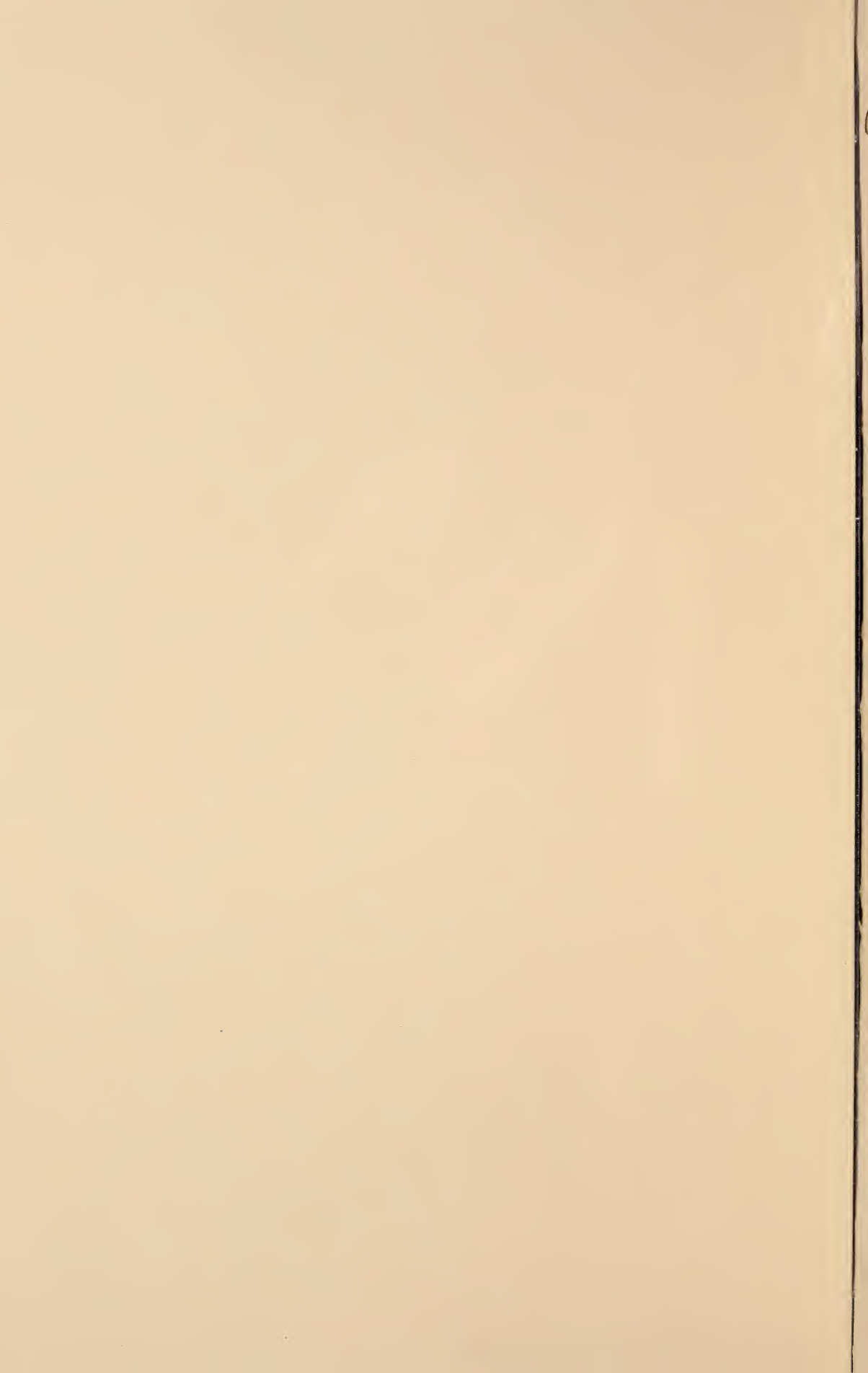


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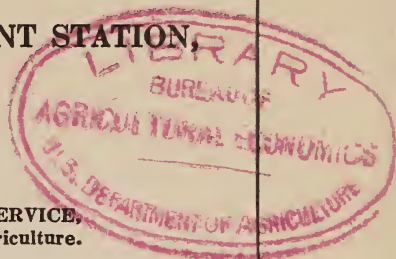


EX
PORTO RICO AGRICULTURAL EXPERIMENT STATION,

D. W. MAY, Agronomist in Charge,
Mayaguez, P. R.

CIRCULAR No. 20.

