115

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ANTISEPTICS.

It will be the object of this paper to give in some detail the results of ~~some~~ experiments undertaken for the determination of the value of the essential oils as antiseptics. In the progress of the experimentation, however, it was found desirable to include a number of the more popular anticeptics by way of compurison; and these ~~experiments~~ will be reported with the others for the better understanding both for the information they give and of the relative value of the limited number of essential oils ~~they will give~~ thus far studied.

For some years past the essential oils seen to have been gaining favor as antiseptics. But in looking up the literuture of the subject I have been impressed with the lack of exact knowledge of their value. It is a fact worthy of notice that many of the reputed anticeptics in use ~~within the years that have past~~ are not such as should be relied upon in

surgical procedures, nor in the treatment of suppurative affections. The most notable case is that of Iodoform, which has been so widely used as to form one of the supposed necessaries of the surgeons case, and is yet without antiseptic value. And although this has been repeatedly pointed out, both by expert clinical observers and by experimentalists, I am sorry to say that it is still widely used for this purpose. Whatever may be the therapeutic value of iodoform it is certain that it is in no sense a ~~disinfectant~~ antiseptic, and ~~it~~ should not be used with this end in view. It is with the hope that it may in some measure serve for the prevention of such mistakes in the future that these experiments have been undertaken.

In doing such a mass of experimentation as I have now to offer you in the time I have been able to catch ~~from~~ of evenings after busy days, ~~and nights of insufficient sleep~~ I would be fortunate indeed if I should be found by those who may follow me, to have been entire

free from error, though I have made every effort at correctness. ~~And especially~~ upon those substances that have seemed useful, carefully I have repeated the observations ~~carefully~~ for the purpose of eliminating all sources of mistake.

I wish to be understood as to the use of the word Antiseptic. We are so unfortunate as to use, in connection with the therapy of micro-organisms, some words in a very loose way. Such is the case with the words antiseptic and disinfectant. Now in my use of the word antiseptic I wish it distinctly understood that I do not mean disinfectant. An antiseptic is a drug that <u>inhibits</u> <u>the</u> <u>growth</u> of microbes. A disinfectant is a drug that <u>destroys</u> microbes. The same drug may be both ~~disinfectant~~ antiseptic and disinfectant, but for these different purposes they would be used differently and in different proportions. As a general rule we are unable to use disinfectants, as such, in medicine and surgery for the

~~very good~~ reuson that the very poisonous properties ~~of~~ of such medicaments would do more harm than their dis~~in~~fectant property would do good. Dentists may use such in the roots of teeth with good effect, and in some favored positions they may be used in contact with the soft tissues; as in very small abscesses. But for the most part we must be content with the ~~m~~ milder remidies, and rely still more on aseptic procedeures.

In the study of the essential oils very great difficulties have been encountered. In the first ~~pl~~ place the quality of the individual oils is ~~a thing of the utmost~~ uncertain~~ty~~. These are compound bodies that are probably liable to fluctuation in quality dependant on the condition of the plant used, even when ~~the utmost care is had in their preparation.~~ carefully prepared

Furthermore, ~~But~~ ~~more than this~~ the conditions of their production ~~is~~ are such in a large number of the oils that ~~that~~ the preparation must be undertaken where the plant grows by persons of no scientific knowledge of the

subject. This being the case it often happens that the most desirable parts of the plant are mixed with undesirable parts, or even parts that injure the product seriously. For instance, the leaves of a certain tree yield a certain oil, and the bark another oil of different quality. Now if the person distilling the oil throws in twigs with the leaves the oils will be mixed and uncertain in quality. Besides this, there is much perplexity arising from the adulteration of the essential oils. Taking these facts into consideration I can say no more than that the specimens of the oils that I have had have yielded such and such results. The same oil in name may be something different in the next specimen. I think, however, that it may be stated that as a certain drug becomes valued in a pure state tradesmen will readily be found who will furnish it in that condition. In the uses to which the essential oils have been put in the past strict purity has not been

of serious consequence.

Mode used in testing the antiseptic value of the oils.

The modes I have used in the experiments which I will report is of consequence to any one who may wish to test the correctness of my findings. Furthermore, it is of consequence that these be closely scanned by the profession as ~~the~~ to the correctness of the procedures by which these results have been attained I will therefore give them very briefly, but in sufficient detail, to enable persons of reasonable skill in this kind of experiment to follow me, or judge of the value of my findings.

In all of my work an incubating oven with a well adjusted thermostat for the automatic regulation of the temperature has been used. The temperature was kept at 99degrees Fahr. ~~for the greater portion of the work~~. I have used beef broth peptonized and sweetened and then carefully neutralized. Much care

has been used that this should be even in quality in all of the experiments so that the proportional representation of the values of the different medicaments should not be seriously marred by variations in the sustaining power of the culture medium. This is one point that has, I fear, not received sufficient attention from some who have tried this class of experimentation: and indeed it is a point of no little difficulty. The infection of the broth has always been made with my own saliva direct, under as near analogous conditions as posible, thus avoiding the use of micro-organisms that may have been weakened in vigor by cultivation under ~~mmmmtnm~~ artificial conditions. The tubes used have been graduated to insure certainty in measurements of the broth, while very fine graduated pipetts have been used for the addition of the medicaments. Each observation has extended over a period of five days unless growth of microbes has been demonstrated earlier. And no less important, accurate notes of everything deemed of ~~importance~~ value

