With the northward movement of yellow fever, the Public Health Service is intensifying its program for control of Aedes aegypti, particularly in international traffic zones of the yellow fever receptive area of the United States.

Measures Against Yellow Fever Entry Into the United States

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THE SURGEON GENERAL of the Public Health Service is authorized by the Public Health Service Act to make and enforce regulations for preventing the introduction of diseases of man into the United States and their spread in this country. The Division of Foreign Quarantine has the responsibility for preventing the importation of disease. This responsibility requires enforcement of quarantine regulations applicable to all traffic arriving by air, sea, or land.

Although there are other important diseases affecting man, the Public Health Service foreign quarantine regulations place particular emphasis on smallpox, cholera, plague, louseborne relapsing fever, louseborne typhus, and yellow fever. These diseases are recognized by the World Health Organization and by the health departments of many countries as the six quarantinable diseases. Five of them involve insects in their transmission and therefore are of particular interest to entomologists.

There are a number of entomological problems in quarantine operations, but at this time particular consideration will be given to the detection and control of *Aedes aegypti* Linn. at airports, in dock areas of seaports, and at land-entry points. *A. aegypti* has played an important role in the transmission of yellow fever in many countries around the world, and it is the only widely distributed mosquito in the United States that is known to be a natural transmitter of the yellow fever virus.

However, *Haemagogus equinus*, a species of mosquito found naturally infected with yellow fever in Guatemala (*1*), occurs near Brownsville, Tex., in limited numbers. This forest-type mosquito was collected in the Brownsville area in 1955 by Trapido and Galindo (*2*), who found it in tree holes of thorn scrub; in 1957, by Eads and Strom (*3*), who found it in water in tree holes of Texas ebony, *Pithecolobium flexicaule;* and by Strom (unpublished record). Breland reported *H. equinus* from cavities in the Texas ebony and from a hackberry tree (*4*). This interesting addition to the mosquito fauna of the United States has a range extending southward from the Brownsville area to Colombia, South America, and is the only representative of the genus *Haemagogus* reported in the United States.

Historical Note

Historically, yellow fever in its urban form has occurred on numerous occasions in epidemic

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proportions in the United States. The last epidemic in this country occurred during the period July to December 1905, with 8,399 cases and 908 deaths (*5*).

Twenty-six cases of yellow fever, exclusive of laboratory cases such as those reported by Berry and Kitchen for the period 1929–31 (*6*), have been reported in the United States since the 1905 epidemic. Twenty-three of these were intercepted on ships in international traffic which arrived at Public Health Service quarantine stations. These cases are reported in the annual reports of the Public Health Service as follows:

Fiscal year	*Cases*	*Deaths*
1907	6	1
1908	3	3
1911	1	0
1912	1	0
1913	1	0
1917	2	0
1922	5	0
1923	[1] 3	0
1924	[1] 1	0

[1] Suspected.

In addition, one case of unknown origin occurred in New Iberia, La., in August 1906; another occurred in Honolulu during October 1911 in a quarantine station employee who was detailed as a guard on a vessel on which a case of yellow fever was present; and an immigrant from Mexico was reported to have died of yellow fever in Houston, Tex., October 8, 1924 (*7*).

Northward Movement

One of the current problems facing the Public Health Service and other health agencies and involving entomology and related disciplines is the northward movement of yellow fever in the Americas. This disease was reported in both its urban and sylvan forms in Trinidad, B. W. I., in 1954 (*8*, *9*) and in its sylvan form in various countries of Central America following its appearance in the Pacora area of eastern Panama in 1948. Human cases of sylvan yellow fever occurred in Panama during the period 1948 to 1952, in Costa Rica in 1951 and 1952, in Nicaragua in 1952, 1953, and 1954, and in Honduras in 1954 (*10*). According to the Weekly Epidemiological Reports of the Pan American Sanitary Bureau, in Panama the disease was again detected in man in 1956 and 1957, and human cases were reported in Guatemala in 1957. Also, as reported in the Weekly Epidemiological Reports, sylvan yellow fever occurred in the simian population in the forested areas of the countries enumerated, and in 1957 the disease in monkeys was found in British Honduras.

