

THE PRACTICAL PREVENTION OF TYPHUS FEVER AND RELAPSING FEVER IN MESOPOTAMIA DURING THE WAR.¹

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BEFORE commencing a detailed study of the occurrence and practical prevention of typhus and relapsing fever in Mesopotamia, it will be helpful to outline the conditions under which the campaign was conducted.

The inhabitants of Mesopotamia during the war may be divided for epidemiological purposes into those imported (British, Indians, Chinese, Egyptians, West Africans, etc.), and those who ordinarily lived in Mesopotamia (Arabs, Jews and Persians). The native civilian population lived in the town in brick native houses, and in the country in reed and mud huts, whilst a large proportion, being nomads, lived in sacking-tents or on native river craft. The troops and labour corps were either in bivouacs, tents, or billeted in native huts.

The distribution of the population falls into three groups. The first group included advanced troops, troops on the march and in outlying posts, Turkish prisoners, and natives of recently occupied villages. The second group, on the lines of communication, consisted of troops doing guard or transport duty, Arab, Egyptian and Persian coolie labour corps, and natives in villages and towns. Finally there existed a large group of troops and labour corps, either stationed at the base or passing through. In each group lice-borne disease occurred and each required the adoption of different preventive methods.

It must be remembered that the condition of warfare in Mesopotamia, especially as it affected the disposition of troops, differed very materially from that of European countries, and occasioned different problems of typhus prevention. In France, Serbia, etc., with a definite front line, and the slow progress of trench warfare, it was generally possible for troops to return from the line to rest camps, and very often to a rail head, allowing for the easy transport of disinfecting apparatus, etc. In Mesopotamia, the campaign consisted of a series of engagements, often between very mobile troops, whilst the largest proportion of the troops was engaged in holding long lines of defences, completely isolated from other units, except for rationing; and not returning to the advanced bases, rail-heads or main lines of communication, for six or eight months at a time. Such lines as the Euphrates defences, Persian front, and front line west of Baghdad,

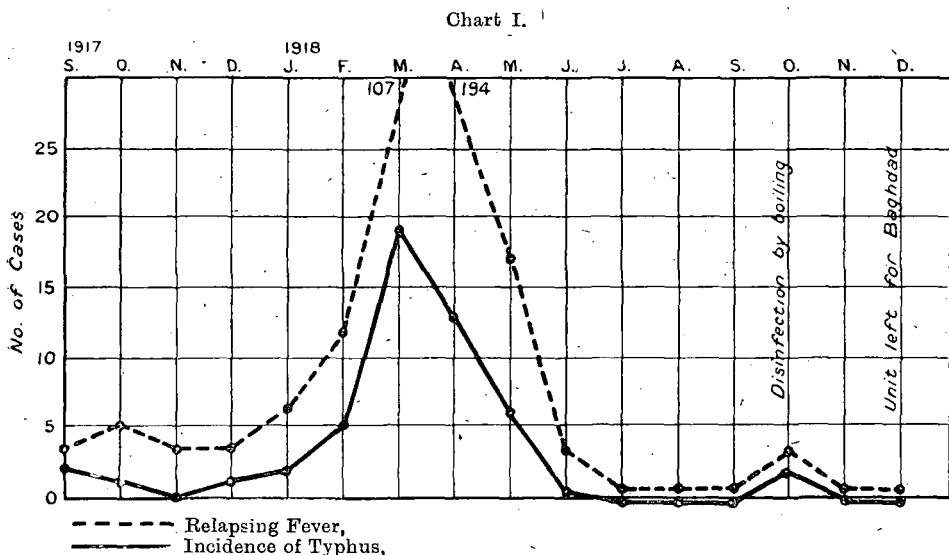
¹ Thesis approved for the degree of Doctor of Medicine in the University of London.

were each as much as two hundred miles in length. The problem was further complicated by the presence of large coolie construction camps on road-work, etc., in the desert. The posts on these defences in the case of troops would consist of perhaps a battalion, and at intervals a complete flying column, of two or three thousand men. The coolie camps contained from two to four thousand men. Further the troops were much more mobile than in France, and complete divisions and coolie-corps spent weeks and months on the march, from post to post, or from one point of construction to another. At certain centres on the river, especially the advanced bases and the main base, troops were closely camped together and, as far as the transmission of infection is concerned, in constant contact through reinforcements, transport of rations, and material, with the large outlying units. In such areas eighteen to twenty thousand men would be living in addition to the civilian population.

