A report on the disinfection of tubercle-infected houses / by Sheridan Delépine & Arthur Ransome.

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A REPORT ON THE DISINFECTION OF TUBERCLE-INFECTED HOUSES.[1]

BY

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IN our preliminary report, published in the BRITISH MEDICAL JOURNAL of November 4th, 1893, we gave an account of the origin of the present inquiry, its first object being to test the value of the method then used by the municipality of Manchester for disinfecting rooms in which tuberculous patients had lived.

TABLE I.—*Virulence of Fresh Human Tuberculous Sputum in Small Quantities.*

Number of Experiment.	Date.	Animal.	Quantity of Sputum.	Seat of Inoculation.	Number of Days after Inoculation.	Degree of Tuberculosis.
4	May, 1892	Rabbit	c.cm. $\frac{1}{10}$	Peritoneum	9	0
3	,,	,,	$\frac{1}{10}$	,,	55	Slight I
62	May, 1893	Guinea-pig	Under $\frac{1}{10}$	Subcutaneous tissue.	21	III
63	,,	,,	$\frac{1}{2}$	,,	52	IV

We have since extended the inquiry to other methods of disinfection, and have also studied the influence of certain natural agents on the virulence of the bacillus of tubercle.

Three series of experiments were undertaken in the first place, in order to make sure that our methods were trustworthy.

(1) The first set of experiments consisted in the subcutaneous and intraperitoneal inoculation of sterilised products

[1] This report was presented to the Scientific Grants Committee of the British Medical Association shortly before the last Annual Meeting of the Association.

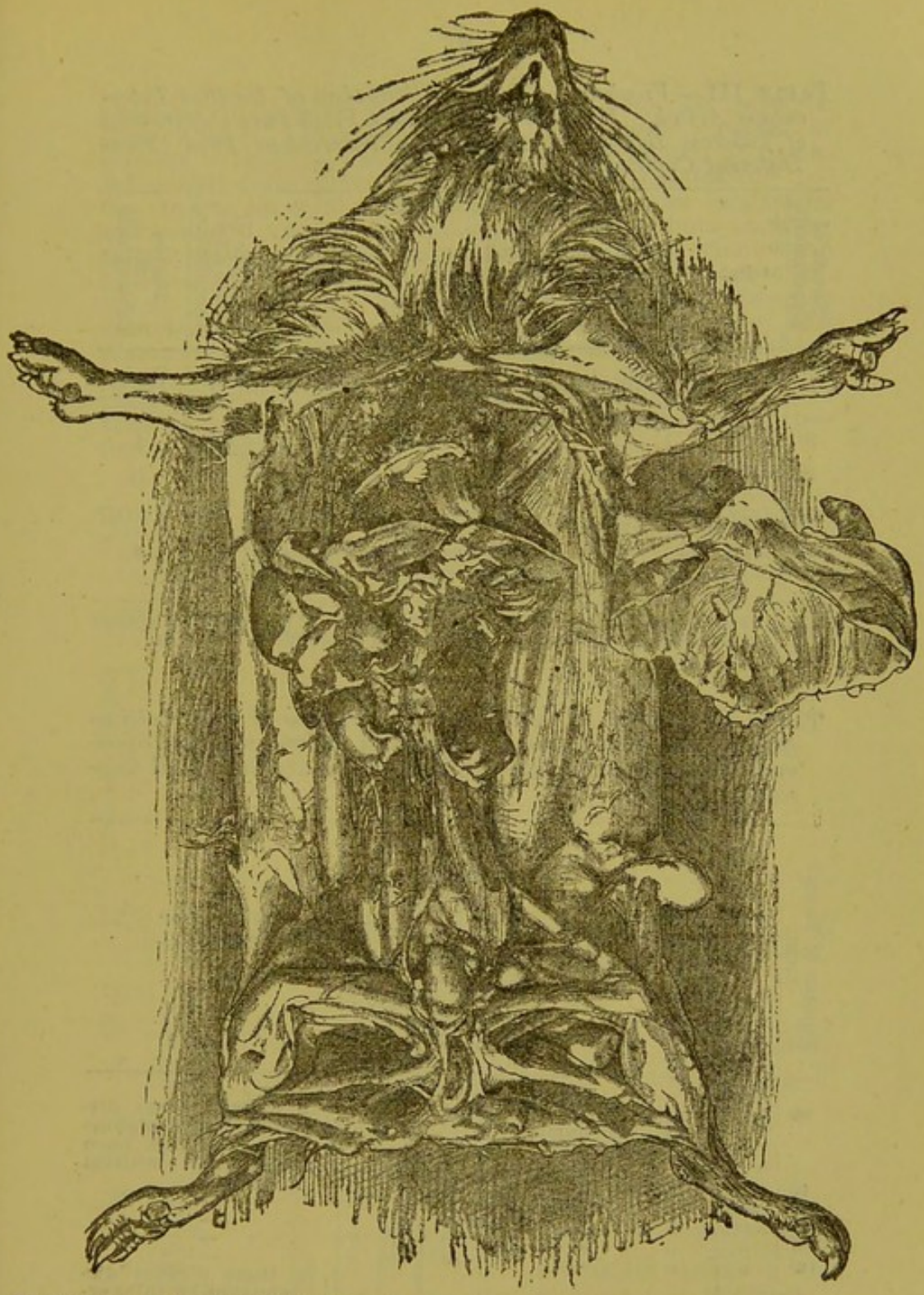
(including paper), the animals being kept in cages identical with those used for the other experiments, and disinfected in the same way. These experiments were numerous, and amongst them might also be included several recorded in the following tables. In no case was tuberculosis produced, even after keeping the animals for several months under observation, so that it may be safely assumed that, under the conditions observed in the pathological laboratory, no secondary infection of wounds has occurred.

