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# The Royal Sanitary Institute

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## REPORT ON, AND SCHEDULE OF, EXPERIMENTS WITH DISINFECTANTS.

BY

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AND

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## SPECIAL COMMITTEE APPOINTED BY THE ROYAL SANITARY INSTITUTE.

## DISINFECTANT STANDARDISATION COMMITTEE.

In the course of their consideration of the above subject, the following Report of Experiments made on behalf of this Committee has been submitted to them by Lieut.-Col. R. H. FIRTH, F.R.C.S., D.P.H., R.A.M.C., and Professor Allan MACFADYEN, M.D., B.SC., F.I.C.

FOR the further elucidation of the question as to what method is best adapted for the routine standardisation of disinfectants, your Committee requested us to carry out additional experiments to those which have already been submitted.

The accompanying schedule presents the results of a large number of observations which have been made under our supervision by Major C. E. P. Fowler, R.A.M.C., in the hygiene laboratory of the Royal Army Medical College on behalf and at the expense of The Royal Sanitary Institute.

The general plan of these experiments has been to test the comparative value of three methods, namely "the Garnet," "the Thread," and the "Drop," using as test micro-organisms (1) spore bearing anthrax bacilli, (2) various strains of the *B. typhosus*, and (3) the *B. produgiosus*. The selection of these particular varieties of bacterial life was made because they respectively represent a typical resistant pathogenic form, a typical fæcal pathogenic micro-organism, and a typical saprophytic microbe. A few observations have been made with the cholera vibrio. Further, the experiments have been carried out to determine, if possible, whether bichloride of mercury could be utilised as the standard reagent in place of phenol, as had been suggested previously, and also to test the three methods with a variety of commercial disinfectants in common use.

#### Report on Experiments with Disinfectants.

The "Garnet" method employed is a modification of that suggested by Kronig and Paul, and has been described already in the proceedings of your Committee. When working with bichloride of mercury, the garnets were washed with sterile saturated ammonium sulphide solution, but when other disinfectants were used, the garnets were washed only in sterile distilled water before being transferred to the broth sub-culture tubes.

The "Thread" method has been carried out in the following way:

Apparatus required :-

18

- 60 sterile watch glasses.
- 30 tubes of nutrient broth.
- 1 sterile test tube.
- 1 sterile glass funnel.
- 1 sterile filter paper.
- 30 sterile silk threads, one inch in length of standard calibre. The standard employed has been Pearsall's flannel embroidery, silk size No. 4 (extra stout), cream colour.
  - 1 empty sterile Petri dish.
  - 2 sterile Petri dishes, each containing two sterile filter papers. Some sterile distilled water.
  - 2 twenty-four-hour agar growths of micro-organisms under observation.

Technique.—An emulsion of the micro-organisms is made by adding 5 cc. of sterile distilled water to each of the agar slope growths and carefully scraping off the growths by means of a platinum wire loop, followed by gentle agitation. The resulting emulsions are then filtered through the sterile filter paper into the sterile test tube. The filtrate there collected is now poured into the sterile Petri dish, and 30 silk threads (of standard length and thickness) soaked in the filtered emulsion for one hour at  $37^{\circ}$  C. After soaking for an hour, each thread is transferred separately by means of sterile forceps to the two other Petri dishes, which have the filter paper covering their bottom. Excess of emulsion is thus absorbed, and the two dishes, with their contained infected threads, allowed to dry by placing them in the  $37^{\circ}$  C. incubator for 20 hours.

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Nature and Dilution of Reagent employed.	Group L of watch glasses containing diluted Disinfectant. Period of Contact in minutes.						cor	tainir	II. of ng Wa ashing	ter, or	Sulp	hide
-outing to real as side of its	24	5	7.5	10	121	15					a cara	
X disinfectant 1-400 E	0	0	0	0	0	0	0	0	0	0	0	0
" " 1-300 D	0	0	0	0	0	0	0	0	0	0	0	0
" " 1-200 C,	0	0	0	0	0	0	0	0	0	0	0	0
" 1-100 B	0	0	0	0	0	0	0	0	0	0	0	0
Phenol " 1-80 A	0	0	0	0	0	0	0	0	0	0	0	0

Diagram illustrating the working of the " Thread " Method.

The 30 broth tubes are arranged in a convenient rack or stand, and marked as belonging to one or other of five groups, A, B, C, D, and E, that is, each group contains six tubes. Each tube is further marked with a number signifying the confact period in minutes. Then, if a maximum 15 minutes contact be decided upon the tubes would be variously marked, A2<sup>1</sup>/<sub>2</sub>, A5, A7<sup>1</sup>/<sub>2</sub>, A10, A12<sup>1</sup>/<sub>2</sub>, A15, B2<sup>1</sup>/<sub>2</sub>, B5, B7<sup>1</sup>/<sub>2</sub>, and so on.

The 60 sterile watch glasses are now arranged in rows, as evident from the accompanying diagram, and divided into two groups of 30 each, namely, Group I. and Group II. Each group contains five rows of six watch glasses. Into those of Group I., sufficient disinfectant solution (of varying dilution) is placed to fill each watch glass. The rows in the group being distinguished by the letters A, B, C, D, E, from below upward. Each row of watch glasses in Group I. will contain a definite dilution of any given disinfectant. Thus, in the diagram, the lower or A row is shown to contain phenol (1 in 80), while the other rows B to E contain varying dilutions of whatever reagent is under comparison. The vertical rows of watch glasses are marked with figures corresponding to those on the broth tubes in the rack, and representing whatever period of time the thread is left in contact with the disinfectant. This is conveniently expressed in minutes.

The watch glasses in Group II. are similarly arranged, but all filled with sterile distilled water, or when working with bichloride of mercury, with sterile ammonium sulphide solution.

Single prepared threads from the Petri dishes in which they have been drying are now placed as quickly as possible in each of the watch glasses of row A in Group I. In half-a-minute from the start, or at such interval of time as has been decided upon for the experiment, other single prepared threads from the Petri dishes are placed in the glasses of B row of Group I., and so on until each watch glass in Group I. has received a thread. Assuming that the experiment has been planned for half-a-

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minute interval, a period of 21 minutes will have elapsed between the transfer of a thread into the first watch glass of row A and of one into the last glass of row E. The thread from the first glass in row A of Group I. is now rapidly transferred by means of sterile forceps to its corresponding watch glass in row A of Group II., and agitated in the water or ammonium sulphide, as the case may be, and left there. On the elapse of halfa-minute from the commencement of this transfer of thread from glass A21 I to A21 II., the thread from B21 I. is transferred to and washed in its corresponding watch glass in row B of Group II. The thread left in A21 II. is now rapidly placed in its corresponding broth tube marked A21. This is readily performed in the half-minute, which makes it time to transfer the thread from  $C2\frac{1}{2}$  of I. to its corresponding watch glass in row C of II. So soon as this is done, the thread which has been left and washed in the glass B21 of Group II. is transferred to its corresponding broth tube marked B21. Another half-minute will now nearly have elapsed, and so soon as it has elapsed, the thread from the first glass of row D in Group I. must be transferred to its corresponding watch glass in row D of Group II. and so on. As soon as the thread in the first glass of row E1 has been washed, and that of D23 transferred to its own broth sub-culture tube, five minutes will have elapsed from the commencement of the transfer of threads to the first glass in A1 row, and it will be time to deal with the thread in the second glass of row A1. In this manner, with half-minute intervals, the whole series of threads can be exposed to varying periods of contact in different dilutions of disinfectant, duly washed and transferred to broth for sub-culture. The interval can be made to vary according to the needs of the operator.

On completion of the whole experiment, the broth tubes, each containing a thread, are incubated at a temperature suitable for the microorganisms employed, and the results duly recorded. In experiments with anthrax spores the incubation has been maintained for a week, with B. *typhosus* two days, and with B. *prodigiosus* five days.

This thread method presents many points of similarity in the matter of its general design to the "Drop" method as devised by Rideal and Walker. In actual practice its working is easier than the verbal description may imply.

The "Drop" method employed in these experiments is that described already by Rideal and Walker.\*

In all the experiments, irrespective of method, the following conditions have been observed:—(1) The observations have been made at room

<sup>\*</sup> Journal of Sanitary Institute, Vol. xxiv., 1903, p. 424.

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temperature, the same being duly recorded; (2) the nutrient broth has been made invariably from chopped fresh meat with the addition of peptone and salt, the finished medium having a standard reaction of +15All tubes of nutrient broth contained 10 cc. of the fluid.