have been written when it occured ~~at the time of its occurence~~ when observed. Nothing has been left to the memory. In some classes of experiments notes have been made each twelve hours, in the others each twenty four hours. It has been my aim to so thoroughly systematize the work as to make the conditions of each of the experiments equal as nearly as posible to that of all of the others, except where these conditions were purposely changed, and noted. The metric system has been used for ~~the~~ convenience in calculating proportions, but all of my statements are made in the form of I of the medicament, or solution of it as the case may be, added to so many parts of the broth. It will be noted that this does not represent percentages. In the construction of tables of results I have in each case copied actual experiments as the notes were made at the time, but of course do not give all of the experiments with each drug, ~~but only~~ only a representative one selected from those made.

Relating to the essential oils I have made the

experiments in two classes, the one with the oil in substance and the other with the ~~aqueous~~ aqueous solution of the oil. Since the solubility of the oils is not accurately known the quantitive value of the solution becomes much more important than the quantitive value of the oil in substance, for the reason that in most of the uses of antiseptics it is only the solution that is effective This is not so generally true of the oils as of crystalline substances; for in many ~~positions~~ cases the oil in substance may be effective, but crystalline substances cannot act atall until dissolved. For this reason I have in all cases given the quantitive value of the solutions of crystalline substances

It seems to have become a custom among experimentors in this field to state effective proportions in the greatest number of figures posible; or to give the proportions of drugs in substance no matter how insoluble they may be, or in what proportion the solution may be effective. This is liable to be very misleading. For instance, if a given drug is effective as an anticeptic in a tube test in the propor-

tion of ~~1 to~~ 1/1100 and dissolves only in the proportion of I to I000 it has no range of antiseptic ~~power~~ value, but must fall below the line of effective work the moment it is mixed with the secretions of a wound I should not say that such a drug could be of no real value, but it must be evident to every one that its use should be limited to a class of cases in which it would not be mixed with secretions or other substances calculated to limit its action, or cause it to fall below the line of active work by reason of dilution. For these reasons I have thought it well to give and illustrate in this way its range of value. the value of the solutions as such, ~~and~~ I think that a study of the tables presented will quickly demonstrate the usefulness ~~value~~ of this form of presentation. All aqueous solutions are saturated solutions except those in which the percentage is given. The solutions of the essential oils are all made in this way; an excess of the oil is mixed with water by violent shaking continued for some minutes. It is then placed in the

If needed it should be ~~added~~ in parentheses after the graduate solution would keep up its effect

1 for the reason that it gives no idea
of ~~range~~ the range of value the drug may
possess — This range of value is found
in the difference between the saturated
solution and ~~that dilution~~ greatest dilution
that will inhibit growth

2 On the other hand if a drug dissolves in
the proportion of ~~1~~ 1,000 and is effective
in ~~one to~~ 1-10,000 it has a long range of
value and the saturated solution may
be much diluted by secretions and still
be effective ~~with~~ very poisonous drugs that
are freely soluble this range must be suppo
to and ~~with~~ such ~~point of~~ a concentration as may be
born without serious evil

~~At most I have used this diffusate suspension~~

incubating oven, where the temperature is 99 degrees Fahr., for 12 hours. It is then again violently shaken and returned to the oven for another 12 hours, 24 hours in all. It is then carefully filtered, and if not perfectly clear and free from all appearance of oil it is refiltered until it is clear. This filtrate is then used as the solution of the oil. The same plan has been used in making saturated solutions of the crystaline substances. In all of the tables the numbers that proved effective in the prevention of growth are printed in ordinary type, while those that were found ineffective are printed in boldfaced type ~~placed in italics~~. If Growth has not occured within the first twenty four hours but has occured within the second a star follows the number; and if growth has been delayed until the third day, or could not be demonstrated until that time, two stars will be found.

I have also grouped the derivatives of the oils with the oils to which they belong, otherwise I have placed them in the table alphabetically.

Table of results of experimental tests of the value of antiseptics.

The antiseptic value of a drug is best expressed by its range of ~~value~~ effective work. This range of value is found in the difference between the saturated solution, or that concentration that may be found injurious to the tissues, and the greatest dilution that inhibits the development of micro-organisms. Those essential oils that are not too irritating have an extension of ~~many~~ range in their use in emulsion, or in substance. Also many drugs have, in greater dilution than that which actually inhibits, a range of restraint that is useful. Only positive inhibition is marked in the tables. The values of the essential oils are given for the oils in substance, for the solutions, (~~in water~~) and for the derivatives. All solutions are saturated in water unless the percentage is given. The figures without marks show inhibition of growth by that proportion of the drug, or its solution. Those marked with a line below show a failure of inhibition within 24

hours. Underlined with the addition of a * shows a failure on the seecond day, and with the addition of ** a failure on the third day. &c.

TABLE.