TABLE II.—*Virulence of Recent Cultivations of Bacillus Tuberculosis Hominis. Experiments made with Pure Cultivations obtained from Two Cases of Tuberculosis (Five Different Cultivations Used).*

Number of Experiment.	Date.	Animal Used.	Seat of Inoculation.	Quantity of Bacilli.	Number of Days after Inoculation.	Degree of Tuberculosis.	Remarks.
184	Mar. 1894	Rabbit	Eye, anterior chamber	Very small	12	Well-marked local, I	
182	,,	Guinea-pig	Subcutaneous tissue (leg)	,,	9	II	
73	July 1893	,,	,,	Less than $\frac{1}{10}$ c.mm.	12	II	There is absolutely no instance of failure, and the amount of tuberculosis is, in all cases but one, proportional to the number of days the animals were kept alive after inoculation.
74	,,	,,	,,	,,	13	II	
149	Feb. 1894	,,	Pillar of fauces	Very small	14	III	
77	July 1893	,,	Peritoneum	Less than $\frac{1}{10}$ c.mm.	16	II	
180	Mar. 1894	,,	Pillar of fauces	Very small	21	III	
183	,,	,,	Subcutaneous tissue (leg)	,,	24	III	
40	Mar. 1893	,,	,,	,,	26	III	
150	Feb. 1894	,,	,,	,,	26	III	
181	Mar. 1894	,,	Subcutaneous tissue (ear)	,,	27	III	
13	Dec. 1892	,,	Subcutaneous tissue (leg)	,,	53	IV	

2. Subcutaneous, submucous, intraperitoneal, and intraocular injections were made of non-tuberculous products, including (1) inflamed tissue from the floor of an ulcer, and also portions of an enlarged lymphatic gland; (2) pus; (3) degenerated adrenals; (4) sputum; (5) cultivations of other bacteria.[2] Nothing resembling tuberculosis was

[2] Many of the experiments recorded in this paper were made by one of us for other purposes than those of this investigation; they have, however, been included in the following tables on account of their important bearings on the question before us; this applies specially to Sections 1 to 5 and Tables IX, X, and XI.



Experiment 205 A.—Dissection of a guinea-pig inoculated thirty seven days before it was killed with $\frac{1}{8}$ c.c. of a tuberculous sputum. This minute drop of muco-pus had been spread on sterilised paper so as to cover an area of about $\frac{1}{2}$ c. square, and kept in a closed capsule—that is, not ventilated—for twenty five days. Before the end of the first day it was quite dry. With this paper the left leg was inoculated just below the inner aspect of the knee, strict precautions being taken to prevent the contamination of the wound with other microbes. It will be noticed that on the inoculated side the popliteal, the superficial and deep inguinal, the sublumbar ganglia are enlarged and cheesy and that the retrohepatic glands and the spleen are also distinctly affected. It is difficult in this illustration to see the state of the lungs and liver, which were also tuberculous. There is no evidence of any affection of the popliteal, superficial or deep inguinal, and of the sublumbar glands on the right side, so that, according to the nomenclature adopted, this animal would be in that stage of tuberculosis described in the tables as Degree III.

TABLE III.—*Virulence of Recent Cultivations of Bacillus Tuberculosis Avium. Experiments made with Fresh Pure Cultivations of Tubercle Bacilli obtained from a Tuberculous Fowl (Three Different Cultivations used.)*

Numer of Experiment.	Date.	Animal used.	Seat of Inoculation.	Quantity of Bacilli.	Number of Days after Inoculation.	Degree of Tuberculosis.
75	July, 1893	Guineapig	Subcutaneous tissue (leg)	½ c.mm.	14	I (II?)
76	,,	,,	,,	,,	33	I
41	Mar., 1893	,,	,,	1 c.mm.	35	II
78	July, 1893	,,	Peritoneum	½ c.mm.	52	II (III)?
14*	Sept., 1892	,,	Subcutaneous tissue (leg)	Large quantity (severl. c.mm.)	101	0

* In this case there was a well marked induration of the inguinal glands on the twenty-eighth day, and for some time before that date.

TABLE IV.—*Effect of Drying on the Virulence of Pure Cultivations of Bacillus Tuberculosis Hominis. Two different Specimens were used; the Infected Papers were kept in Closed Capsules in the Dark.*

Number of Experiment.	Date.	Animal Used.	Seat of Inoculation.	Quantity of Bacilli.	Number of Days Bacteria kept Drying before Inoculation.	Number of Days after Inoculation.	Degree of Tuberculosis.	Remarks.
	1893.			c.mm				
89	July	Guinea-pig	Subcutaneous tissue (leg)	½	13	14	I	In these 2 cases disinfection by sulphurous acid had been attempted without success.
90	,,	,,	,,	½	13	14	I	
60	April	,,	,,	2	16	20	III	—
129	Nov.	,,	,,	1½	130	30	0	—
127	,,	,,	,,	½	130	36	0	—
128	,,	,,	,,	1	130	36	0	—
86	July	,,	,,	½	9	46	III	In these 2 cases disinfection by sulphurous acid had been attempted without success.
87	,,	,,	,,	½	9	46	IV	
61	April	,,	,,	2	16	64	III	—

All the experiments in which disinfection was attempted without success might be added to this list, which, however, has been limited to the cases in which, apparently, the influence of drying alone had been at work. Experiments 89, 90, 86, and 87 have been introduced to show the virulence of the cultivations used in Experiments 127, 128, and 129.

obtained in any of these experiments (over 25), even in cases kept under observation for many weeks or months. In these are not included the results of inoculation with tuberculous matter successfully disinfected.