Under the supervision of the STATES RELATIONS SERVICE,
Office of Experiment Stations, U. S. Department of Agriculture.



MOSQUITO SURVEY OF MAYAGUEZ

BY

W. V. TOWER, Entomologist.



Issued November 2, 1921



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[Under the supervision of A. C. TRUE, Director, States Relations Service, United States Department of Agriculture.]

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MOSQUITO SURVEY OF MAYAGUEZ.

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INTRODUCTION.

Statistics show that many of the deaths which yearly occur in Mayaguez are directly traceable to mosquitoes. Those of the genus *Anopheles* are responsible for malaria, and others carry yellow fever, dengue fever, and filaria (elephantiasis). In view of these facts a survey of the town was made to determine where these species of mosquitoes breed and how they can best be eliminated.

Mosquitoes are among the worst enemies of the human race. In all newly settled countries where progress has been made, the land has been won from the wild, in many instances, only after mosquitoes have been either exterminated or brought under control. After they have been brought under control they can be kept there by constant vigilance and untiring efforts. Such efforts are amply repaid by vastly reduced mortality rates.

DISEASES AND HOW THEY ARE CARRIED BY MOSQUITOES.

Many dangerous diseases are carried by mosquitoes, but the two that are most common are malaria and yellow fever. These diseases can be transmitted only by the bite of a mosquito, which acts as the intermediate host of a parasite. After developing in the mosquito this parasite is transmitted to man. These diseases have caused great loss to man and to commerce. During the last century yellow fever was intermittent in the southern States and in the West Indies, but since the wonderful work on transmission and prevention of the disease done in Cuba during the American occupation it has been practically eliminated.

Porto Rico has been free from yellow fever for more than twenty years. Twenty-five years ago there were as many as 1,000 cases of

yellow fever in San Juan alone. Although the yellow-fever mosquito is a very common species in Porto Rico, there is no yellow fever. This is due to the effective work of the quarantine service, which is now universally maintained and which has succeeded in exterminating the parasite of yellow fever in the island. Dr. Juan Guiteras, of Cuba, states¹ that "in those places where there is no immigration in large masses the yellow-fever parasite is actually dying a natural death, a spontaneous death, through the natural isolation of the sick."

The great work done in Cuba by members of the Medical Board of the United States Army should serve as an impressive object lesson to mankind. Several persons lost their lives in this heroic work. Others, to prove that the disease can not be conveyed by infected clothing, which was the belief at that time, slept in beds in which patients had just succumbed to yellow fever. It is stated that² "in Havana during the year 1900-1901, when the sanitary authorities were putting forth every effort known at that time to sanitary science in order to control the march of the disease, the yellow-fever cases numbered 1,240 and the deaths 305. In the following year, 1901-1902, when yellow fever was fought on the theory that the specific agent of this disease is transmitted solely by means of the bites of infected mosquitoes, there were 61 cases and 6 deaths."

Malaria is still causing serious losses. Every year takes its toll of life through this disease both in the States and in the Tropics. Malaria is accompanied by sickness and continued general debility and in many cases it is followed by death. Medical and hospital services are frequently maintained by the plantation owners for the use of their employees, many of whom become so weakened from malaria that they have to depend on the employers for maintenance. These services are usually free to employees and do so much good that their great expense is considered worth while.

Malaria and yellow fever are held in abeyance by proper sanitary measures, for example, by good drainage, protection of stored water from mosquitoes, and by oiling all standing water that can not be drained off. Yellow fever is further held in check by quarantine measures and by protecting infected people from the bite of mosquitoes.

Malaria is worse in some sections of the island than in other parts, there being more on the south coast, especially where there are large areas of coastal swamps and where sugar cane is grown under irrigation, than elsewhere. Malaria caused 1,528 deaths in Porto Rico in 1918 and 1,576 deaths in 1919.

