THE CONTROL OF CULICINE MOSQUITO BREEDING IN SEPTIC TANKS BY MEANS OF D.D.T. BRICKS

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ALL septic tanks on W.D. land on Singapore Island breed culicine mosquitoes in enormous numbers if left untreated. The extent of breeding has to be seen to be believed and, as the tanks are usually in close proximity to billets and married quarters, the nuisance at night is very considerable. Furthermore many of the bites tend to become septic, particularly with women and children. Control is essential, both from the civilian and army standpoint.

For eighteen months this was effected by normal weekly oiling with anti-malaria oil, but there are certain objections to this method, viz.:

(*a*) Each chamber of the tank must be oiled. This entails removing all cover slabs and in practice, oilers, unless very closely supervised will not do this diligently.

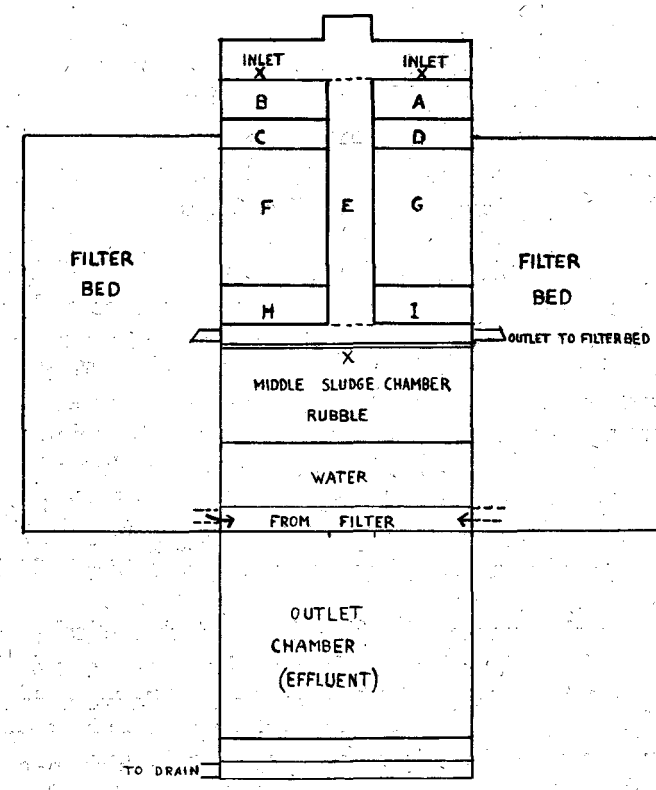
(*b*) The oil eventually reaches the filter bed and theoretically reduces the aeration capacity. Actually no deterioration was noticed during the eighteen months, but it is possible that the cumulative action of the oil over a longer period may lead to a sudden breakdown of the filter bed.

(*c*) A possibility of destruction of the bacterial action which is so essential in a septic tank. This theory was propounded many times by the civilian health authorities, but during the whole period no detrimental effects were ever noticed in any septic tank under control. It is difficult to visualize that an oil film would prevent the action of anaerobes. On the contrary it should assist, and this objection was never seriously considered.

However, the first two objections remained very real, and in an endeavour to overcome these it was decided to try what measure of control could be obtained by means of D.D.T. bricks. The experiments were commenced in January 1949 and terminated in September 1949 and were conducted in various types of septic tank, although the main experiments with controls were made in an Ihmoff type tank constructed as shown in the diagram. Bricks were cast to a standard size of 4 in. x 4 in. x 3 in. and were made from both cement and plaster in the proportions of 1 part cement to 6 parts sawdust and 1 part plaster to 4 parts sawdust—by volume.

The bricks were thoroughly dried in the sun, a process which took forty-eight to seventy-two hours, and then soaked for twenty-four hours in a solution of 5 per cent technical D.D.T. powder in anti-malaria oil. The amount of oil

absorbed averaged 12 ounces by weight, with little variation, and no increase in absorption was obtained by soaking up to seventy-two hours.



X = Valves.

Measurements: Chambers A & B 3 ft. × 3 ft.; C & D 3 ft. × 1½ ft.; F & G 6 ft. × 3 ft.; H & I 3 ft. × 1 ft.; E 10 ft. × 1½ ft.