With the exception of experiments, Nos. 102, 103, 104, 105, 120, 130 to 140, in which 24 hour broth cultures were used, all the observations with *B. typhosus* and *B. prodigiosus* have been made by adding to the various dilutions of the disinfectant a filtered emulsion of the organism, made by scraping the growth off a 24-hour old agar slope culture and emulsifying in 5 cc. of sterile distilled water, subsequent filtration and breaking down of lumps being secured by passing through a sterile filter paper in a sterile glass funnel. In the case of anthrax cultures, these were all seven day old growths and always contained spores, as verified by microscopical examination. The subsequent preparation of the emulsion has been explained.

In the "Drop" method experiments with bichloride of mercury, the tubes of broth for sub-culture have in the majority of cases received two drops of sterile saturated ammonium sulphide solution. The addition or withholding of the sulphide to the broth in each experiment is noted in the schedule in the column devoted to method. In the same column is noted also the temperature at which the experiment was carried out.

Practically, throughout the series of "Drop" experiments, the same circular platinum loop has been used for inoculating the sub-cultures; the size of the loop being 3 mm. in diameter, and the calibre of the wire 0.4 mm.

With the exception of experiments Nos. 131, 133, and 140, in all the "Drop" method observations, the platinum needle with loop has been boldly passed into and agitated in the mixture of disinfectant and culture. In the case of the three exceptions named, the platinum loop was allowed only to drop gently below the surface of the fluid.

With the exception of experiment No. 137, one drop of infecting emulsion or broth culture has been added for each cubic centimetre of diluted disinfectant, and, as in all cases, 5 cc. of diluted disinfectant has been used, each of these tubes has received five drops of infective material. In the exception quoted, 1 cc. of the infective fluid was added to 5 cc. of the diluted reagent, and the figures in the schedule showing the dilution of the reagent employed in the experiment are those of the actual and final dilution, after the addition of the extra volume of infecting fluid.

In experiments Nos. 92, 124, 126, 127, and 128, the efficiency of the reagent in the presence of organic material was tested, by making the

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required dilutions of the reagent, not with sterile distilled water only, but with four parts of sterile water and one part of sterile urine.

While fully recognising that the precise interpretation to be placed upon these scheduled experiments rests with your Committee, we venture to express our own views as to the conclusion which we ourselves think may be deduced from the work of Major Fowler.

As to the "Garnet" method, we think the results are too irregular to justify its adoption as a means of obtaining any comparative figure of disinfecting efficiency.

By the "Thread" method we are of opinion that a co-efficient or measure of comparative efficiency can be obtained, but the experiments so far made indicate that such coefficient ( $qu\hat{a}$  phenol) will be lower than that obtained by the drop method. This does not militate against its value, as this lower figure appears to be constant for all commercial disinfectants; it is a point, however, to be noted, as it is quite clear from the results before us that a given disinfectant may have say a phenol coefficient against a particular micro-organism of nine or ten by the drop method, and but one or two by the thread method. The importance of stating by what method the co-efficient has been obtained in any given case will be obvious.

We consider the technique of the "Thread" method to be so elaborate that, no matter what may be its merits, its adoption as a standard procedure seems impossible. It is eminently unfitted for working with micro-organisms at all sensitive to desiccation; see experiments Nos. 59 and 60.

In working the "Thread" method with ordinary disinfectants other than bichloride of mercury, it was found necessary to double the contact period, as will be seen by reference to experiments Nos. 26 to 60, all of which show twice the contact period as compared with experiments 16 to 25.

Provided the operator works in a room free from obvious draughts or air currents, in spite of the apparent risks of contamination by exposure of the watch glasses to the air, we find that chances of error and vitiation of sub-cultures by contamination are so remarkably small as to constitute a negligable factor.

As to the "Drop" method, we consider that, for general simplicity and facility of working, it is superior to both the garnet and thread methods, yielding in most instances results which are sharper or more definite. It must, however, be noted that even with this method difficulties are met with in securing clear and sharp results; the disturbing factors being variations in temperature rather than variations in the strain of the same species of micro-organisms employed, and any slight differences in personal technique.

The question of temperature is very important, as the higher or lower temperature of the room in which a given experiment is carried out materially affects the efficient action of certain disinfectants, particularly phenol and the phenoloids. We anticipate some difficulty in insisting upon any precise temperature at which this class of observation should be made, but we suggest that consideration be given to the point whether a range of from 60° to 65° F. should not be laid down as desirable in standardisation experiments.

The influence of variations in strain of micro-organisms is a difficult one, and too much importance must not be attached to it, as the experiments, submitted herewith, show that the behaviour of several strains of B. typhosus in the presence of various disinfectants in corresponding solutions is remarkably similar. We are impressed with the fact that different strains of B. typhosus present certain differences as to tendency to clump, and for this reason admit some predilection for the employment of filtered cultures of this micro-organism, but the erro. from this source we think is small, provided that due care be taken to see that the particular strain employed is normal in all its cultural features. It is noticeable that the results with B. prodigiosus are largely concordant, and we suggest the advisability of your Committee considering whether it might not be advisable to employ a simple saprophytic micro-organism possessing well known stable cultural features, such as the B. prodigiosus as the standard against which to test the comparative efficiency of different The phenol coefficient of many commercial disinfectants disinfectants. in relation to this micro-organism appears to be nearly the same as that given when B. typhosus has been used in standardisation experiments.

An extended experience of the "Drop" method impresses us with the view that no coefficient should be deduced from any particular experiment unless there are at least two negative results in the phenol or comparative reagent line. Further, that before stating that any given disinfectant has a definite coefficient as against a particular micro-organism by this or any other method, the same result should be obtained in not less than three out of five observations, and with more than one sample of the reagent.

We are strongly of opinion that the practical value of any statement regarding a disinfectant would be enhanced if a duplicate series of experiments be made, using for its various dilutions not simple sterile water, but

#### Report on Experiments with Disinfectants.

sterile water containing some organic matter as represented by the addition of sterile urine. The importance of this point is manifest in experiments Nos. 92, 124, 126, 127, and 128, in which the phenol coefficient of certain reagents differs markedly according as to whether organic matter be present or not.

As an alternative method, we direct attention to experiments 141 to 155, in which, in place of testing the disinfectants against "naked" bacteria, that is pure cultures suspended in either sterile water or broth, the reagents have been tested against an emulsion of fresh fæces and urine. This has been prepared by rubbing up one gramme of fresh fæces in a mortar with 100 cc. of fresh urine, the whole being roughly strained by passage through an ordinary filter paper to remove clumps. This mixture contains many micro-organisms, and approximates in general character to the material against which disinfectants would be generally used in daily practice. Three cubic centimetres of this foculent emulsion were placed in the test tubes, and an equal volume of various dilutions of the disinfectants added, the subsequent technique being that usual in carrying out the "Drop" method. The dilutions shown in the detail of experiments are those actually resulting after adding an equal volume of diluted re-agent to the fæculent fluid. Thus, where a dilution of 1 in 100 is shown, it means that three cubic centimetres of a 1 in 50 dilution of a given disinfectant were added to a similar volume of urine and fæces, the final dilution being then 1 in 100. If the results be read off and taken after 24 hours' incubation, remarkably constant and sharp results are obtainable, and quite as good as those obtained when working against "naked" bacteria. If the results be taken after a more prolonged incubation irregular readings are obtained, owing to the development of adult forms from pre-existing spores; but if the result be taken at 24 hours, the effects are recorded only so far as relates to non-sporing microorganisms. The procedure entails little or no extra trouble, and has the advantage of standardizing the disinfectant against a natural mixture of bacteria, resembling the material against which the reagents are likely to be used in medical practice.

The evidence in favour of the superiority of phenol over bichloride of mercury, as the standard reagent for comparison, appears to us to be overwhelming.

In conclusion, we wish to place on record our appreciation of the time and labour which Major Fowler has given to this inquiry.

> R. H. FIRTH. Allan Macfadyen.

November 24th, 1905.

