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CHAIRMAN'S ADDRESS

A REVIEW OF DISINFECTANTS AND DISINFECTION

I HAVE chosen, as my address to the Conference, the subject of disinfectants, not only because of their great importance in the life of the community and the maintenance of our public health, but also because I consider them to be pharmaceutically important. The subject now rightly occupies quite an appreciable part of the study-time of the present day pharmacy student and indeed it is only within schools of pharmacy that the study of the complete subject, the chemistry, the microbiology, the evaluation, standardisation and the formulation is studied as a whole. Moreover the study is easily imposed upon the general groundwork in microbiology and links up with other branches devoted to sterilisation, antiseptics and preservatives. The modern pharmacist therefore should be able to give specialist advice on disinfectants in the hospital to the medical profession, to the public or to public authorities. In the hospital particularly he should be the adviser on the subject and should be able amongst other things to evaluate commercial claims; to be proof against the high powered sales talk, to select the good from the spurious and to exercise a balanced economy with efficiency in the consumption of these products. Certainly he is the only man in the hospital with an all-round knowledge in this particular field. I have used the term "disinfectant" deliberately because it does imply "something which destroys the causes of infection" and that, after all, is the target.

In order to keep this dissertation within reasonable limits, I have, of necessity, had to restrict myself to a review of a few aspects of the subject and in the main I want to deal with (a) the question of evaluation and standardisation of disinfectants and (b) the new type of disinfectant known as the quaternary ammonium compound.

EVALUATION AND STANDARDISATION

When we come to the question of the evaluation and standardisation of disinfectants we immediately enter a field of controversy which is as fierce now as ever, although opinion is hardening as to how it should be effected. Inevitably it revolves around that type of test represented by the Rideal-Walker test and its product the so-called phenol coefficient. Introduced about 1903, this test has emerged fundamentally unaltered through a welter of criticism to its present status as a British Standards Institution test. It is still misunderstood and its intentions are warped

from those of its authors. It is still, often, intentionally misused in advertisement to gull the uninformed layman, yet, this must be said to its credit, it has had the effect of turning off the market so-called disinfectants which were useless. It has acted as a minimum performance test in that respect. In spite of all that has been said on the subject, I still have the temerity to add my quota of argument to the stockpile in the hope that we may define the issues and the possible remedies more clearly. Much of what I shall emphasise has been said before but I still claim that it wants reiterating.

The problem of evaluating a new disinfectant, getting it recognised and used, differs little from that of launching a preparation of a new drug. First we must have uniformity of potency otherwise all subsequent trials have no basis. Moreover the preparation will not be adopted unless the uniformity is guaranteed. In order to assure uniformity of potency we must set up standards and these standards must act as guarantees to the buyer or user. The clinician must have this guarantee otherwise he cannot control dosage and effect. Secondly it must be evaluated in the clinical field.

For the standardisation of potent galenicals we always try in the first instance to set up a specification which includes a chemical assay, but if the drug does not lend itself to this type, then we usually devise a biological assay. It is a poor second method and it is to be discarded if and when a chemical assay becomes available. We, in pharmacy, are well grounded in the principles of biological assay and we know that, first of all, we must set up a standard reference substance against which the unknown test must be compared. The standard and the test must be the same substance or material, i.e., we must only compare *like* with *like*. The comparison of the effects of standard and test must be made at the same time on the same animal or animals or part of an animal. The answer that we get is that the test is x times stronger than the standard, and may then be diluted accordingly. It is important to emphasise that this standardising process merely ensures a preparation of constant potency, and the assay process gives no information whatsoever as to the therapeutic value or dosage on a human.

Let us look at the Rideal-Walker test, whereby the unknown test is compared with a standard reference substance, phenol, by matching the concentrations which will kill *Bacterium typhosum* in distilled water at 18° to 20°C. in a specified time. It is, of course, a biological test, but it breaks one of the most fundamental rules, for the test and the standard may not be, and usually are not, the same. Thus we may be comparing *unlikes,* and these may have quite different characteristics. If the substances are not very dissimilar, such as phenol and cresol, it may not matter, but if we are comparing phenol and chloroxylenol or benzylchlorophenol, the divergence will be much greater. If we attempt to compare a substance which is not a phenol, such as cetrimide, the result is even worse.