3. In two cases in which septic organisms were inoculated at the same time as the tuberculous matter, once accidentally, suppuration and intense œdema of the whole limb followed rapidly after inoculation, and the swollen part was found to be tender. In both these cases the guinea-pigs ultimately recovered; at the end of two weeks they had distinctly swollen inguinal glands, but when they were killed later on they were free from tubercle. In none of the other cases did anything similar occur after inoculation; this shows that in our experiments this source of fallacy (namely, microbic antagonism) may be excluded.

TABLE V.—*Effect of Drying on the Virulence of Tuberculous Sputum. Specimens of Six Different Sputa were used; the Infected Papers were kept in imperfectly-closed Capsules in the Dark.*

Number of Experiment.	Date.	Animal Used.	Seat of Inoculation.	Quantity of Sputum.	Number of Days the Sputa were kept Drying before Inoculation.	Number of Days after Inoculation.	Degree of Tuberculosis	Remarks.
191	Mar 1894	Guinea-pig	Subcutaneous tissue (leg)	c.c. $\frac{1}{8}$	35	23	II	Distinct retardation of the process.
192	Mar 1894	,,	,,	$\frac{1}{8}$	35	23	I (II ?)	,,
151	Feb. 1894	,,	,,	$\frac{1}{8}$	1	31	III	No marked retardation.
126	Dec. 1893	,,	,,	$\frac{1}{4}$	54 (drying very slow)	37	II (III ?)	Distinct retardation.
205 a	June 1894	,,	,,	$\frac{1}{15}$	25	37	III	,,
205 b	June 1894	,,	,,	$\frac{1}{15}$	25	—	III	,,
58	April 1893	,,	,,	$\frac{1}{15}$	16	43	III (IV ?)	,,
10	June 1892	,,	,,	Very small	A few days	45	0	Result not explained.
12	June 1892	,,	,,	$\frac{1}{2}$	,,	80	III (IV ?)	Distinct retardation.
6	June 1892	Rabbit	Peritoneum	1	,,	84	Local	—

4. A few experiments were undertaken only to show that quantities of fresh tuberculous sputa, smaller than those used in the disinfection experiments, were capable of producing tuberculosis. With the exception of a rabbit (No. 4 Experiment) that died accidentally soon after being inoculated, all the others became tuberculous.

TABLE VI.—*Effect of Euchlorine on Tuberculous Sputum previously dried. (Three Specimens of Sputa found Virulent in Control Experiments were used.)*

No. of Experiment.	Date	Animal Used.	Seat of Inoculation.	Quantity of Sputum.	No. of Days Drying before Inoculation.	Application of Euchlorine.		Results.		Remarks.
						Distance from Place where Gas was Generated.	Length of Application.	No. of Days after Inoculation.	Degree of Tuberculosis Obtained.	
48	April, 1893	Guinea-pig	Skin of leg	$\frac{1}{8}$ c.cm.	16	10 feet	2 hours	23	0	In all these experiments it is doubtful whether the capsules were always carefully protected from sunlight as they usually passed through several hands. It is therefore possible that even the few cases of immunity may be due to this cause and not to the disinfectant.
47	,,	,,	,,	,,	16	6 feet	,,	28	II	
46	,,	,,	,,	,,	16	1 foot	,,	46	II	
53	,,	,,	,,	,,	16	6 feet	,,	50	II	
9	June, 1892	,,	,,	1 c.cm.	?	?	,,	80	0	
54	April, 1893	,,	,,	$\frac{1}{8}$ c.cm.	16	12 feet	,,	97	IV	
52	,,	,,	,,	,,	16	1 foot	,,	118	IV	
1	May, 1892	Rabbit	Peritoneum	1 c.cm.	?	?	,,	48	0	
5	June, 1892	,,	,,	,,	?	?	,,	76	0	

TABLE VII.—*Effect of Euchlorine on Pure Cultivations of Bacillus Tuberculosis Hominis previously Dried.*

No. of Experiment.	Date.	Animal Used.	Seat of Inoculation.	Quantity of Sputum.	No. of Days Drying before Inoculation.	Application of Euchlorine.		Results.		Remarks.
						Distance from Place where Gas was Generated.	Length of Application.	No. of Days after Inoculation.	Degree of Tuberculosis Obtained.	
49	April, 1893	Guinea-pig	Skin of leg	Under 2 c.mm.	16	1 foot	2 hours	30	III	Grouping Tables VI and VII together it will be seen that out of 13 experiments on guinea-pigs tuberculosis was produced in 11 (77 per cent. failures.)
50	,,	,,	,,	,,	,,	6 feet	,,	34	III	
57	,,	,,	,,	,,	—	12 feet	,,	43	IV	
51	,,	,,	,,	,,	,,	10 feet	,,	53	IV	
55	,,	,,	,,	,,	,,	1 foot	,,	74	IV	
56	,,	,,	,,	,,	,,	6 feet	,,	84	IV	

TABLE VIII.—*Effect of Sulphurous Acid on Pure Cultivations of Bacillus Tuberculosis Hominis previously Dried.*

