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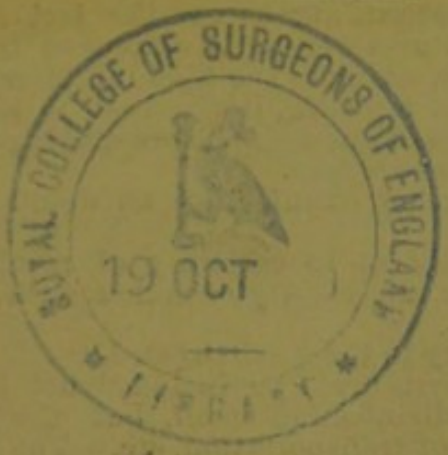

NOTES ON HOUSEHOLD DISINFECTION BY FORMALDEHYDE.

Paper read in the Section of Pathology and Bacteriology, at the Annual Meeting of the British Medical Association held in Montreal, September, 1897.

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DURING the past year the use of formaldehyde as a disinfectant has been greatly increased in America, its efficacy having largely become known through the work of Dr. J. J. Kinyoun and Professor F. C. Robinson. It is astonishing how little we actually know of what actually happens in the ordinary routine disinfection of rooms by different methods in comparison with our knowledge of what happens under more rigid experimental conditions. It seemed that devising simple and fairly uniform methods of testing room disinfection which would enable it to be done by the ordinary sanitary officials in the regular course of their duties, important information could be obtained which would be of service in making a choice of methods.

I have designed a little outfit for use by the Board of Health of the Province of Quebec for this purpose, in which by having the infected test objects (small bits of rubber bands dipped in bouillon culture) placed in muslin packets of distinctive colours, the degree of penetration of steam or disinfectant vapours can be tested by an unskilled person (a red packet is exposed near source of disinfectant, a yellow packet is exposed far from source of disinfectant, a green packet is covered lightly or placed in a pocket, a blue packet is covered deeply in a blanket roll or in a mattress). The packets to go in an envelope marked with blank spaces for details as to cubic space, amount of disinfectant used, etc., and can be sent by post. The use of colours and a small metal fastening for the packets also enables any bleaching or tarnishing effects to be detected. These were invariably present with sulphur fumigation, never with formaldehyde. During the past year, a good deal of disinfection of elegant private houses has been done by us. No injury whatever has been reported from formalin. In planning the test outfit, valuable advice was received from Dr. W. H. Park (New York). Practically these test outfits were found to

answer well. Staphylococcus aureus was the test organism chiefly used. Spore cultures were only employed in case of steam. We found that, owing to the high inhibitory powers of even minute traces of formalin, it was best to neutralise the test objects in excess of ammonia before making cultures, or to allow several hours to elapse.

The desiderata in room disinfection we would rank as follows:

1. Efficiency especially as to certainty of result under known conditions. The uncertainty of action with sulphur gas is a great drawback.
2. Freedom from injury to the goods treated.
3. Cost, in which there must be included not only the direct outlay for the disinfection itself, but the cost of apparatus, staff, means of transportation, etc. The methods in general use are disinfection by solutions and fumigation by sulphur or formalin, with steam for articles which require penetration. Preliminary fumigation, so as to disinfect the surfaces of articles to be removed for steam treatment is a safeguard, but causes delay.

What I have to report at present concerns the use of formaldehyde. As is well known, solutions of this substance are powerful and rapid disinfectants, and the vapour has shown considerable powers of penetration. If not so rapid in its action as steam, it is far more certain than sulphur gas, and has no tendency whatever to destroy goods.

In room disinfection I have chiefly employed regenerators, by which the gas is liberated under pressure from a mixture of equal parts of formalin and 20 per cent. calcium chloride solution. The small apparatus made by the Sanitary Construction Company (New York) has been found on the whole most convenient, though I have tried a number of others. My experience with formaldehyde lamps has been less satisfactory. Their effects seemed uncertain, and a quantity of methyl alcohol vapour passes off unconverted as the draft of the lamp increases. The results as to penetration were relatively more satisfactory when the lamps were used in a small enclosed space than would be expected from the results obtained in ordinary rooms.

We found that it was advisable to use larger quantities of formaldehyde than are generally advised, and our results, at first disappointing, became very satisfactory upon using 1 lb. of formaldehyde per 1,000 cubic feet or 1 quart wood alcohol for the same space, and prolonging the actual time of generating the vapour to from one to three hours. We notice that others who, at first, recommended smaller amounts, now advise larger ones. Most of those who report poor results with formaldehyde use small amounts of the agent. Those whose results are surprisingly good with minute quantities of disinfectant we find usually employ culture methods, which do not exclude all inhibitory effects.