At first it might be thought that the isolation would have automatically "ringed round" outbreaks of typhus or relapsing fever, but practically this was not found to be so. Chart I shows the incidence of an outbreak of relapsing fever and typhus in one such outlying community. I attribute such outbreaks to one of the following reasons. In the first place constant communication had to be maintained between all units for rations, material, etc. This was undertaken as far as personnel was concerned by Persian and Arab coolies, who were invariably extensively louse-infected and consequently offered a ready means for the spread of infection from unit to unit. Further, the cases of illness in order to reach an infectious hospital had often to pass through and stay the night in, areas occupied by troops and large coolie corps, the patients travelling long distances by camel, motor ambulance, or launch to the hospital. It might be urged that cases occurring in outlying units should, therefore, be treated by that unit. This was considered, but was impracticable owing to the shortage of medical personnel which did not allow of a medical man being attached to the majority of these corps, the necessity of a microscope for diagnosis, and finally the impossibility of providing intravenous treatment. One of the most prolific causes of localized epidemics was undiagnosed cases. A coolie would report sick, and owing to the fact that no microscope was available, the case was diagnosed pyrexia of unknown origin, and sent down the line to hospital. By the time the man reached hospital his fever had subsided, and diagnosis was impossible. After a few days in hospital he would be discharged and returned either to his own unit or to another. Several such attacks might occur before one attack of pyrexia coincided with his being in hospital. Such a case would leave in its wake a train of infected louse communities, each a potential start for an epidemic. Further a certain number of ambulatory cases occurred and were most difficult to detect. Finally, as a cause of outbreaks in isolated and other units must be mentioned, the failure of such machines as Serbian barrels, Thresh machines, etc., to effectively kill eggs of lice in practice, a subject

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dealt with later. It is interesting to note the two curves of infection in the corps incidence shown in the chart. It will be noted that during the greater part of the winter, cases were comparatively few, but occurred constantly. Then suddenly in the same corps an extensive epidemic occurred involving thirty per cent of the strength. The regular occurrence of a few cases in a corps was generally due to a fault in the method of disinfection, adopted by the unit, or lack of discipline when carrying it out, enabling a few men to escape. This succession of cases was generally stopped by thorough disinfection. The sudden outbreak I attributed to the influx of infected lice with a new draft of coolies, from an infected corps, or from Persia. As will be discussed later such drafts were continually arriving in uninfected units.



In No. — Persian coolie corps during the period September, 1917, to December, 1918, showing typical smouldering case incidence in an outlying unit, with an epidemic in March and April, and the complete disappearance of the disease during the summer and for two months after complete disinfection by boiling.

Looked at broadly the infectious diseases of Lower Mesopotamia may be divided into those that are endemic and those which are not. Consequently it is important to consider carefully the probable origin of the disease. Small-pox, plague and, probably, cholera are endemic and occur to a varying extent throughout the civilian population in river-side towns and in remote villages isolated from trade routes. I found no reason to suppose that either typhus or relapsing fever is endemic in Lower Mesopotamia. My work in searching for cases of infectious endemic diseases took me into villages far remote from intercourse with trade routes. In no case did I find a case of typhus or relapsing fever in a village unless recruits had returned to that village from a labour corps.