No. of Experiment.	Date.	Animal Used.	Seat of Inoculation.	Quantity	No. of Days Drying before Inoculation.	Application of Sulphurous Acid.		Results.		Remarks.
						Distance from Source.	Length of Application.	No. of Days after Inoculation.	Degree of Tuberculosis Obtained.	
89	July, 1893	Guinea-pig	Skin of leg	½ c.mm.	13	5 feet	4 hours	14	I	It is possible that during the time the glass capsules were out of the laboratory some may have been exposed to sunlight. A pound of sulphur was used for 825 cubic feet of space. In 66 per cent. of these experiments the sulphurous acid failed to disinfect.
90	,,	,,	,,	,,	13	7 feet	,,	14	I	
88	,,	,,	,,	,,	9	4 feet	,,	45	0	
91	,,	,,	,,	,,	13	6 feet	,,	45	0	
86	,,	,,	,,	,,	9	7 feet	,,	46	III	
87	,,	,,	,,	,,	—	5 feet	,,	46	IV	

TABLE IX.—*Effect of Soluble Products of Combustion on Tuberculous Sputum previously Dried.*

No. of Experiment.	Date.	Animal Used.	Seat of Inoculation.	Quantity	No. of Days Drying before Inoculation.	Application of Solution.		Results.		Remarks.
						—	Length of Application.	No. of Days after Inoculation.	Degree of Tuberculosis Obtained.	
152	Feb., 1894	Guinea-pig	Skin of leg	$\frac{1}{8}$ c.cm.	1	Solution full strength	3 hours	31	II	—
155	,,	,,	,,	,,	2	,,	1 hour, slow drying afterwards	33	III	100 per cent. of failure to disinfect.

TABLE X.—*Effect of Chlorinated Lime Solution (Strength 1-10 and 1-100) on Tuberculous Sputum previously Dried.*

No. of Experiment.	Date.	Animal Used.	Seat of Inoculation	Quantity	No. of Days Drying before Inoculation.	Chlorinated Lime.		Results.		Remarks.
						Strength.	Length of Application.	No. of Days after Inoculation.	Degree of Tuberculosis Obtained.	
189 II	March, 1894	Guinea-pig	Skin of leg	½ c.cm.	35	1/10	1 minute 4 brushings	22	0	In all those experiments in which the sputum had been kept thirty-five days dry, it was found that the control inoculations gave positive results. In two cases, 191 II and 192 II, the experiment with disinfected paper was made on one side of the body, and that with non-disinfected paper prepared in the same way on the other side of the body (see 191 I and 192 I, Table V).
190 II	,,	,,	,,	,,	35	1/10	,,	22	0	
191 II	,,	,,	,,	,,	35	1/10	,,	23	0	
192 II	,,	,,	,,	,,	35	1/10	,,	23	0	
154	Feb., 1894	,,	,,	¼ c.cm.	2	1/10	5 minutes 1 dipping slow drying for 17 hours	33	0	
153	,,	,,	,,	,,	2	1/10		57	0	

TABLE XI.—*Effect of Filtered Chlorinated Lime Solution on Pure Cultivations of Bacillus Tuberculosis Hominis.*

No. of Experiment.	Date.	Animal Used.	Seat of Inoculation	Quantity	No. of Days Drying before Inoculation.	Chlorinated Lime.		Results.		Remarks.
						Strength.	Length of Application.	No. of Days after Inoculation.	Degree of Tuberculosis Obtained.	
105	July, 1893	Guinea-pig.	Skin of leg	½ c.mm.	14	$\frac{1}{100}$	1 dipping slow drying	11	0	
102	,,	,,	,,	,,	14	$\frac{1}{10}$	,,	25		
103	,,	,,	,,	,,	14	$\frac{1}{10}$	,,	33	0	
101	,,	,,	,,	,,	14	$\frac{1}{10}$	,,	36	0	
106	,,	,,	,,	,,	14	$\frac{1}{100}$	,,	36	0	
104	,,	,,	,,	,,	14	$\frac{1}{100}$	,,	42	0	No infection

TABLE XII.—*Effect of Ventilation on the Virulence of Tuberculous Sputum. Specimen of Two different Sputa were used, the Infected Papers were Kept in the Dark, and in Closed Capsules when not Subjected to a Current of Air.*

No. of Experiment.	Date.	Animal Used.	Seat of Inoculation	Quantity of Sputum.	No. of Days Sputum kept Drying before Inoculation.	Ventilation.		Results.		Remarks.
						No. of Days.	Amount.	No. of Days Animals kept after Inoculation.	Degree of Tuberculosis.	
170	March, 1894.	Guinea-pig	Subcutaneous tissue of leg	½ c.cm.	17	3	Good	24	II	Sputum not broken up after being dried.
160	Feb., 1894.	,,	,,	,,	9	8	Moderate	32	III	Sputum broken up.
203	June, 1894	,,	,,	$\frac{1}{10}$ c.cm.	25	2	Good	37	III	Sputum not broken up
8	June, 1892	Rabbit	Peritoneum	1 c.cm.	45	28	Moderate	86	Slight	—

In none of these experiments did the temperature rise above 30° C.