R. H. FIRTH AND ALLAN MACFADYEN.

No. of	Method and Tem- perature	Micro- organisms.	Disinfectant.	Dilution.	Le	ngths		osure o nutes,	r Cont	act	Perio and Tempera- ture of
Expt.	at which performed.	organisms.	1. 18		$2\frac{1}{2}$	5	71	10	$12\frac{1}{2}$	15	lacuba- tion.
1	Garnet	Anthrax,	HgCl.	1:1100	+						7 days
1	62° F.	spore-		1:1050	+	+	+	+			at 37° C.
	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	bearing	1 14	1:1000	+					+	
	1 44	10000	The state	1:950		+		+			
	a area	and the		1:900		+		•••			
2	Garnet	Anthrax,	HgCl <sub>2</sub>	1:1100	+	+	+				7 days
1	62° F.	spore-	0 2	1:1050	+	+	+		+		at 37° C.
	and the	bearing	and a second	1:1000	+	+	+				
	the second	+ 5	and the second	1:950	+	+	+				1
		1		1:900	+	+	••••		+		
3	Garnet	Anthrax,	HgCl <sub>2</sub>	1:1100	+						7 days
	60° F.	spore-		1:1050	+						at 37° C.
		bearing	and the second	1:1000	+						
	-		131-1	1:950	+						
		1	1 1 1 1 1 1 1	1:900	+						
4	Garnet	Anthrax,	HgCl,	1:250	+	+	+				7 days
0	61° F.	spore-		1:20J	+						at 37° C.
		bearing	Her I -	1:175	+						
			and the second	1:170	+						1.00
	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	2.2.9	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1:125		+					
5	Garnet	Anthrax,	HgCl,	1:250	+	+					7 days
	62° F.	spore-	Boul	1:200							at 37° C.
		bearing	1.58	1:175							
	Sector .			1:150		+					
	-	1. 1. 1. 1. 1.	1.200	1:125				• • •			
6	Garnet	Anthrax,	HgCl <sub>2</sub>	1:500	+		+				7 days
0	60° F.	spore-	ingoig	1:400	+		+				at 37° C.
	00 11	bearing	1	1:300	+						A State of
				1:200							
				1:100		•••					
7	Garnet	Anthrax,	HgCl <sub>2</sub>	1:150			+				7 days
	59° F.	spore-	ingoing	1:125		+	+				at 37° C.
	00 11	bearing	1000	1:100	+	+	+	+			
			1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	1:75	+			+		•••	
	1	-14	WIT - The	1:50					+		
8	Garnet	B. typho-	HgCl <sub>2</sub>	1:25000			+	+			2 days
0	61° F.	sus	inger2	1:20000	+	+	+			+	at 37° C.
	01 1.	ous		1:15000	+	+					1299
	1 the second		and the second	1:10000							100
	1.00	and the second second	Phenol	1:120	+	+	+	+	•••		
0	Canad	P. turbe	HaCl	1:30000	+	+	+	+	+	+	2 davs
9	Garnet 63° F.	B. typho-	HgCl <sub>2</sub>	1:25000	+					+	at 37° C.
	00 F.	sus		1;20000	+	+	+				
	1		the second second	1:15000			+				
	1 1 1		Phenol	1;120	+	+		•••		•••	10.3
-	0	n.	Heft	1:35000		+	+				2 days
10	Garnet	B. typho-	HgCl <sub>2</sub>	1:30000				+			at 37° C.
	62° F.	sus		1:25000		+				+	
		1	Phenol	1:120	+	+	+	+		+	
	And the second s	and the second se	1 HOHOL	1:100	+						1

Schedule	of E.	periments	with	Disinf	ectants.
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No. of	Method and Tem- perature	Micro- organisms.	Disinfectant.	Dilution.	L	engths		osure o inutes,	or Cont	act	Period and Tempera- ture of
Expt.	at which performed.				21	5	71	10	$12\frac{1}{2}$	15	Incuba- tion.
11	Garnet	B. typho-	Liq. cresyl	1:1150				1			2 days
	63° F.	sus	sap. (J.)	1:1100							at 37° C
				1:1050			+				
		1		1:1000	+						1
	1		Phenol	1:90							a contraction
12	Garnet	B. typho-		1:960	+			+			2 days
	60° F.	sus	sap. (J.)	1:920	+	+				+	at 37° C
	1.	- Section and the section of the sec		1:880 1:840				•••			
			Phenol	1:040	+	+			+		12373
3	Gamat	D madi	Dhanal	1.110							
10	Garnet 60° F.	B. prodi- giosus	Phenol	1:110 1:100	+	+	+	+		•••	4 days at 22° C
	00 .	giosus		1:90	+						at 22° C
				1:80		 +	+				
				1:70			+				
4	Garnet	B. prodi-	Liq. cresyl	1:1150	+	+	+			+	4 days
	58° F.	giosus	sap. (J.)	1:1000		+	+			+	at 22° C
				1:1050	+	+			+		
				1:1000		+					
			Phenol	1:90							
5	Connot	D panedi	Dhanal	1,190				1	100		4 days
0	Garnet 62° F.	B. prodi- giosus	Phenol	$1:120 \\ 1:100$	++++			+	+		at 22° C
	0. r.	giosus		1:100			++++	+	+	+	1 and a
				1:90	+	+	т	+			1 martin
				1:80	÷	+			+		1
16	Thread	Anthrax,	HgCl <sub>2</sub>	1:1100	+	+	+	+	+	+	7 days
	62° F.	spore-		1:1050	+	+	+	+	+	+	at 37° C.
	NH4HS	bearing		1:1000	+	+	+	+	+	÷	
	used			1:950	+	+++	+	+		+	1 1 1 1 1 1
	123			1:900	+	+	+	+	+		1 States
7	Thread	Anthrax,	HgCl <sub>2</sub>	1:1100	+	+	+	+	+	+	7 days
	64° F.	spore-		1:1050	+	+	+	+	+	+	at 37° C.
	NH4HS	bearing		1:1000	+	+	+	+	+		10000
	used			1:950 1:900	++++	+++	+	+			
	-			1:000	Ŧ	Ŧ	+	+			1
8	Thread	Anthrax,	$HgCl_2$	1:700	+	+					7 days
	65° F. NH <sub>4</sub> HS	spore- bearing		1:600	+	+.					at 37° C.
	used	bearing	A CONTRACTOR OF	1:500 1:400	++++						1.1.1.
	uocu			1:300							-
0	Thread	Anthuan	HeCl	1							1
9	64° F.	Anthrax, spore-	HgCl <sub>2</sub>	1:550 1:450	+	•••			••••		7 days
	No No	bearing		1:450	+						at 37° C.
	NH4HS			1:250							
			Mark Park	1:150							1 22.0
0	Thread	Anthrax,	HgCl.	1:700	+		+ .	+	and the		7 days
	62° F.	spore-	8-12	1:600	+	+					at 37°C.
	NH4HS	bearing	a series and the	1:500	+		+				
	used		144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144 - 144	1:400							1. 1.7
	Section Section 1		and a family of	1:300							

A

No. of Expt.	Method and Tem- perature at which	Micro- organisms.	Disinfectant.	Dilution.	Le	ngths	of Exp in mi	nutes.	or Cont	act	Period and Tempera- ture of
	performed.		the second		21	5	7∄	10	121	15	lncuba- tion.
21	Thread 58° F.	B. typho- sus (O)	Phenol	$\begin{array}{c} 1:105\\ 1:100\\ 1:95\\ 1:90\\ 1:85 \end{array}$	+++++	+++++	+++++	+++++	+++++	+++++	2 days at 37° C.
22	Thread 60° F.	B. typho- sus (O)	Phenol	$\begin{array}{c} 1:80\\ 1:75\\ 1:70\\ 1:65\\ 1:60 \end{array}$	+++++	+++++	+++++	+++++	+++++++++++++++++++++++++++++++++++++++	+++++	2 days at 37° C.
23	Thread 62° F.	B. prodi- giosus	Phenol	$\begin{array}{c} 1:120\\ 1:115\\ 1:110\\ 1:100\\ 1:90 \end{array}$	+++++	+++++	++++++	+++++	+++++	+++++	4 days at 22° C
24	Thread 60° F.	B. prodi- giosus	Phenol	$1:80 \\ 1:75 \\ 1:70 \\ 1:65 \\ 1:60$	+++++	+++++	+++++	+++++	+++++	+++++	4 days at 22° C.
25	Thread 60° F.	B. prodi- giosus	Phenol	1:551:501:451:401:35	+++++	+++++	+++++	+++++	+++++	+++++	4 days at 22° C.

