Teaching Hospitals. Transferred officers may opt to retain their existing salaries and conditions of service. The appointment will be subject to the National Health Service Superannuation Regulations, 1947, and (unless a transferred officer) to the passing of a medical examination. A house will be available for the successful candidate at a rental to be agreed.

Applications stating age, qualifications and full details of experience, together with the names of three referees, should be sent not later than 28th April, 1950, to: Arnold Tunstall, Secretary and Principal Administrative Officer, The United Cardiff Hospitals, The Cardiff Royal Infirmary, Newport Road, Cardiff.

OBITUARY.

News of the death of Mr. William Anderson Flack, at the early age of 46 years, came as a great shock to members of the I.H.E. Mr. Flack was one of our very early members, and was for some time a member of Council, and rendered the Institution invaluable service in those pioneering days when we were endeavouring to set ourselves up and become a recognised body.

Mr. Flack was held in high esteem by the Officers and Staff at Runwell Hospital, where he has held the post of Chief Engineer since 1936. The funeral service was held at Wickford Parish Church, and the interment took place at Maldon Cemetery, on Tuesday, March 7th, 1950. Mr. J. H. Hargreaves, Mr. H. Wright, Mr. G. A. Quenet, and Mr. J. Cooper attended, and laid a wreath to pay their last respects on behalf of the Institution.

The Members of the Institution extend to Mrs. Flack their deepest sympathy in her terrible loss.

ANNOUNCEMENTS

ANNUAL GENERAL MEETING
at Harrogate on September 2nd, 1950

The Yorkshire Branch Annual General Meeting Sub-Committee desires to draw the attention of all members to the necessity for returning, as soon as conveniently possible, their requirements for Hotal Accommodation and Luncheon bookings on the counterfoil attached to the Invitation Leaflet, which should by now be in the hands of every Member.

We have had the utmost assistance given to us by the Harrogate Corporation Officials and Hotel Proprietors, and the facilities being placed at our disposal are the best that could be obtained anywhere.

We are, therefore, extremely anxious that this annual function should have a record attendance, which will then give satisfaction, and make the efforts of all concerned really worth while.

It is also desirous, if at all possible, to make the bookings for the Luncheon as accurate a forecast as is possible, and a remittance for the 10/6, along with any request for Hotel Accommodation, would be greatly appreciated.

We would also like members to note that Tea will be served in the Lounge Hall during the meeting, at a nominal charge. Please give us your support.

Yours faithfully,

T. W. BRODIE, *Chairman.*

C. R. THWAITES, *Hon. Branch Secretary.*

Ministry of Pensions Hospital,
Chapel Allerton, Leeds, 7.
24th March, 1950.

ANNUAL SUBSCRIPTIONS

Members are reminded that subscriptions for 1950 became due on January 1st, 1950.

Will members whose subscriptions are still outstanding please remit without delay to : H. S. Clarke, Esq., 14 The Villas, St. Mary's Hospital, Stannington, Morpeth, Northumberland.

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