TABLE XIII.—*Effect of Sunlight on the Virulence of Tuberculous Sputum. Specimens of Four Different Sputa were used, the Infected Papers, when not exposed to Sunlight and to Air, were kept in Closed Capsules in the Dark.*

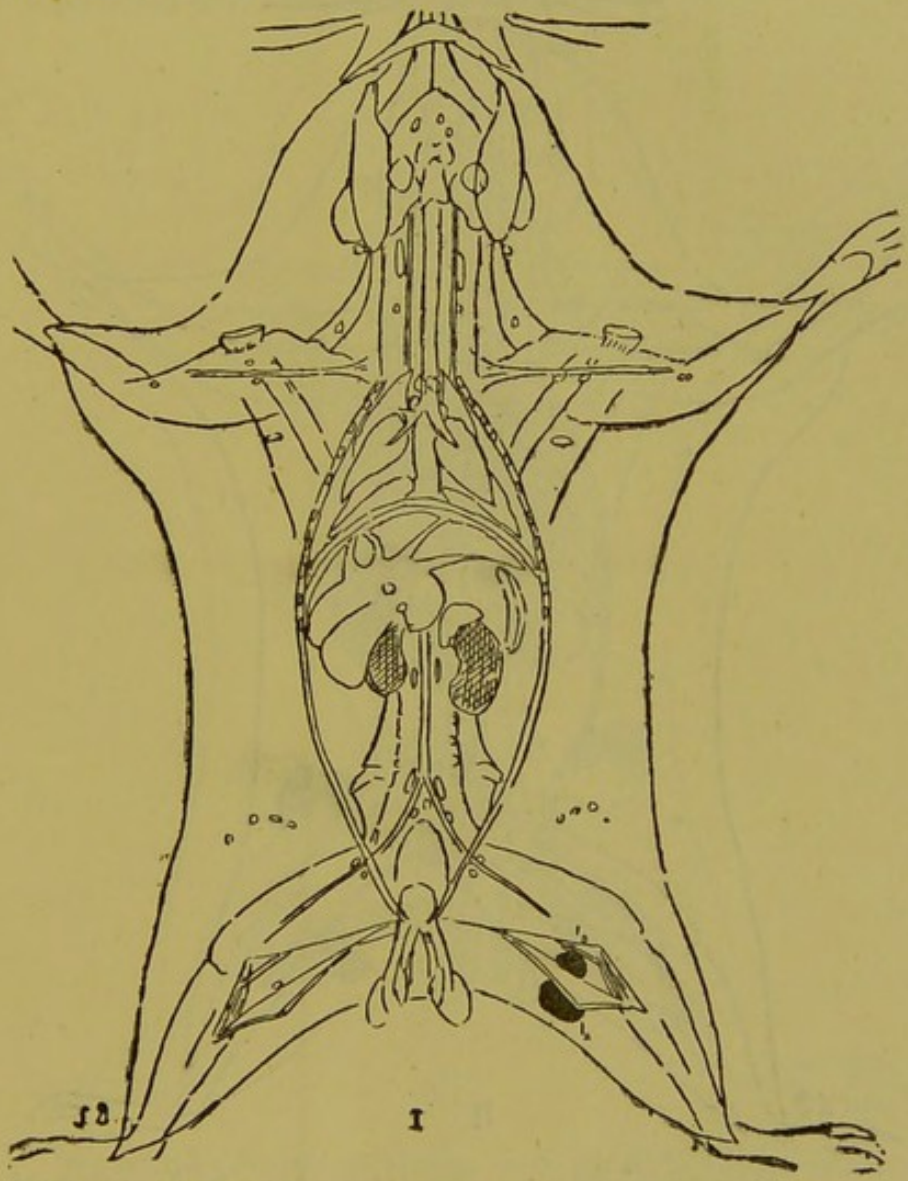
Number of Experiment.	Date.	Animal Used.	Seat of Inoculation.	Quantity of Sputum.	Number of Days kept Drying before Inoculation.	Ventilation.		Maximum Temperature (Centigrade).	Sunlight.		Results.		Remarks.
						Number of Days.	Amount.		Diffuse in Days.	Radiant Hours.	Number of Days Animal kept after Inoculation.	Degree of Tuberculosis.	
186	March, 1894	Guinea-pig	Subcutaneous tissue (leg)	$\frac{1}{8}$ c.cm.	32	3	Good	About 30°	3	3 bright afternoons	4*	0	All these sputa were known to be infectious in control experiments.
187	,,	,,	,,	,,	,,	,,	,,	,,	?	?	7*	0	
188	,,	,,	,,	,,	,,	7	,,	31.0°	7	15 hours	7*	0	
189 I	,,	,,	,,	,,	35	,,	,,	,,	,,	,,	22	0	
190 I	,,	,,	,,	,,	,,	2	Slight	15.5°	2	Short time	,,	0	
202	June, 1894	,,	,,	1 c.cm.	25	1	Moderate	30.0°	1	9 hours	37	0	
156	February, 1894	,,	,,	$\frac{1}{4}$ c.cm.	4	3	,,	10.0°	3	1 hour	46	0	
11	June, 1892	,,	,,	$\frac{1}{4}$ c.cm.	45	28	,,	?	28	?	80	0	
7	,,	Rabbit	Peritoneum	1 c.cm.	,,	,,	,,	?	,,	?	86	0	

* Time insufficient.

