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DISINFECTING POWER OF COAL-TAR DIPS.

INTRODUCTION.

The experiments reported in this bulletin were undertaken to determine the value as disinfectants of various preparations commonly known as coal-tar dips. The object was not primarily to find their value as disinfectants as compared with one another, but to see if any or all of them were reliable disinfectants when used in very dilute solutions. The dips tested that properly come under the head of coal-tar preparations are Zenoleum, Cremoline, Lincoln Dip, Car-Sul, Moore's Hog Remedy and Chloro-Naptholeum. The other preparations tested were carbolic acid, kerosene emulsion and Mortipest Sheep Dip. Samples of these dips were obtained on the market with the exception of Cremoline and Mortipest, these being sent to the experiment station from the manufacturers. Cremoline had been in the laboratory about six months before it was tested while Mortipest was received after the work was started; samples of the other dips had been in the laboratory for about two years.

No chemical analysis was made of any of the dips to determine the per cent of phenols or other substances and the advertising matter from the various companies gives no idea of their composition except in the case of the Lincoln Dip where such preparations as oils, sulphur and

nicotine are mentioned. It is not likely that dips of this character are always uniform in their composition and for this reason samples obtained from different sources might give results materially different from those obtained in this series of experiments. However, considering the general way in which these dips are prepared, it is possible to obtain a nearly uniform product when such is desired. The basis from which the coal-tar dips are made is the heavy oils of tar which may be collected in the distillation of coal and the manufacture of coke or illuminating gas. These oils are saponified more or less completely in order to cause them to mix readily with water and form an emulsion when they are diluted for use. All of the coal-tar dips are heavy black liquids varying in specific gravity from 1.037 to 1.060. They are readily miscible with water giving a milky color to the mixture. In many cases the mixtures made in the laboratory were allowed to stand for several days without any noticeable separation of the dip and water. In most of them a small amount of oil will collect in drops or globules on the surface and some black sediment will usually collect on the bottom of the flask after the solution stands for a few hours but these do not interfere at all with the use of the preparation. The mixture of these dips with water is commonly referred to as a solution but they are emulsions formed with saponified oils of tar. However, the term solution is commonly used in referring to such preparations of dips and it will be used in this connection in the following pages.

There is no way to estimate the general value of disinfectants when properly prepared and used. They not only kill the germs of disease that may be present but by using them such germs are not able to begin their growth. Practically all communicable diseases that are caused by bacteria can be limited to some degree by using a good disinfectant and many of them are of such a nature as to be easily controlled when disinfectants are used. If germs of the various diseases can be killed in the laboratory experiments they can be killed in practical sanitary work if the disinfectant is brought into contact with the germ. The efficiency of work with disinfectants depends on the thoroughness with which it is done as there can be no half-way disinfection. The method employed in laboratory experiments is such as to bring the disinfectant into contact with every germ, hence the uniform results when the solution is of sufficient strength to kill the germs. Such results are possible in actual practice if the solution is used in sufficient quantity and strength.

METHOD OF TESTING THE DIPS.

The method first used in testing the efficiency of the dips consisted in adding one cc. of a 24 hour bouillon culture of the organism to 98 cc. of sterile water plus one cc. of the dip to be tested. The water and dip were thoroughly mixed before the culture of the germ was added. After the culture was placed in the solution of dip it was thoroughly shaken and a drop taken out at the stipulated time and placed in 5 cc. of water for the purpose of washing the disinfectant from the germ. Agar plates were made from the tubes containing the washed germs using three and five loops respectively in the two plates (a loop is about 1-10 of a drop). The colonies in all plates were counted at the end of 96 hours incubation at 37 degrees C. The question arose in this method as to the effect of the dip solution carried over into the blank on the bacteria therein, and whether it would have any effect on their growth in the plates. To answer this checks were made by placing one cc. of the same culture in 99 cc. of water and carrying a drop over into a 5 cc. water blank and plating as above, then adding to this charged blank one drop of a sterile one per cent solution of the same dip used and plating again in the same manner. The checks made by both methods showed no variation so it was concluded that the small amount of disinfectant carried over had no ill effect. The disinfectant carried from the one per cent solution to the 5 cc. water blank made a solution of the disinfectant in the water blank of one to fifteen thousand.