Typhus and relapsing fever constantly disappear during the heat of the summer in Mesopotamia. The comparative coldness of Persia, Turkey, and Afghanistan allow lice to persist throughout the summer, whilst it is impossible to find lice in Mesopotamia after June. The probability is, that not only has lice-borne disease to be re-introduced every autumn, but that the insects themselves must be conveyed to the country when the lowered temperature at the end of summer allows them to exist. In this I am at variance with Colonel James who states that the disease, and presumably the lice, are endemic in Lower Mesopotamia (*Trans. Soc. Trop. Med. and Hygiene*, November, 1918). The infection of the community with lice might occur along almost any route from a colder country, e.g., France, Northern India, etc., whilst the infection with the disease occurred along two defined channels. The commencement of the outbreak of lice-borne disease in the winter of 1916 in Lower Mesopotamia can be definitely traced to the advent of a party of 800 Turkish prisoners, which arrived from up the line, suffering from this disease, and before whose arrival the disease had not occurred. Infection then came from Turkey and Asia Minor, where lice-borne disease is endemic, and infected the louse-community of Lower Mesopotamia, outbreaks occurring thereafter regularly, until the summer. In the autumn of 1917 and 1918 the disease was re-introduced by a new channel. Large labour corps were at this time being recruited from Persia, through Bushire. By the terms of their contract the coolies served times, varying from one to six months, in Mesopotamia and were then returned to Persia. This necessitated a constant traffic in thousands of lice-infected coolies, between Bushire and Lower Mesopotamia. As the voyage to Basra only occupied three days, a man infected with the disease in Persia would develop it after arrival in Basra. As a port health officer, I met and examined such coolie ships regularly, and frequently detected cases of relapsing fever amongst the coolies on board. Further, in the examination of between four and five hundred ships arriving from India, during the winter, I failed to find any case of lice-borne disease among the sick on board. The endemic centres in Northern India may therefore be excluded as an origin of the disease, and we may say that whilst in 1916 lice-borne disease in Lower Mesopotamia was of Turkish origin, it was in 1917 and 1918 in all probability Persian, the front line having advanced beyond Baghdad, which now became the base, where all Turks were disinfected before reaching Lower Mesopotamia, the Turkish channel of infection therefore ceasing to exist.

With regard to the transmission, as far as could be observed, the main agent appeared to be *Pediculus corporis*. The bed-bugs (*Cimex lectularius* and *C. rotundatus*) are not found in Lower Mesopotamia.

With respect to racial predisposition, no race was immune. Lice infected from and living on Persians or Arabs, would spread the disease readily to either negroes or Chinese camped next to them. As far as my experience goes the infected louse-community fed indiscriminately

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from black, white or yellow skins. Children were relatively immune. Cases were absolutely rarer amongst Arab children, who greatly preponderated, than amongst Persian children.

Mesopotamia offered a special opportunity of observing the relation of typhus to famine and mental depression. Mr. James Berry (*Proceedings of the Royal Society of Medicine*, 1918), Miss Robertson (*ibid*, 1917), and Soubotitch (*Proceedings of the Royal Society of Medicine*, 1918), lay stress on the close connexion of lice-borne disease with famine. Soubotitch says: "Does malnutrition operate directly by increasing the opportunity of men getting infected with lice, etc., or indirectly by making men susceptible to doses of infection, which could have had no effect had their nutrition been good? The association of relapsing fever with famine is so close that the latter explanation suggests itself for that disease." It is interesting to note that in Lower Mesopotamia generalized famine was unknown. The coolies were drawing very much higher pay than ever before in their lives, and were in addition supplied with a full Government ration; and yet certain corps had an incidence up to forty per cent of their strength of relapsing fever and typhus. This bears out rather the first of Soubotitch's alternatives (cf. Rathlin Island in 1817 when typhus raged on the mainland, the disease did not occur on the island—though famine was present in both places). Nor could I trace that mental depression *per se* had any direct influence, as even amongst the most heavily infected coolie corps happiness and jollity were invariable amongst the healthy. In Mesopotamia the epidemic had no connexion with either famine or mental depression.

In combating lice-borne disease, especially in its minor epidemic form the aim should be the destruction of every infected louse, and not the mere reduction of their numbers. There are three possible positions for the insect, viz., firstly, on the body of the host; secondly, in his clothing; and, thirdly, in his billet or tent. Most careful search of quarters recently inhabited by troops or natives known to be louse-infected, has invariably failed to find lice except on cast-off clothing and sacking; nor in my experience has clean clothing become louse-infected when introduced to a dug-out or hut. Experimental examinations comprised the interiors of dug-outs, reed-huts, and tents, and not only were both woollen and cotton clothing introduced for varying times, but the floor, tent, or tent-walls were systematically wiped with both moist and dry cloths, which were examined before and after incubation.

