liable to cause smarting. If your stock of ointment and powder is exhausted, apply to the man in your unit who is responsible for the distribution of these preparations.

4. Just previous to going to the trenches be careful to treat the clothing and body as directed.

5. Use the preparations about every four days. Experiments in the trenches have shown this to give the best results.

6. See that any material, blankets, empty sandbags, etc., which may be present to increase the comfort of the dug-out or billet, are treated with the powder preparation.

7. Take advantage of all the facilities offered at the baths.

Divisional Baths.

1. Each division should be provided with two baths, each capable of dealing with eighty bathers per hour, and two Foden lorry Thresh disinfectors.

2. Baths should be built, and not improvised (except in specially favourable circumstances) from permanent buildings. The design of the building should be such that contamination is impossible.

FIG. 10.—Suggestion for a Divisional Bath (from one now working at the front.)

3. *Procedure for Bathing.*—Man strips in undressing room, outer clothing handed in or collected for ironing; then enters bathroom, and bathes; enters dressing-room, and given clean change of underclothing, uses insecticide, receives ironed clothing, and dresses.

4. *Treatment of Underclothing.*—Laundry work may possibly be carried on with advantage at one centre, and not at each bath.

A. *Garments Disinfected in Thresh Apparatus.*—Three-quarters of an hour at 215° F., in horse-drawn type; half an hour at 220° F., and 5 lb. pressure in the Foden lorry type; washed; dried; folded; stored.

B. *Cresol Solution, Auxiliary Method, Suitable for Detached Units.*—Steep garments thoroughly for two hours or more in solution (1 pint of cresol to 8 gallons of cold water); rinse to rid of surplus cresol; wash, etc., in usual way.

C. *Boiling Water, Auxiliary Method, Suitable for Detached Units.*—Allow garments to soak thoroughly and remain in boiling soapy water for five minutes; remove, and wash, etc., in usual way.

5. *Treatment of Outer Clothing.*—Clothing collected (tunics, trousers, and cardigans), ironed with hot iron, particularly at seams and forks of trousers; brushed with a hard brush; distributed to men in dressing-room.

For the Trenches.

While a unit occupies a trench it should be the duty of a man set apart for the work to see that an adequate supply of insecticides is available for distribution to the

men, and for general use in the dug-outs. Company officers should see that their men take the necessary precautions against the pest.

For Billets.

This applies particularly to infantry in the rest areas and to isolated units, such as ammunition columns and infantry transport:

1. Men should be afforded set times for the express purpose of inspecting their clothes.

2. A general inspection by the company officer or medical officer is recommended at least once a week, but men of known unclean habits require special attention, if only for the sake of their comrades.

3. A keen look-out for cases acting as bad lice-carriers should be maintained and such men dealt with speedily.

4. In addition to existing methods for maintaining clean billets, all old clothing should be removed. Floors and skirting boards should be washed with soapy water to which has been added crude oil and cresol.

5. If bathing and changing facilities do not exist, the ironing of garments should still be attempted.

For Hospitals.

These remarks apply particularly to hospitals and rest stations carried on by field ambulances, where conditions are frequently difficult.

Even if patients are retained for one night some measures should be employed. When possible a patient should bathe, have a change of underclothing, and have the outer garments ironed.

None of these recommendations are difficult in themselves. The real difficulties are in the regular and persistent use of the methods during exceptional and trying circumstances. For troops living in billets and hospitals the work is feasible, but for infantrymen matters are more difficult. It is necessary, however, to emphasize that the most effective measures may be carried on while men are out of the trenches. In the trenches the work necessary is reduced to the regular distribution and use of insecticides.

To conclude, the matters of cardinal importance are, first, that a definite plan of campaign be formulated, and secondly, that the plan be followed up vigorously by the work of proficient men. It is not so much a problem of pure science as one of common sense management.

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NOTES ON PEDICULUS HUMANUS (VESTIMENTI) AND PEDICULUS CAPITIS.*

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BODY LICE, *Pediculus humanus (vestimenti)*, and head lice, *P. capitis*, were reared and kept confined in small entomological glass-bottomed boxes, the lids being removed and fine silk gauze (cliffon) stretched across the open ends in their place. The insects fed readily through the gauze when this was placed against the skin. Boxes containing the lice were carried in waistcoat pockets during the day, and placed beneath a belt against the body during the night. The insects had therefore approximately from six to seven hours daily during which they could feed. In one experiment opportunities of feeding during the day were also afforded them, with the result that egg production was increased. The totals and averages of the eggs laid must be taken only as a comparative guide to fertility; in nature, or under more favourable conditions, the numbers would probably be exceeded. It is probable that the conditions were better suited to the body than to the head louse.

Pediculus humanus is larger, more robust, and less active than *P. capitis*; the females having a relatively

* Abstract of a paper in course of publication in the *Journal of Hygiene*.

greater egg-carrying capacity than those of the head louse. The eggs are slightly larger and the number laid was greater, while the habits associated with egg-laying differ, although by transposing the conditions suitable for other species a considerable degree of uniformity may be produced. It is probable that in nature their egg-laying habits are quite distinct.

Cross pairings between the insects are easily brought about and might, under exceptional circumstances, occur naturally. Hybrid strains resulting from pairings of *P. capitis* males with *P. humanus* females, and *vice versa*, were maintained without trouble until the F_3 generation, and there seemed no reason why such strains could not be continued indefinitely. Nevertheless, the marked disparity in the sexes of the F_1 generation of some crosses between *P. capitis* male and *P. humanus* female was suggestive of the specific rather than the racial rank of the two insects.

