DEVELOPMENTS IN MOSQUITO CONTROL

THE APPLICATION OF INSECTICIDE DUSTS BY EXPLOSIVES

Should Be Useful Also in Mosquito and Malaria Control Work

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Experiments here reported, which were originally undertaken to explore the possibility of finding a more economical method of treating mature forest areas with insecticides, as for gypsy moth control, have produced results which may have significance for the war effort and otherwise as a mosquito and malaria control procedure.

Forest Spraying is Difficult and Expensive

Spraying the forest trees and undergrowth thoroughly with an arsenical insecticide has been an accepted method of suppressing gypsy moth colonies which appear in forested areas of the barrier zone. High-power spray outfits are employed which are capable of maintaining a pressure of 1000 pounds per square inch, or sufficient pressure to reach the tops of the tallest trees.

Such an outfit is stationed near an adequate water supply, and heavy, one inch, high pressure hose is laid down leading into the forest, sometimes as far as two miles; whereupon with lateral leads the forest is sprayed thoroughly for some distance on each side as the hose is withdrawn section by section toward the power plant. By repeating this process, the infested forest area is covered strip by strip. Such spraying operations are difficult and expensive; the cost having been estimated to

be in the neighborhood of $10.00 per acre.

Hitherto Available Alternatives Impracticable

Much of the barrier zone is mountainous, with airplane landing fields usually few and remote. For these reasons, airplane dusting would be extra hazardous if not physically impracticable.

No commercial power duster operating from the ground could reach the tree tops, even if it were not excluded by the vegetation and the topography.

So much for the general problem.

Experimental Dusting by Explosives

When he first approached the senior author with the general idea, Mr. Blair had already carried on some experiments with the dispersal of insecticide dusts from near the surface of the ground, by means of an explosive charge embedded in a package of the insecticide. This however had proved unsatisfactory, because it resulted in an undesirably and wastefully heavy application near the center of dispersion.

A manufacturer of fireworks, whose services were enlisted in order to have the benefit of his explosives permit, reported that some years before he had made a number of experimental insecticide bombs for a California customer. These, however, appear to have consisted of an explosive bomb designed to be fired from a mortar, and timed to explode at a predetermined height. They appear thus to have been prohibitively complicated and expensive.

Working at once for simplification and for adaptation to appropriate insect control requirements, it was soon found to be quite sufficient to fire a loose charge of the insecticide dust directly from a suitable mortar on the ground; the height reached by the charge of insecticide and the character of its dispersion in the air being determined by the dimensions of the mortar, the quantity of insecticide, the method of loading, and the kind and quantity of explosive used.

Various kinds of mortars, and charges in many combinations have been tried. A mortar six inches in diameter and 18 inches deep fired the charge too high and too compactly for good nearby coverage; and even when filled with earth to a 12-inch depth, this mortar still gave excessive drive. A heavy, rolled paper, fireworks mortar 8 inches in diameter and 10 inches deep gave excellent lift and mushrooming, but appeared to have a too large capacity for the best control of coverage when used in batteries.

The experimental mortar last used was a 4-inch gas pipe nipple, 4-inches long and threaded at both ends, with one end closed by a threaded 4-inch pipe cap.

This mortar was charged in the following manner:

1. A 3-ounce charge of "Grade A, 4F" rifle powder was placed on the bottom of the mortar.

2. A suitable length of fuse was added, one end placed in the powder and the other end allowed to trail over the edge from the open end of the mortar.

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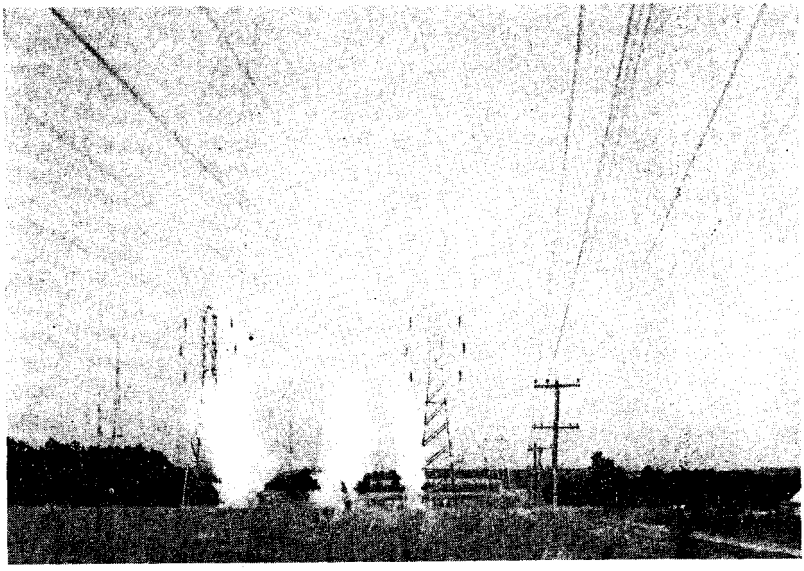
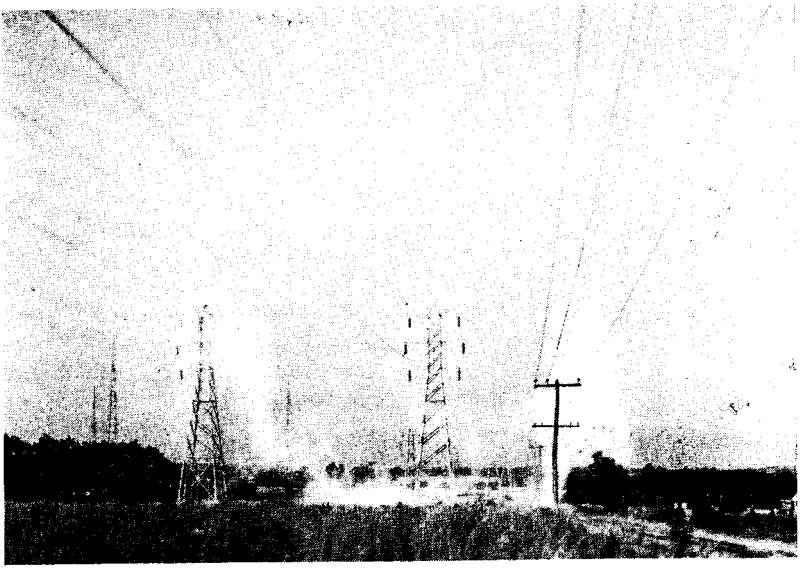