Aseptol. (Merk's 33.3per cent. solution)	~~I-5, I-7, I-10,*I-25,~~		I-10, I-15, I-20,
Benzoic acid, (sol.)	I-I,	I-2,	I-3,
Betanaphtol. (sol.)	I-I,	I-2,	I-3, I-4, I-5,
Boracic acid, (sol)	I-4,	I-6,	I-8,* I-10
Carbolic acid, 5% solution,	I-300,	I-560	I-900.
	~~I-8, I-4,~~	~~I-6,* I-8,~~	
	I-8	I-10	I-12 I-15 I-20
Copper sulphate, (sol.)	I-100,	I-200,*	I-400,
Creasote, (Com'cl)	I-400,	I-500,	I-900,
Morsons wood tar)	I-700,	I-910,	I-1200,
(solution)	I-I,	I-2, I-4,	I-8,
Hydronaphtol, (sol)	I-I,	I-2, I-3,	I-4, I-5,
Iodoform,	Growth in the saturated solution among the undissolved powder.		
Mercuric bichloride,	I-25000,	I-50000,	I-100000
I-500 solution.	I-50,	I-100,	I-200,
Resorcin, 6.5% solution.	I-4,	I-6,	I-8,* I-10,
Oil of bergamot.	I-200,	I-400	I-720,
(solution)	I-I,	I-4	I-5,
Oil of cajeput,	Growth in the emulsion.		

Oil of cassia	I-3000,	I-4000,	I-5000.*	
(solution.)	I-2,	I-3,	I-4,	I-8, I-10,*
Oil of cinnamon, (ceylon)	I-2000,	I-2700*	I-4000.	
(solution)	I-1	I-2,	I-3,	I-4,* I-5,
Oil of cloves	I-1100,	I-1200,	I-2000,	
(solution)		I-1,	I-2,	I-3,* I-4
Eugenol,	I-640,	I-800,	I-1200,	
(solution)	I-1,	I-2,	I-3,	I-4,* I-5,
Oil of copaiba	Growth in the emulsion.			
Oil of coriander.	Growth in the emulsion.			
Oil of cubebs	Growth in the emulsion.			
Oil of eucalyptus,	Growth in the emulsion.			
Eucalypti extract,	I-100,	I-240,	I-480,	
(solution)	I-1,*	I-2,	I-3,	I-4, I-5,
Eucalyptol.	I-100,	I-380,	I-650,	
(solution)	I-1 ,	I-2,	I-3,	I-4, I-5,
Oil of fennel,	Growth in the emulsion.			
Oil of mustard.	I-1000,	I-1500,	I-2000,	
(solution)	I-1,	I-2,	I-4*	I-6, I-10,
Oil of pennyroyal,	I-480,	I-720,	I-960,	
(solution)	I-1,	I-2,	I-3 ,	I-4, I-5,
Oil of peppermint,	I-375,	I-600	I-800,	
(solution)	I-1,	I-2,	I-3,	I-4, I-5,
Menthol, (solution)	I-1,	I-2,	I-3,	I-4, I-5,
Oil of sassafras,	I-270,	I-540,	I-800,	
(solution.)	I-1,	I-2,	I-3,	I-4, I-5,

Oil of thyme Growth in the emulsion.

Oil of terpentine I-500, I-600, I-800.
(solution) I-I, I-2,* I-3, I-4, I-5,
Terebene I-480,* I-800, I-1400,
(solution) I-I,* I-2, I-3, I-4, I-5,
Terpinol, I-520, I-720, I-960,
(solution) I-I, I-2, I-3, I-4, I-5,

Oil of valerian, Growth in the emulsion.

Oil of wintergreen, Growth in the emulsion.
Salacylic acid, (sol) I-I, I-2, I-3,* I-4, I-5,

Oil of wormseed. I-280, I-720 I-880,
(solution) I-I, I-2, I-3, I-4, I-5,

~~Experimental tests in broth containing 5 per cent of egg albumen~~

In the following tests three solutions of the bichloride with a new broth were used. A I-500 solution of bichloride of mercury was made and divided into three equal parts. That marked (p) was left plain. That marked (a) received 5 per cent. of hydrochloric acid. That marked (s) received IO per cent. of chloride of sodium.

Mercuric bichloride,		(s)	I-25000,	I-50000,
" "	" "	(a)	I-25000,	I-50000,
" "	" "	(s)	I-20000,	I-I0000,
" "	" "	(a)	I-20000,	I-I0000.
" "	" "	(s)	I-3700,	I-2500,*
" "	" "	(a)	I-3700,	I-2500,*
" "	" "	(s)	I-2500,*	I-I500,**
" "	" "	(a)	I-2500,*	I-I500,**

Carbolic acid 5% Solution I-8 - I-10 - I-12 I-15 I-20

Oil of cassia, (sol)	I-3,	I-5,	I-8,	I-I0,*
Copper sulphate, (sol)		I-I00,	I-200,	I-400.

~~With a new broth and new solutions made in the same manner and amounts, the following facts were made;~~

Mercuric bichloride,	(p)	I-5000,	I-7500,	I-I0000,	I-I500
" "	(s)	I-5000,*	I-7500,*	I-I0000,	I-I500
" "	(a)	I-5000,*	I-7500,*	I-I0000,	I-I500
(Of the solution,		I-I0,	I-I5,	I-20,	I-30.)