TABLE XIV.—*Effect of Sunlight on the Virulence of Pure Cultivations of Bacillus Tuberculosis Hominis. One Culture only was used, and the Papers, after being Infected, were treated exactly as in Experiments recorded in Table XIII.*

Number of Experiment.	Date.	Animal Used.	Seat of Inoculation.	Quantity of Bacilli.	Number of Days kept Drying before Inoculation.	Ventilation.		Maximum Temperature (Centigrade).	Sunlight.		Results.	
						Number of Days.	Amount.		Diffuse in Days.	Radiant Hours.	Number of Days Animal kept after Inoculation.	Degree of Tuberculosis.
85	July, 1893	Guinea-pig	Subcutaneous tissue (leg)	½ c.mm.	9	4	Good	40°	4	13	43	0
98	,,	,,	,,	,,	13	—	Bad	36°	2	6¼	78	0
97	,,	,,	,,	,,	,,	—	,,	40°	6	18½	150	0
110	August, 1893	,,	,,	,,	24	24	Slight	?	9	?	140	0

For facilitating the tabulation of results, Roman numerals have been used to indicate the degrees of tuberculosis described in more detail by one of us.[3] No. I shows the production of local lesions only. No. II invasion of lymphatics not contiguous with the point of inoculation (the spleen may conveniently be included in this stage). No. III invasion of the viscera. No. IV recurrent invasion of lymphatic glands. These different degrees of infection are seen in the diagrams on the following pages.

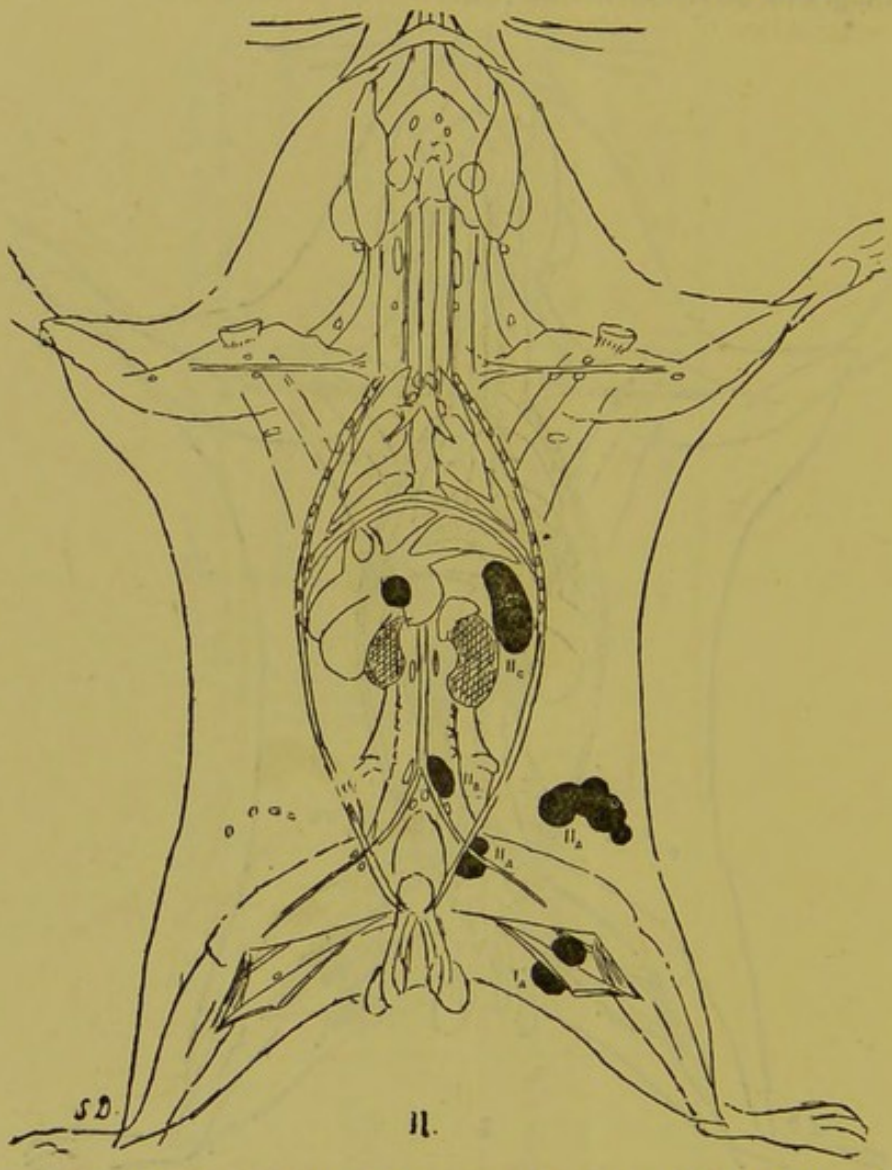


5. Tables II, III, IV, and V deal with experiments intended at once to serve as control tests, and to indicate the extent of the disease produced at various intervals after inoculation. In Table II the virulence of fresh pure cultivations is shown, It will be seen that in all cases tuberculosis was produced. and that there was a steady increase in the extent of the lesion according to the number of days the animal was allowed to live after inoculation, and this was noted whatever

[3] Delépine, British Medical Journal. September, 1893, and March, 1894, also *Medical Chronicle*, May, 1894.

the seat of inoculation. Tuberculosis was already quite distinct in nine days.

Table III shows that it is important, in experiments on disinfectants for tuberculous products, to deal with the human tubercle bacillus only. Cultivations of avian bacillus give slight results as compared with those recorded in Table II. After the first weeks there is a tendency towards recovery; thus after 100 days a guinea-pig, having shown distinct signs