The following table gives the results obtained from the above method.

Table No. 1.

Effect of a one per cent solution of Lincoln Dip on a 24 hour bouillon culture of the following organisms.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant.						
	Check	0	1	3	5	8	10
B. hog cholera	3	0	0	0	0	0	0
B. swine plague	6	0	0	0	0	0	0
M. aureus	1	0	0	0	0	0	0
B. coli	4	0	0	0	0	0	0
B. subtilis	2	0	0	0	0	0	0

It will be seen from this table that this method gives too few organisms in the check plates which makes the results unsatisfactory. To overcome this it was suggested that either an older bouillon culture be used, one in which the number of bacteria had materially increased over that in a 24 hour culture, or that more of the 24 hour culture be used, or that the germ be grown on agar slopes and the growth removed to a sterile water blank, thoroughly agitated and filtered to remove the clumps. These three methods were therefore tried using the same procedure in every other respect as in the preceding experiment. In order to use more of the bouillon culture, as outlined in the second suggestion, 94 cc. of water was mixed with 5 cc. of a 48 hour bouillon culture of the germ to be tested and one cc. of the dip added to this, making a one per cent solution.

The following table gives the results obtained by trying each of the three methods using Lincoln Dip in a one per cent solution.

Table No. 2.

CULTURE OF B. COLI USED	Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Action of Disinfectant.					
	Check	1	3	5	8	10
Seven day bouillon culture	18	‡	0	0	0	0
Filtered culture from agar	18	0	0	0	0	0
Five cc. bouillon culture, water, 94 cc.; dip 1 cc.	147	5	0	0	0	0

‡Average less than one per loop.

It is apparent from the above results that the number of germs in the check plates is too small in all except the last, where five cc. of the bouillon culture was added to 94 cc. of water. The other methods were discarded and the latter used for the remainder of the work. Instead, however, of using the 24 hour culture, 48 hour cultures were used as this gave a greater number of colonies in the check plates which was very desirable.

The following is a complete description of the method as followed in the remainder of the work. Five cc. of a 48 hour bouillon culture of the germ to be used were added to 94 cc. of sterile water and thoroughly mixed by shaking. One drop of this mixture was added to 5 cc. of sterile water and three and five loops respectively were added to

two agar tubes and plates poured. These were the check plates. After the check plates were poured one cc. of the disinfectant to be tested was added to the mixture of germs and water, making 100 cc. in the flask, less what was used in making the check plates, or a one per cent solution of the disinfectant. At the end of the time indicated in the various tables one drop of the solution was placed in 5 cc. of sterile water and from this plates were poured, using three loops for one and five for the other as was done in making the check plates. The columns indicating the 0 time mean that the drop was removed from the flask as quickly as possible after the disinfectant was added, which would be in from ten to twenty seconds. This method gives as perfect distribution and exposure of the germs to the disinfectant as can be obtained by any method and the washing of the germs in the sterilized water prevented the carrying of any quantity of the disinfectant over into the agar plates. It will also be noticed that the plates containing the germs acted upon by the disinfectant were prepared as were the check plates, so that the difference noticed in the number of germs in the check plates and in the 0 column is due to the action of the disinfectant for the short length of time necessary to mix the disinfectant and the water containing the germs and to remove a drop, which as before stated, was usually from ten to twenty seconds.

The tables given are made up from laboratory notes of the experiment. The following table is from the laboratory notes and the last line or average is found in table No. 5.

Duplicate test of 1 per cent solution of Zenoleum on B. anthracis.

Time germ was exposed to solution	Check	0	½	1	2
Number of germs in three loops	20	8	4	4	5
Number of germs in five loops	62	7	7	8	9
Average number of germs per loop	10	2	1	1	2

Duplicate tests were always made but were never made on the same day or from the same cultures but were always made from cultures and solutions prepared in every way as for the original test.