I would here state briefly some of the difficulties peculiar to the Mesopotamian campaign which complicated the problem of preventing lice-borne disease. The climate during the winter after the extremely hot summer encouraged men to put on excessive clothing, to wash as little as possible, and to huddle together in their quarters. The medical officers, who were chiefly sent out direct from England or France, had few of them seen typhus or relapsing fever. Consequently early cases of typhus or

relapsing fever in a unit, the diagnosis of which is of the utmost importance, were overlooked frequently, and not until an extensive outbreak occurred in the unit was the disease recognized.

Further, the fear of hospital inherent in natives and coolies led to the sick hiding themselves. Especially did this occur on board ship amongst the coolies working the cargoes at Basra. On several occasions during organized search for cases that were hiding during cholera and typhus outbreaks I found coolies dead or moribund from one of these diseases in remote corners of the ship. The reason for the search generally was an outbreak of one of these diseases in a coolie-unit, apparently sporadic, but probably due to the dead coolie. Added to this, weekly disinfection was carried out very ineffectively by units, the method employed (*vide infra*) being at fault in most cases; whilst further, that dangerously erroneous idea prevailed universally that if one-third of a unit were disinfected each week, all lice must be killed in that unit. As will be shown later, it is of the greatest importance if relapsing fever is to be prevented that an absolutely effectual method of louse-destruction be evolved, and that further it is essential for a unit to be completely disinfected in one day. Otherwise not only do the louse infested infect the clean, but it is impossible to insure that every man is disinfected (*vide infra*), especially in such partially disciplined corps as labour and coolie units. In consequence, lice-borne disease of both kinds was occurring regularly throughout the winter, raging in some units and districts as a widespread epidemic (forty per cent of some units being affected), whilst in others a regular crop of cases occurred each week throughout the cold weather.

The area sanitary officer is the most important person in typhus prevention. He should have had extensive experience at a hospital for infectious diseases. It is well too, that he should learn at once the enormous importance of early diagnosis and early disinfection, and that he adopt a method that will invariably destroy all lice that can be infected.¹

The early diagnosis of typhus is of great importance. It is often mistaken for influenza when the first case appears in a unit at the beginning of the cold weather. Diagnosis depends on the presence of catarrh, the leucocyte count, and on the clearer mental condition of the influenza patient. The diagnosis of cerebrospinal fever is often made in a case of typhus. This tendency is partly due to the fact that a modified Kernig's sign occurs in typhus, and partly because the cerebrospinal fluid is under pressure when lumbar puncture is performed. Cases were sent to the infectious diseases hospital with a diagnosis of cerebrospinal fever on account of headache, Kernig's sign, and the marked pressure of the cerebrospinal fluid. It is easy therefore, unless meningococci are definitely found,

¹ In order to provide for the early recognition of sporadic cases of lice-borne disease, classes for medical officers were arranged at the Isolation Hospital, by Lieutenant-Colonel F. E. Fremantle, when instruction was given in the diagnosis of infectious diseases.

for the cause of an eventual outbreak of typhus to be overlooked and no due precautions taken. A prodromal rash in small-pox may closely resemble that of typhus, and even when seen side by side on stretchers the rashes are most difficult to distinguish. A recent well-marked vaccination is an important point in differentiation. The diagnosis of typhus is often exceedingly difficult and sometimes impossible, and it is a most valuable rule to treat any suspected case as typhus and thoroughly disinfect. This is of great importance in Mesopotamia where the disease disappears in the summer and the first few cases appearing in the autumn are easily overlooked with most serious results. It is essential therefore, to keep a most careful watch for the appearance of lice-borne diseases directly the insects themselves appear after the summer, so that any outbreak may be immediately "ringed round" and the discovery of the channel by which the infection has entered the country facilitated.

In considering the detailed steps adopted it is convenient to revert to the classification given under distribution earlier, viz., advanced areas, areas on the line of communication and the base area—each of these will be dealt with separately under the headings *A*, *B* and *C*.

(A) The prevention of lice-borne diseases in advanced and outlying areas comprising troops on the march, units occupying outlying posts, consisting of one to two thousand men, large labour coolie camps of 3,000 to 4,000 men, Turkish prisoners, and natives of recently occupied villages—units scattered at distances varying from three miles to thirty miles along a front of perhaps 200 to 300 miles and in constant epidemiological connexion with other units for rations, transference of sick, and war materials, outlying units often only being reached by passing through other units.