¹ Quoted in Rpt. Gov. Porto Rico (1919), p. 141.

² Porto Rico Sta. Circ. 14 (1912), pp. 6 and 7.



FIG. 1.—TUBS FILLED WITH WATER TO KEEP THEM FROM FALLING TO PIECES. BREEDING PLACES OF COMMON HOUSE AND YELLOW-FEVER MOSQUITOES.



FIG. 2.—POOL FROM A LEAKY FAUCET. BREEDING PLACE OF COMMON HOUSE MOSQUITO.



FIG. 2.—CONTAINERS LEFT ABOUT A PUBLIC FAUCET. BREEDING PLACES OF YELLOW-FEVER MOSQUITOES.



FIG. 1.—OPEN DITCH IN THICKLY POPULATED SECTION OF MAYAGUEZ. BREEDING PLACE OF MALARIAL AND COMMON HOUSE MOSQUITOES.

DIFFERENT SPECIES OF MOSQUITOES AND THEIR BREEDING PLACES IN AND AROUND MAYAGUEZ.

Several kinds of mosquitoes are found in and around Mayaguez. Eight species were obtained during this survey. However, the three which are very common are usually distinguished by their most striking characteristics. These species are the common house mosquito, the yellow-fever mosquito, and the malarial mosquito.

THE COMMON HOUSE MOSQUITO OF THE TROPICS (*Culex quinquefasciatus*).

The predominating characteristics of this mosquito are its color markings. In general color it is brown. Its wings are transparent, and the scales on the wings are dark brown, while those located on the front margin of the wings have a bluish luster. The thigh is clothed above with black scales which have a bluish and bronzy luster. The knees and tips of the foreleg and ankles are black scaled with a pale, brassy luster beneath.

The larvæ of the common house mosquito are more compact and thickset than the larvæ of the yellow-fever mosquito, which are shaped like a thin silver cord. The former are not as active as the latter when frightened and do not try to get away from the light; neither do they cluster when they are disturbed. When at rest they hang head downward from the surface of the water.

The common house mosquito breeds wherever there is standing water (Pl. I). It is generally found in open containers and not in protected barrels and cisterns, as is the yellow-fever mosquito, though it is frequently found with it. This mosquito has been found in the water in fire pails, in pans used to collect water under ice chests, in tins filled with water and placed under the legs of food containers to prevent ants from reaching the food, in flower vases, in coconut shells, and in catch basins in patios. It will lay its eggs wherever it can find water.

THE YELLOW-FEVER MOSQUITO (*Aedes (Stegomyia) ægypti*).

The predominating characteristics of this mosquito are its color markings. It is black, with very striking silver markings. The silver markings on the head and thorax form a lyre. The abdomen is marked with silver stripes. The legs are long and slender and are marked with silver bands. The wings along the veins are clothed with very fine scales.

The yellow-fever mosquito larvæ are always found in clear water, in covered rain-water barrels and cisterns, and in places where there is no direct sunlight (Pl. II, fig. 2). When the cover is removed from such containers the larvæ become frightened and immediately start for the bottom. To accomplish this they whip their bodies back

and forth in the form of the figure eight. The larvæ are very active and try to avoid the light. When at the bottom of a container they cluster in a compact mass and remain quiet for some time; to get air, however, they gradually float to the surface, occasionally whipping their way up. When at rest they hang from the surface of the water with their heads down. A stream of water constantly passes through the mouth parts of the larvæ, and from the water they take small particles of food. The mouth parts of the larvæ are constantly in motion.

The mere tipping over of barrels and other containers does not always remove all of the larvæ, many of which remain in the water, adhering to the sides and bottom of the container, especially when the material has a rough surface. Mosquitoes will often develop and live under such moist conditions. Barrels and water containers should, therefore, be thoroughly cleaned at least once a week. They should be scrubbed with a brush, or with a piece of coconut husk. Containers of water, though constantly used, very frequently breed mosquitoes, the presence of the larvæ not being suspected because they wriggle to the bottom as soon as the water is disturbed.