It will be noticed in connection with table No. 3 that the result of the test indicates the complete disinfection of the preparation containing the B. subtilis and this is also seen in table No. 5 in the origi-

nal test on B. anthracis. As is well known both organisms are spore producing and are difficult to destroy by the use of disinfectants. These results mean that in those particular cultures the germs had not formed spores as tests were made in a number of the experiments to determine spore formation. These tests were made by heating the tubes from which the check plates were made to 80 degrees C. for ten minutes, after which plates were poured as in making the checks. The results showed that when spores were present the colonies in the plates made from the tubes after heating were about as numerous as were the colonies in the plates that had been acted on by the disinfectant. This indicates that the disinfectants as used had no effect on the spores.

EXPLANATION OF TABLES.

The figures given in the tables (fractions omitted) are the averages obtained in the experiment by using a one per cent solution of the various dips. The spaces containing zeroes indicate that all of the germs were killed and spaces containing the dash indicate that no test was made for that time. The figures at the head of the columns indicate the number of minutes the germ was exposed to the disinfectant. As a rule such germs as hog cholera, swine plague etc., were exposed for a shorter length of time than was given to the anthrax or subtilis. After the first tests showed that the solution was effective for certain germs the time was cut down to two minutes for all except the anthrax and subtilis germs, and these were generally exposed for the full time of 30 minutes. In all cases. unless a statement to the contrary is made, the tests were made on a 48 hour bouillon culture grown at 30 to 35 degrees Centigrade and the colonies were counted after the plates had been incubated for 72 hours at the same temperature.

BACTERIA USED IN THE EXPERIMENT.

The bacteria used in the experiment are such as would give a fair test of the disinfecting qualities of any drug, the germs causing hog cholera and swine plague being comparatively easy to kill while the aureus is a very resistant germ and its common use in experimental work makes it a desirable germ to use. The Bacillus of anthrax and B. subtilis were used as types of the spore producing bacteria. The Bacillus of typhoid fever which was used in table No. 13 is another germ that is very commonly used in testing disinfectants. Its relation to typhoid

fever and its presence in the stools from typhoid patients makes it very necessary to use some disinfectant in order to make such infected material harmless.

AGE OF CULTURES.

The age of cultures, even in the non-spore producing forms, has considerable to do with the disinfecting power of any substance. In table No. 12 the test was made with a one per cent solution of Lincoln Dip on all of the germs used in the experiment when cultivated forty-eight hours, eight, and seventeen days. In old cultures the non-spore producing forms become very resistant and under such conditions are more difficult to kill with a disinfectant than when they are in young cultures. This may account in many cases for the failure of certain substances to act as a disinfectant in wounds or abscesses where the same strength of solution was found to be effective in laboratory work. In such cultures as hog cholera and swine plague the difference in the resisting power of the forty-eight hour culture and the eight day culture is very marked but this difference does not increase in proportion in the seventeen day culture.

Table No. 3.

Disinfecting power of one-half per cent solution of Lincoln Dip.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant.							
	Check	0	1	3	5	8	10	15
B. hog cholera	151	61	60	51	20	24	11	...
Duplicate	147	63	59	33	32	36	21	14
B. swine plague	121	28	18	12	10	7	8	...
Duplicate	107	31	9	4	3	1	2	1
M. aureus	21	7	6	6	7	5	11	...
Duplicate	12	5	4	6	2	‡	‡	...
B. coli	143	114	81	38	36	4	1	...
Duplicate	27	9	9	3	2	1	1	...
B. subtilis	8	0	0	0	0	0	0	...
Duplicate	13	0	0	0	0	0	0	0

‡ Average less than one per loop.

Table No. 4.

Disinfecting power of one per cent solution of Lincoln Dip.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant.											
	Check	0	½	1	2	3	5	8	10	12	15	30
B. hog cholera	205	8	.....	0	...	0	0	0	0	...	...	...
Duplicate	388	180	193	95	55	...	...	...	...	...	...	...
B. swine plague	70	0	.....	0	...	0	0	0	0	...	...	...
Duplicate	407	187	217	70	8	...	...	...	...	...	...	...
M. aureus	44	14	.....	0	...	0	0	0	0	...	...	...
Duplicate	54	28	16	18	9	...	...	...	...	...	...	...
B. coli	39	0	.....	0	...	0	0	0	0	...	...	...
Duplicate	422	99	106	67	51	...	...	...	...	...	...	...
B. subtilis	73	20	24	25	...	24	17	24	...	21	21	19
Duplicate	28	7	4	9	7	...	11	9	8	...	11	10
B. anthracis	25	2	2	2	...	2	2	1	...	3	2	3
Duplicate	31	6	6	6	7	...	8	6	11	...	5	7

The original tests in the above table were made August 24, 1903 and the duplicate tests were made February 8, 1904. By comparing the results it will be seen that the dip was effective in the first tests and that it had practically lost its disinfecting properties by the time the second tests were made.