Thus two dilutions matched at 20°C. will not match at 37°C. Similarly

if the time be altered or the test organism changed to another type, the dilutions will not match. It has been shown repeatedly that, as a substituted phenol becomes more complex, specificity develops and the substance no longer has the wide kill which is characteristic of phenol and cresol. Thus by changing the test organism from *Bacterium typhosum* to, for example, a staphylococcus a very different picture may be given. Organic matter added to matched dilutions may cause a variance. These are the penalties for comparing *unlikes,* and it follows that in order to get reproducible results with the standard Rideal-Walker test one has to keep a very tight control on all the factors which may cause this divergence, such as temperature, time, the test organism (even to the strain and previous history), the composition of the culture medium and the *p*H. If we were comparing phenol with phenol we should always get the same result no matter how the factors were varied, no matter what time, temperature, medium or test organism were employed.

The Value of the Test

In view of all this, what value has the test? I would offer the following criticisms:—

(a) It is a badly designed biological test because it compares *unlikes,* and, therefore, all the factors which cause variance must be carefully controlled if reproducible results are to be obtained. Reproducible results should, however, be obtained by it; and it could be used as a standardising test, to prove that sample and bulk are identical. But why a biological test for this purpose? The answer must be that we want it only if we cannot devise a chemical or physicochemical specification. Many disinfectants are controlled by the latter method. Thus the Pharmacopœia lays down chemical and physical specifications for lysol, Dakin's solution, solution of chloroxylenol, solution of formaldehyde, cetrimide, phenylmercuric nitrate and acriflavine. Biological tests are not necessary for these in order to get uniformity. It is true that the control of lysol is rather loose, but it could be tightened if it were considered necessary. On the other hand, Black and White fluids are examples, I understand, of disinfectants, where chemical standards could not be set up, yet there must be a standard to guarantee reproducibility of batches. For these preparations, therefore, a standardising biological test is unavoidable as a buying and selling test and the Rideal-Walker test can so function. If it were practicable, it would be far better to set up a standard Black or White fluid as a reference substance. There are, however, difficulties in producing such a standard. I think it is safe to say that, had it been possible to write a controlling monograph for these preparations, they would have been in the British Pharmacopœia or British Pharmaceutical Codex long ago. They are such valuable products.

(b) The result of a Rideal-Walker test, if positive, provides the information that a certain concentration of the disinfectant in distilled water will kill a particular strain of *Bacterium typhosum* at a certain temperature in a certain time.

These observations give us a very small and very limited piece of

information on the performance of a preparation as a bactericide. One might call the Rideal-Walker test a minimum performance test, but it cannot by any stretch of imagination be translated into terms of therapeutic activity or practical applicability and utility. Certainly with it alone no one has the right to market a disinfectant, no matter how large the advertising poster or how persuasive the sales talk. The Rideal-Walker phenol coefficient, by itself, is not dependable evidence of efficiency for varying operations. Yet preparations are still marketed with the phenol coefficient as the sole scientific recommendation. Blazoned forth in public advertisement is the statement that the disinfectant is five times stronger than carbolic acid. It is true that coupled with the statement are the words "phenol coefficient test," but this means nothing to the lay public. The obvious intention of the advertisement is to induce the public to believe that for all purposes the preparation is five times stronger than something they may have heard about, namely, carbolic acid. It is a great pity that the scientific members of organisations marketing disinfectants cannot control their enthusiastic colleagues who are only concerned with efficient advertisement and sales. They must be ashamed of some of the claims which are made.

Official Specifications Required

I would emphasise that, in the first instance, disinfectants must have a specification such as that provided by a B.P. or B.P.C. monograph, preferably with chemical or physical data. If this is impossible, there only remains a biological test such as the Rideal-Walker test. This test can so function, but it would be better to set up standards which would compare *like* with *like*. Such a comparison is the only really useful function of the Rideal-Walker test, namely, to guarantee reproducibility of potency, or what I have called a buying and selling test. The setting up of this type of standard is a minor matter in comparison with the real problem, that of devising tests which will evaluate the utility of the disinfectant after standardisation. It is the problem which we know so well, of a new drug of which the efficiency must be proved by careful experiment and practical trials before being adopted for general use. There is no single standard test which will do this—only the submission of clinical evidence.