The adult yellow-fever mosquito is a day flier and seeks dark places during the day to rest. It is generally found in dark corners and in dark places under desks and tables. It is also found in rain-water barrels, tanks, and covered cisterns. During the rainy season the common house mosquito (*Culex*) has been found associated with the yellow-fever mosquito. Often the three common species of mosquitoes have been taken from the same container or pool.

THE MALARIAL MOSQUITO OF PORTO RICO (*Anopheles albimanus*).

This mosquito is a night flier, and has been found in a number of places around Mayaguez. The resting position of *Anopheles* is its predominant characteristic. The four anterior legs cling to the object on which it rests, while the hind legs are suspended in air and the body is pitched at nearly right angles to the resting place. The head and body are thrust between the first and second pair of legs.

Two species of *Anopheles* have been found on this island: *A. albimanus* and *A. grabhamii*. Both of these are grayish brown and have wings that are transparent, with very few scales. *A. albimanus* is a little darker in color than *A. grabhamii*. The legs of the latter are very long, while those of the former are short. The last ankle segment is white and there is a black band next to the claw.

The larvæ of the malarial mosquito when at rest float in the water, with the head and body parallel to the surface. They feed in this position, keeping their mouth parts continually moving; and, if one observes rather closely he can see the water moving toward and away from the mouth in a well-defined stream or current.



FIG. 2.—SHALLOW DEPRESSION IN REAR OF BUILDINGS. BREEDING PLACE OF NUMBERS OF MALARIAL MOSQUITOES.

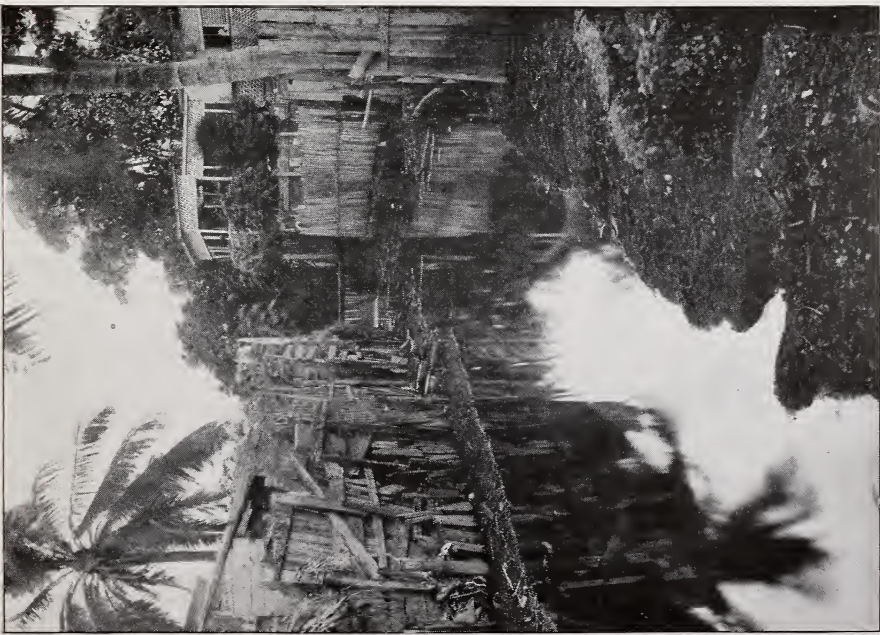


FIG. 1.—STAGNANT STREAM NEAR SEASHORE. BREEDING PLACE OF MALARIAL AND COMMON HOUSE MOSQUITOES.



FIG. 2.—POORLY MADE STREET DRAINS CHOKED WITH RUBBISH, BREEDING PLACE OF MOSQUITOES.



FIG. 1.—SWAMPY LAND NEAR THE SEA, BREEDING PLACE OF MALARIAL MOSQUITO.