R. H. FIRTH AND ALLAN MACFADYEN.

No. of	Method and Tem- perature	Miero- organisms.	Disinfectant.	Dilation,	Le	ngths		osure o nutes,	or Cont	act	Period and Tempera- ture of
Expt.	at which performed.	organisms.	10.0		175	20	$22\frac{1}{2}$	25	27 1	30	lncuba- tion.
26	Thread	B. typho-	Phenol	1:80	+	+	+		+		2 days
	60° F.	sus (O)		1:75	+	+		+			at 37° C.
				1:70							
		1. 1. 1.		$1:65 \\ 1:60$							
07	100	P topha	Dhanal	1:90	1						0.4
27	Thread 61° F.	B. typho- sus (O)	Phenol	1:50	++	+++	++++	+++	+++		2 days at 37° C.
	01 1.	sus (0)		1:80	+	+	+				acor c.
	1			1:75	+	+					12
		-		1:70							-
28	Thread	B. typho-	Liq	1:960	+	+	+	+	+	+	2 days
	60° F.	sus (O)	cresyl	1:920	+	+	+	+	+	+	at 37° C.
	1		sap. (J.)	1:880	+	+	+	+	+	+	
			Phenol	$1:840 \\ 1:80$	+++	+++	+++	+++	+	+	
29	Thursd	P. tomba	Cullin	1:1000	-	-			-		0.4
29	Thread 61° F.	B. typho- sus (O)	Cyllin	1:960	++++	+++	++++	+++	+++	+++	2 days at 37° C.
	01 1.	sus (0)		1:920	+	+	+	+	+	+	a
				1:880	+	+	+	+	+	+	100
			Phenol	1:80	+	+					1.1
30	Thread	B. typho-	Liq.	1:320	+	+	+	+	+	+	2 days
	62° F.	sus (O)	cresyl	1:280	+	+	+	+	+	+	at 37° C.
			sap. (J.)	$1:240 \\ 1:200$	+	+	+++	+	+	+	
	120	the star	Phenol	1:200	++++	+++	+	+	+	+	
31	Thread	B. typho-	Liq.	1:140	14						2 days
01	60° F.	sus (0)	cresyl	1:120							at 37° C.
			sap. (J.)	1:100							
				1:70							
			Phenol	1:70	+						
32		B. typho-	Cyllin	1:735	+	+	+	+	+	+	2 days
	62° F.	sus (0)		1:700 1:665	+++++	++	+++++	++	++++	+++	at 37° C.
				1:630	+	+	+	+	+	+	12
			Phenol	1:70							
33	Thread	B. typho-	Cyllin	1:600	+	+	+	+	+	+	2 days
	62° F.	sus (O)		1:560	+	+	+	+	+	+	at 37° C.
				1:480	+	+	+	+	+	+	
			Phenol	1:40J 1:80	+++	+++	+	+	+	+	1.12
34	Thursd	D to 1		21.0323							0.0
01	Thread 63° F.	B. typho- sus (O)	Cyllin	1:320 1:280	+	+++	+++	+++	++++	+++	2 days at 37° C.
		ana (0)		1:240	++++	+	+	+	+		aron c.
				1:200	+	+	+	+	+		
		-	Phenol	1:80	+						-
35	Thread	B. typho-	Liq.	1:200	+	+	+	+	+		2 days
	60° F.	sus (O)	cresyl	1:160	+						at 37° C.
		-	sap. (J.)	1:120							
		A CONTRACTOR OF	Phenol	1:100							

Schedule of Experiments with Disinfectants.

### R. H. FIRTH AND ALLAN MACFADYEN.

No. of	Method and Tem- perature	Miero- organisms.	Disinfectant,	Dilution.	Le	ngths	of Expe in mit	nutes,	or Cont	act	Period and Tempera- ture of
Expt.	at which performed.		13-15- 18:		17‡	20	$22\frac{1}{2}$	25	$27\frac{1}{2}$	30	Incuba- tion.
36	Thread	B. typho-	Cyllin	1:200	+	+	+	+	+	+	2 days
	63° F.	sus (O)		1:160 1:130	+	+	+				at 37°
	25. 2.1	1 11 11		1:100	+	+					
		1 and a	Phenol	1:80	+	+	+				
37	Thread	B. typho-	Cyllin	1:320	+	+	+	+	+	+	2 days
	62° F.	sus (K)		1:240	+	+	+	+	+	+	at 37° C
	- Ye	2. 1-		1:160 1:100	+	+	+				1 Contraction of
	-	10 m	Phenol	1:80	+++++++++++++++++++++++++++++++++++++++	÷					
38	Thread	B. typho-	Izal	1:350	+	+	+	4	-		2 days
	64° F.	sus (0)		1:280	+	+	+	+++	+++	+++	at 37° C
			1. 1. 2.	1:210	+	+	+	+	+	+	
	1-		Phenol	1:140 1:70	+++	+	+	+	+	+	
	and the second	1 million	I nenor	and the second	Ŧ	+				•••	
39	Thread	B. typho-	Liq.	1:200	+	+	+	+			2 days
	63° F.	sus (O)	cresyl sap.	1:150 1:100	+	+	+				at 37° C.
		12	San. (B.)	1:70							
	1. 1.	an in	Phenol	1:70	+						1
40	Thread	B. typho-	Izal	1:200	+	+	4	+	+	+	2 days
	62° F.	sus (K)		1:160	+	+	+	+	+	+	at 37° C.
	1.00			1:130 1:100	++++	+++	+		+		
			Phenol	1:70	+	+					
41	Thread	B. typho-	Izal	1:250	+	+	+	+	+	+	2 days
	62° F.	sus		1:200	+	+	+	+	+	+	at 37° C.
		(MeF.)	Sec. m	1:150 1:100	+	++	++	+++	+++	+	
			Phenol	1:90	+++++	+	+	+			
42	Thread	B. typho-	Tr. Iodi	1:500	+	+	+	+	+	+	2 days
-	64° F.	sus	11. 1000	1:400	+	+	+	+	+	+	at 37° C
		(McF.)		1:300	+++	+	+	++	+++	+++	1000100
			Phenol	1:200 1:90	++	+	+	+	+	+	
					100			14	1.		2 days
43	Thread 64° F.	B. typho-	Tr. Iodi	$1:200 \\ 1:150$	+++++	+++	+++	+++	+++	+++	at 37°C
	04° F.	(McF.)		1:100	+	+	+	+	÷	÷	
	1 2 3	(and a start		1:70	++++++	+					
	1		Phenol	1:100	+	+					
44	Thread	B. prodi-	Phenol	1:55	+	+					4 days at 22° C.
	63° F.	giosus		$1:50 \\ 1:45$	+						at 22° C.
	1 4	and all a series		1:40							
			1 1 2	1:35							
45	Thread	B. prodi-	Liq.	1:600	+	+	+	+	+	+	4 days
10	63° F.	giosus	cresyl	1:575	++++	+	+	+	+	+	at 22° C
			sap. (J.)	1:550 1:525	+	+++	+++	+++	+++	+++	
	and a series	A Carlo and	Phenol	1:525	+++	+	+				

			Strategy States of Mar
Cabadula	of Experiment	o mith	Disinfectants
Nemenne	of Luber unche	S weene	Distriction .

No. of	Method and Tem- perature	Miero-	Disinfectant.	Dilution.	Le	ngths		nutes.	or Cont	act	Period an Tempera ture of
Expt.		organisms.		T	171	20	22 ł	25	$27\frac{1}{2}$	30	lncuba- tion.
46	Thread	B. prodi-	Liq. cresyl	1 : 200	+	+	+	+	+	+	4 days
0	62° F.	giosus	sap. (J.)	1:175	+	+	+	+	+	+	at 22° (
	0. 1.	Brooke	cally (a.)	1:150	+	÷	+	+	+		1
		1 1		1:125	+	+	+				
			Phenol	1:50							-
7	Thread	B. prodi-	Liq. cresyl	1:125	+	+	+	+	+	+	4 days at 22° (
	60° F.	giosus	sap. (J.)	1:100							at 22- 0
		-		1:75 1:50							
			Phenol	1:50							
8	Thread	B. prodi-	Cyllin	1:500	+	+	+	+	+	+	4 days
0	64° F.	giosus	oyum	1:450	+	+	+	+	+	+	at 230 (
		Broom		1:400	+	+	+	+	+	+	1 Carlos Carlos
				1:350	+	+	+	+	+	+	1
	-		Phenol	1:50							
9	Thread	B. prodi-	Cyllin	1:300	+	+	+	+	+	+	4 days
	62° F.	giosus	1	1:270	+	+	+	+	+	+	at 22° (
				1:240	+	+	+	+	++	+	1
			Phenol	$1:200 \\ 1:60$	+	+	+	+	+	+	
0	Thursd	P mudi		1:175		-		+	+	+	4 days
0	Thread 65° F.	B. prodi- giosus	Cyllin	1:140	+	+++	+++	+	+		at 2_0 (
	00 r.	giosus	1.1	1:105	Ŧ	+	+				1
		170 10	WE PP	1:70	++++	÷					
			Phenol	1:70	+	+	+				
1	Thread	B. prodi-	Cyllin	1:160	+	+	+	+			4 days
	60° F.	giosus		1:130	+	+	+				at 22° (
				1:100							
				1:70							
			Phenol	1:70	+	+	+				
2	Thread		Liq. cresyl		+	+	+	+			4 davs at 22° (
	60° F.	giosus	sap. (J.)	$1:140 \\ 1:105$	+						atas
		14. 1		1:70							1
		-	Phenol	1:70	+	+					-
3	Thread	B. prodi-	Izal	1:250	+	+	+	+	+	+	4 days
	63° F.	giosus		1:200	+	+	+	+	+	+	at 22° (
			1000	1:150	+	++++	+	+	+	+	1
			Phenol	1:100 1:70	+++++	+	+	+	+	+	1
	(T)	D									4 4
4	Thread 62° F.	B. prodi-	Liq. cresyl	1:200	+++	+++	++	+++	++	+++	4 days at 22° C
	os r.	giosus	sap. (San, A)	1:150 1:100	+	+		+		-T	
		1. 1. M. 1. M.	A Case and	1:70							
			Phenol	1:70	+	+					
5	Thread	B. prodi-	Lysol	1:200	+	+	+	+	+	+	4 days
	65° F.	giosus		1:150	+++	+	+	+	+	+	at 22° 0
				1:100	+	+	+				2
	1 4 3		711 1	1:70	+						1 2
	11	1	Phenol	1:70	+						1

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#### R. H. FIRTH AND ALLAN MACFADYEN.

