

period transferred to the ships, mild cases were soon afterwards removed from their homes to the wharves, and at last all cases, with few exceptions, were so treated, and the land hospitals admitted fever cases only. Under these circumstances the total expense may be fairly divided between the two diseases. The total expense of the land hospitals during the period was £171,759. Deducting one-half, it leaves £85,880 to be added to the cost of the epidemic ... 85,880

f. A similar deduction can be made from the total expenditure on the land ambulance service, but in this case one-quarter only should be deducted, as three-quarters of all the patients were suffering from small-pox, and were carried either to the hospitals or the wharves, and the expense must be debited in either case to small-pox ... 19,800

Total ... £257,165

As 11,060 cases were admitted during the period, it follows that each case cost £23 5s.

This is exclusive of the capital expenditure on the sites and buildings of the hospitals, wharves, and ambulance stations and steamboats. The sums thus expended are raised on loan from the London County Council, at 3½ per cent. interest, and are repayable in an average of fifty years. The cost of the epidemic was defrayed from the current account of the managers, and was a charge on the rates of the several parishes of the district.

For the purpose of estimating the comparative cost of ship and land hospitals, the question may be considered under three heads—(a) cost of buildings and site, (b) ambulance service or apparatus for conveying patients, (c) annual cost of maintenance; and in doing so I shall quote the figures given by Mr. Hudson to the Council as the estimated cost in providing a ship hospital, and figures suggested by consideration of Dr. Thorne Thorne's report to the Local Government Board, together with the experience gained in West Ham itself. Many items may be left without consideration, as they would entail the same expense in both ship and land hospital, such as furnishing, cost of nursing, and medical attendance.

(a) ESTIMATED COST OF SITE AND BUILDINGS.

SHIP.	
Site—Mooring Fee at £200 per annum, capitalised	£6,000
Buildings—Pontoon ... ..	9,450
Fitting ditto ... ..	14,000
	<u>£29,450</u>
LAND.	
Site—Fifty Acres of Land, at £60 per acre	£3,000
Building and Fitting Hospital of Fifty Beds	12,500
Steam Disinfecting Chamber ... ..	200
	<u>£15,700</u>

(b) ESTIMATED COST OF AMBULANCE SERVICE.

SHIP.	
Launch for 8 or 10 Patients ... ..	£700
Land Ambulance and horse (already in use) ...	—
LAND.	
Land Ambulance (already in use) ... ..	—
Extra Horse, at £50... ..	£50

WEEKLY EXPENSE IN REMOVING PATIENTS.

SHIP.				£	s.	d.
Captain of Launch ... ..	...	...	...	2	10	0
Mate ... ..	...	...	...	2	0	0
Youth ... ..	...	...	...	0	16	0
Engineer ... ..	...	...	...	2	5	0
Coals and Stores ... ..	...	...	...	3	0	0
Incidentals for Doctor and Nurse ... ..	...	...	...	2	0	0
Driver of Ambulance ... ..	...	...	...	1	10	0
Keep of Horse, &c....	...	...	...	0	15	0
				<u>14</u>	<u>16</u>	<u>0</u>
LAND.				£	s.	d.
Driver... ..	...	...	...	1	10	0
Keep of two Horses, &c. ... ..	...	...	...	1	10	0
Incidentals ... ..	...	...	...	0	10	0
				<u>3</u>	<u>10</u>	<u>0</u>

(d) The annual cost of maintenance in either case will vary in accordance with the decision of the Council as to whether the hospital shall be kept ever in readiness to receive cases or not. If, during inter-epidemic periods, when no small-pox cases exist, the hospital is to remain in the hands of caretakers simply, there will doubtless be no great difference between the annual expenditure of ship and land hospital; but if, as I submit should be the case, the hospital is to be kept in readiness to receive any case suddenly arising in the shortest possible time, then the heavy outlay incurred in connection with the river service militates strongly against the adoption of a ship hospital.

In conclusion, I submit that the facts cited in this memorandum suggest—(1) the advisability of erecting a land hospital in preference to converting a ship for that purpose, (2) that a hospital of 50 beds, with an administrative block capable of dealing with double that number of beds, would be sufficient accommodation for the requirements of the Borough at present, (3) that the hospital should be within, if possible, five or six miles from the Borough, and situate a mile from a populated district.

RECK'S DISINFECTOR.

By GEO. REID, M.D., M.O.H. Staffordshire County Council.

In the last number of PUBLIC HEALTH, page 117, a drawing and a brief description is given of Reck's Disinfecter, and as I, assisted by Dr. Whitelegge, West Riding County Council, Dr. Barwise, Derbyshire County Council, and Dr. Blumer, Stafford, have recently had an opportunity of testing the apparatus, an account of the experiments may prove of interest.

