INSECT CONTROL IN STANDING BARRACKS.
A REPORT ON THE USE OF D.D.T. IN JAMAICA,
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BY
Corporal H. G. DeMONT,
Royal Army Medical Corps.

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In the early part of 1945 D.D.T. became available in a limited quantity
in Jamaica. The problems of correct usage resolved themselves into those
attendant on the type of insect pests present in Jamaica, the economical use
of the substance, technical difficulties and organization. That the problems
were solved is due to the help and guidance from numerous well-wishers
including Dr. Hill, formerly of the Rockefeller Foundation in Jamaica, Mr.
Edwards and Mr. Dixon, entomologists, Jamaica, and numerous others.

It is hoped that in reporting these experiences some practical help may
become available to other units faced with the problem of insect control in
standing barracks. It is the purpose of this paper therefore to record the
organization of insect control, to report the methods used, reasons for their
adoption and to give a rough idea of control effected in Jamaica.

ORGANIZATION.

Early in 1945 Jamaica Garrison was situated in Up Park Camp with out-
stations at Port Royal, on the Palisadoes, in Coast Batteries, in a hill station at
Newcastle, in a large hulled camp at Mona, at Moneague and in a tented camp
at Shettlewood. Most of the accommodation was found in permanent or semi-
permanent wood and concrete huts of standard design which harboured insects
Insect Control in Standing Barracks

of many varieties. Such a garrison was scattered, varied in requirements and included a variety of units. A considerable proportion were negro troops, while white troops were in a minority.

White troops complained of a mosquito menace and from September, 1941, to September, 1945, 428 cases of dengue fever had occurred in Up Park Camp. No cases were reported in 1945 up to time of writing though this probably had no connexion with D.D.T. but with improved routine mosquito control in Up Park Camp.

Coloured or negro troops have been infested with bedbugs so much so that they became a byword. Occasional cases of malaria occur in "malarious" districts but this is not a major problem in the colony.

Cockroaches were numerous in ration stores and cookhouses in spite of careful and scrupulous cleanliness. This infestation was particularly heavy in Port Royal.

The Camp at Newcastle, where a good number of barrack rooms and store rooms had been closed for some months, was heavily infested by fleas. On entering the rooms the insects swarmed up our legs in clouds.

The choice of methods for use depended on the limited quantity of D.D.T. available, the confinement of insect pests to barracks, and the advice at our disposal. It was finally decided to start with treatment of barracks with 5 per cent kerosene solution of D.D.T., a choice later confirmed by a War Office Memorandum. This had the merit of acting as an adjustment to the anti-mosquito measures already in force without disturbing an efficient routine. Damage to useful insects was avoided (for bees remain out of doors) but at the same time a considerable number of "death-traps" were furnished for insects that invaded human habitations.

To obtain an efficient and trained unit the anti-mosquito squad in Up Park Camp, the sanitary corporal at Mona and others were trained in handling solutions and apparatus available. In this connexion the work done by L/Cpl. W. Grattan and Rfn. J. Bourdon of the Canadian Army must be mentioned, for without their enthusiasm and perseverance the routine could not have been completed. With a trained core of three or four men, and with untrained fatigue parties of six to ten, all the accommodation for a battalion could be treated in three days.

(a) Directions accompanied by a pro forma were sent out to each unit requesting as a rough guide the "Square footage" required to be treated. For this estimation each room was considered to be five feet high, in order to simplify calculation, which then became the sum of the length added to the breadth with a "0' on the end of it." It was considered that the very human habit of asking for twice as much as would be required would counteract any shortage. This was borne out in practice.

(b) A few days before treatment a pro forma covering date of treatment, preparation of solutions, provision of fatigue parties, transport, preparation by units and rations was sent to the unit.

(c) During treatment of rooms two members of the squad were required to direct proceedings while one member controlled refilling and repair of damaged
apparatus (the latter being the most important job). The unskilled fatigue party did the actual spraying and usually enjoyed it.

(d) Personal precautions against poisoning included directions to wash whenever uncovered skin became saturated with kerosene solution, the wearing of gas capes and, occasionally, respirators. Later respirators were discarded except in very small rooms. A mild degree of dermatitis developed in four men probably as much from kerosene as D.D.T. One man owned to previous skin reactions from kerosene oil. The commonest point for dermatitis was just above the boots where puttees and stockings became saturated. The provision of gum boots would be the obvious preventative. Headaches were frequent when spraying continued into the fourth or fifth consecutive days, and it was the habit in this area to space treatments at least a week apart.