In the case of Mesopotamia where, though lice-borne disease was not endemic, yet the climatic and campaigning conditions in winter greatly favoured an outbreak of lice-borne disease and where a constant influx of Turks, and later Persians provided a constant source of infection, it was early decided that the special conditions called for the introduction of a new form of prevention, unless epidemics were to occur regularly on varying scales as hitherto. Once a unit becomes infected the aim must be not merely to delouse the unit in a general way but to evolve a method that will invariably kill every louse and egg in that unit and so to organize the disinfection that it is impossible for any individual of that unit to avoid the process. Further, it is obvious that unless delay is to occur, each unit must not only have its own disinfecting plant as hitherto, but that plant must invariably kill lice-eggs even when worked by the untrained personnel of the unit. Furthermore such a method must provide for the delousing of as many as 3,000 men per day, to allow of a unit disinfecting itself completely in a day, and to avoid the most unsatisfactory practice of disinfecting a unit in sections on successive days. Caste, too, must be provided for, to enable both sepoy and sweepers

in a regiment to be dealt with on the one day, and the apparatus, as the troops were mobile and advanced, must be as simple as possible, light and not highly specialized. Every unit must, on receipt of a wire from the infectious diseases hospital, have a method of self-disinfection which when carried out by themselves would invariably destroy all lice and eggs in the community, avoiding the false sense of security that other less effective methods were giving to the medical officer and the commanding officer of the unit.

The broad method to be adopted was that of stopping the influx of infection to Lower Mesopotamia by segregation of Turkish prisoners and Persian coolies (the latter owing to the great scarcity of labour was not always possible) and further the "ringing round" of sporadic outbreaks or more commonly (from late or wrong diagnosis of the initial cases) of localized epidemics, by a thoroughly effectual method. Coolies and Turkish prisoners were segregated on arrival, unless, as frequently occurred, the urgent need for labour prevented this very desirable step from being possible. In the latter case a wire was sent to the medical officer of the unit to which the draft was proceeding, informing him of the danger.

Let us critically review the methods hitherto employed in Mesopotamia for louse destruction and the dangers attached to the "routine disinfection of units."

Serbian barrels first used in Serbia by Colonel Hunter and Lieutenant-Colonel Stammers were in use by many units. These, as actually used in the field generally failed to kill lice-eggs. Though eggs are killed when the barrel is working well with trained men, it is found in practice that as one goes round a camp that is being deloused by Serbian barrels, in the great majority of cases eggs placed on the top layers of the clothing in barrels are unaffected and hatch out after incubation. This is borne out by the fact that in many units in which cases of relapsing fever were occurring regularly, perhaps six or eight a week, it was possible to cut short the disease absolutely when a more satisfactory method was adopted. Further the Serbian barrel (sixty gallons capacity) deals only with ten blankets and one full kit (including spare kit) in an hour; thus to disinfect a unit of 1,500 men, 200 Serbian barrels working for seven hours would be required. The large amount of handling of infected clothes with the danger to the personnel, the time (one hour) required for each group of kits increasing the difficulty of maintaining complete separation of deloused from the louse-infected men, the impossibility of completely disinfecting the unit in a day with a reasonable number of barrels, their weight in the long transport to outlying units or for mobile units, and lastly their ineffectiveness in practice made their use under the conditions of the Mesopotamian campaign undesirable.

Many units placed reliance in *Thresh machines*. This apparatus has many of the practical drawbacks of the Serbian barrel and in addition it is very difficult to move without damage on rough desert transport roads

owing to the frequent breakage of the wheels. Both the Serbian barrel and the Thresh machine should be looked upon as palliative and as useful only when the reason for delousing is the comfort of the men or when an extensive and wide-spread epidemic is raging and more than a diminution of the disease cannot be attempted.