The apparatus with which the experiments were conducted was the one which Mr. Reck exhibited this autumn at the Sanitary Institute Congress, at Liverpool, and at our request, and with the sanction of the local authority, he very kindly had it erected

in Stafford after the closure of the exhibition, so that we might have an opportunity of thoroughly testing its powers.

The apparatus is made in various sizes, but the one in question, which is cylindrical in shape, measures 7 feet by  $3\frac{1}{2}$  feet. The special features of the apparatus are—(a) the use of low-pressure steam, (b) the absence of any steam jacket, and (c) an arrangement by which a cold water shower can be turned into the chamber with the object of removing, as far as possible, the condensed steam from the clothing, &c. As regards the cold shower, it is introduced at the top of the apparatus and falls on to an umbrella spread in the upper part of the hot chamber, which distributes the steam over a large surface and conducts the water to the lower part of the apparatus, where it escapes in such a manner that it does not come in contact with the articles which are being disinfected. The result of the sudden introduction of the cold shower is a rapid cooling, and the consequent formation of a vacuum, to replace which air rushes in through a valve in the front of the apparatus. The theory of the intended drying process is that the steam, as soon as the vacuum is produced, rises out of the clothing, and is replaced by the incoming air.

It is obvious that a simple cylinder which has to resist only a small pressure ( $1\frac{1}{2}$  lb. to the square inch) can be constructed at a much smaller cost than a jacketed high-pressure cylinder, and it is this which mainly accounts for the small cost of Reck's apparatus compared with the modern apparatus in use in this country. If it be a fact, therefore, that the less costly apparatus answers all requirements, a great want which has long been felt, especially by small sanitary authorities and public institutions, will have been supplied.

The objects we had in view in our experiments were to ascertain—(1) the penetrating power of the low-pressure steam, and the temperatures attained in various thicknesses of clothing; (2) the degree of moisture remaining in the articles after the process; and (3) the destructive power of the apparatus as regards organisms.

By means of an electric thermometer, set to ring at  $212$  deg. F., and recording maximum thermometers placed between various folds of blankets, etc., the rapidity of penetration, and the temperatures under different conditions as regards resistance were ascertained. The amount of moisture remaining in the articles was estimated by weighing them before and after the process. As regards the efficiency of the apparatus, its power of destroying various bacteria, suspended in the chamber and placed in folded blankets and between mattresses, was ascertained by cultivation experiments.

The following table shows the temperature attained under various conditions:

In 15m. Folds of blankets.			In 35 minutes.		
4 folds	8 folds	16 folds	In chamber	In 16 folds blankets	Between mattresses
$219^{\circ}$	$218^{\circ}$	$212^{\circ}$	$215.6^{\circ}$	$220^{\circ}$	$211^{\circ}$

As regards the rapidity of penetration, it may be considered highly satisfactory, for it probably does not often happen in actual experience that greater resistance than is represented by sixteen folds of woollen material will have to be overcome, and that the results recorded in the table can be attained by the Reck apparatus was demonstrated by a series of tests. Placing the thermometer between two thick flock mattresses is a very severe test, and it speaks well for the apparatus that in thirty-five minutes after the introduction of the steam a temperature within one degree of boiling point was recorded. It is interesting to note that the temperature in the cavity of the chamber was over four degrees lower than the recorded temperature within sixteen folds of blanket—a circumstance which in all probability is explained by the liberation of latent heat owing to condensation in the interstices of the material.

As regards the dryness of the blankets at the end of the process, the following are the results with and without using the cold water shower:—

	Without cold shower.								With cold shower.							
	Two blankets.		Four blankets.				Two blankets.		Two blankets.		Four blankets.				Two blankets.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
Weight before introduction ...	6	$5\frac{3}{4}$	12	2	12	2	12	2	6	$5\frac{3}{4}$	12	2	12	2	6	$5\frac{3}{4}$
Weight on removal ...	6	9	12	$9\frac{1}{4}$	12	$7\frac{1}{4}$	12	$9\frac{3}{4}$	6	$9\frac{1}{4}$	12	$8\frac{1}{4}$	12	$9\frac{3}{4}$	6	$6\frac{3}{4}$
Weight after shaking in open air	6	$6\frac{3}{4}$	12	4	12	3	12	7	6	$6\frac{3}{4}$	12	$4\frac{1}{4}$	12	$7\frac{1}{4}$	6	$7\frac{1}{4}$

\* In the fourth and seventh experiment the blankets were hung loosely in the apparatus; in the others they were folded compactly.