No. of	Method and Tem- perature	Micro- organisms,	Disinfectant.	Dilution.	Le	ngths	of Expe in mit		r Cont	act	Period and Tempera- ture of
Expt.	at which performed.	organismo	13 2		$17\frac{1}{2}$	20	221	25	$27\frac{1}{2}$	30	Incuba- tion.
56	Thread	B. prodi-	Tr. iodi	1:500	+	+	+	+	+	+	4 days
	61° F.	giosus		1:400	+	+++	+	+	+	+	at 22° C.
			1000	1:300	+	+	+	+	+	+	
	a sea and	A DEAL AND		1:200	+	+	+	+	+	+	
	1		Phenol	1:80							
57	Thread	B. prodi-	HgCl <sub>2</sub>	1:100000	+	+	+	+	+	+	4 days
	60° F.	giosus		1:80000	+	+	+	+	+	+	at 22° C.
				1:60000	+	+	+	+	+	+	1.1.1.
	1 4 1 1 1 1		in the second	1:50000	+	+	+	+	+	+	-
		-	Phenol	1:90	+	+	+				
58	Thread	B. prodi-	HgCl <sub>2</sub>	1:40000	+	+	+				4 days
	62° F.	giosus		1:30000							at 22° C
		0	and states	1:20000							A State
		the second second	1000	1:10000							
	1 .	1 47	Phenol	1:90	+	+					
59	Thread	V. chol-	Cyllin	1:4000	+	+	+		+		2 days
1900	61° F.	eræ		1:3500	+	+			+	+	at 37° C
		There are not	1 st	1:3000	+	+	+		+		
	1000	and the second	the second second	1:2500	+	+	+	+			A STATE
		-	Phenol	1:100							
60	Thread	V. chol-	Cyllin	1:3000	+	+		+	+		2 days
	60° F.	eræ	A CONTRACTOR OF THE	1:2500	+		+				at 37° C
	1	-	and the second	1:2000		+					a state of the
	1		and the second second	1:1500		+					
	The state	1	Phenol	1:150	+						

1 ....

and constants there is a

No. of	Method and Tem- persture	Micro- organisms.	Disinfectant.	Dilution.	Le	ngths		osure o nutes,	or Conta	tet	Period and Tempera- ture of
Expt.	at which performed.	or Bannenna.	the ser	-11-1	21/2	5	71	10	$12\frac{1}{2}$	15	lncuba- tion.
61	Drop	Anthrax,	HgCl <sub>2</sub>	1:80							10 days
	64° F.	sporo-		1:70							at 37° C
	NH4HS	genes		1:60							
	used			1:50							
	-	6		1:40							
62	Drop	Anthrax,	HgCl <sub>2</sub>	1:80							10 days
	62° F.	sporo-		1:70							at 37° C
	NH4HS	genes		1:60							
	used		1 1 M	1:50							
				1:40		+					
63	Drop	Anthrax,	HgCl <sub>2</sub>	1:80							10 days
	64º F.	sporo-		1:70							at 37° C.
	NH4HS	genes		1:60							1
	used			1:50	+						
		190° 19	and the	1:40	+						+
64	Drop	Anthrax,	HgCl <sub>2</sub>	1:130	1						10 days
01	62° F.	sporo-	ngor <sub>2</sub>	1:120							at 37° C.
	NH4HS	genes	1.1	1:110			+				1000 0
	used	8	1	1:100		+					1 1 1 1
				1:90		+					in the second
0=	Dron	Anthnor	H-Cl	1.100							10 1
65	Drop 65° F.	Anthrax,	$HgCl_2$	1:180			+	+			10 days
	NH4HS	sporo-	A DECEMBER OF	1:170 1:160					+		at 37° C.
	used	genes		1:150							1
	uscu			1:140							
-		and the second second	Sector Contraction	10 1000							1 martin
66	Drop	Anthrax,	HgCl <sub>2</sub>	1:330							7 days
	62° F.	sporo-		1:300							at 37° C.
	NH4HS	genes		1:260					+		
	used			1:230 1:200				+			
				1:200							1000
67	Drop	Anthrax,	HgCl <sub>2</sub>	1:200		+					7 days
	64° F.	sporo-		1:150				+			at 37° C.
	NH4HS	genes		1:100	+						-
	used			1:75				•••			1 3
	-			1:50							
68	Drop	Anthrax,	HgCl <sub>2</sub>	1:300			+				7 days
	65° F.	sporo-		1:250		+					at 37° C.
	NH4HS	genes		1:200	+						1
	used			1:150		+					1000
				1:100			•••				
69	Drop	Anthrax,	HgCl <sub>2</sub>	1:125	+		+	+			7 days
	65° F.	sporo-		1:100	+						at 37° C.
	NH4HS	genes		1:75	+						
	used		Dhanal	1:50							
		-	Phenol	1:5	+	+	+	+	+	+	1
70	Drop	Anthrax,	HgCl <sub>2</sub>	1:125					+		7 days
	64° F.	sporo-		1:100		+					at 37° C.
	NH4HS	genes		1:75							
	used.	-	Th: 1	1:50			+				
	1		Phenol	1:5	+	+	+	+	+	+	1.0

Schedule of Experiments with Disinfectants.

R. H. FIRTH AND ALLAN MACFADYEN.

No. of	Method and Tem- perature	Micro- organisms.	Disinfectant.	Dilution.	Le	ngths	of Exp in mi		r Cont	act	Period and Tempera- ture of
Expt.	at which performed.	Organ Billo.			21	5	$7\frac{1}{2}$	10	$12\frac{1}{2}$	15	locuba- tion.
71	Drop	Anthrax,	HgCl <sub>2</sub>	1:600	+	+					7 days
1 1	63° F.	sporo-		1:500		+					at 37° C.
	No	genes.		1:400				+			
	NH <sub>4</sub> HS	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Phenol	1:300 1:5	 +	+	+	+	+	+	
72	Drop	Anthrax,	HgCl <sub>2</sub>	1:550							7 days
	61° F.	sporo-		1:500	+						at 37° C.
	No	genes.		1:450							
	NH <sub>4</sub> HS		Phenol	1:400 1:5	+	+	+	+	+	+	
											T dama
73	Drop	Anthrax,	HgCl <sub>2</sub>	1:900	+	+	+	+	+	+	7 days at 37° C.
	63° F.	sporo-	1 5	1:800	+++	+++	+++	+++	+		at 01-0.
	NO NH <sub>4</sub> HS	genes.		1:600	+	+		+	+		
	MI4115		Phenol	1:5	+	+	+	+	+	+	
74	Drop	B. typho-	HgCl <sub>2</sub>	1:40000							2 days
	64° F.	sus		1:35000							at 37° C.
	No	(McF.)		1:30000							
	NH <sub>4</sub> HS used.		Phenol	1:25000 1:110	+	+					
75	Drop	B. typho-	HgC!	1:80000							2 days
	63° F.	sus	ngo.2	1:70000							at 37° C.
	No	(McF.)	. In state	1:60000							
	NH4HS			1:50000							
	used.		Phenol	1:120	+	+	+				the server
76	Drop	B. typho-	HgCl <sub>2</sub>	1:120000							2 davs
	65° F.	sus		1:110000							at 37° C.
	No	(MeF.)		1:100000							1 1 1 1 1 1 1
	NH HS		Phenol	1:90000 1:120	 +	 +					
	used.										2 days
77	Drop	B. typho-	$HgCl_2$	$1:16^{\circ}000$ 1:150000							at 37° C.
	64° F.	SUS (MoE)		1:130000							
	No NH <sub>4</sub> HS	(McF.)		1:130000							
	used.		Phenol	1:120	+	+				•••	1
=0	Duon	P troho	HgCl <sub>2</sub>	1:300000							2 days
78	Drop 61° F.	B. typho-	Ingoi2	1:250000				***			at 37° [C.
	No	(McF.)	Contract States	1:200000							
	NH4HS			1:180000							
	used.		Phenol	1:120	+						100
79	Drop	B. typho-	HgCl <sub>2</sub>	1:500000							2 days at 37° C.
	61° F.	sus		1:450000					***		acor c.
	No	(McF.)		1:400000 1:350000	+++	+++					Case -
	NH4HS used.		Phenol	1:350000	++						
		and second		1 00	-						4 days
80	Drop	B. prodi-	Dharal	1:90	+++						at 22° C.
	62° F.	giosus	Phenol	$1:80 \\ 1:70$	T						
	-			1:60							-
				1:50							