A study of the table will show that of the oils Some are of no value ~~whatever~~ while thus far studied, there is ~~the~~ a wide ~~range~~ difference in their antiseptic value, and Some of those of widely of those that ~~have power to~~ inhibit growth reputed merit are shown to be of no value whatever. This is especially true of oil of wintergreen of which salacylic acid is a derivitive. I tried ~~about ten~~ a number of specimens of this oil obtained from different sources and microbes grew freely on the emulsion of ~~all of them~~ each, while salacylic acid has a ~~very~~ moderate range of antiseptic power. It is to this matter of range of antiseptic ~~power~~ value that I wish especially to call the attention of the profession at this time. I think that very few appreciate the shortness of the range through which any drug may be used for this purpose. That is to say, the point of concentration of poisonous properties that will inhibit the growth of microbes is generally ~~very close to~~ not very far from the point that will seriously injure any animal tissue to which it may be applied; or if the medicine is one that is but or be liable to produce toxic effects by absorption

The general rule is, that the greater the range of antiseptic value, the more dangerously poisonous the drug

feebly poisonous to the animal tissues its range of antiseptic ~~power~~ value is very short indeed. There has been no exception to this rule among the antiseptics that I have thus far studied. Bichloride of murcury has a very great range of antiseptic power in the absence of albumen, and it is also very poisonous. On the other hand the preparations of eucalyptus are very feeble poisons, so ~~much so~~ feeble that they may be used upon the tissues almost at will. But at the same time my trials show them to be very feeble antiseptics, and have a very short range of value indeed. Nothing less than the saturated solution is effective in inhibiting growth. ~~And this is more true in the eucal-~~ The specimens of the oil that I have had have not been effective in any quantity, but the other two preparations eucalyptus extract and eucalyptol have, and thus really exert a restraining power that I am unable to express in my tables. Indeed I do not feel that I yet understand this power which I find so prominent in eucalypti extract and especially in oil of cassia. For instance microbes grow promptly

in a broth to which an equal volume of the saturated solution of the eucalypti extract is added, but the growth ~~seem~~ seems abnormal to such a degree that the specimen has no resemblance to the control tube. The broth usually remains entirely clear while waxy bulbs grow up in the bottom of the tube or cling to its sides. This character is presented lessoning in degree as the dilution is increased very slowly so that in ~~a dilution of~~ one of the solution to four of broth the growth is usually less than one fourth that in the control tube and has a very different appearance. It is in this restriction of the growth of microbes that this drug has its value rather than its complete inhibition of growth.

This peculiarity is still more strongly expressed in the oil of cassia, and in this case it is united with a fairly wide range of anticeptic value. Indeed this drug presents the widest range of power, all things considered, of any that I have thus far studied. That is if we consider it in relation to its behavior

toward albumen which will be especially considered presently. The drugs most likely to dispute this are boracic acid, resorcin, and posibly aseptol, creasote and carbolic acid. Its virtues, as is the case with all of the powerful antiseptics, receives a very powerful check in the development of its irritating properties. This is sufficient to blister the skin after rubing on the oil three or four times per day for two days. I have used it in this way in the treatment of some skin affections supposed to be microbic in their etiology with very prompt results. When the blisters were healed the case was well in each instance. It has also proven the most effective antipyogenic that I have yet employed. It may be used in the form of an emulsion in any but very large abscesses and infected wounds. Dr David Prince of Jacksonville has been using it at my suggestion in capital surgical procedures with the most excellent results in the prevention of sepsis and pus formation

but finds that where the pure oil comes in contact with the skin and remains for some time it produces a blister. A mode of use that has grown in favor is to slightly moisten powdered boracic acid with the oil and in this way use the two in conjunction as a dry dressing. In dentistry the pure oil or the oil diluted with a bland oil makes a most excellent dressing for foul root canals and abscesses. It should not be frequently repeated in the treatment of abscesses however, on account of its irritating property. It is this oil that renders the I-2-3 mixture so efficient

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Carbolic acid, (melted crystals) ..... I part.
Oil of cassia, ... 2 parts.
Oil of wintergreen ..... 3 parts.

Mix the oils and add the melted crystals of carbolic acid.

My original thought in the mixing of this preparation was to get the best posible antiseptic effect of the carbolic acid and at the same time overcome

its evil effects on the tissues by the stimulating effects of the oils; but I had not used it long until I found that I had something else, something that I never understood fully until I had made experimental studies of the oil of cassia. Really, the I-2-3- mixture has an antiseptic ~~and disinfectant power~~ value much greater than pure carbolic acid without its evil effects on the tissues; or at least with a very great moderation of them.

Transfer to end of page 22

~~But~~ I cannot now take time for the discussion of special drugs, nor even mention ~~again the most~~ many of the articles included in the table. It will be seen that many of the oils studied are of no value while some of them may be made useful. A study of the table in connection with the properties of the oils already well known in our literature will be a sufficient guide in their use, and the selection of them for special purposes.

Two other points in regard to the oil of cassia should receive mention; ~~before they are past~~; the fluctuation in quality and the deteriation of the saturated solution by standing. As to the first, I have had a number of samples bought in the market and the results with the best and the worst will suffice. The saturated solution of the best gave;

I-I I-3 I-5 I-8 I-10*

and the poorest;

I-I I-2 I-3 I-4 I-5*

a difference of considerable moment. Nevertheless dealers inform me that the oil of cassia being one of the cheaper oils there is much less liability to adulterations than with the more costly. But little seems to be known of the production of this oil. It all comes from the interior of China and no one seems to know much about it.