The malarial mosquito has been found in rain-water barrels, in cattle troughs, in ditches, in cane fields, on overflowed pastures, in streams bordered with grass, and in irrigation and drainage ditches (Pls. III and IV). The main source of infection, however, is the rain-water barrel which is seen in and about town. The houses in the outlying districts of town have no running water in them, and, as a result, the people have to depend on public faucets, which are often far apart. Water is carried from these faucets to the homes, and not infrequently rain-water barrels are filled in this way. During the wet season barrels are used to catch the rain as it falls from the roof, and often from three to six barrels can be found under the eaves of one house. During the dry season a little water is kept in these barrels so that they will not fall to pieces. Such receptacles are, naturally, excellent breeding places for mosquitoes, and one or two species usually can be found in them.

Very few of the old Spanish type of cistern can now be found in Mayaguez, which has had a water system since 1866. Where these cisterns are still in use they should be covered with large planks, over which is placed cement. The conductors should be fitted with wire screens so that the adult mosquitoes can not enter them. Poorly covered cisterns are comparatively dark and very often are the breeding places of the yellow-fever mosquito. In the city proper most of the houses are supplied with running water, and for this reason there are in use comparatively few rain-water barrels and small containers for the storage of water. Occasionally, however, one finds a small cistern in use for the storage of drinking water.

It can be safely stated that during the dry season the city of Mayaguez, in the outlying parts, breeds its mosquitoes in rain-water barrels and other containers. Now and then one finds a tin can or tub in which mosquitoes are breeding, but these are among the least important of the breeding places. If the small water-storage systems could be eliminated, the city would be much freer from mosquitoes than it now is. However, since the people have to carry water long distances, it is only natural that they store as much rain water as possible.

In Mayaguez there are more mosquitoes during the rainy than during the dry season, with the exception of the period of northers which may occur in the dry season. Mosquitoes then become abundant. It is thought that either the winds bring the mosquitoes or that they fly into town against the wind from the swamps, which are located southwest of it. No extensive breeding places have been found north of Mayaguez. The country there is rolling and is drained by small streams.

It would be well if there were followed a systematic practice of oiling all low places where water collects, because in such places

hundreds of mosquitoes breed. These places are found in the town as well as on the outskirts, and especially where pasture lands border the towns. Cattle traveling over wet lands leave footprints, which fill with water during the rainy season and form ideal breeding places for mosquitoes. Comparatively few *Culex* are found during the dry season, and the predominating species is the yellow-fever mosquito.

MOSQUITO BREEDING PLACES AROUND MAYAGUEZ IN JANUARY AND FEBRUARY, 1920.

The following table shows the species of mosquitoes and the places where they were found in and around Mayaguez :

Species of mosquitoes and where found.

Common name.	Scientific name.	Number of species found.	Number and kind of places where found.					
			Barrels.	Tins.	Stand- ing water.	Ditches.	Tanks.	Total.
Malarial mosquito.	<i>Anopheles albimanus</i> .	<i>Per cent.</i> 6.55	1	1	.....	2	.....	4
Yellow-fever mosquito.	<i>Aedes</i> (<i>Stegomyia</i>) <i>ægypti</i> . ¹	65.57	35	2	.....	2	1	40
Common house mosquito.	<i>Culex quinquefasciatus</i> .	24.59	11	.....	1	3	.....	15
	Other species (undetermined).	3.29	1	.....	.....	1	.....	2
Total.....	.....	100.00	48	3	1	8	1	61

¹Insector Inscitiæ Menstruus, 8 (1920), Nos. 10-12, p. 181.

The yellow-fever mosquito is a day flyer, though it does not fly any great distance. It is not very troublesome and is easily traced to its breeding place. *Culex* is the most abundant night-flying mosquito and is the most troublesome of the three species under discussion. It is found everywhere and seems to be a strong flyer. The malarial mosquito is not so common as are the other species, as is shown by the foregoing table, but it has been found in a number of places. The swamp southwest of Mayaguez is probably an ideal breeding place for this species. *Anopheles* and one species of *Culex* have recently been taken from this swamp.

The *Anopheles* mosquito has breeding places at Guanajibo, Boca Morena, Peña Cortada, Vista Alegre, Punta Brava, Quintita, Rabo Ratón, Terrenos de Cristy, fin de la Alameda de los Mangoes, Terrenos de la Viuda de Perea, Barrio Buena Vista, Neuvo Londres, Estación Agronómica, and Barrio París.