Schedule (	of Ex	periments	with	Disinfectants.
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No. of	Method and Tem- perature	Micro- organisms.	Disinfectant.	Dilution,	L	engths		osure ( inutes,	or Cont	act	Period and Tempera- ture of	
Expt.	at which performed.				21	5	$7\frac{1}{2}$	10	121	15	lncuba- tion.	
81	Drop	B. prodi-	Phenol	1:120	+	+	+	+	+		4 days	
	63° F.	giosus		1:110	+	+	+	+		+	at 22° C	
			The second second	1:100 1:90	++++	+	+					
				1:80	+	+					100	
82	Drop	B. prodi-	Liq. cresyl	1:400	+	+	+	+	+	+	4 days	
	65° F.	giosus	sap. (J.)	1:350	+	+	+	+			at 22° C	
		2		$1:300 \\ 1:250$	+	+	+		<b></b>		1	
			Phenol	1:100	++++	+	+	 +				
83	Drop	B. prodi-	Cyllin	1:1000	+	+	+	+	+	+	4 days	
	65° F.	giosus		1:950	+	+	+	+	+	+	at 22° C	
				1:900 1:850	+++	+++	+++	+++	+	+	1	
			Phenol	1:100	+	+	+	+	+		1	
84	Drop	B. prodi-	Cyllin	1:900	+	+	+	+	+	+	4 days	
	60° F.	giosus		1:850 1:825	+	+	+				at 22° C.	
	1			1:825	+	+					1	
			Phenol	1:90	+						and a	
35	Drop	B. prodi-	Liq. cresyl	1:350	+	+	+	+	+	+	4 days	
	61° F.	giosus	sap. (J.)	1:300	+	+	+	+	+	+	at 22° C.	
				1:250 1:200	++++	++++	++				1	
			Phenol	1:100	+	+	+	+	+		100	
36	Drop	B. prodi-	Izal	1:600	+	+	+	+			4-days	
	63° F.	giosus		1:500	+	+					at 22° C.	
				$1:400 \\ 1:300$							Level -	
			Phenol	1:100	+	+	+					
37	Drop	B. prodi-	Izal	1:650	+	+					4 days	
	70° F.	giosus		$1:600 \\ 1:550$	+	+	•••				at 22° C.	
				1:500	+						17 9	
		10000	Phenol	1:100	+							
8	Drop 62° F.	B. prodi-	Liq. cresyl	1:500	+	+					4 days	
	02- r.	giosus	sap. (San. B.)	1:450 1:400	+++						at 22° C.	
			(000. 2.)	1:350	+						100 - 20	
			Phenol	1:100	÷	+	+				100	
9	Drop 66° F.	B. prodi-	Liq. cresyl	1:400	+	+	+	+	+	+	4 days	
	00 r.	giosus	sap. (San. A.)	1:350 1:300	+++	+++	+++	++	+++	+	at 22° C.	
				1:250	+	+	+		+		1170	
			Phenol	1:100	++++	÷					he's -	
0	Drop 69° F.	B. prodi-	Lysol	1:250	+	+	+				4 days	
	00 r.	giosus	C. Cor. Char	1:200 1:150	+						at 22° C.	
				1:100							-	
-		and the second s	Phenol	1:100	+						1 1 1	

R. H. FIRTH AND ALLAN MACFADYEN.

No. of	Method and Tem- perature	Micro- organisms.	Disinfectant,	Dilution,	Le	ngths	of Exp in mi	osure o nutes.	r Cont	act	Period and Tempera- ture of
Expt.	at which performed.		1.4. 3. 1		21	5	71	10	$12\frac{1}{2}$	15	Incuba- tion.
91	Drop	B. prodi-	Chinosol	1:100	+	+	+	+	+	+	4 days
	65° F.	giosus		1:50	+++++	+++	+	+	+	+	at 22° C.
				$1:30 \\ 1:20$	+	+	+	+	+	+	
			Phenol	1:100	+	+++					
92	Drop	B. prodi-	Lysol, the	1:300	+	+	+	+	+	+	4 days
	70° F.	giosus	diluting water	$1:200 \\ 1:200$	+						at 22° C.
			containing	1:50							1 .
			1/5 part of sterile urine	1.100							
		and and	Phenol	1:100	+						
93	Drop	B. prodi-	Listerine	1:15	+	+	+	+	+	+	4 days at 22° C.
	69° F.	giosus		$1:10 \\ 1:5$	+++	+++	+++	++++	+++	+++	at 22° C.
	-			1:3	+						
			Phenol	1:100	+						
94	Drop	B. prodi-	Tr. lodi.	1:2500	+	+	+	. +	+	+	4 days at 22° C.
	66° F.	giosus		1:2000 1:1700	++++	+	+	+	+	+	at 22° C.
				1:1500							1 Start
	Tole T	The !!	Phenol	1:100	+	+					
95	Drop	B. prodi-	Permangan-	1:5000	+	+	+	+	+	+	4 days
	68° F.	giosus	ate of potas-	1:4000	+++	++	+++	+++	+++	+++	at 22 <sup>6</sup> C.
		1	sium	1:3000 1:2000	+	+	+			-	
			Phenol	1:100	+	+					1000
96	Drop	B. typho-	Phenol	1:100	+	+	+	+	+	+	2 days
	63° F.	sus (0.)		1:90	+++	+	+	+			at 37° C.
				1:00	+						
	1000	and the		1:60							and the second
97	Drop	B. typho-	Phenol	1:100	+	+	+	+	+	+	2 days
-		sus (K.)		1:90	+	+	+	***			at 37° C.
				1:80 1:70	+						
	Sec. 2			1:60							
98	Drop	B. typho-	Liq. cresyl	1:500	+	+	+	+	+	+	2 days
	60° F.	sus (K.)	sap. (H.W.)	1:400	+	+	+	++++	+++	+++	at 37° C.
	1			$1:350 \\ 1:250$	+++++++++++++++++++++++++++++++++++++++	+++++	++++	+			1.3.2
	E.	1	Phenol	1:90	+	+	+	+			In the second
99	Drop	B. typho-	Liq. cresyl	1:300	+	+	+	+	+	+	2 days
	62° F.	sus (K.)	sap. (B.T.)	1:250	+	+	+	+			at 37° C.
			The off	1:200 1:100							
	12154		Phenol	1:90	+	+	+				
100	Drop	B. typho-	Liq. cresyl	1:300	+	+	+	+	+	+	2 days
100	63° F.	sus (K.)	sap. (T.M.)	1:250	++++	+++	++++	+++	++++	+	at 37° C.
			Call Country of Call	1:200 1:100	++	+	+	+			
			Fhenol	1:100	+	+	+				

Schedule (	of Ea	periments	with	Disin	fectunts.
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No. of	Method and Tem- perature	Micro- organisms.	Disinfectant,	Dilution.	Le	ngths		osure o nutes.	or Conti	act	Period and Tempera- ture of Locuba-
Expt.	at which performed.	organisms			21	5	71	10	121	15	lncuba- tion.
101	Drop	B. typho-	Liq. cresyl	1:300	+	+	+	+			2 days
	62° F.	sus (K.)	sap. (B.B.)	1:250	+	+					at 37° C.
				1:200	+						
				1:100							
			Phenol	1:100	+	+	+				
02	Drop	B. typho-		1:190	+	+	+	+	+	+	2 days
	61° F.	sus (K.)	sap (B.)	1:180	+	+	+	+	+	+	at 37° C
				$1:170 \\ 1:160$	++++	+++	+++	+	+	+	1 1
			Phenol	1:100	+	+	+				1 1 1 1 1 1
.03	Drop	B. typho-	Liq. cresyl	1:300	+	+	+	+	+		2 days
.00	60° F.	sus (K)	sap (H.)	1:250	+	+					at 37° C
	1			1:200	+						A STAR
91.5	1			1:100							1.
	and the second second		Phenol	1:100	+	+	+	+	+		
104	Drop	B. typho-	Liq. cresyl	1:275	+	+	+	+	+	+	2 days
	59° F.	sus (K.)	sap. (W.O.)	1:250	+	+	+	+	+		at 37° C
		A CALLER OF		1:225	+	+	+				1
			Phenol	1:200 1:80	+++++	+++	+				-
			Thenor	1.00	at .	Ŧ	Ŧ				and
05	Drop	B. typho-	Nobe's Fluid	1:50	+	+	+	+	+	+	2 days
	64° F.	sus (0,)		1:40	+	+	+	+	+	+	at 37° C
			1 1 1 1 1 1	$1:30 \\ 1:20$	+	+	+	+	+	+	1
			Phenol	1:20	++++	+++	++++	+++			1
00	Duon	D tumbe	D: 1 1	1 500				1			0.0
106	Drop 64° F.	sus (0,)	Pino-phenol	$1:700 \\ 1:600$	+	+	++++	+	+	+	at 37° C.
	01 I.	eus (01)		1:500	+++	+++	+++	+++	+++	+++	ator C.
				1:400	+	+	+	+			
			Phenol	1:80							
107	Drop	B. typho-	Pino-phenol		+	+	+	+	+	+	2 days
	61° F.	sus (0.)		1:220	+	+	+	+			at 37° C.
				1:210	+	+	+				1
			Phenol	$1:200 \\ 1:80$	++++	+++					-
108	Duan	D. tomba	¥1	1 1000					-		10.
100	Drop 61° F.	B. typho- sus (K.)	Liq. cresyl	$1:1000 \\ 1:950$	+	+++	+++	+	+	+	2 days at 37° C
	01 I.	ous (n.)	sap. (J.)	1:900	+++	++	+	+++	+++	+++	ator
				1:850	+	+	+	+	+		10
			Phenol	1:90	+	+					
109	Drop	B. typho-	Liq. cresyl	1:950	+	+	+	+	+	+	2 days
	62° F.	sus (O.)	sap. (J.S)	1:900	+	+	+	+	+	+	at 37° C.
				1:850	+	+	+	+			and the second
			Phenol	1:800 1:90	+++						
110	Deen	P turk									10.7
110	Drop 65° F.	B. typho- sus (0.)	Liq. cresyl	1:1250	+	+	+	.+	+	+	2 days
	00 F.	ous (0.)	sap. (J.S.)	$1:1150 \\ 1:1000$	++	+++	+++	+++	+++	+	at 37° C
				1:800	+	+	+				11
			Phenol	1:100	+	+	+				