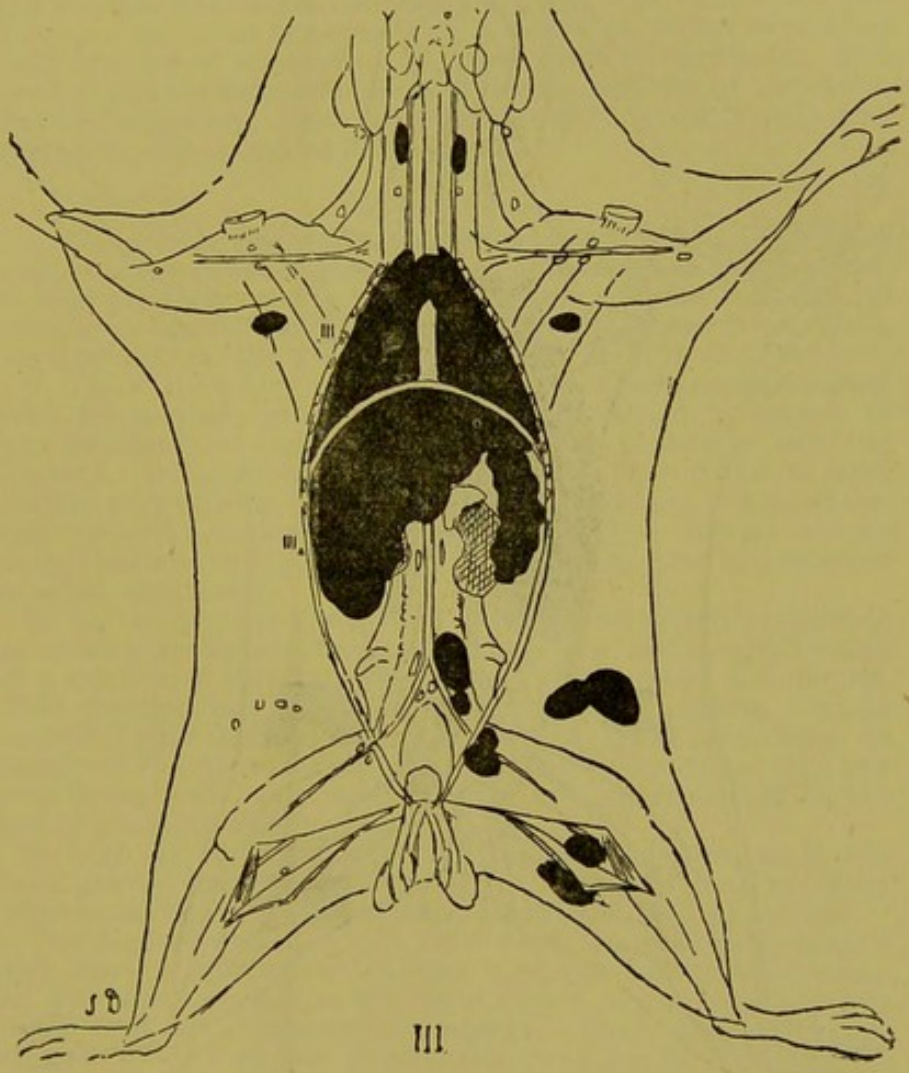
of the disease on the twenty-eighth day, had recovered entirely, as was proved by the *post-mortem* examination.

Table IV shows the modifications in the virulence of pure cultivations of the bacillus tuberculosis hominis produced by drying in the dark, in closed capsules. Moderate desiccation slightly retards the first manifestations of tuberculosis, prolonged drying may ultimately kill the bacillus; thus after 130 days the virulence was in three experiments altogether destroyed. This will be found to be of importance later on, as in all the experiments on disinfectants dried products have been used.

Table V gives the 'results of similar experiments made with sputum. After fifty-four days' keeping, the sputum was still very virulent.

We turn next to the experiments on the action of certain disinfectants on the bacillus.

Tables VI and VII give the results of experiments on the action of euchlorine on sputum and on pure cultivations of the bacillus. In no case had these specimens been kept more than 16 days; in 77 per cent. of the cases in which guinea-pigs were used the disinfection was of no value beyond slight retardation of the action of the virus.