So, too, with new disinfectants; an evaluation can only be made by considering the results of many diverse tests. In the experimental stage much information about its possible utility can be obtained by *in vitro* and *in vivo* tests in the laboratory. By ascertaining, for example :

1. The effect of variation of time, temperature and dilution on its bactericidal power.
2. Its value with the above variations against a variety of organisms including spores, and in the presence and absence of organic matter, including blood and serum.
3. Its bacteriostatic values.
4. The effect of possible inactivators.
5. Skin irritation tests and if for wounds, tissue toxicity tests.

6. Oral toxicity tests.
7. *In vivo* tests by an animal method.

These tests, however, are only preliminary sorting tests, for they must subsequently be reinforced by further tests designed to simulate the actual conditions of use. By this time a picture of the utility of the preparation will begin to emerge, judgement can be formed and recognition sought.

Legal Control

But the pertinent question arises as to how such recognition is obtained in this country. The answer is that there is no official body which will adjudicate on new disinfectants, as the Medical Research Council does on drugs, or any legislation which will compel a manufacturer to produce evidence so that claims and performance can be reconciled before the preparation is marketed. It is true that if a disinfectant is labelled or advertised in terms " calculated to lead to its use for the treatment of human ailments, injuries or infirmities " the Pharmacy and Medicine Act of 1941 requires a disclosure of formula, but clever advertisement can avoid these words and still imply utility. Moreover, the disclosure of formula gives inadequate information on performance value. I understand that the use of the word " germicide " is not considered to make the regulation operative and to require disclosure of formula. Certainly the word " disinfectant " does not, but the word " germicide " implies a killing action on bacteria and the word " disinfectant " implies a removal of the danger of infection. It is this latter condition which is the sole object of the use of disinfectants, whether the preparation is applied to a wound or poured down an infected drain. It is a curious piece of logic which distinguishes a difference in intention of these two operations. We do not pour a disinfectant down a drain just for the joy of killing bacteria. We do it to remove the risk of infection and we put our trust in the disinfectant. These words " germicide," " bactericide," " fungicide," " antiseptic " and " disinfectant " should have a legal meaning which guarantees their ability to perform the action which they imply. It is really an amazing fact that Britain—which was, and is, the pioneer in so many reforms for the betterment of public health such as the provision of pure drinking water, sewerage schemes, housing conditions, the production and distribution of wholesome food, the purity of drugs, even the control of ice cream—has produced little legislation to control disinfectants which play such an important part in the realm of public health. Many of the dominions have legislation which demands that disinfectants shall be labelled to indicate the effective strength at which they must be employed and the use to which they may be put. A much more ambitious scheme which operates in the United States of America attempts to enforce special tests and definitions. Sales of disinfectants are controlled by the Food, Drug and Cosmetic Act, the administration of which is in the hands of the Department of Agriculture. In addition to this control, the American Medical Association, through its Council on Pharmacy and Chemistry, exerts an unofficial but powerful

influence by withholding approval of preparations which in its opinion do not satisfy the claims made for them. There is a wealth of accumulated experience here which could be studied by us with advantage.

There is, however, in Britain the beginning of legislative control over disinfectants in the action taken by the Ministry of Agriculture and Fisheries for the purposes of the Diseases of Animals (Disinfection) Order, 1936, wherein is given a list of approved disinfectants together with the dilutions at which they must be used. Also by the Ministry of Food and the Ministry of Agriculture and Fisheries under the Milk and Dairies Regulations, 1949, whereby specifications are laid down for the strength of hypochlorite solutions for use in dairy operations. These Regulations also include a list of approved preparations, together with the names and addresses of the manufacturers. More recently there has been published the valuable Medical Research Council Memorandum No. 11 on " The Control of Cross Infection in Hospitals " which contains, in an Appendix, instructions on disinfection and sterilisation. It gives advice to hospitals on the types of disinfectants to be employed for varied routine purposes and is extensive in its range. The advice given is sound, for it combines efficiency with economy, and there is no doubt that the Memorandum will materially assist hospitals in making wise use of disinfectants. I should like to think that this is a beginning, and that the Ministry of Health might also adopt some similar method to deal with disinfectants as sold on the open market. I am certain that responsible manufacturers will give full support to any constructive proposals for the creation of recognised standards.