Experiment I

Cement-sawdust bricks were *dropped* into chambers A.D.G.I. shown on the diagram. Chambers B.C.F.H. and E. were left as controls. Breeding was heavy, comprised all stages, and was approximately equal in all chambers.

After twenty-four hours: No noticeable decrease of breeding in any chamber.

After forty-eight hours: A slight decrease in the controlled chamber, none in the controls.

After seventy-two hours: Approximately 50 per cent decrease in the controlled chambers. Controls normal.

No further decrease was noted and by the eighth day breeding in the controlled chambers commenced to increase and had returned to its previous level at the fourteenth day.

The controls remained approximately constant throughout. Slight traces only of oil were noticed in the controlled chambers.

Experiment II

A plaster-sawdust brick was dropped into the outlet chamber shown on the diagram and further plaster-sawdust bricks, one to each controlled chamber, into a simple rectangular septic tank divided by baffles. In each case other chambers of the two tanks were used as controls. Culicine breeding was heavy throughout.

A moderate reduction of breeding was noted in all controlled chambers after twenty-four hours but, by the end of a week, larvæ were as numerous as ever. There was no noticeable reduction in the control chambers.

Experiment III

Further trials were conducted with cement-sawdust bricks in relatively clear open pools in which both culicine and anopheline larvæ were breeding. These were made to test the efficiency of a cement-sawdust as opposed to a plaster-sawdust brick, as it was known from experience in the Middle East that the latter gave excellent control under similar conditions. Again, an initial moderate decrease in breeding occurred, but was not maintained and the suspicion arose that possibly the D.D.T. was being hydrolysed by the alkali in the cement.

It was then decided to concentrate on the use of plaster-sawdust bricks. The failure of experiments I and II could be attributed only to the fact that the bricks had become covered with sediment at the bottom of the chambers, and the oil release inhibited. To understand the nature of experiments IV to VI a brief description of the working of the septic tank is given. There are two inlets, one of which works through chambers A—I and the other through chambers B—H. Each inlet with corresponding chambers can work independently of the other. Run-off to the filter beds is through E. Effluent from the filters passes along a small channel in front of, but not directly connected with the middle water chamber. The latter merely takes surplus liquid from the sludge when this is run-off periodically. From the small channel, liquid passes to the final effluent tank and thence to the drain.

On the basis of this, there should be a steady liquid movement from A to B to the final outlet, but excluding the middle water chamber. Chambers A to I and B to H are not completely divided, but separated only by baffles.

Experiment IV

One plaster-sawdust brick was suspended about 6 inches below the water level at the inlet end of the outlet chamber. All other chambers were left untreated as controls. Breeding was heavy and fairly equal throughout. At the end of twenty-four hours a noticeable reduction in breeding had occurred. By the end of forty-eight hours almost all larvæ were dead, but a number of pupæ remained. The latter were still present at the end of the third day, but full control had been effected by the fourth day. The pupæ had possibly developed into adults, but this obviously could not be verified. On the eighth

day larvæ and pupæ were seen in the chamber, and as the latter had been checked clear the previous day their existence could be accounted for only by being washed down from the main inlet chambers which were breeding heavily. On investigation larvæ and pupæ were actually seen in the channel from the filter bed outlet and moving to the inlet of the outlet chamber. Further investigation revealed large numbers of larvæ and pupæ flowing on to the filter tippers and from these to the filter bed. No doubt the mortality on the latter is heavy, but a reasonable number struggle through. During the whole course of the experiments this phenomenon was found to be very constant when breeding was allowed in the inlet chambers.

After twenty-four days from the placing of the brick, breeding in the chamber commenced to increase and could not be kept under control. This was attributed to a great deal of scum and old vegetation which had been washed into the chamber by heavy rains. (That the brick was still releasing D.D.T. was proved by removing it after five weeks to an uncontrolled chamber, when it gave immediate control.) A second plaster-sawdust brick was suspended in the outlet chamber after removing all surface debris, and this brick maintained full control for seven weeks, a period which coincided with lack of heavy rain. The outlet chamber was built in an excavation, some 10 feet below ground level and collected a considerable amount of run-off water from the surrounding slopes.

