

completely drained and were thoroughly dried up early in the summer. Other ponds were cleaned around the margins and stocked with minnows.

Ravines were cleaned, dumps where tin cans had been accumulating over a period of years covered, and a great many spots where casual water collected eliminated.

A small truck was fitted with an oil drum pump and spray equipment. A few pack-back sprayers were acquired and the stand-by sections of the Station Fire Department organized as abatement crews. Used crank case oil of which there was a considerable quantity available was mixed with thinner oil and spraying operations started when larvae began to appear in such pools as remained.

No attempt was made to trap and identify the various species of mosquitoes present in the area. Results obtained from the drainage and spraying operations, however, have been highly satisfactory as the number of mosquitoes has been tremendously reduced in comparison with previous years.

Property owners, the railroads, and the Illinois State Highway Departments were most cooperative. Invaluable advice was furnished by the personnel of the Lake Forest Abatement District whose territory lies just south of the Great Lakes area.

DEVELOPMENTS IN MOSQUITO CONTROL

NON-DRUG ASPECTS OF MALARIA CONTROL

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In this article three recently developed phases of malaria control are emphasized as applicable to the war effort: mechanized equipment, outdoor spraying of repellants, and aniline dye dusts. An attempt has been made to show where these new methods fit into the picture of malaria control.

Reports from the Philippines, from China, Burma, India, the Southwest Pacific and Africa describe malaria as an even more disabling disease than we know it to be in North America.

Forty years ago medical men pictured malaria as a chain of three links, and reasoned that if any one of the links could be broken the disease would be conquered.

The first link consisted of the parasite in man. They reasoned that if a drug could be found to kill the parasite in man the first link of the chain would be broken.

The second link consisted of eradication of the malaria carrying mosquito. They reasoned that if mosquitoes could be exterminated in a city or county no new cases would develop; and so the second link of the chain would be broken.

The third link consisted of separating man and mosquito. They reasoned that actually, it would not be necessary to kill the parasite in man, nor would it be necessary to kill the mosquito; but simply devise a means of keeping the mosquito from biting man.

Inasmuch as the severing of any one link would suffice, the medical man embarked enthusiastically upon breaking the first link with quinine. It cured many cases but not quite all. Always beneath the apparently healed surface there remained a telltale, tantalizing irreducible minimum reservoir of parasites that made the first link to appear like rubber to stretch but not to break. Other drugs were tried but all were found wanting because of the hidden reservoir of parasites and the involved human equation. Drugs are a godsend to individual sufferers but as a chain breaker it is a disappointment.

The breaking of the second link was assigned to the engineer and the entomologist because they working together could ferret out and destroy the breeding of the mosquito by drainage and the spraying of chemicals and oils. In large cities mosquito control is most satisfactory from the viewpoint of cost

and comfort and in small cities it is well within economical limits. The second link in the chain of malaria has been broken in a thousand cities. Success is limited to communities leaving the second link unbroken in rural areas.

Another method of breaking this second link (killing the mosquito) is so simple and unpretentious that after discovery and successful use it was allowed to lapse and then to be discovered again recently in a new form. The plan consisted of swatting infected mosquitoes, not hapahazardly by individuals, but according to plan. It yielded wonderful results. Recently an insecticide has been used to replace the swatter. This improved method may be called species control of infected mosquitoes. It is a cheaper and quicker means of breaking the second link and applicable under field conditions where supplies of repellants are too limited to carry on outdoor protection with high-pressure spraying units.

The third link in the chain of malaria transmission, the separating of man and mosquito, is the one that has received the least attention. Around this link revolves success or failure of conspicuous results in control among the military forces.

This link can be broken by separating man and mosquito by screening, by applying mosquito repellent hand lotions, and by spraying of outdoor mosquito repellents.

During World War I, for the first time in war history the second link of the chain of malaria transmission was broken by drainage of mosquito breeding places in and around military camps; and too, a great deal of attention was given to screening of barracks in order to break the third link.

During World War II drainage and screening are being continued on an even larger scale; and to this gain is being added double or vestibule door screening, and even bed-nets inside barracks; and this latter is supplemented by spraying of insecticides in barracks twice nightly. Indoor protection may not be overworked because these multiple checks and balances are necessary when dealing with the human element. However there is a form of protection which is being sadly neglected. Persons working outdoors at night, as individuals or groups, should be given protection in a manner as thorough as those sleeping indoors.

Individuals in mosquito ridden regions are being furnished with mosquito repellent hand lotions for the first time in war. This is a simple but glorious step forward and should be pressed to the limit.