Table No. 5.

Disinfecting power of one per cent solution of Zenoleum.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant.									
	Check	0	½	1	2	3	5	8	10	12
B. hog cholera	126	0	...	0	...	0	0	0	0	...
Duplicate	123	0	0	0	0	...	...	...	...	...
B. swine plague	113	0	...	0	...	0	0	0	0	...
Duplicate	181	0	0	0	0	...	...	...	...	...
M. aureus	57	3	...	0	...	0	0	0	0	...
Duplicate	16	4	0	0	0	...	...	...	...	...
B. coli	485	0	...	0	...	0	0	0	0	...
Duplicate	93	0	0	0	0	...	...	...	...	...
B. subtilis	20	0	...	0	...	0	0	0	0	...
Duplicate	14	1	‡	‡	1	...	...	...	...	...
B. anthracis	7	0	...	0	...	0	0	0	0	...
Duplicate	10	2	1	1	2	...	...	...	...	...

‡ Average less than one per loop.

Table No. 6.

Disinfecting power of one per cent solution of Car-Sul.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant.											
	Check	0	½	1	2	3	5	8	10	12	15	30
B. hog cholera	187	0	0	0	0	...	...	...	...	...	...	...
Duplicate	169	‡	0	‡	0	...	...	...	...	...	...	...
B. swine plague	211	0	0	0	0	...	...	...	...	...	...	...
Duplicate	368	0	0	0	0	...	...	...	...	...	...	...
M. aureus	8	1	1	0	0	...	...	...	...	...	...	...
Duplicate	26	4	1	‡	0	...	...	...	...	...	...	...
B. coli	280	0	0	0	0	...	...	...	...	...	...	...
Duplicate	439	‡	0	0	0	...	...	...	...	...	...	...
B. subtilis	115	13	17	23	15	...	...	...	...	...	...	...
Duplicate	30	12	5	8	10	...	9	8	10	...	12	11
B. anthracis	15	2	2	2	2	...	3	2	3	...	3	3
Duplicate	20	‡	0	‡	0	...	‡	0	0	...	0	0

‡ Average less than one per loop.

Table No. 7.

Disinfecting power of one per cent solution of Cremoline.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant.											
	Check	0	½	1	2	3	5	8	10	12	15	30
B. hog cholera	440	0	0	0	0	...	...	...	...	...	...	...
Duplicate	212	0	0	0	0	...	...	...	...	...	...	...
B. swine plague	166	0	0	0	0	...	...	...	...	...	...	...
Duplicate	438	0	0	0	0	...	...	...	...	...	...	...
M. aureus	10	3	0	0	0	...	...	...	...	...	...	...
Duplicate	73	‡	‡	0	0	...	...	...	...	...	...	...
B. coli	217	0	0	0	0	...	...	...	...	...	...	...
Duplicate	622	0	0	0	0	...	...	...	...	...	...	...
B. subtilis	8	‡	0	1	1	...	...	...	...	...	...	...
Duplicate	17	5	9	8	4	...	5	4	7	...	9	6
B. anthracis	1	‡	0	0	0	...	...	0	...	...	0	‡
Duplicate	17	‡	‡	‡	1	...	‡	0	1	1	‡	‡

‡ Average less than one per loop.

Table No. 8.