As to the deteritation of the solution I have but one observation. A bottle of the filtered solution stood in the case at the College from May to January

fully exposed to the light. The following trials were made with it.

I-I I-2 I-3* I-4 I-5.

The bottle unfortunately had ~~no~~ lost its special mark and I would not risk saying ~~whether~~ To which of my samples it belonged ~~to~~ but in any case it shows a considerable reduction of antiseptic power.

Forms of antseptics for use.

In regard to the use of antiseptics in different positions and for different purposes I should divide them into three forms, each of which has especial advantages ~~in different positions, and under different circumstances.~~

These forms are; ~~the powder, the oil, and~~ the solution in water, the oil, and the powder.

The solution in water is especially useful for ~~the~~ cleansing ~~of~~ infected surfaces of wounds, ~~the~~ washing ~~of~~ abscesses, and indeed for any thing where there is something that can be removed by the act of washing. While in the performance of this act the antiseptic is diffused to all parts of the wound or abscess mechanically to the best advantage. It is more likely to reach every part in this form than in any other; and this is an advantage that can hardly be over estimated; for ~~as I shall show presently,~~ it is very difficult to reach all parts of an abscess by any mode of procedure now known to us on account of the very

tardy diffusion of liquids. And in case the liquid containing the antiseptic does diffuse, its very diffusion and mixture with the surrounding fluids very soon dilutes it below its range of ~~effective work~~ antiseptic value. It is therefore necessary that the washing be continuous to obtain the ~~full~~ continued effect of the drug. This is generally impracticable, and for this reason the watery form of antiseptics is very much limited in usefulness. The continuous drip, or the application as often as every fifteen or twenty minutes, in some favored positions, gives effective results, but is very difficult to carry out, and much trouble. The continuous bath is still more limited in its range of application. Neither of these can be of use in dental practice. With us the watery anticeptics should be limited to the cleaning of infected parts. They cannot be trusted to prevent septic action for any length of time for the reason that they so soon become diluted below their range of antiseptic ~~work~~ value by admixture

Since studying the power of antiseptic drugs more closely my feeling is that it will not do for us to expect to do 25
much disinfectant work in connection with the tissues and antiseptics only retard growth during their presence with the secretions, or with the juices of the flesh. Hence the necessity for continuous, or oft-repeated application. In using these much aid may be had by making the solution in peroxid of hydrogen instead of water so as to obtain the mechanical advantage of the ebelution caused by in mixing the antiseptic with the secretions the oxygen evolved. There is posibly some antiseptic virtue in the oxygen itself as well, but I am apt to think that its principle use is the mechanical one. And that is a very important use. Thorough cleaning is excellent antiseptic work. ~~This~~ The peroxide of hydrogen will do this in many positions where nothing else will, and while doing ~~this~~ it, will carry the antiseptic proper to the more remote parts of the wound, or abscess.

After the cleaning with the watery form of the antiseptic we need some thing that will be more enduring in its effects; and according to the conditions, should chose between the oils and the powders. If it is an abscess with which we have to deal an oil which is in itself an antiseptic, or an oil holding the ~~effective~~ antiseptic drug in solution in effective proportions may

be introduced into the cavity and so agitated as best to bring it in contact with all of its parts. This will, on account of its sparing solubility, remain in position for effective work very much longer than the watery forms; and the essential oils ~~especially~~, are ~~very much~~ more diffusable than the ~~other~~ fixed oils, or indeed, any other forms of the antiseptics ~~that~~ with which I am yet acquainted ~~with~~. At the same time a sufficient amount for very extended work is contained in ~~very~~ small compass. These are of especial value in such positions as the roots of teeth. In this position any but the most irritating of the antiseptic essential oils may be used to good advantage and may be relied upon for many days together. In the choice of the oils it is by no means ncessary that the most powerful of them be ~~chosen~~ selected. It should be remembered in making the choice that the more powerful antiseptics are the most irritating, as the rule to which ~~there are but few exceptions to be found, and these are only as to degree.~~ There are only modifications to this. There are indeed differences as to the quality or kind of irritation produced

It is therefore often best to chose antiseptics of very moderate range, especially where its is only required to preserve a condition of asepsis. For instance, when a very foul root canal is opened such an antiseptic as oil of cassia is indicated, and it may, after appropriate cleaning, and especially in case cleaning is to be defered for fear of forcing poisonous material through the apical foramen, be used in full strength in which form it may be relied upon as a disinfectant as well. But afterward, when it is only a matter of holding an aseptic condition during the healing of the parts an antiseptic of shorter range that is not so liable to injure the tissues is to be prefered. For this purpose the eucalypti extract ~~used~~ in substance is a very useful agent. Its range of actual inhibition is very short, ~~indeed~~, but its injurious effects on the tissues is also very slight, so that the healing process may go on in its presence without hinderance. The oil of cloves or

Furthermore, this oil has a very extended range of restraining influence beyond its range of actual inhibition that is undoubtedly of much use. This oil may be exchanged for terpinol where a little more stimulating effect is regarded as beneficial. The oil of cloves and the oil of cinnamon seem to occupy a middle ground and may be made useful in a large class of cases if the others are in any wise distastful to the dentist or his patient. The oil of mustard, though a good antiseptic of short range has an irritant action that must limit its use. Yet in cases where it is desireable to arouse the tissues from a state of inactivity this property action is combined with the antiseptic in a high degree. It is also one of the most diffusable of the antiseptic oils thus far studied.