R. H. FIRTH AND ALLAN MACFADYEN.

No. of	Method and Tem- perature	Micro- organisms.	Disinfectant,	Dilution.	Le	ngths		osure o nutes,	r Cont	act	Period and Tempora- ture of
Expt.	at which performed.	or Bannania.	21- 79.5	19-10-	$2\frac{1}{2}$	5	$7\frac{1}{2}$	10	$12\frac{1}{2}$	15	lincuba- tion.
111	Drop	B. typho-	Liq.	1:1250	+	+	+	+	+		2 days
	64° F.	sus (K.)	cresyl	1:1200	+			+			at 37° C
			sap. (J.)	1:1150 1:1100							
		A state of the	Phenol	1:100	+						
112	Drop	B. typho-	Liq.	1:455	+	+	+	+	+	+	2 days
	61° F.	sus (0.)	cresyl	1:450	+	+	+		+		at 37° (
			sap.	1:405	+	+	+	+			
	-	100	(S.A.) Phenol	1:360 1:90	+++	+	+				
13	Drop	B. typho-	Liq.	1:450	+	+	+	+	+-		2 davs
1	66° F.	sus (0.)	cresyl	1:400	+	+	+				at 37° (
			sap.	1:350	+	+	+			•••	
			(S.B.) Phenol	$1:300 \\ 1:100$	+++		+				
			Fnenor	1:100	+	+					
114	Drop	B. typho-	Liq.	1:550	. +	+	+	+	+	+	2 days
	64° F.	sus (0.)	cresyl	1:500 1:450	+	+++	+	+	+	+	at 37° (
			sap. (S.B.)	1:400	++++	++	+				
			Phenol	1:100	+	+	+				1
115	Drop	B. typho-	Liq.	1:450	+	+	+	+	+	+	2 days
	62° F.	sus (0.)	cresyl	1:400	+	+	+	+	+		at 37° (
			sap.	1:350	+	+					
	21-	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	(S.A.) Phenol	$1:300 \\ 1:100$	+++	+++	+++	+	+	+	
116	Drop	B. typho-	Cyllin	1:1050	+	+	+	+	+	+	2 days
110	62° F.	sus (0.)	0,min	1:1000	+	+	+	+	+	+	at 37° C
				1:950	+	+	+	+	+	+	
	12 - 4	4	Phenol	1:900 1:100	+ +	+++	+++	+++	+		1
117	Dean	R typho	Izal	1:600	+	+	+				2 days
	Drop 64° F.	B. typho- sus (O.)	16.41	1:550	+						at 37° (
				1:500							
			Phenol	1:450 1:100	+	+	+				
		Della		1:650	T	+	+	+	+	+	2 days
118	Drop 65° F.	B. typho- sus (K.)	Izal	1:600	+	+	+	+	+		at 376 C
	0.0 1.	5us (m.)		1:550	++++	+	+				
	-	1000	Phenol	1:50) 1:90	++						
				1							2 days
119	Drop	B. typho-	Cyllin	1:1210	+	++	+++	+++	+++	+++	at 37° C
	66° F.	sus (McF.)		1:1100 1:990	++++	+		····			
	1	(mer.)		: 880	+						
			Phenol	1:110	+	+	+				
120	Drop	B. typho-	Cyllin	1:1200	+	+	+	+	+	+	2 days at 37° C
-	66° F.	sus		1:1100	+	+	++++	+++	+++	+++	ator-C
	1	(McF.)		1:1000 1:900	+++++	++++	++	+			
			Phenol	1:120	+	+	+	+			

Schedule of Experiments with Disinfectants.

No. of	Method and Tem- perature	Micro- organ'sms.	Disinfectant.	Dilution.	Le	ngths		osure c nutes.	or Cont	act	Perio : an Tempera ture of
Expt.	at which performed.	organ sms.			$2\frac{1}{2}$	5	71	10	121	15	lncuba- tion.
21	Drop	B. typho-	Perman-	1:400							2 days
-	68° F.	sus	ganate of	1:300							at 37° (
		(McF.)	potassium	1:200							
				1:100							
			Phenol	1:120	+	+	+				
22	Drop	B. typho-	Perman-	1:2000							2 days
	63° F.	sus	ganate of	1:1500							at 37° (
		(McF.)	potassium	1:1000							
			Phenol	$1:800 \\ 1:120$	 +	 +	 +	···· +	 +		
	1201		I HUHUI	and the second second	т	T	Ŧ	-	+		
23	Drop	B. typho-	Perman-	1:10000	+	+	+	+	+		2 days
	68° F.	sus	ganate of	1:9000	++++	+	+	+	+		at 37° (
		(McF.)	potassium	1:7000	+	+	+	+			1
			Phenol	1:5000	+	+					- 3
			Phenoi	1:120	+	+					
24	Drop	B. typho-	Perman-	1:3000	+	+	+	+	+	+	2 days
	65° F.	sus	ganate of	1:2000	+	+	+				at 37° (
		(McF.)	potassium	1:1000	+						
			dilutions	1:500	+	••••					1220
			made with 1/5 part of								
			sterile								1.00
			urine								and the second
			Phenol	1:120	+	+	+	+			1
25	Drop	B. typho-	Sanitas Co.'s.	1:250	+	+					2 days
	61° F.	sus	Liq. cresyl	1:180	+						at 37° (
		(McF.)	sap. (A.)	1:130							1.01
				1:100							42.83
			Phenol	1:90	+						
26	Drop	B. typho-	Cyllin	1:990	+	+	+	+	+	+	2 days
	67° F.	sus	dilutions	1:880	+	+	÷	+	+	+	at 37° (
		(McF.)	containing	1:770	+						
			1/5 part	1:660							1
			sterile urine								
			Phenol	1:110	+	·					1
37	Drop	R tunho	The Lodi	1 100							
	62° F.	B. typho-	Tr. Iodi. dilutions	1:500 1:400	+	+	+	+	+	+	2 days
		(McF.)	containing	1:300	+++	++++	++++	++++	+++	+++	at 37° 0
		(	1/5 part	1:200	+	+	+	+	+	+	
			sterile							1.0	1 1 2 3
			urine	in and in							
			Phenol	1:110	+	+	+				- L. P.
28	Drop	B. typho-	Tr. Iodi.	1:200	+		wear.				2 days
	65° F.	8118	dilutions	1:150	+						at 37° C
		(McF.)	containing	1:100							
		1	1/5 part	1:50							1
			sterile	-							17 90
			urine	1 110		and the					
			Phenol	1:110	+	+					