I carried out a series of experiments with *sulphur dioxide* as the lethal agent. In the first case a hut (twenty feet by twenty feet by twenty-two feet) was built of dried mud and reeds. This was made gas-tight, the clothes hung on lines stretched across the hut, burning sulphur introduced and the hut sealed up with mud. In a further modification I used the hold of an iron barge which was connected with a portable $2\frac{3}{4}$ horse power Clayton sulphur dioxide disinfecting engine. The clothes were placed on lines in the hold, the hatches closed and the Clayton apparatus set in motion until a high percentage of sulphur dioxide was found in the hold on testing specimens of the air by the absorption method. Both methods were in practice unsatisfactory. The eggs were often not killed, the time occupied in arranging the clothes on the lines with the great danger to the personnel employed and the length of time before the clothes were available for issue to the men made this method impossible. We may therefore exclude sulphur dioxide as a practical lethal agent.

Ironing of clothes, though most satisfactory in its lethal effect, has great practical drawbacks. To iron a single uniform completely and efficiently requires in practice five minutes, and this for a battalion means the employment of a very large staff of men, if the unit is to be done in a day. This in itself offers very great opportunity for scamping, with consequent re-infection of the unit with lice almost immediately. Again a false security is engendered.

In Mesopotamia I tested specimens of the commonly used *Insecticides* on lice and their eggs, both in the laboratory and in the field with such powders scattered on the clothing of the men. Practically it is impossible to get men to scatter the insecticide efficiently in their clothes. Moreover the effect of insecticides in the laboratory is very unsatisfactory, many specimens failing to kill lice, much less their eggs. The insecticides tested included naphthalene, camphor, iodoform and several well-known makes of insect powder. (Cf. Jackson and Castellani in *The Journal of Tropical Medicine and Hygiene*, November, 1915.)

The conditions required in a method of delousing applicable to a country where the disease is not endemic are different from those of a country in which the disease is "endemic." In the former it is desirable to "ring round" outbreaks with an absolutely efficient ring of disinfection, rather than to attempt a generalized and partial delousing of the whole district. In a campaigning army in such a country as Mesopotamia it is impossible to kill all lice, and almost universal lousiness exists. As far as serious epidemic disease is concerned it is useless merely to

reduce their numbers but it is practicable to "ring round" outbreaks with absolute destruction of all infected lice. This is the line on which we should work in a country in which the disease is not endemic rather than attempt incomplete disinfection on a wide scale. If both policies are possible they should be adopted but the conditions of war generally prevent this. In districts when the routine disinfection of corps by sections, each week with unsatisfactory apparatus, was replaced by a method of absolute destruction of all lice, directly a sporadic case or an epidemic occurred in the unit, a greatly diminished incidence of lice-borne disease generally, as compared with the results under the older policy of routine disinfection, resulted.

TABLE I.

Unit	Strength	Boiling vats	Baths, canvas	Serbian baths as available	Oil cookers, etc.	Chimneys	Remarks
30th Persian Labour Corps	500	1	1	..	2	1	
21st Arab	500	1	..	..	2	..	
22nd	800	2	1	..	4	1	
37th Persian	700	2	1	..	4	1	
I.W.T. R.E. N. Magil	4,000	6	2	..	12	2	
Railway Shipping Officer's Camp ..	500	1	..	..	..	1	
Ordnance Depot	900	2	1	..	4	1	
Railways	2,000	3	1	..	6	2	
Sanitary Section	120	2	1	..	4	1	
6th Labour Corps	1,400	2	1	..	4	1	
P.C. and C. S. Magil	900	2	1	..	4	1	
10th Dis. Porter Corps	1,400	2	1	..	4	1	
30th Persian Labour Corps (Coal Island)	200	1	..	..	2	1	
No. 4 Works Company	700	2	1	..	4	1	
Port Traffic Labour Camp (Chinese Section)	..	3	1	..	6	2	
Labour Camps, Gurmat Ali Bridge	400	1	1	..	2	1	
Gurmat Ali Brickfields	400	1	1	..	2	1	
P.C. and C. N. Magil	900	2	1	..	4	1	
Base Supply Depot	300	1	1	..	2	1	

The method to be generally adopted throughout a district must be formulated early in the summer, so that sanitary officers can submit the requirements for units in their area for the following winter. It is then possible for each unit to have at the end of the hot season a thoroughly effective disinfecting station, which is mobile if required, which has been approved by a sanitary officer, and which on receipt of a wire that lice-borne disease has been recognized in one of their sick in hospital, can be immediately utilized. Each unit was visited during the summer, a scale of articles required drawn up (see Table I) and a second visit made at a later date to see that each unit had an effective disinfecting station, barbed wire for enclosures, baths and oil-cookers (vide infra). This was of particular importance in outlying units. When a case or series of cases of typhus or relapsing fever occurred, notification was received by