Taking the means of these figures, and expressing the degrees of dampness by the percentage increase of weight in each case, the following results are arrived at :

		Percentage increase in weight.	
Blankets compactly folded	{ Without shower	{ On removal from apparatus	2.6
		{ After shaking in open air	0.8
	{ With shower	{ On removal from apparatus	3.3
		{ After shaking in open air	1.1
Blankets loosely suspended	{ Without shower	{ On removal from apparatus	4.0
		{ After shaking in open air	2.6
	{ With shower	{ On removal from apparatus	4.0
		{ After shaking in open air	2.7

It would seem then that the cold shower, especially when articles are compactly folded, does not assist in the drying process, for the blankets were found to be dryer, both on removal and after shaking, when the apparatus was worked without the shower than when the shower was used. The shower, however, had a very marked effect in condensing the steam in the apparatus, for without it volumes of steam escaped on opening the door, whereas with it little or no steam was perceptible. In all probability this condensation explains the absence of drying, the shower having the contrary effect to that with which it is credited, and some portion of the condensed steam being deposited on the blankets. That this is probably the case is borne out by the experiments with the blankets loosely suspended in the apparatus, as a much larger surface is thus exposed, upon which deposit of steam may take place on opening the door or on using the shower. That the shaking process is less effectual in removing moisture in the latter case is no doubt explained by the fact that the heat is largely retained in blankets which are folded up, and when they are suddenly shaken in the air evaporation would naturally be more active than it would be in the case of blankets which, owing to the large surface exposed, had cooled considerably while being removed from the apparatus before the shaking.

As regards the bacteriological tests, which Dr. Barwise kindly conducted, anthrax bacilli and spores, garden soil, and human excreta were used, and, with the exception of a few soil bacteria which are highly tenacious of life and survived the process, this part of the experiment was entirely successful, as was proved by control experiments in every case. The bacteria, as already mentioned, were placed free in the chamber as well as within sixteen folds of blankets and between two flock mattresses, and subjected to the prescribed routine of treatment, and in no instance, with the above exception, did any growth take place on gelatine in the case of the disinfected specimens, while in every instance duplicate specimens which had not been treated in the apparatus freely germinated on gelatine plates.

To sum up, then, I think the experiments warrant the conclusion that in Reck's disinfector we

have a very efficient apparatus, capable of destroying the ordinary pathogenic microbes, and although the cold shower does not seem to lessen the deposit of moisture in the clothing, the dampness remaining is very slight; indeed, after the articles are shaken it is hardly perceptible to the touch; besides, a drying chamber heated by the exhaust steam from the apparatus is provided, and this, no doubt, would meet the difficulty.

## A CONTRIBUTION TO THE ETIOLOGY OF TUBERCULOSIS,

INCLUDING AN ANALYSIS OF 246 CASES OF GENERALISED TUBERCULOSIS, RECORDED IN THE POST-MORTEM REPORTS OF GUY'S HOSPITAL, DURING THE TEN YEARS 1883-92,

*By kind permission of Dr. Shaw, Curator of Pathological Museum.*

By J. M. HOBSON, M.D. B.Sc.

*Introduction.*—While it is admitted on all hands that tuberculosis is a communicable disease, dependent upon some implantation of a specific virus from the outside as an essential factor in its production, and while experimental research has abundantly proved that the alimentary canal in animals may become a channel of infection through infected food contained therein, the belief that in man the digestive tract is commonly also a channel of infection, the virus finding therein a portal through the mucous membrane, rests upon inference rather than upon actual observation.

Now, if the human subject were at all frequently infected by tubercular food, the vestiges of invasion by way of the alimentary canal should be found with proportionate frequency within the tube or its immediate precincts. The small intestine is the place where one would naturally go for these vestiges, for though it is conceivable that the virus introduced with food might find entrance in any part of the digestive tract, from the lips to the anus, we should regard these other parts as less likely places of invasion than that section where, at the same time, the food has the longest journey to make, the absorbing surface is largest, and absorption is the most active.

Let us briefly examine the foundations of the above-mentioned belief, to wit, that tuberculosis has a frequent origin in man from food ingested.

*I. Feeding Experiments.*—These are so numerous that no doubt is left that in animals tuberculosis may be conveyed in matter swallowed. Chauveau, speaking from the chair at the Congress for the Study of Tuberculosis in Man and Animals, in Paris, in July 1888, stated that when the virus was introduced by the natural passages, animals were more completely and rapidly tubercularised than by inoculation. It does not appear that in animals the primary lesion is necessarily palpable in the mucous membrane of the alimentary tract; for Principal