The acceptance of a new disinfectant by expert users must of necessity be a slow process and decisions must be cautious until confidence is established. It is obvious that, all other things being equal, the deciding factor must be the cost of operating. If, however, a new substance or class of substance offers some new character, this factor may of itself tend to level out the competition with existing preparations and the newcomer may establish itself on its merits, irrespective of adverse cost. If one looks at the total world output of research for substances possessing bactericidal action, one is amazed at its volume and at the time, thought and ingenuity displayed. Some of the work is of a fundamental character, speculating on mode of action and chemotherapy, but much can be characterised as definite attempts to find compounds which have a commercial value. It is also amazing how very few compounds get beyond the laboratory stage, although they have bactericidal activity. Some few products will establish themselves as specialist preparations in a restricted field such as the treatment of wounds and the sterilisation of skin or surgical instruments, but they may fail in the larger fields of general sanitation, being wrecked on an economic rock, or because they are lacking in all-round efficiency, or possess some unsuitable character.

The Quaternary Ammonium Compounds

Phenols for general disinfection work, and hypochlorites for such purposes as the treatment of water for swimming baths, dairy and food

utensils and for machinery, etc., are so efficient and so economic in use that for some new substance to emerge from the experimental stage and challenge them on their own ground is an event of major importance and interest. This challenge is occurring now with the quaternary ammonium compounds and I believe that there is a very good chance that they will succeed in certain fields, probably at the expense of the hypochlorites. These new compounds have certain properties which the others do not possess, properties which may tend to offset any adverse cost factors even on large scale operations. It is only necessary to follow the literature to realise that a very stern fight is going on with big commercial issues at stake. The new substances passed the laboratory experimental stage long ago and are already in reasonably large scale production.

The quaternary ammonium compounds are, of course, ammonium chloride or bromide in which the four hydrogen atoms are replaced by various organic radicals so that the molecule contains a large hydrocarbon portion in the active ion, as in the soaps. They are colourless, odourless compounds, soluble in water and such solutions possess very high surface activity, exhibit micelle formation and have excellent detergent properties. Generally, the solutions froth very considerably on shaking. The ion to which all their activities are due is the complex cation and this distinguishes them from other detergents such as a soap like sodium oleate, or the so-called soap substitutes such as sodium lauryl sulphate, where the active ions are the anions. Because of this difference they have been called "reversed soaps."

Credit for demonstrating bactericidal properties in these quaternary ammonium compounds must be given to Domagk, in Germany, who in 1935 published a paper entitled "A new class of disinfectant." He demonstrated with the compound, alkyl (mainly cetyl) benzyl dimethylammonium chloride, which was subsequently marketed as Zephiran or Zephirol. This was the beginning of an intensive research campaign, particularly in America, where it fitted in with the search for new detergents, both anionic and cationic. There is a statement in one of these research papers drawing attention to the efficacy of cetyl trimethylammonium bromide as a compound with possibilities. This substance is now in the British Pharmacopœia as cetrimide. The new anionic detergent compounds were also examined for bactericidal power and the general antibacterial picture is that such anionic detergents as show bactericidal action are active only against Gram-positive organisms, the activity increasing as *p*H diminishes. Such cationic detergents as are active show no such specificity, but are active against both Gram-positive and Gram-negative organisms, inhibiting metabolism in concentrations ranging from 1 in 3,000 to 1 in 60,000. Usually their activity increases with increasing alkalinity and diminishes with acidity. They are neutral and stable in solution, non-corrosive to metals, non-irritating in wounds, relatively non-toxic to tissues. Their high surface activity gives a facility for wetting surfaces and penetrating power.

The combination of detergency and bactericidal or bacteriostatic action gives them a special value in the washing of wounds and it is these two

properties also, together with the absence of odour and taste (in the dilutions generally used) which mark these compounds out for use in the larger fields of hygiene, such as the cleansing and sanitisation of milk churns and dairy utensils and machinery, and also the hands of the milker. They are also in the trial stage for the sanitisation of eating and drinking utensils, crockery and drinking glasses in restaurants, hotels and public houses.

It would be unreasonable to expect that the particular properties of any one compound would be suitable for all purposes, for each field has its own special requirements. Thus the tendency to excessive frothing may be a disadvantage in mechanical washers. It is claimed that it is possible to produce a compound which has not this property and yet retains its detergent and bactericidal activities. Hard water tends to reduce the bactericidal activity of the quaternary compounds, but it is claimed that this tendency can be overcome by formulating with alkalis such as trisodium phosphate or sodium carbonate.