Any of these oils may be used in the emulsion if for any reason it is not thought well to use the oil in substance. This form is especially recommended for

supperating wound surfuces and the washing of abscesses. In this way small quantities of the oil may be widely diffused and left in a multitude of minute globules to gradually dissolve where it is most wanted, forming a kind of connecting link between the true solutions and the oils in substance. For this purpose a little of the oil selected may be diffused through water by severe shaking, or better, by repeatedly filling and violently emptying the syringe, and the milky emulsion thus formed may be used in the same manner as the solution.

I have said that all antiseptics are poisons. I wish to emphasize this statement. They are antiseptic by virtue of their power of restraining life forces; and their use as antiseptics is permited only by shades of difference in the action of the poisons toward the different forms of life by which they effect the fungi more prominently than the animal tissues.. Each of these agents has its own peculiar quality of poisonous effect; and a choice is to be made of antiseptics in this respect for application

in special cases. For instance, carbolic acid has the property of benumbing the parts to which it is applied, and the slowing of all of the life processes; the oil of cassia has, on the other hand, the reverse effect of quickening all of these movements. The one is a depressant irritant, while the other is a stimulant irritant, or excitant. These properties are happily blended in the I-2-3 mixture. The range of value of the eucalypti extract may be increased and its qualities rendered suitable for this case or that, as they are presented, by admixtures of the stronger antiseptics, such as 5% of the crystals of carbolic acid, or 5% of oil of cassia, more or less as may seem best. In such ways mixtures may be formed that will unite in the greatest degree such effects as we may wish to combine with the antiseptic property.

The form of powder has become known in surgery as the dry antiseptic dressing. For this purpose an antiseptic in the form of powder ~~that when dissolved in solution of which full strength~~ Crystaline is required the saturated will not be to irritating. It is sufficiently manifest that very poisonous drugs cannot be employed for this purpose, for by their solution in the secretions they would do irreparable injury. As a dry dressing Boracic acid seems to stand at the head of the list. It has a longer range of antiseptic power than any other that may be used in this form, and the quality of the irritation produced is not such as to seriously hinder the growth of granulations, so that wounds heal readily in its presence. We have however, in hydronaphtol, betanaphtol, and salicylic acid, ~~very fine adjuncts, or~~ drugs that may be used in the same way very effectively, though they are of much shorter range of ~~power~~ value and probably not so diffusable by the tissues and with al are not so kindly borne I once saved a life by stuffing a quinine jar full of salacylic acid into a stinking gunshot wound at a time

when the patient was in a state of apparent coma from septic fever.

The plan of the dry antiseptic dressing is to heap the powder in more or less thickness on the wound and apply retaining bandages over it so that the antiseptic may slowly dissolve in the secretions and in this way keep up constantly something near a saturated solution in contact with the wound. In this way the dry dressing acts much in the same manner as the oil dressing. Indeed the object is the same in each case, i.e. to keep an effective solution of the antiseptic in contact with the wound continuously In this respect these modes of application are the counterpart of the watery forms applied in the form of the continuous drip or the bath, and when applied successfully have the same result with much less difficulty in their application.

This leads me to speak just here of the principle that should hold in the use of all of the

antiseptic drugs; that of continuous application for a long period, or until the wound has healed. The antiseptics are not <u>disinfectants</u>. They do not ~~destroy~~ destroy micro-organisms; but only prevent their growth. If the antiseptic is removed, or is reduced below its range of effective work by dilution in the secretions spesis may occur. A failure to appreciate this fact is the most general explanation of the failures that are so constantly seen in surgical practice. How ~~m~~ long micro-organisms will live while their growth is held in check by an antiseptic we do not yet know, but it is certain that they will live for many days in the presence of most of the antiseptics that are safe to use on the tissues. That they do die in time — there is no doubt, but how long ~~that time is~~ they live is a question that is not yet solved. They seem to die as a shrub would ~~die~~ when placed under conditions that prevent its growth, and are as apt to spring into active life if the conditions of their development is

restored by the renoval, or dilution of the antiseptic. as the shrub when planted in good soil