Shots Fired at Approximately One Second Intervals



Dispersion After Approximately Three Minutes

3. A disk of heavy cardboard was then placed over the powder and the inner end of the fuse.

4. A 15-inch square of heavy kraft paper was next placed in the mortar so as to rest smoothly on the cardboard disk at the bottom, and carefully folded at the sides so as to line the mortar smoothly and project some inches above the top.

5. The charge of insecticide (about three pounds) was finally placed in the mortar within the paper lining, the paper neatly folded over the top, the fuse coiled above and, with a bit of crushed paper to hold everything in place, the charge was enclosed by a second threaded 4-inch pipe cap lightly screwed on as a cover to make the whole secure and safe.

Without the paper lining, the drag of the insecticide dust against the sides of the mortar will interfere with the proper lift and mushrooming of the charge.

With such a charge in such a mortar, a lift and mushrooming at a height of more than 100 feet is easily obtained; and in our tests excellent coverage was obtained at distances much greater than 100 feet from the mortar. When the dust is carried by a light breeze, good coverage has been observed at distances up to 200 yards and more.

Preferred Designs

The iron mortars last described, while excellent for experimental work, are heavy and relatively expensive. Because of their cost, they

Some of The Experimental Mortars Used

must be retrieved after use; and their weight adds to the cost of operation when they are placed and gathered up.

In practice, it would be best to use a rolled and cemented paper mortar that would be lighter and cheaper, and so not worth recovering. The bottom, of course, should be so attached that it will hold against the thrust of the explosion. The built-up wall need be only about 3/16 to 1/4-inch thick.

Dimensions of mortars, quantities of insecticide dusts required, and the nature and quantities of explosives to be used, should be worked out in collaboration by an entomologist and an expert in ballistics to meet different special requirements as they are encountered or foreseen.

Avoidance of Fire Hazard

The use of untreated paper and cardboard would constitute an unnecessary fire hazard. This can easily be avoided by the use of a non-smoldering fuse, and by using only cardboard and paper which have been infiltrated with a high melting, fireproof, chlorinated hydrocarbon such as the chlorinated napthalene "halowax" and the like, or otherwise made fire safe.

Contemplated Method of Use

In a forest that is to be dusted, for example, the charged mortars should be placed the day before. Each unit should be provided with a suitable waterproof enclosure, and should have a bit of the waterproof fuse projecting.

Then in the early morning while the leaves are still moist, while the air is still, and thus while conditions are most favorable for dusting operations, men would be assigned, each equipped with a blow torch, and one to each row of mortars previously placed. Each man would pass rapidly along his row of mortars, igniting the fuse of each before passing on to the next.

With properly charged mortars of appropriate size placed 105 feet apart or four to an acre, and with correct allowance for wind-drift, any forest area could be thoroughly covered with an insecticide or other dust very quickly, at the most favorable time, and at a very modest cost.

The drive of the explosions will set in motion a complicated system of air currents and eddies which should assure thorough coverage of undergrowth under any ordinary conditions, as well as coverage of both upper and under surfaces of the leaves.

Possible Uses for Malaria Control

Some very important malaria carrying anopheline mosquito species may develop in relatively inaccessible places. For example, those which develop in the small but innumerable accumulations of water retained by some tree inhabiting epiphytes, and those which develop in the often highly inaccessible water of mangrove swamps and the like.

Appropriate adaptations of the method here described might help in solving these and other problems.

With such dusting by means of explosives, mosquito breeding, tree inhabiting epiphytes could easily be reached at any height; and appropriate copper bearing, or other dusts which would be tolerated by neighboring or associated plants, might thus be deposited in the accumu-

lation of mosquito breeding water in concentrations sufficient to destroy the mosquitoes, and possible even to kill the offending, epiphytic plants themselves.

In mangrove swamps and places that are similarly difficult of access, with a series of appropriately designed and placed mortars and with a favoring wind, a rolling fog of an appropriate insecticide dust could be made to cover a very large area in a very few minutes.

Experiments, and experience in other fields have made it seem that the application of insecticide dusts by explosives may have promise of usefulness in mosquito and malaria control, and thus in the war effort.

It seems that a charge of insecticide dust and explosive suitably packed in a light and inexpensive rolled paper waste mortar might easily be worked out, which would be appropriate for this purpose; and this report is offered now in order that any such possibility need not be missed.