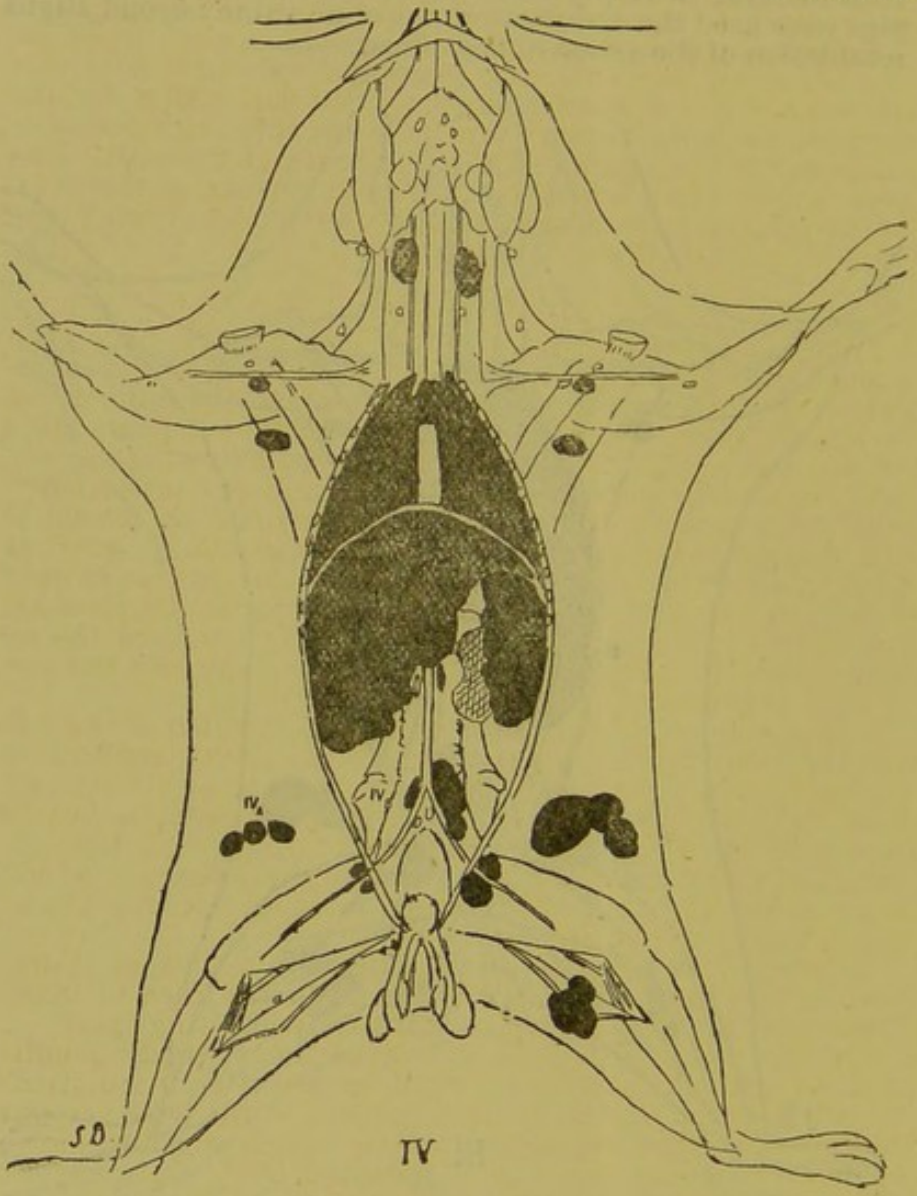
III

We would also call attention to a possible source of error mentioned in the column of remarks in Table VI, namely, the action of light, which will be found later on to have some significance.

Table VIII gives similar observations made with sulphurous acid, and pure cultivations of the bacillus. The specimens had never been kept more than 13 days. A pound of sulphur was used to 826 cubic feet of space, and yet we have to note 66 per cent. of failures, as well as the possible influence of light to account for the successes.

We have to acknowledge the kindness of Drs. Tatham and Paget who gave us the opportunity of testing this question in a practical manner, that is, in infected houses, and under circumstances most favourable to the success of the method.

Tables X and XI give the results of experiments undertaken by one of us; they show the effects of solutions of common chlorinated lime of strengths of 1 in 10 and 1 in 100. These were tried both in the laboratory and in houses, on



pure cultivations and on sputum. In every instance the disinfection was complete; there was no case of transmission of disease even after a single application of the solution either with the brush or by dipping the infected paper in the disinfectant and allowing it to dry afterwards.[4]

[4] The strong (1 in 10) solution is very unpleasant to use owing to the rapid evolution of chlorine. Dr. Paget, who at the request of one of us very kindly tried it on the large scale, thinks that, on this account, it cannot be generally used; the weaker solution is, however, quite efficient and more free from objection. See *Med. Chronicle*, May, 1894. S. Delépine, On the Disinfection of Rooms.

Table XII shows the effect of simple ventilation in the dark. So far as these experiments extend they show that ventilation diminishes but does not destroy virulence. In no case, even after twenty-eight days of exposure to moderate currents of air, did it entirely destroy the power of the microbe, and, as we have already shown, simple drying is in itself enough to reduce and ultimately entirely destroy the virulence of tuberculous products.

Tables XIII and XIV. These experiments, made both with sputum and pure cultivations, show the remarkable disinfecting power of sunlight. They complete an investigation begun by one of us some years ago.[5] We have evidently not reached the minimum exposure that will suffice for the purpose, for in no instance was there any infection even after only one day of exposure with nine hours of sunlight. The experiments were carried on at different seasons of the year, but the temperature never rose above 40° C., and in only two instances did it exceed 30°.

Conclusions.

Putting aside the numerous experiments which have been made for the purpose of testing (1) the virulence of the tuberculous products used in the experiments; (2) the influence of collateral factors (such as dryness, ventilation, heat, etc.), we may sum up the results obtained in the following way:—

1. The disinfection of rooms which have been contaminated with tuberculous products cannot be obtained by means of the fumigation methods such as are generally used at present. Sulphurous acid, chlorine, and euchlorine, as used under supervision by experienced municipal disinfectors, have proved practically useless. This only confirms the results obtained by Koch and his pupils in the case of a number of other organisms.

2. The only other method of disinfection which seemed to promise more satisfactory results was the direct application of a solution of chlorinated lime to the walls to be disinfected. This method has given so far satisfactory results, but is attended with discomfort on the part of those who have to carry out the disinfection.[6] It must be remembered that the experiments of Schill and Fischer are unfavourable to the use of perchloride of mercury.

3. Light is, in the case of the tubercle bacillus, as it has been proved by several observers to be in the case of other organisms, the most important natural disinfecting agent.

The diagrams on pp. 15, 16, 17, 18 show the lymphatic ganglia and viscera affected at various intervals after inoculation. In all cases the skin on the inner aspect of the left knee was inoculated with tuberculous matter. Each diagram corresponds to one of the degrees adopted by S. Delépine for descriptive purposes. The degree being indicated by the figure at the foot of the diagram (I, II, III, IV). In each diagram the tuberculous glands are black and their size is given approximately (a little less than half natural size).

[5] Ransome, *Proceedings of the Roy. Soc.*, vol. xlix, November, 1890, On Certain Conditions that Modify the Virulence of the Bacillus of Tubercle.

[6] This difficulty can be overcome (S. D.)