Experiment V

One plaster-sawdust brick was suspended 6 in. below the water surface in the middle chamber. As noted previously this particular water was static and completely isolated from the general flow in the tank. Breeding was very heavy, but full control was obtained within three days and maintained for twelve weeks, after which 3rd and 4th instar larvæ, and pupæ appeared and continued to increase. Numerous egg-rafts were present throughout the experiment, but from the third to the twenty-second day no larvæ or pupæ were found by dipping. After this time, hundreds of 1st and 2nd instar larvæ were noted, but for twelve weeks no later instars were ever found.

Experiment VI

One plaster-sawdust brick was suspended by wire in each of chambers A and B. The length of the wire was adjusted so that each brick just reached the bottom of the first baffle. After twenty-four hours there was an appreciable difference in the number of larvæ and pupæ in these two chambers, and after three days control was complete apart from the existence of odd pupæ. There was no decrease in breeding in the other chambers; if anything, a slight increase. By the twelfth day, control was still complete in chambers A and B (no pupæ had been seen since the fourth day) although numerous egg-rafts were seen at each daily inspection. There was no indication of control in any other chamber.

It appeared obvious, that despite the direction of liquid flow in the tank,

and the depth of the brick, the baffles were effectively preventing the penetration of D.D.T. oil film to other chambers. D.D.T. bricks were then suspended in all chambers. After twenty-four hours no larvæ were found in C.D.H.I., but a few pupæ still remained. E.F.G. showed a marked reduction in breeding, but it was four days before full control was established. So far, through sixteen days of experiment, numerous egg-rafts were always noted. It was common to count fifty in any one chamber, and this was by no means a full count.

Many dead adult mosquitoes were also seen. Whether due to contact with D.D.T. oil film when egg-laying, or on emergence from pupæ was not ascertained at the time.

Full control was maintained with one brick for each chamber for periods as shown below:

A —	Breeding	commenced	6	weeks	after	placing	D.D.T.	brick
B —	,,	,,	9½	,,	,,	,,	,,	,,
C —	,,	,,	7½	,,	,,	,,	,,	,,
D —	,,	,,	8½	,,	,,	,,	,,	,,
E —	,,	,,	10	,,	,,	,,	,,	,,
F —	,,	,,	6½	,,	,,	,,	,,	,,
G —	,,	,,	5½	,,	,,	,,	,,	,,
H —	,,	,,	6½	,,	,,	,,	,,	,,
I —	,,	,,	6½	,,	,,	,,	,,	,,

Breeding increased steadily from the times shown above, until three months after the experiment was commenced, larvæ and pupæ were as numerous as before control started.

Experiment VII

To further check the efficiency of cement-sawdust bricks, one was suspended in each of chambers B.D.G.H. and one plaster-sawdust brick was suspended in each of chambers A.C.F.I. Full control was obtained in forty-eight hours with the plaster bricks, but partial control only was obtained with the cement bricks, and after seven days breeding increased with the latter bricks and was maintained. After fourteen days all cement bricks were replaced by plaster ones as it was obvious that control was inefficient. All plaster bricks maintained full control until replaced after one month.

Similar experiments were conducted in a second identical septic tank. The duration of full control was inclined to be shorter than with the first tank, and varied from four and a half to six weeks.

No experiments were made on the middle chamber of the second tank as for some reason breeding was never found. However, an interesting discovery was made. At first, the outlet chamber only was controlled, as all the inlet chambers A to I were completely sealed off with concrete slabs and all joints cemented, and it was not thought that any breeding could possibly occur. The sudden appearance of larvæ and pupæ in the bottom chamber placed the inlet

chambers under suspicion and on breaking the joints and opening up, heavy breeding was seen, and again larvæ and pupæ were observed flowing on to the tippers and through the filter bed. The only ingress for the female mosquito was through the outlet pipe to the filter tippers, and furthermore, so far as could be ascertained breeding was occurring in absolute darkness, which is not generally considered possible.