Disinfecting power of one per cent solution of Moore's Hog Remedy.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs were Exposed to Disinfectant.											
	Check	0	½	1	2	3	5	8	10	12	15	30
B. hog cholera	80	0	0	0	0	...	...	...	...	...	...	...
Duplicate	172	0	0	0	0	...	...	...	...	...	...	...
B. swine plague	42	0	0	0	0	...	...	...	...	.	...	...
Duplicate	166	0	0	0	0	...	...	...	...	...	...	...
M. aureus	23	2	0	0	0	...	...	...	...	...	...	...
Duplicate	11	0	0	0	0	...	...	...	...	...	...	...
B. coli	27	0	0	0	0	...	...	...	...	...	...	...
Duplicate	244	‡	0	0	0	...	...	...	...	...	...	...
B. subtilis	16	2	6	3	1	...	...	...	...	...	...	...
Duplicate	30	1	0	‡	‡	...	‡	...	...	...	...	...
B. anthracis	22	5	1	2	3	...	2	1	2	...	2	2
Duplicate	9	‡	‡	‡	‡	...	‡	‡	‡	...	0	‡

‡Average less than one per loop.

Table No. 9.

Disinfecting power of one per cent solution of Chloro-Naptholeum.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant.											
	Check	0	½	1	2	3	5	8	10	12	15	30
B. hog cholera	112	0	0	0	0	...	...	...	...	...	...	...
Duplicate	674	0	0	0	0	...	...	...	...	...	...	...
B. swine plague	124	0	0	0	0	...	...	...	...	...	...	...
Duplicate	511	0	0	0	0	...	...	...	...	...	...	...
M. aureus	51	0	0	0	0	...	...	...	...	...	...	...
Duplicate	27	1	0	0	0	...	...	...	...	...	...	...
B. coli	53	‡	0	0	0	...	...	...	...	...	...	...
Duplicate	450	0	0	0	0	...	...	...	...	...	...	...
B. subtilis	37	‡	‡	2	0	...	...	...	...	...	...	...
Duplicate	74	20	17	17	15	...	...	...	...	...	...	...
B. anthracis	17	‡	‡	‡	‡	...	‡	‡	‡	...	‡	‡
Duplicate	52	7	...	6	6	...	5	16	9	...	8	8

‡Average less than one per loop.

Table No. 10.

Disinfecting power of one per cent solution of Mortipest Sheep Dip and of kerosene emulsion.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant.									
	Mortipest					Kerosene Emulsion				
	Check	0	½	1	2	Check	0	1	2	5	8
B. hog cholera	118	182	67	84	76	163	41	12	11	2	1
B. swine plague	525	220	295	337	282	428	23	7	4	2	4
M. aureus	5	5	4	3	3	14	3	3	2	1	‡
B. coli	875	852	675	408	732	244	40	139	37	18	8
B. subtilis	243	142	27	146	40	30	3	3	3	2	2
B. anthracis	112	101	109	98	57	7	‡	‡	1	‡	‡

‡Average less than one per loop.

Mortipest has the appearance and odor of a nicotine dip. It mixes readily with water giving a dark straw color.

The kerosene emulsion was made according to the following formula:

Hard soap, one-half pound, kerosene, two gallons, water, one gallon.

Dissolve the soap in the water by boiling, remove from the fire and add the kerosene and spray back until thoroughly emulsified. To this add seven gallons of water when ready to use.

This test was not run in duplicate as neither preparation possessed any marked disinfecting power.

Table No. 11.

Disinfecting power of one per cent solution of carbolic acid.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant.								
	Check	0	½	1	2	3	5	8	10
B. hog cholera	573	1	0	0	0	...	...	...	...
B. swine plague	315	3	0	0	0	...	...	...	...
M. aureus	62	3	0	0	0	...	...	...	...
B. coli	315	34	‡	0	0	...	...	...	...
B. subtilis	82	17	20	6	9	...	...	...	...
B. anthracis	32	4	...	5	4	...	4	...	6

‡Average less than one per loop.

Carbolic acid was used in the same strength solution as the coal-tar preparations because it is the disinfectant in most common use. By comparing the results obtained with the carbolic acid and the other preparations tested it will be seen that it is a no better disinfectant than Zenoleum, Chloro-Naptholeum, Car-Sul, etc.

Table No. 12.

Disinfecting power of one per cent solution of Lincoln Dip when used on cultures 48 hours old, eight and seventeen days old.