TECHNICAL CONSIDERATIONS.

(1) Dilutions.—Powder sprays of D.D.T. were not used in Jamaica to any great extent for the reasons mentioned above and where used were found to lose efficiency quicker than solutions.

In preparing the 5 per cent solution of kerosene the following practical tips are of value:

(a) An Elastoplast (3 inches) tinful of D.D.T. is approximately seven ounces and is enough to make one gallon of 5 per cent kerosene solution.

(b) The longer the period allowed for solution the more efficient it became especially if kept in the sun for four or five days.

(c) Confirmation was found of the tips given in Army pamphlets on D.D.T. Particular reference must be made to the partial solution of all D.D.T. in a small portion of kerosene over a low flame before mixing in the kerosene drum.

(2) Parts of Buildings Treated.—It was decided that one gallon of solution would treat 1,000 square feet of wall space (equivalent to 200 mg. D.D.T. per square foot) as directed in Army pamphlets from Colonel J. W. Scharff, R.A.M.C., and U.S. War Department Technical Bulletin. This was later confirmed.

The walls of sleeping quarters were sprayed to a height that could easily be reached by the fatigue party and this was taken as five feet.

Cookhouses and messroom walls were completely sprayed.

In barracks badly infested with fleas the floors were also sprayed and those in which bedbugs were abundant the bedsteads received an overflow treatment.

Horse-manure heaps and garbage heaps, when discovered not to be properly packed and seen to be infested with fly-larvae, were sprayed before they were removed.

In an attempt at fly control in cookhouses D.D.T. was mixed with whitewash and painted on the walls. Admixture is assisted if the D.D.T. powder is added to the tallow just liquefied in a low flame. The whitewash is then made up as usual.

(3) Types of Buildings Treated.—Barracks treated varied from those built in 1907 to those erected as late as 1943. It was noted that unpainted wooden huts, whitewashed walls, absorbable brick walls and any other porous surface
did not form a good insecticide film and required much more kerosene solution. This will be shown in the report.

(4) Sprays Used.—The provision of apparatus was a considerable problem. D.D.T. kerosene solution could be used as a paint applied by brush. This was only suitable for small areas and was wasteful. In discovering suitable sprays the problem resolved itself into that of suitable nozzles and that of reservoirs and power.

Stirrup pumps have two disadvantages. The spray jet is as a rule too coarse (unless adjustable) and the solution left behind in the bucket tends to be thrown away. Secondly they require two persons to handle them. However, these pumps are useful and handy if the nozzle can be modified. Flit sprays atomize the D.D.T. solution but are too small and too delicate for efficiency.

A paint-spray with pump and pressure gauge seemed to be the ideal for a time but could not be cleaned out easily and became choked.

Most of the work in Jamaica has been done with Lowell's knapsack sprays fitted with No. 4 or 5 diaphragm nozzles suitable for the "Bordeaux mixture" for Leaf Spot Control in the Banana industry. Through the kindness of the Secretary of the Leaf Spot Control Board, Jamaica, twelve of these sprays were obtained on loan. The nozzles were such that the diaphragms could easily be removed for cleaning and the perforation small enough to leave an even film. The tubing was long enough to ensure delivery rapidly and at a distance of several feet from the body. A handle fitted with a spring tap made for easy control. The cannisters contained about two gallons each. The pump was convenient and easily repaired. It was discovered that the sheet rubber diaphragm to this pump tore and perished easily but could be more efficiently replaced by leather well treated with "dubbin."

We consider this type of spray to be most convenient, if available, because of its portability and simplicity.

DEGREE OF INSECT CONTROL EFFECTED.

In making an assessment of the results it was manifestly impossible with personnel available to formulate controlled experiments. A qualitative report was easy through the kindness of Messrs. Edwards and Dixon, Government Entomologists, Jamaica, but the quantitative assessment depended on the reports from the units. In justification of this method it is submitted that the results have been assessed by people most concerned and ready to tell us of failure.