A very serious difficulty in the use of the dry antiseptic dressing in surgery exists in the cakeing of the powders by being moistened with the secretions so that with the reduction of the secretions after a few days a space is left between this caked material and the surface of the wound. In this case the dissolved antiseptic is soon diluted below its ~~line of effective work~~ range of antiseptic value and is as completely removed as if taken away al together, ~~only that it may prevent re infection,~~ and a septic condition may develop uder the arch thus formed. If we undertake to pervent this bu useing but little of the powder we are liable not to have a sufficient quantity for solution in the secretions and fail to mend matters. In this dilemma it has been proposed by Dr Prince to make use of the vapor of the essential oils in connection with the dry dressing. This suggestion seems to have sprung

excellent -

from some clinical observations of the effects of the oil of cassia placed in considerable quantity on boracic acid after it was heaped up over the wound after ovariotomy. When this suggestion was communicated to me I at once made a number of experiments with the view of testing ~~the~~ its merits but have found it very difficult to copy the conditions by artificial modes. My experiments were made in this way; A test tube containing ordinary beef broth (about two inches depth) was infected with saliva as usual in my experiments and before replacing the cotton stopper a drop of the oil of cassia was placed on its lower end. In this case there was constantly a marked modification of the growth but not a complete inhibition. A normal growth occured in the lower portion of the broth while from one fourth to one third of the upper portion remained clear. These experiments indicate that the vapor of this oil will dissolve in the secretions sufficiently to inhibit growth in the surface portions; ~~but its~~

but that its diffusion is not sufficient for it to extend to any considerable depth. From this it seems probable that this kind of combination of the oils with the dry dressing will enhance its value.

The combination indicating this form of use may be pursued about the mouth of the anus

Another form in which the crystaline antiseptics have an important though limited use is ~~in~~ the the hypodermic injection, For this purpose those that are feebly soluble in water or the juices of the flesh are dissolved in ether or similar menstrum and injected into the tissues, In this case the substance is quickly precipitated in the tissues to be slowly dissolved by the juices of the flesh and maintain an antiseptic action for a considerable time, By this plan some affections may be treated successfully that cannot be reached by other forms of application ~~can be reached~~ such as erysipelas progressive gangrene and those of like nature

This plan of application may be occasionally used ~~about~~ the mouth effectively for the prevention of putrefactive changes in ligated stumps of tumors such as occur frequently ~~in~~ tongue and other pedicular tumors

The diffusion of antiseptics, or rather the difficulty of diffusion is a subject that has strongly attracted my attention since I have been experimenting with the drugs named in the tables. In some experiments undertaken for the study of this subject I have found it posible to inhibit growth in the upper portion of the broth in a tube while the lower part was growing in a normal manner. This is very readily done by allowing the solution of the bichloride of mercury to run down the side of the tube and spread over the surface of the broth, ~~and set~~ The tube should be set away quietly. There will be so little diffusion of the bichloride that the broth will be decomposed to within a short distance of the top while this portion will remain clear and free from growth. Although I have not studied this subject at all sufficiently I have made a considerable number of experiments in but what I have seen indicates that much may be done to increase the diffusion of antiseptics in the secretions of

wounds and the juices of the flesh in the neighborhood of injuries. For instance, a I-500 solution of mercuric bichloride in sufficient quantity to inhibit growth in the contents of a sertain tube when well mixed will diffuse so as to inhibit growth but one inch in a horizontal direction. If, however, five per cent of hydrochloric acid is added to the bichloride solution the diffusion will extend about four inches. The addition of the same amount of common salt will ~~also~~ serve to extend the diffusion almost as much. My experiments also confirm what was before known to physicists, that diffusion of liquids takes place very slowly through narrow openings. If two tubes are connected ~~together~~ by a narrow opening and filled with infected broth and an antiseptic added to one, growth will be inhibited in the one while it ~~the growth~~ will progress normally in the other. There will be little or no diffusion through the narrow opening. These are facts of very considerable importance in the

treatment of abscesses and sinuses, and especially
~~and strongly suggests the value of a~~
infected penetrating wounds. ~~It is to large a sub-~~
~~ject of Peroxide of Hydrogen as a solvent for antiseptics~~
~~feet however for me to do more than to make this~~
~~mention of it in this paper.~~ and suggests
strongly the value of peroxide of hydrogen
as a solvent for the crystaline antiseptics
and the oils as well,

It also shows plainly that we cannot
expect that the influence of antiseptics
laid in root canals will extend to the
tissues beyond the apical foramen
unless the medicament is forced through
at the time of its application

The relation of albumen to antiseptic work is of very considerable importance for the reason that its presence contra-indicates one of the most powerful of the antiseptics in use; bichloride of mercury. It has long been known that albumen is an antidote to bichloride of mercury, ~~and notwithstanding that fact the drug has~~, Yet, on account of its great potency in the absence of albumen, the drug has grown into very extended use in the utmost disregard of the antagonism of the two substances. Experimental tests indicating this have been published by several experimentors but seem ~~not~~ to have been heeded by ~~large numbers of the~~ very few medical men. In order to estimate the degree of antagonism that exists between these two substances, and to see if this applied to other drugs as well I began a series of comparative experiments, but have not found the time to carry them through with any considerable number of medicaments. I have, however, made ~~pretty~~ fairly thorough work with bichloride of mercury, the results

of which are given in the tables. My first experiments(not given in the tables) were in reference to the decomposition of the solution of the bichloride when exposed continuously to light. These experiments showed conclusively that for a period of two months the addition of 5 per cent of hydrochloric acid to the solution of I-500 of the bichloride protected it perfectly so that its ~~effective~~ range of antiseptic ~~power~~ value was the same at the end of that time as at the beginning. The plan of experimentation was to mix the solution and set it in the full light of day(not in the sun) This solution was tested for its limit of antiseptic value in a certain broth infected with saliva. Other tubes of the same broth were kept for the purpose and two tests made each week for the period of two months without showing any diminution of power. The same solution without the addition of the acid lost power very rapidly.