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wire from the hospital to which the case was sent, to be confirmed later from the Infectious Diseases Hospital. The importance of immediate action in a non-endemically infected country cannot be over-estimated, as every hour means further "contacts" and the possible infection of other units. To wait for a trained sanitary staff to go down perhaps one or two days' journey to disinfect the unit is dangerous. It is essential, therefore, for each unit to have its own disinfecting station which it can use itself (i.e., is fool-proof and efficient) and which is immediately available for use on receipt of a wire, thereby avoiding delay.

Sporadic outbreaks and localized epidemics were continually occurring, too little importance often being attached to the lice that escaped destruction, either on account of an inefficient method or lack of discipline, and which served to infect other units and to cause recrudescences in the original unit. Experience shows that weekly routine disinfection by units themselves by the ordinary methods in unskilled hands is very slipshod, and is, therefore, highly dangerous once the unit has become infected.

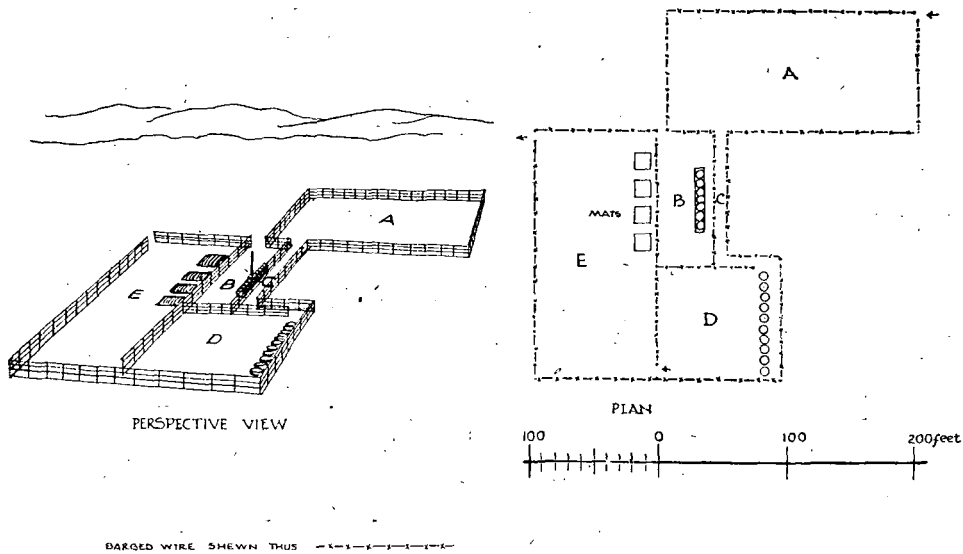


FIG. 1.—Mobile disinfecting station for advanced and outlying units supplied to Magil Area, Euphrates Defences, etc.

The most practical and thorough medium for units in the first group (A) is the immersion of all kit and clothing in *boiling water for 1½ minutes*, and discipline and disinfection can only be insured by the use of barbed wire cages run up temporarily (see fig. 1).

Immersion in actually boiling water, especially after the *addition of alkali* invariably kills lice and eggs in one and a half minutes. The method enables the commanding officer of the unit or a political officer, to have his own station, in the event of an outbreak of typhus or relapsing

fever in his unit, it requires a minimum of apparatus, works rapidly, so that if necessary, 4,000 men can be deloused in a day (this was regularly done, when required); combined with a barbed wire construction as described below it makes the escape of any individual from disinfection impossible. It is readily modified to provide for caste differences, thus enabling both sepoys and sweepers of a regiment to be disinfected on the same day; it can be readily and effectively worked by the untrained men of the unit, and finally it invariably destroys both lice and their eggs. The objections that may be urged against boiling are threefold,—firstly, the shrinkage of woollen garments, secondly, the difficulty of maintaining the water at a vigorous boil, when a large number of kits are immersed, and thirdly, the question of drying the clothes.

(To be continued.)