R. H. FIRTH AND ALLAN MACFADYEN.

No. of	Method and Tem- perature	Micro- organisms.	Disinfectant,	Dilution,	Le	ngths	of Expe in mi	osure o nutes,	r Cont	act	Period and Tempera- ture of
Expt.	at which performed.	or Ball o His	12. 12		$2\frac{1}{2}$	5	71	10	12 <u>1</u>	15	Incuba- tion.
129	Drop	V. cho-	Cyllin	1:5000	+	+	+	+	+		2 davs
	66° F.	leræ		1:4500	+	+	+	+	+		at 37° (
		Service and		1:4000	+	+	+				and the second second
			Phenol	1:3500 1:200	+++	 +	 +	 +			
130	Drop	B. typho-	Cyllin	1:1430	+	+	+	+	+	+	2 days
	63° F.	sus		1:1210	+	+	+	+	+		at 37° (
		(McF.)		1:990	+	+					
			Phenol	1:770 1:110	 +	 +	 +	 +			
131	Drop	B. typho-	Cyllin	1:14:0	+	+	+	+			2 days
101	62° F.	sus	Cynn	1:1210	+	+					at 37° C
		(McF.)	-	1:990							
	The second			1:770						•••	
	1	Se linguage	Phenol	1:110	+						1
132	Drop	B. typho-	Cyllin	1:1210	. +	+	+	+	+	+	2 days
	66° F.	sus		1:1100	+	+	+	+	+	+	at 37° C
		(McF.)		1:990 1:880	+++	+					
			Phenol	1:110	+	 +	+	+	+	+	
133	Drop	B. typho-	Cyllin	1:1210	+	+	+	+			2 days
100	65° F.	sus	- Juni	1:1100	+	+					at 37° C
		(McF.)		1:990	+						
			Phenol	1:880	+++						
	1.	C. C. Carlos									0.1
134	Drop	B. typho-	Cyllin	1:1430	+	+	+	+	+		2 days at 37° C
	70° F.	sus (W.)		1:1300 1:1170	+++	+					ator 0
		-	Part and the	1:1040							
			Phenol	1:130							
135	Drop	B. typho-	· Cyllin	1:1430	+	+	+	+			2 days at 37° C
	70° F.	sus (W.)		1:1300	+	+	+			•••	at of "C
				$1:1170 \\ 1:1040$	+++	+					
			Phenol	1:130	+						
136	Drop	B. typho-	Cyllin	1:1300	+	+	+	+	+	+	2 days
	62° F.	sus		1:1100	+	+	+				at 37° C
	1 12 12	(McF.)		1:900	+	+					
	1.1		Phenol	$1:700 \\ 1:100$	+++++	 +	+	+	+	+	
137	Drop	B. typho-	Cyllin	1:780	+	+	+	+	+	+	2 days
101	65° F.	sus	- Juni	1:720	+	+	+++	+	+	+	at 37° C
		(McF.)	-	1:660	++++	++++	++	+++	++++		
			Phenol	1:600 1:100	++	++	+	·	+		A STREET
100	D	DA		1:1100	+	+	+	+	+	+	2 days
138	Drop 63° F.	B. typho-	Kerol	1:990	+	+	+	+	+	+	at 37° C
	05 T.	F. sus (McF.)		1:880	+++++	++++	++++	+			
	1. 1.	(	A State of the second	1:770	+	+	+				
			Phenol	1:110	. +	+	+	+	+		1

Schedule of Es	periments u	with Disinfectants.
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No. of	Method and Tem- perature	Miero-	Disinfectant.	Dilution.	Le	engths		osure c nutes.	or Conta	tet	Period and Tempera- ture of
Expt.		organisms.			$2\frac{1}{2}$	5	71	10	$12\frac{1}{2}$	15	Incuba- tion.
139	Drop	B. typho-	Izal	1:1100	+	+	+	+	+	+	2 days
	63° F.	sus	-	1:990	+	+	+	+			at 37° C.
		(McF.)		1:880	+	+	+				
			Phenol	1:770 1:110	++	+++	+	+	 +	+	
140	Drop	B. typho-	Izal	1:1100	+	+	+	+			2 days'
140	64° F.	sus	LGGL	1:990	+	+	+				at 37° C.
	1.1	(McF.)		1:880	+	+	+				
			Phenol	$1:770 \\ 1:110$	···· +	 +	 +	+	+		
141	Deser	Passa									Ditter
141	Drop 67° E.	Fæces and urine	HgCl <sub>2</sub> 2 grammes	1:10000 1:6000	+++	+++	+++	++	++++	+++	24 hours at 37° C.
	01 44	and urme	HCl 4 cc.	1:4000	+	+	+	+	+	+	acor c.
		1.100 100		1:2000	+	+	+	+	+		
			Phenol	1:90	+						in the second
142	Drop	Fæces	HgCl <sub>2</sub>	1:4000	+	+	+	+	+	+	24 hours
	66° F.	and urine	2 grammes	1:3000	+	+	+	+	+	+	at 37° C.
			HCl 4 cc.	1:2000 1:1000	+++	++	+++	+++	+	+	1
			Phenol	1:90	+	+					-
143	Drop	Fæces	HgCl <sub>2</sub>	1:800							24 hours
	64° F.	and urine	2 grammes	1:600							at 37° C.
		1	HCl 4 cc.	1:400							
			Phenol	$1:200 \\ 1:90$	+						
144	Drop	Fæces	HgCl <sub>2</sub>	1:1050	1000						24 hours
111	65° F.	and urine	2 grammes	1:950	++++	+++	++++	+++	+	+	at 37° C.
			HCl 4 cc.	1:850	+	+	+				
	1 112	1 Contractor	1011	1:750	+						1 Alar
			Phenol	1:95	+	+	+				1
145	Drop	Fæces	HCl	1:300	+	+	+	.+	+	+	24 hours
	65° F.	and urine		$1:200 \\ 1:150$	+++	+++	+++	+	+	+	at 37° C.
				1:100	+	+		+			-
		a second and	Phenol	1:95	+	+	+	+			1
146	Drop	Fæces	HgCl <sub>2</sub>	1:800	+	+	+	+	+	+	24 hours
	68° F.	and urine		1:600	+	+	+	+	+	+	at 37° C.
				$1:400 \\ 1:200$	+++	++++	+++	+	+	+	
			Phenol	1:90	+	+					
147	Drop	Fæces	HgCl,	1:300	+	+	+	+	+	+	24 hours
	65° F.	and urine	-B - 13	1:200	+	+	+				at 37° C.
				1:150	+						1. 2. 3
		1 -	Phenol	$1:100 \\ 1:90$	 +	 +	 +	+			6 100
148	Drop	Fæces	Formalin								24 1
	65° F.	and urine	Tormann	1:135 1:100	+++	+++	+++	+++	+++	+++	24 hours at 37° C.
			-	1:70	+	+	+				
			DL	1:50							
		1	Phenol	1:90	+	+	+				

R. H. FIRTH AND ALLAN MACFADYEN.

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No. of	Method and Tem- perature	Micro- organisms.	Disinfectant.	Dilution.	Lei	act	Period and Tempera- ture of				
xpt.	at which performed.	The second second	13- 1 · · ·		$2\frac{1}{2}$	5	$7\frac{1}{2}$	10	$12\frac{1}{2}$	15	lneuba- tion.
149	Drop	Fæces	KMnO4	1:700	+	+	+	+	+	+	24 hours
	64° F.	and		1:650	+	+	+	+	+		at 37° C
		Urine		1:600	+	+	+				
				1:550	+						
		Distance of	Phenol	1:90	+	+	+	+			
150	Drop	Fæces	Tr. Iodi.	1:225	+	+	+	+	+	+	24 hours
	68° F.	and		1:180	+	+	+	+	+	+	at 37° C
		Urine		1:135	+	+++	+	+	+	+	
				1:90	+	+	+	+	+	+	
	1.00		Phenol	1:90	+	+			••••		
151	Drop	Fæces	Lysol	1:375	+	+	+	+	+	+	24 hour
	67° F.	and		1:300	+	+	+	+	+'	+	at 37° C
		Urine		1:225	+	+	+	+			
				1:200	+	+					
	1	1	Phenol	1:90	+	+	+				
152	Drop	Fæces	Cyllin	1:910	+	+	+	+	+	+	24 hour
	69° F.	and		1:840	+	+	+				at 37° C
		Urine		1:770	+						
				1:700			••••				
			Phenol	1:90	+						
153	Drop	Fæces	Kerol	1:810	+	+	+	+	+	+	24 hour
	65° F.	and		1:720	+	+	+	+	+		at 37° C
		Urine		1:630	+	+					
			1	1:540							
			Phenol	1:90	+	+	+	+			
154	Drop	Fæces	Izal	1:540	+	+	+	+	+	+	24 hours
	65° F.	and		1:450	+	+	+	+			at 37° C
		Urine		1:360	+	+				***	
	1			1:270							
			Phenol	1:90	+	+	+	+			
155	Drop	Fæces	Liq. cresyl	1:350	+	+	+	+	+	+	24 hour
	66° F.	and	sap. (H.W.)	1:250	+	+	+	+	+		at 37° C
	-	Urine	A CONTRACTOR OF THE	1:200	+	+	+				
				1:150							
	a state of the	Section Section	Phenol	1:90	+	+	+	+			1