NAME OF GERM	Age of Culture	Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant									
		Check	0	½	1	2	3	5	8	10	12
B. hog cholera	48 hrs	205	8	...	0	...	0	0	0	0	...
" "	8 days	479	92	67	23	4	...	...	...	...	...
" "	17 "	124	53	...	17	8	...	‡	...	...	...
B. swine plague	48 hrs	70	0	...	0	0	0	0	0	...	...
" "	8 days	393	8	2	0	0	...	...	...	...	...
" "	17 "	1217	546	...	214	173	...	23	...	...	...
M. aureus	48 hrs	44	14	...	0	...	0	0	0	0	...
"	8 days	82	19	21	9	1	...	...	...	...	...
"	17 "	69	18	...	16	12	...	11	...	...	...
B. coli	48 hrs	39	0	...	0	...	0	0	0	0	...
"	8 days	212	37	11	1	1	...	...	...	...	...
"	17 "	92	30	...	11	3	...	3	...	...	...
B. subtilis	48 hrs	73	20	24	24	25	...	24	17	24	...
"	8 days	53	19	18	8	15	..	...	...	...	...
"	17 "	185	19	...	16	12	...	19	...	...	15
B. anthracis	48 hrs	25	2	2	2	2	...	2	2	1	0
"	8 days	39	9	11	7	10	...	8	5	11	11
"	17 "	82	37	...	35	23	...	28	...	55	31

‡Average less than one per loop.

This table was completed on September 22, 1903, while the Lincoln Dip was as effective as any of the preparations that were tested.

Table No. 13.

Table showing the effect of the various preparations tested when used on the Bacillus typhosus.

NAME OF DIP	Average Number of Bacteria per Loop and Number of Minutes Germs Were Exposed to Disinfectant.				
	Check	0	½	1	2
Mortipest	139	122	68	77	118
Duplicate	204	164	143	126	161
Carbolic acid	133	0	0	0	0
Duplicate	46	12	‡	0	0
Moore's Hog Remedy	42	0	0	0	0
Duplicate	192	0	0	0	0
Lincoln Dip	154	51	48	40	12
Duplicate	100	36	29	17	5
Chloro-Naptholeum	85	0	0	0	0
Duplicate	55	0	0	0	0
Car-Sul	114	0	0	0	0
Duplicate	207	0	0	0	0
Cremoline	77	0	0	0	0
Duplicate	41	0	0	0	0
Zenoleum	101	0	0	0	0
Duplicate	138	0	0	0	0

‡Average less than one per loop.

The original test in the above table was made on Feb. 17, 1904 and the duplicate test was made on Feb. 20, 1904.

Table No. 14.

Disinfecting power of a one per cent solution of Creolin-Pearson.

NAME OF GERM	Average Number of Bacteria Per Loop and Number of Minutes Germs Were Exposed to Disinfectant.								
	Check	0	½	1	2	5	8	10	15
B. hog cholera	501	0	0	0	0	...	...	...	...
" " 7 day c .ltivation	466	0	0	0	0	...	...	...	...
B. swine plague	588	0	0	0	0	...	...	...	...
M. aureus	102	3	0	0	0	...	...	...	...
B. typhi	189	0	0	0	0	...	...	...	...
B. Coli	239	0	0	0	0	...	...	...	...
B. subtilis	10	4	4	6	5	2	4	4	3
B. anthracis	174	91	82	74	68	64	78	68	94

By comparing the above table with other tables where one per cent solutions were used, it will be seen that the disinfecting power of the commercial dips compares very favorably with that of creolin. Creolin is a preparation of cresols and other hydrocarbons of coal tar held in emulsion by a resin soap. It has a very extensive use in both human and veterinary surgery as a disinfectant, and is also used quite extensively as a deodorizer. In appearance creolin is very much like the commercial dips, being a heavy black liquid, easily miscible with water and with a specific gravity of 1.045.

GENERAL CONSIDERATIONS.

In any community where stock raising is the principal industry there is prevalent at all times some of the various diseases, caused by parasites or bacteria, that require some form of treatment in order to cure the disease or to limit its spread. In many of the skin diseases, the use of some effective remedy will act both as a cure and as a means of prevention. Remedies used in connection with infectious diseases should not be used merely as a cure but they are used much more effectively in many cases as a means of preventing the spread of the disease. The use of such preparations as will free the skin of parasites, such as lice, mange, mites, etc., or that will destroy the germs of such diseases as are common among farm animals, is coming to be very extensive since it is generally understood that such skin diseases can be cured or infectious diseases prevented from spreading by the use of some effective disinfectant.