The cost for private disinfection is not considerable, at the rate of 25 to 30 cents per lb. per 1,000 cubic feet, and though this would be relatively high in municipal work, it is not at all prohibitory. With these quantities, we succeeded in most instances in securing sterilisation of the exposed objects, and of a large proportion of these lightly covered, that is, placed in pockets or beneath the bed clothes or pillows, but in room fumigation, test objects placed inside blankets or inside matresses were not sterilised. We have to deal in the con-

tents of an ordinary sick room with several different sets of articles. First, surfaces curtains which are relatively accessible to vapours. Secondly, carpets and hangings, which are less accessible. Thirdly, blankets, mattresses, and pillows, which are difficult to penetrate. In order to disinfect articles of the second and third classes in an ordinary room, a great excess of vapour and consequent waste is necessary. By the use of closed chambers, a greater penetration of the vapour can be secured, and a smaller amount is required. The vacuum method of securing penetration does not appear to give the same rapidity of effect that it does in the case of steam. We have been able to secure complete sterilisation in two hours of test objects placed in a closely rolled blanket, by using a vacuum of 15 inches followed by an air pressure of 10 lbs. In this apparatus, however, the steam jacket had to be incidentally heated in obtaining the vacuum, and the action of formaldehyde is known to be increased in proportion to the temperature. In any case, the use of a vacuum does not make penetration a matter of a few minutes as in the case of steam.

Placing the articles in a cupboard or trunk, and blowing in the vapour usually gave fair penetration, if excess of vapour was used. Pasting up minute cracks does not appear to make much difference. Though no large crevices or draughts should be allowed in the room we found it quicker and less troublesome to generate an excess of the vapour than to paste up cracks. I have devoted some attention to constructing a portable chamber or receptacle suitable for room disinfection. One such chamber, 40 inches by 30 inches by 60 inches, made of galvanised sheet iron was light enough to be carried (with some difficulty) on a stretcher by two men, and could be closed so as to give a vacuum of 2 to 3 inches. This was found clumsy in actual practice, and the saving in time did not permit of its being used in two places on the same day. Out of door disinfection is out of question in a Canadian winter. Recently I have tried the plan of using a tent or canopy with those articles requiring most penetration placed beneath it, spread out on convenient articles of furniture. The gas being conducted under this by a rubber tube gave some increase of penetration, while enough escaped from beneath it to sterilise the exposed surfaces in the room.

My latest attempt in this direction has been the construction of bags which are as nearly as possible air tight or gas tight. The cost does not exceed 5 to 8 dollars for one as large as an ordinary disinfectant chamber, 5 ft. by 3 ft. by 4 ft. By using "enamelled duck" and having a projecting flap round the open end so as to be rolled up with a corresponding flap of the cover, the sealing up is fairly good, though capable of improvement in construction. Owing to an unexpected interruption to work, I have not yet had an opportunity of testing this apparatus thoroughly at the time of the meeting, but it appears worthy of trial to see whether the best results are got by blowing in the vapour and by placing in articles which have been sprayed with formalin solutions. Carpets, rugs, mattresses, and pillows can be well sprinkled without being drenched, and placed in the bag, or when the articles cannot stand direct wetting, clothes drenched with the solution can be placed inside. In this way the effects of disinfectant spraying are greatly enhanced, though to what precise extent this may prove useful in room disinfection I am not

at present able to say. From the first, I have been strongly of opinion that methods which permitted of all the articles in the sick room being disinfected without the necessity of removal was very desirable for localities unprovided with larger disinfecting plants and staffs, and that even in cities, economy might be effected by thus doing away with transportation.

With regard to disinfecting solutions, my favourite one is formalin used by means of a pump or spray, as suggested by A. C. Abbott. A ½ to 1 per cent. solution seems sufficient, and the cost of this, though more than than that of 1-1000 sublimate, is only about two cents per gallon. The pump used costs a few shillings, and weighs but a few ounces, but apparently answers just as well as the heavy and expensive Equifex sprays sold for the purpose. The public need clearer ideas of the "effective cost" of different disinfectant solutions—that is to say the cost of a given quantity of solution of effective strength. I think that the adoption of a uniform standard, say, that sufficient to destroy staphylococcus aureus in five minutes would be a convenient strength for house disinfection. The effective cost of several disinfectants is about as follows, when used in amounts generally required for private disinfection:

Carbolic acid, 1-30, costs 7 cents per litre.

Sublimate, 1-1000, costs ¼ cent per litre.

Formaldehyde, 40 per cent. strength, 1-200, costs ⅓ cent per litre.[1]

Few realise the waste of money involved in the use of carbolic acid. The cheaper grades sold as carbolic acid contain practically no phenol at all. Other things being equal, I think that preference should be given to substances which are not poisonous. I need not here go into the matter of formalin vapour for treating goods liable to be injured by steam or disinfecting solutions further than to say that it is a most satisfactory agent for this work for which we previously had no reliable method. Whether the dust in the walls and cracks are absolutely sterilised or not by fumigation, most sanitarians will agree that the average fumigation suffices to remove the danger of infection from exposed surfaces, as far as can be judged from epidemiological evidence.

NOTE.

[1] Recent reports seem to show that the very conservative estimate of the effective strength assigned to formaldehyde is too low. Thus Le Dentu (*Sem. Méd.*, 1897, p. 315) stated that instead of the 40 per cent. commercial solution being one-fifth as effective as the same weight of sublimate it is really twice as effective in equal quantities. This, if true, would raise the effective strength of formalin and formol to tenfold what is represented in the table.