The experiments for testing the influence of albumen was first made with two solutions. Each contained 1 of the bichloride of mercury to 500 of water. To the one 5 per cent of hydrochloric acid was added, and to the other 10 per cent. of chloride of sodium. The chloride of sodium was added through the suggestion that it would prevent the precipitation ~~of the~~ of the albumen by the bichloride, which indeed ~~if the fact, for~~ seems to be correct. I found that the addition of this solution to broth containing 5 per cent, of albumen caused no clouding of the liquid while the addition of the other in even very minute quantities rendered it milky; and if mutch were added the albumen was thrown down.

The tests made with these solutions ~~are given in the tables, and~~ not when compared with the power of the bichloride ~~as given in the principle table offers a~~ without albumen in the absence of albumen shows plainly that fair showing ~~of the influence of albumen~~. ~~They also~~ the two substances are antagonistic; and that ~~since that~~ the addition of chloride of sodium is of bichloride no advantage notwithstanding the fact that the albumen is not precipitated.

I then made other solutions more carefully in that a solution of I to 500 of the bichloride was divided into three parts in order to be sure that and I give the results with three in the tables the three were exactly alike; The ~~one~~ first was left plain (Marked (p) in the tables) The seccond received 5 per cent, of hydrochloric acid (Marked (a) And the third received IO per cent. of chloride of sodium (Marked (s).

These solutions were then tried, using for the purpose a new broth, ~~which it will be seen~~ and gave a ~~result~~ higher range of value slightly ~~different from the preceding~~, either from a difference in the broth or in the solutions, it is difficult to tell which. ~~An examination of th these shows that the results were better than with the previous solutions; but still there is a great reduction of antiseptic power.~~ These experiments show Such a reduction of the range of value of the bichloride in the presence of albumen ~~indeed~~ that when we consider that in many of the positions in which the antiseptic is used there is present from eight to ten per cent. of albumen we

dilution that could safely be placed in contact with the tissues. There is however, a range of restraint, ~~which in this case is pretty well~~ shown by the frequent ~~stars~~ asterisks in the table, which may account for some benefit in the use of the drug even though it does not fully inhibit growth. It will be noticed that the results with the plain solution ~~is~~ are the poorest and that the results of the hydrochloric acid solution is much the ~~better~~ best. I take it that this effect represents the antiseptic values of the hydrochloric acid ~~and the salt~~ rather than any beneficial effects of these agents on the action of the bichloride of mercury

add

My own clinical observation agrees very well with the experimental results. For years past I have used only the I to 500 solution, when I have used it at all, as an antiseptic. My reasons for doing so were that it did not seem ~~to me~~ to effect the purposes intended in less strength; and even in that strength

Page 48 > add

These results are in substantial agreement with those obtained by Dr Ernest Laplace of New Orleans under the direction of Prof Koch of Berlin ~~except~~ he using tartaric acid instead of hydrochloric also with those by Van Ermengem, and those by Dr Bolton under the direction of Dr Sternberg and reported ~~in the~~ by the american public health Association Pages 157 to 160 inclusive — The experiments have ~~very~~ been very differently made in these different cases and the figgures ~~are very~~ are different; yet the prommence of the loss of power of the bichloride in the presence of albumen is the same in all

Page 45 > Add This is in agreement with Dr Bolton's results (Page 159 Report of american public Health association) in which ~~as solution~~ an addition of 1 to 100 of the bichloride of mercury of bichloride was required to effect sterilization in the presence of 10% of egg albumen.

degree of concentration it has not proved a good anti pyogenic unless the washing was carried on with a very large amount of the solution.

There can be no reasonable doubt of the effectiveness of the bichloride of mercury in the absence of albumen. Therefore it ought to hold the place it has gained for the disinfection of instruments and ~~the disinfection~~ of the skin previous to operations. It should, however, be used in greater strength than it is generally employed for these purposes.

I made various tests with the oil of cassia in connection with albumen and all odf these gave results that coinside very perfectly with the experiments in broth without the addition of the albumen. With this agent the presence of albumen is of no consequence.

The tests of the effects of albumen on the power of carbolic acid show a diminution of its ~~antiseptic~~ range & value ~~power~~ which remained constant, but it is so little

that it may safely be ignored in practice.

I have made but few experiments with agents as disinfectants, and these few have been confined to bichloride of mercury and the oil of cassia. I made a number of efforts to sterilize saliva with the bichloride of mercury, all without success. I carried the concentration to I-250 and planted broth from this at intervals for two days, with due caution in well proven sterile tubes of broth, but every one of them grew freely within the first twenty four hours. The amount of albumen coagulated in these tubes of saliva show plainly that the addition of five per cent. ~~is to little~~ of albumen to the broth is far to little to give the proper expression to the effect of albumen in the use of this drug in the mouth, in abscesses or in wounds.

Oil of cassia in full strength solution or in emulsion destroys all micro-organisms, in the absence of spores, promptly, but the spores of B. subtilis and some other bacilli

resist it for ~~several hours~~. a considerable time - However my experiments have not yet been sufficiently attested by repetition for me to feel like giving exact figures