The coal-tar preparations that were tested in this experiment are widely advertised as dips for all forms of external parasites, especially for sheep scab, mange in cattle and for hog lice. In another report it is expected to show the value of such preparations on skin parasites and on some of the skin diseases. Mortipest, one of the preparations used in these experiments is not sold as a disinfectant but as a sheep dip, and kerosene emulsion, although commonly used as a dip or wash to kill lice, was tested to determine its disinfecting properties. As the results show in table No. 10, neither preparation has any qualities as a disinfectant sufficient to warrant its use. All of the disinfectants tested, that properly come under the head of coal-tar preparations, are good disinfectants, they are cheap and non poisonous and should be extensively used where disinfectants are necessary.

The practical application of disinfectants is of importance to any one handling stock. Even when there is no contagious or infectious disease that would require the use of such remedies there is hardly a time on a stock farm when there is not occasion to use such remedies in dressing sores, wire cuts, etc. The coal-tar preparations are not irritating and may be used in wounds or sores without injury to the tissue. Such diseases as hog cholera, swine plague, glanders, etc., are infectious and animals may easily contract them by being placed in stalls or pens where diseased animals have been. In order to lessen the danger from such infection it is necessary to use disinfectants of some kind or allow the stables or pens to go unused for sufficient length of time for them to become disinfected by drying and sunlight. If some disinfectant is to be used choice may be had of a large number of chemicals, but some one must be selected that is suitable for that particular work. Any disinfectant that can be used in the form of a liquid may be applied in the form of a spray or by means of a broom or mop. A one per cent solution was used in all of the laboratory tests and this strength was found to be effective in most cases but the work was done under very different conditions from those usually met with in actual practice. To disinfect a stall, harness, or wood work of any character, a two per cent solution should be used and sufficient fluid applied to thoroughly wet the material to be disinfected. When a lot of any considerable size becomes infected it is not practicable to attempt disinfection by using any chemicals. The amount of material required to make the work thorough would be too expensive. Exception might be made where very small enclosures such as small chicken runs etc., become infected.

As has been mentioned before, to make use of these preparations in actual work, it is recommended to use at least a two per cent solution. To make this would require one gallon of the dip to 49 gallons of water or larger amounts could be made in the same proportion. For small amounts use one ounce of the dip to three pints of water.

The first tests were made in September 1903 and all of the dips tested, with the exception of Mortipest and Kerosene emulsion, proved to be effective. Some of the tests were not completed until about six months later when it was found that the Lincoln Dip had practically lost its disinfecting power. This will be seen by referring to table No. 4.

The following is a list of the dips tested, their manufacturers, and market price of the dips as given in their advertising matter.

Zenoleum. Zenner Disinfecting Co., Detroit, Mich. Price per gallon, $1.50, in 50 gallon barrels $1.00 per gallon.

Cremoline. Cremoline Mfg. Co., St. Louis, Mo. Price per gallon $1.50.

Lincoln Dip. Pasteur Vaccine Co., Chicago, Ill. Price per gallon $1.50.

Car-Sul. Moore Chemical Mfg. Co., Kansas City, Mo. Price per gallon $1.50.

Moore's Hog Remedy. Moore Chemical Mfg. Co., Kansas City, Mo. Price per gallon $2.50.

Chloro-Naptholeum. West Disinfecting Co., New York, N. Y. Price per gallon, $1.50.

Mortipest Sheep Dip. W. J. Bush & Co., 5 Jones Lane, New York, N. Y. Price per gallon $6.00.

For those who are familiar with bacteriological work the tables showing the disinfecting properties of the various preparations are sufficiently conclusive but it is well to add a brief summary of the general conclusions reached.

When the various coal-tar dips were used in a one per cent solution they were effective disinfectants in laboratory experiments but in practical work at least a two per cent solution should be used.

They were equally as good and in some of the tests proved to be better disinfectants than carbolic acid when used in the same strength.

The coal-tar dips tested are non poisonous and are not irritating to the skin or when used in wounds. As compared to carbolic acid they were certainly as effective, are cheaper and are not so dangerous to use.

The coal-tar preparations tested are not only good disinfectants but are also good deodorizers.

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