I. Types of Insect Destroyed.—

(a) Cockroaches:
   i. Blatella Germanica.
   ii. Periplaneta Americana.
   iii. Periplaneta Australasia.
   iv. Blaberus discoidalis.
   v. Nyctibora laborator.
   vi. Lencophea Maderae.
   vii. Blaberus giganticus.

(b) Bedbugs:
   i. Cimex lectularius.

(c) Flies:
   i. Musca domestica.

(d) Fleas:
   i. Pulex irritans.
   ii. Ctenocepharus canis.

(e) Mosquitoes:
   i. Aedes agypti (Stegomyia).
   ii. Culex fatigans.
   iii. Anopheles albozusnus.

(f) Crickets:
   i. Gryllus domesticus.
Most of the cockroaches were flying varieties and some specimens were two and a half inches long.

In addition to the above scorpions, centipedes and spiders of several varieties were destroyed including one "Black Widow" spider.

II. Detailed Results of Treatment.—Results are shown under four main headings of Mosquito Control, Fly Control, Bedbug Control and Roach Control when reporting particular buildings.

(1) **Military Hospital, Jamaica.**

Area treated: 48,000 sq. ft. on March 13 and 14, 1945.

(a) Mosquito Control: Slight nuisance, no difference noted.

(b) Fly Control: In the cookhouse area flies diminished for a day or two only. This is apparently due to the inexhaustible breeding places outside and the appearance of flies whenever food was being prepared.

(c) Bedbug Control: In local forces wards where bug infestation was extreme, complete clearance after a few days was effected for five months. In European wards no bedbug infestation was noted in six months.

(d) Roach Control: In the hospital kitchen roaches practically disappeared for five months; in the scullery no roach infestation was noted after six months.

(2) **Palisadoes Camp.**

Area treated 160,000 sq. ft. on March 20 to 23, 1945.

(a) Mosquito Control: Slight nuisance, no difference noted; this camp is completely wired against mosquitoes.

(b) Fly Control: Similar results to those of the hospital kitchen.

(c) Bedbug Control: Complete disappearance of bedbugs reported.

(d) Roach Control: After considerable diminution of roaches reinfestation of cookhouses was noted after five months.

(3) **Barrack Compound, Up Park Camp.**

Area sprayed 220,000 sq. ft. on March 28 to 30, 1945.

(a) Mosquito Control: One barrack room was left untreated and the occupants complained of the mosquito nuisance. In adjoining huts mosquito nets were not used for four months.

(b) Fly Control: No real change noted in cookhouses.

(c) Bedbug Control: The infestation of the huts was very heavy. Since treatment 90 per cent of the barrack rooms were completely free of bedbugs after six months.

(d) Roach Control: Clearance of roaches noted in cookhouses after treatment; reinfestation discovered after five months but considerably less than before treatment.

(4) **Gibraltar Camp, Mona.**

A camp of unstained wood and concrete construction. It was almost impossible to make a film on the surface of walls.

(i) 1st Area treated 80,000 sq. ft. on April 10 and 11, 1945.

(a) Mosquito Control: No obvious difference.

(b) Fly Control: No obvious difference.
(c) Bedbug Control: No bedbugs noted in August, 1945, on reopening the camp after it had been unoccupied for one month.
(d) Roach Control: Roaches plentiful in cookhouse on reopening in August, 1945.

(ii) 2nd Area treated 100,000 sq. ft. on April 30 to May 4, 1945.
(a) Mosquito Control: No result from treatment of barrack rooms.
(b) Fly Control: Some diminution of flies for about one week only.
(c) Bedbug Control: Complete elimination of bedbugs.
(d) Roach Control: Elimination of cockroaches which lasted up to five months.

(5) SMALL UNITS, MESSSES, OFFICERS’ MESSSES, UP PARK CAMP.
Area sprayed 20,000 sq. ft. on May 17 and 18, 1945.
Individual reports vary. Taken on the whole a marked decrease was noted in the numbers of all insects after three months.