From July, 1919, to March, 1920, 34 deaths from malaria were recorded for the Mayaguez district.

HOW TO FREE A COMMUNITY FROM MOSQUITOES.

Before a successful mosquito campaign can be conducted public interest must be aroused and cooperation secured. While the work done by inspectors accomplishes a great deal of good, much more can be accomplished when the public is sufficiently interested to cooperate in eradicating the mosquito. When public sympathy is lacking, the inspectors can not make the progress that is desirable. A vast amount of good can be done by cleaning up the various dumps where are deposited tin cans, old bottles, coconut husks, and other containers which hold water; by screening all cisterns and water barrels; by oiling every pool of standing water; and by draining water from and filling in the low places. This is, however, just the beginning. The real work commences with the weekly inspection, because by this time the public is likely to have lost some of its interest and is ready to relax and weaken in its good resolutions. This is, then, the critical time, and unless the inspectors are constantly on the watch for new mosquito breeding places it will be only a short time until conditions are as they were before the work was undertaken. After the general clean-up ceaseless and untiring efforts are necessary to prevent a return to old conditions, but the small work required is worth while when it results in ridding the Tropics of its most serious pest.

HOW TO FREE MAYAGUEZ FROM MOSQUITOES.

Mayaguez is located in a valley at the foot of the range of mountains which crosses Porto Rico from east to west, and on the shore of the Mona passage joining the Atlantic Ocean and the Caribbean Sea. The Yaguez River bisects the town and has a constant flow of enough velocity to afford excellent drainage. All surface water in the city proper can be readily run into the river. There are two sections near Mayaguez which are somewhat difficult to drain, the swamp lying south of the river along the sea, and the smaller swamp lying north of the river along the sea. Several creeks flow through these swamps, going on into the sea during low tide and after heavy rainfall. During high tide and at times of low rainfall the mouths of the creeks are silted up with sand. These swamps breed mosquitoes, but could be so handled that the insects would be exterminated. The swamps could be drained without any great expense into the creeks, which in turn could be kept open to the sea by drains with mouths far enough out from shore to avoid silting up.

The top minnow has been found in the small streams. These are mosquito-eating fish, and doubtless keep the streams cleaned to a large extent of mosquitoes. The main attention, however, should be focused on the drainage of these areas, which would be a feat requir-

ing no great amount of engineering ability. The swamps are not wholly submerged. Water stands on them only because of lack of proper surface drainage. After they have been properly drained rigorous care should be exercised to see that the landowners, who grow cane and coconuts there, keep their drains open.

Most of the mosquitoes in and about Mayaguez are bred in containers which are kept about the dwellings for the storage of water. Rain-water barrels constitute the greatest single source for breeding mosquitoes. The greatest number of barrels, tin cans, and cisterns are found in the poorer quarters of the town. They are used for the storage of water, but could well be eliminated if more public faucets were built, or there were enforced the now existing anti-mosquito laws, which provide that all containers of storage water be made mosquito proof. A competent force of inspectors could be employed to carry out these enactments. Mayaguez should be inspected at least once a week by two or three active men, who at the same time could do a great amount of educational work.

The town should be divided into two or three districts and each inspector assigned a certain fixed district which he would have to cover weekly. Each breeding place found during the week should be listed, and the inspectors should explain to the tenants why the rain-water barrels, tin cans, and other containers of water must be kept covered. The anti-mosquito regulations should be enforced when the instructions are not carried out within a reasonable time.

In certain parts of the town there are a number of open ditches and drains which should be tiled, drained, or cemented, or, if this is not possible, they should be oiled weekly or oiled automatically. Automatic oilers can be regulated so that they will distribute sufficient oil to establish a film on the surface. All dumps where garbage is deposited should be gone over carefully once a week, and the tin cans which accumulate should be flattened so that they can not hold water. During the very wet season many hollow places fill with water which becomes stagnant. These places should be drained or systematically oiled. Such pools are not permanent breeding places; nevertheless, it should be remembered that the much-dreaded malarial mosquito breeds in standing water in fields, drains, open ditches, and swamps.