The mortality of females of *P. capitis* crossed with *P. humanus* males points in the same direction, but there was no such obvious disparity in the sexes of the first generation of hybrids from this cross, nor was there any marked disparity in the proportion of the sexes in the following hybrid generations.

In size the hybrid insects are approximately intermediate, but inclining in form, activity and habits towards *P. capitis*. Extreme disparity in the size of some individuals of either sex was noted in some of the broods of the F_3 generation; very large males and small females being observed.

Habits.

The body louse exhibits habits of gregariousness, especially during the moulting phases, and a preference for retiring to a particular spot to oviposit, which leads to the clustering of eggs; both of these habits are shown, though in a less marked degree, by *P. capitis*, and it is possible that they might be partly due to the conditions of captivity, though it seems more probable that the divergence in its habitat is accentuating both tendencies in *P. humanus*.

Pairing with both species took place at any hour, and was very frequently observed when the insects were examined after feeding; males with but little food in the alimentary tract were, however, often seen in coitus. The period during which the insects remained together was on several occasions noted to exceed an hour, but no limit of time was determined.

A male of *P. humanus* fertilized 18 out of 21 females placed with him in succession. Attempts with *P. capitis* were less successful; out of four trials one male fertilized 10 females, and might possibly have equalled the record of *P. humanus* but for the scarcity of virgin females while the experiment was in progress.

Eggs are laid by virgin females of both species on the second or third day following the final ecdysis, and continue to be freely laid so long as feeding continues and the body conditions of temperature prevail, but these unfertilized eggs do not hatch. The longest period for which a female *P. humanus* retained the power to lay fertilized eggs after the removal of the male was twenty days; more usually it would seem to be from sixteen to eighteen days. In the case of *P. capitis* the period was considerably shorter, twelve days being the longest ascertained period, while it was usually about seven to eleven days.

The greatest number of eggs laid by any one female of *P. humanus* was 295—an average of 6.4 per day; the daily average of a number of females being 5.1. Females of *P. capitis* showed a lower fecundity—the highest record being 141, with a daily average of 4 per day; the average of a number of females being 3.7 daily. These figures would probably be exceeded under natural conditions. An experiment in which some females of *P. humanus* were given an opportunity to feed for two hours by day in addition to seven hours each night, showed unmistakably the extent to which egg production was dependent upon food—the average of these females rising to eight per day. The fertility of the eggs laid was unaffected by the increased feeding. The greatest number of fertilized eggs laid by a female *P. humanus* after the removal of the male was 115; with a female of *P. capitis* the parallel figure was 70.

Length of Life.

The life of the male *P. humanus* which fertilized 18 females was 32 days after reaching maturity, while the longest female life after maturity was 46 days—the average of a number of females being 34 days. With *P. capitis* the figures were: Male life 30 days; female life 38 days—the average of a number of females being 27 days. The lives of the hybrid insects were not noticeably shorter than those of *P. humanus* and the hybrids seemed to breed more freely than *P. capitis*.

Tests made with unfed *P. humanus* showed that the longest lives were at a medium temperature of 60° to 65° F.; many of the insects living from 3 to 4 days, while two lived 5, and one 7 days. At 76° F. all died within 5 days, and at 98° F. all died within 3 days.

Newly-hatched larvae, unless fed, lived less than 24 hours at 98° F., and if kept in a box in the vest pocket they lived but little more than a day, unless fed; none survived a second day.

Adults kept in a box in an outer pocket of a walking coat during March lived five days without food.

Of forty young lice which emerged from the egg on the same day the following record of the moulting periods was made:

First Moulting.				Second Moulting.			
3 per cent. on the 3rd day				15 per cent. on the 7th day			
42	"	"	4th "	72	"	"	8th "
55	"	"	5th "	13	"	"	9th "
Third Moulting.							
5 per cent. on the 10th day				...	...	...	mature
3	"	"	11th "	...	...	...	"
55	"	"	12th "	...	...	...	"
32	"	"	13th "	...	...	...	"
5	"	"	14th "	...	...	...	"

Cold.

Active specimens of *P. humanus* survived two days at a temperature of 28° F. to 30° F., but none after exposure to these conditions for a week.

Hatching of Eggs.

Under humid conditions in an incubator kept at 87° F.—

3 per cent. of the 1,300 eggs tested hatched on the 7th day			
56	"	"	8th "
33	"	"	9th "
8	"	"	10th "
0.2	"	"	11th "

A test carried out with eggs taken from a stock box—date of laying uncertain, some having been laid possibly as many as three days previously—showed that none hatched at 60° to 65° F., while at 76° F. there was considerable mortality in the egg stage. The hatching period of those that survived was spread over a longer period than usual. At 98° F. the period of hatching only covered five days, while the mortality was not excessive.

To give some idea of the possible rate of multiplication of *P. humanus*, we may estimate the egg period as twelve days and a further twelve days to the maturity of the females. Allowing an average of eight eggs per day, spread over a fertility period of forty days, we find that during her life a single female may have 4,160 offspring.

AN INVESTIGATION OF THE BEST METHODS OF DESTROYING LICE AND OTHER BODY VERMIN.

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II.

In a preliminary communication¹ to the BRITISH MEDICAL JOURNAL I described some early experiments in breeding lice, which showed that the humidity of the atmosphere was of importance—a fact which I have since ascertained to have been previously discovered by Mr. Bacot, of the Lister Institute, with regard to the breeding of fleas.²

Up to the present I have been unable to determine the constant conditions that would enable lice to breed and live in the incubator, the lice being removed from the incubator only while feeding on the human body. On one occasion, out of some forty experiments with different samples of lice, it was found possible to keep the lice alive and to hatch out their eggs when they were suspended over water by means of a cotton-wool plug