(6) HARMAN BARRACKS.
Area sprayed 44,000 sq. ft. on May 29, 1945.
(a) Mosquito Control: Nuisance slight, no difference noted. Officers sleeping in barracks on duty nights report freedom from mosquito nuisance strikingly unusual.
(b) Fly Control: A whitewashed cookhouse with ample fly screening presented an ideal experimental occasion for the use of D.D.T. in the whitewash.
5 per cent D.D.T. in whitewash was effective for two weeks.
10 per cent D.D.T. in whitewash kept the fly infestation to a minimum for six weeks.
(c) Bedbug Control: Bedbugs completely eradicated.
(d) Roach Control: No roaches detected in cookhouse.

(7) NEWCASTLE HILL STATION.
Area treated 120,000 sq. ft. on June 9 to 15, 1945.
This station presented a problem in transport and organization but spraying was completed in four days.
Numerous fleas in unoccupied quarters were cleared and had not returned in three months.
(a) Mosquito Control: No obvious change noted.
(b) Fly Control: Fly nuisance was traced to improperly disposed mule dung and rubbish tips; it was considerably abated by spraying the dungheaps, the stables and by regular carting.
(c) Bedbug Control: Bedbugs eradicated.
(d) Roach Control: Improvement noted in all cookhouses though complete eradication not effected.

(8) MONEAGUE CAMP.
Area treated 20,000 sq. ft. on July 9, 1945.
(a) Mosquito Control: Very few mosquitoes noted after treatment.
(b) Fly Control: Some diminution noted after treatment.
(c) Bedbug Control: Complete elimination obtained.
(d) Roach Control: No reinfestation in two months.
(9) SHETTLEWOOD CAMP.
Area treated 18,000 sq. ft. on July 24, 1945.
This was a tented camp with Mess rooms, cookhouses and recreation rooms in a country house.
Tented site badly flea infested; the ground near tents sprayed and eradication of fleas effected.
(a) Mosquito Control: Considerable improvement.
(b) Fly Control: No obvious improvement.
(c) Bedbug Control: None reported after treatment.
(d) Roach Control: Eradicated for two months.

(10) FORT ROCKY.
Area treated 12,000 sq. ft. on July 30, 1945.
This unit was situated on the Palisadoes in close proximity to mangrove swamps in which Anopheles albimanus bred and was the main vector of malaria. About 12 per cent of the personnel of this fort contracted malaria from September, 1944, to January, 1945, during the rainy season only.
(a) Mosquito Control: Diminution noted for two months.
(b) Fly Control: Considerable reduction noted for a few days after treatment.
(c) Bedbug Control: Bedbugs completely eliminated.
(d) Roach Control: Roaches almost eliminated but still being found dead two months after treatment.

(11) PORT ROYAL.
Area treated 72,000 sq. ft. on July 30, 1945.
(a) Mosquito Control: No obvious change.
(b) Fly Control: No obvious improvement.
(c) Bedbug Control: Complete eradication.
(d) Roach Control: Roaches and crickets completely destroyed. It is to be noted that where repeated application was effected at this station all insects were controlled.

III. Effects on Insects.—It was observed that when insects were caught in the spray death was immediate. Fleas, mosquitoes, flies and roaches died in a few seconds. This was undoubtedly due to the kerosene. Later it was observed that when a roach walked over a treated surface it gave a start at first and ran up the wall. After a while it stopped climbing, then began aimlessly and in a confused fashion to walk around, finally falling off the wall to the ground and would die, often several hours later.

In one ration store the storeman would sweep out scores of dead roaches each morning for over two months.
Bedbugs are killed off within a few days. It is emphasized that D.D.T. has no immediate reaction.
SUMMARY.

(1) An organization of insect control in barracks by treatment with D.D.T. spray is described. This treatment was an adjuvant to regular mosquito control and not a replacement.

(2) Apparatus in use has been described together with minor improvisations and other technical considerations.

(3) Results show a destruction of a wide variety of insects and indicate the method to be particularly useful in bedbug control and roach control. These are insects that normally inhabit crevices in which D.D.T. might be expected to persist when applied in the manner described.

In the control of flies and mosquitoes it was shown that the effect of D.D.T. was transient. That renewed treatment of sheltering places was necessary and that a non-absorbable surface to the wall was preferable. In no way does the treatment of walls by D.D.T. replace routine sanitary and anti-malarial measures in the control of flies or mosquitoes.

It is suggested that a watery emulsion of D.D.T. not absorbed by wall surfaces would help to lengthen the effective lethal time for mosquitoes and flies.