There are the all-important questions of (a) toxicity and (b) action on the skin of workers in daily contact with these substances. Here everyone must be very cautious, more especially as these substances may be used in conjunction with the preparation of food and drink and traces of them may be present in the final products. It is relatively easy to conduct experiments on animals to measure chronic and acute toxicity. There is much evidence of this type of test, but it is the very long date test which is important and which is not easy to evaluate. I think, however, after weighing up all the evidence, we can express a preliminary opinion that there seems to be no reason at all to regard these compounds as otherwise than safe in use and probably much safer than some disinfectants which are already established. All this makes a fair picture, but there are of course limiting factors and characteristics which must be understood. I would list these as follows:—

1. They are not very good at killing bacterial spores, and may have difficulty here in competing with the phenols.

2. They are rather susceptible to temperature variations and lose much activity at low temperatures.

3. Hard water tends to reduce their activity, but this can be overcome in sanitisation work by formulating with alkali. The bactericidal action is reduced or even abolished by contact with certain substances, e.g., anionic compounds such as soap, or sodium lauryl sulphate or similar detergents, also by serum, calgon, such phospholipids as lecithin and by ox-bile.

This conception of possible inactivators to the bactericidal action of quaternary ammonium compounds is rather important, particularly as it has been claimed, and also denied, that in certain circumstances bacteria which have been exposed to the action of quaternary ammonium salts and not yet killed, may be rescued if treated with an inactivator. Much work has been done on the mode of the bactericidal action of these compounds, and there is insufficient time to discuss fully the conclusions.

Quite simply, it may be stated that the first stage in the killing is one of adsorption of the quaternary ammonium compounds on to the bacterial surface. In this condition the organism, although still alive, cannot multiply even in a culture solution. This is a period of bacteriostatis which can be brought about by low concentrations of bactericide. Incidentally, it has been shown that during this period the bacterial cells leak nitrogen and phosphorus compounds into the surrounding medium and, unless the adsorbed layer is washed off or desorbed, the organisms dies. The action is almost analogous to the hæmolysis of red blood cells. Thus, in ordinary circumstances, the reaction is irreversible and leads to death.

This picture of the mode of action of quaternary ammonium compounds and of possible inactivators is most important, for so much follows from a proper understanding of it. Research, particularly in recent years, has provided much information on the mode of action of other bactericides and examples of inactivators in such action. One can, however, go back to the early days of disinfectants for the first example when Koch in 1881 registered the claims of mercuric chloride as a powerful and reliable bactericide. It was Geppert, in 1889, who showed that the action was only inhibitory, and that the organisms could remain viable for several years after treatment with mercuric chloride. They appeared to be dead because they would not grow in culture solution. If, however, they were treated with ammonium sulphide and then placed in a culture medium, they would multiply. This exposure of a pseudo-killing action did not eliminate mercury compounds from the disinfectant field, for other mercury compounds were devised such as mercuric potassium iodide, in which the mercury ion is a complex ion, and the organo mercurials, such as merthiolate, phenylmercuric nitrate, metaphen and mercurochrome. All these compounds would not react with ammonium sulphide, and it was claimed that, although they exhibited an extraordinary bacteriostatic action, they were bactericidal as well. We know now, thanks to the work of Rapkins in 1931 and Fildes in 1940, that even these complex mercurials will react readily and stoichiometrically with certain thiol compounds, and the resulting compound has no bactericidal action. Moreover, it was shown that organisms after exposure to these materials entered into a state of bacteriostasis and would not multiply, but if they were then treated with a thiol compound they would revive and multiply. The effect of this work appeared to reduce these newer mercurials to the rôle of bacteriostatics. Thus the thioglycollate could act in two ways; first as an inactivator of the mercury compound when mixed with it prior to, or at the time of, meeting the organisms, and as a reviver of mercury-treated organisms, if it were added after the mercury compound had acted upon organisms.

It is important to appreciate this dual action of the thioglycollate as an inactivator and as a reviver. Now, all inactivators will not function as revivers, for when certain bactericides come into contact with bacteria they may start a reaction which, in the light of our present knowledge, appears to be irreversible. We do not know of a reviver for phenol-

treated organisms, but revivers have been found for iodine, hypochlorites and formaldehyde.