In smaller type septic tanks there is very often an incomplete formation of surface scum, and culicine breeding has been found to be heavy in the small "islands" of liquid throughout the scum. The suspension of D.D.T. plaster bricks below the scum on the assumption that the released oil would float upwards to the "islands" of breeding has not been found successful. Several experiments were made in different septic tanks but control of isolated pockets of breeding enclosed by thick scum was a complete failure, using D.D.T. bricks. Normal oiling was found to be the only practicable method of elimination.

Theoretically, these "islands" of liquid should not exist, and with a normal working septic tank scum should form over the whole surface of the scum chamber. In practice, however, they have been proved to be a troublesome, if minor, source of breeding.

Several more experiments were made, involving every type of septic tank known, and the method of suspension of the D.D.T. brick in the chamber was used throughout. In all cases where breeding occurred in chambers with a liquid surface only, full control was obtained and maintained for never less than one month, and usually six weeks. No failure was recorded.

Discussion

The control of culicine mosquito breeding in septic tanks by the use of plaster-sawdust bricks soaked in 5 per cent. D.D.T. in antimalaria oil has been tried in an effort to obtain full control by means of minimum oil, labour, and time.

With D.D.T. bricks a septic tank need be opened once a month only, and in some cases less frequently, as opposed to weekly opening when normal oiling methods are used.

The method is more certain in that the various chambers of a septic tank are less likely to be missed, and, if so, are easily traced on inspection by the absence of a brick.

The bricks do not easily disintegrate, and can be removed, washed, dried, and resoaked in oil.

Possibility of damage to the filter bed by large doses of oil is eliminated.

A system of control for septic tanks has been found necessary owing to the frequency of opening up for maintenance by R.E. personnel.

Conclusions

Mosquito breeding on moving and static liquid surfaces in a septic tank can be fully controlled by D.D.T. plaster-sawdust bricks.

A brick must be suspended and not dropped, in each chamber of the tank.

Full control by one brick will continue for at least one month on a moving liquid surface, and for three months on a static liquid surface, provided no scum is present.

Cement-sawdust bricks are useless, probably due to hydrolysis of the D.D.T.

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ARMY DERMATOLOGICAL RESEARCH UNIT

RESEARCH ON SKIN DISEASE IN F.A.R.E.L.F. 1947–8.

THE O.C., Dermatological Research Team, recently presented a report on two years' work by the Team on dermatological problems among Army personnel in the Far East. The following is a brief summary of the findings:

FUNGUS INFECTION

The most important dermatological problem among male British troops in S.E. Asia is fungus infection of the skin. Clinically this entity divides itself naturally into infection of the soles and toe clefts and infection of other areas. These conditions will be referred to as "foot ringworm" and "body ringworm" respectively. It must be constantly borne in mind that although these are clinically distinct, the same organisms can (and frequently do) give rise to both; it is therefore necessary, when dealing with epidemiology, to consider fungus infection as a whole.

A clinical consideration of body and foot ringworm follows.

Body Ringworm

Incidence.—Of some 1,700 B.O.R.s examined at skin inspections, 33·5 per cent were found to have ringworm of the body. From this overall figure, indicating infection at any given moment of 1 man in every 3, only small deviations were found among different units among troops in different localities, and among troops with different occupations (e.g. R.E.M.E. as compared with Infantry). Men were inspected in Singapore, at various stations on the western side of the Malayan peninsula, and in Hong Kong during the hot season, and in all these places an infection rate of roughly 1 in 3 was found.

Ætiology.—Body lesions from a total of 88 individuals were cultured and yielded the following pathogenic fungi (figures represent percentage incidence of each species):

Species	*Abbreviation*	% *incidence*
Trichophyton mentagrophytes var. asteroides	*TMA*	54
Epidermophyton floccosum	*EF*	33·7
Trichophyton rubrum	*TR*	8·2
Trichophyton interdigitale	*TI*	2
Trichophyton violaceum	*TV*	1
Microsporon gypseum	*MG*	1

It can be seen that over one-half of all infections were due to *TMA* and about one-third to *EF*, other fungi play a relatively unimportant part. It should be noted that several individuals were infected, either successively or simultaneously, with more than one fungus.