There is another step that has not been taken which offers dramatic results. Comfort and disease prevention for groups working outdoors may be provided by fog-spraying of liquid repellents. In malarial regions men are required to change to long clothes and leggings at night. This protection is not sufficient, the principle protection at night should be the spraying of outdoor repellents.

Machinery suitable for this service is described in "Mechanized Mosquito Control: Puddle Jumper, Swamp Angel, Dinosaur, Skeeter-Eater, and Corner Cutter" published in the Proceedings of the New Jersey Mosquito Extermination Association in 1942. Pictures of this machinery in operation will appear during September 1943 in Life Magazine describing mosquito control in the Des Plaines Valley Mosquito Abatement District. This machinery is also used for routine application of mosquito larvicides.

The four-wheel-drive units used by the military forces of the Jeep type may be converted into marsh buggies by turning the disk wheels outward in order to provide body clearance for the large 1350 x 24 tires.

Military units are equipped with decontaminators which may serve as sprayers of mosquito larvicide and mosquito repellent. A camp site could be cleared of mosquitoes within one hour. This protection will last for 24 hours at least. However large wheel marsh buggies are needed for marsh spraying.

THIS TREND OF THOUGHT WOULD LEAD TO THE CONCLUSION THAT IF A DISEASE CAN BE PREVENTED BY THE USE OF MECHANICAL EQUIPMENT BETTER THAN IT CAN BE CONTROLLED BY DRUGS THERE SHOULD BE NO HESITATION UPON THE PART OF ANY DE-

PARTMENT, CIVIL OR MILITARY, TO GRANT APPROPRIATIONS FOR THE PURCHASE OF MECHANICAL EQUIPMENT.

IN A CIVILIAN POPULATION OF 100,000 MOSQUITOES CAN BE CONTROLLED FOR 25c PER CAPITA PER YEAR; IN A MILITARY AREA THE COST SHOULD BE LESS. HUMAN LIFE CAN NOT BE MEASURED IN DOLLARS AND CENTS ESPECIALLY WHERE IT INVOLVES THE NATION'S MOST PRECIOUS POSSESSION, THE YOUTH OF OUR COUNTRY.

ANILINE DYE DUSTS

In far flung projects in the tropics where new species of mosquitoes are encountered, or species of which the habits are little known, aniline dye dusts may be used to study flight range, longevity and other habits.

At present the Des Plaines Valley Mosquito Abatement District is carrying on a series of staining experiments to determine the day-to-day movements of mosquitoes in a limited area, following the initial long flight immediately after emergence of a brood at a marsh, takes place.

This method of staining is described in the Proceedings of the New Jersey Mosquito Extermination Association, 1937, under "New and Significant Experiences in Mosquito Control in the Des Plaines Valley Mosquito Abatement District," also in the 1943 Proceedings of the New Jersey Mosquito Extermination Association entitled "Flight Range and Longevity of Mosquitoes Dusted with Aniline Dye."

CRUDE OIL USED FOR MOSQUITO CONTROL

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Crude oil is being used successfully for the control of mosquitoes at the U. S. Naval Air Training Center, near Corpus Christi, Texas.

According to Ginsburg and Rudolfs (1941)*, the ideal mosquito oil should contain enough of a low boiling petroleum fraction to insure quick penetration into the tracheal system and rapid kill of larvae and pupae; and a sufficient quantity of a high-boiling fraction to leave a lasting film.

Tests were made on this oil and the results as compared with the "ideal oil" as recommended by Ginsburg and Rudolfs are as follows:

	Ideal Oil	Crude oil used by U. S. N. A. T. C.
Type	Distillate fuel	Crude - distillate
Gravity (A.P.I.) 60° F.	27 - 33.....	42.5
Flash	130° F. or higher	100° F.
Viscosity at 100° F.	35 - 40.....	34
Odor	none offensive.....	same
Distillation	90% at 630°	590° F.
	10% at 430° - 450° F. ..	444° F.
	50% at 510° - 550° F. ..	497° F.

This crude oil is obtained from an oil company adjacent to the Naval air Station and offers the solution to our mosquito oil problem. The oil is highly toxic to the larvae and pupae, spreads rapidly and has a lasting film on either the fresh or saline water that is present.

For the distribution of this oil, a decontamination unit, that was not being used by the Chemical Warfare Department, was adapted for mosquito control. The unit consists of a solution tank, pump, and motor. The tank is constructed of wood with steel rims. It has a five hundred gallon capacity. The three cylinder pump operates under a recommended pressure of 400 pounds