Of ultimate importance is the fact that certain thiol compounds, such as glutathione occur in body tissues and evidence is accumulating that if pathogenic organisms, after exposure to mercury compounds, are injected parenterally, they may be revived and become infective. This is undoubtedly an alarming fact and we must take it into account in our work and try to evaluate it. This conception of a "false" death or bacteriostasis produced by certain bactericides which formerly we have regarded as quick killers often comes as a shock, and so, too, is the fact that the organisms may recover from the effects of the bactericide if suitably treated.

Design of a Test

What, then, should be the design of a test for disinfecting reaction? The instructions in the British Pharmacopœia under tests for sterility are evidently inadequate, for in order to prove loss of infectivity, it is not sufficient to (a) dilute out in the case of phenols or (b) add a suitable substance which will neturalise the inhibitory effect of the bacteriostatic. It is necessary to add what I have called a "reviver," something which will reverse the reaction which has begun upon organisms and revive them. But if after exposure to the bactericide the organisms are doomed to die unless rescued, why try to rescue them? I would like to suggest that the word "disinfectant" provides the answer. The dictionary meaning of the word is "anything which destroys the causes of infection." The causes of infection are, of course, the multiplication of pathogenic micro-organisms after entry into the animal or human body and any substance which is the active agent in preventing this is acting as a disinfectant. It may work by killing the organisms either in a wound on the skin, down a drain or in the air; the locality is not an issue. It could also work by acting upon the organisms and producing a state of stasis leading to death, always provided that the body does not provide in the tissues, mucous surfaces, alimentary or pulmonary tract, a substance which can reverse the reaction and revive treated organisms. The discovery of a reviver which acts only *in vitro* and does not occur in the body, is usually of academic interest only.

Reverting to the case of the quaternary ammonium compounds, which in high concentration are probably bactericidal, but in lower concentrations show this period of bacteriostasis preceding death, how will they evaluate out in a prevention of infection test? The evidence at the moment is that, in the concentrations now being recommended for sanitisation purposes, there is no reason to believe that the body would reverse the reaction, as it appears to do with mercury compounds. If we are satisfied with this conception it will make a big difference in the economics of the quaternary ammonium compounds, for they can then be used with confidence in less concentrated solutions.

With regard to the standardisation of quaternary ammonium compounds, it would be absurd to attempt to affix a phenol-coefficient figure

to them, no matter whether it is intended as a standard for reproducibility of potency or as indicating some therapeutic or clinical activity. Surely the constancy of composition could be standardised chemically or physico-chemically whereas the evaluation of utility must rest on many diverse tests and be decided on experience. If it is necessary to have a biological standard and to set up a standard reference substance, let the latter be a pure sample of a particular quaternary compound.

In such sanitisation work as the treatment of dairy utensils and machinery, eating and drinking utensils, etc., there is no necessity to demand a 100 per cent. kill. Any tests applied should be based upon the power of the disinfectant to reduce considerably the bacterial population, an effect which is quite satisfactory in practice. This is another reason why a Rideal-Walker type of method is unsuitable. I do not wish to imply that all sterilising operations could have an end-point which depends on a reduction of the bacteria present, for 100 per cent. death must be guaranteed in such cases as parenteral injections, surgical instruments, sutures and dressings and, if I may instance that extraordinary feat of technical skill, the provision of sterile air for aerating deep-tank culture media.

Finally, I would plead that in spite of this panegyric on a new class of disinfectant, the older types should not be lightly discarded. The hypochlorites are a very valuable weapon against infection and will continue to solve problems which other compounds will not solve. I have great confidence in the phenolic preparations, lysol and the Black and White fluids, because their wide non-specific action makes them very reliable. I would plead with those who decide these things in hospitals to pause before substituting for these preparations something new which is offered and to seek expert advice. This plea is strengthened by the advice given in the Memorandum of the Medical Research Council, which I have mentioned. I would make a special plea for lysol, which has suffered in competition with preparations that depend for their action on chloroxylenols only. These latter substances are often formulated to produce a high anti-typhoid effect and, therefore, appear desirable on a Rideal-Walker phenol coefficient basis but their action is usually poor against the staphylococcus which is such an important pathogen. The older phenolic preparations have been good servants in hospital practice and provide a greater margin of safety in use than many of the newer preparations.

What hospitals require is a new phenolic preparation as economical in use as lysol and with all its desirable properties. It should have a wide and quick kill, produce a clear dilution with water, have a detergent action, and yet be non-toxic and non-irritating to the skin.