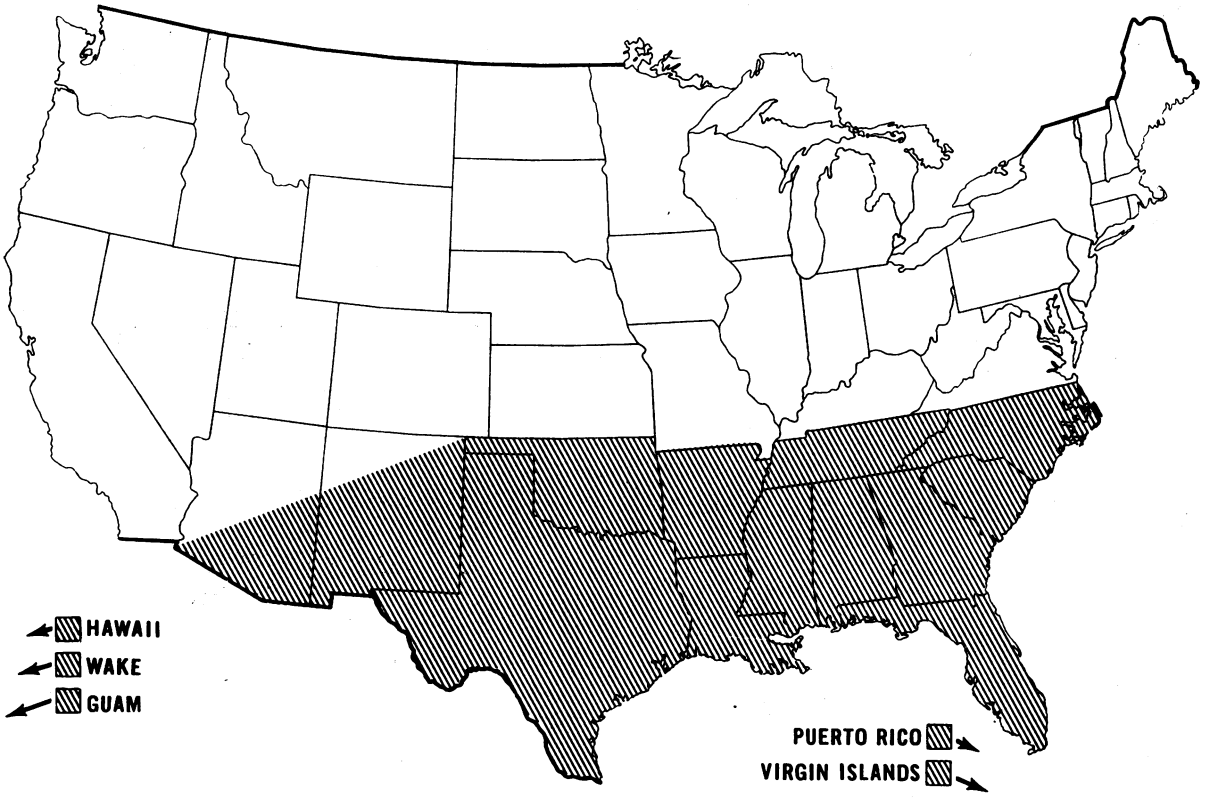
The yellow fever virus was isolated from naturally infected *Haemagogus mesodentatus* K. and K., *Haemagogus equinus* Theob., and *Sabethes chloropterus* Humboldt collected in Guatemala in 1956 (*1*), and from *Haemagogus lucifer* (H. D. and K.) collected in Panama in 1957 (*11*), thus adding substantially to the list of known and potential transmitters of the yellow fever virus in nature. Sylvan yellow fever, as reported in the Weekly Epidemiological Reports, has occurred in all countries of Central America except El Salvador. Thus, only Mexico separates the continental United States from the Central American countries where yellow fever is known to occur.

Receptive Areas

Under the terms of the World Health Organization International Sanitary Regulations now in force (*12*), areas in which the virus of yellow fever does not occur, but in which *A. aegypti* or any other domiciliary or peridomiciliary vector of yellow fever is to be found under conditions that would permit development of the virus in the event of its introduction, are considered receptive to this disease and must be so declared. Thus, the area of the United States, including insular Territories and possessions, where *A. aegypti* occurs constitutes our yellow fever receptive area. Although yellow fever does not occur in this area, it might conceivably be introduced and become established, at least temporarily.

The yellow fever receptive area of the United States, as delineated by the Public Health Service and reported to the World Health Organization in 1953, in accord with article 70 of the International Sanitary Regulations, comprises 13 southern States. Puerto Rico and the Virgin Islands in the Caribbean area, and Hawaii and Wake Island in the Pacific area. Also, Guam has been added to this list, as reported in the Weekly Epidemiological Record of the World Health Organization, January 1958. In the

Yellow fever receptive area in the United States.



yellow fever receptive area (see map) the incidence of *A. aegypti* is considered sufficiently high to support yellow fever transmission, particularly during the warm months of the year. The delineated area will be modified as may be necessary to reflect changes in the distribution pattern of the mosquito.

Preventing Entry Into the U. S.

The United States has a human population which presumably is not immune to yellow fever; it has a widespread distribution of a mosquito vector of the disease; and it has a history of outbreaks of the disease. Also, the disease is present in areas comparatively close to our possessions in the Caribbean area and to our southern ports and land-entry points. Furthermore, modern rapid transportation makes it possible for persons in the incubation stage of the disease and infected mosquitoes, monkeys, or other animals to bring in the yellow fever virus from countries where it now occurs.

Although the last outbreak of yellow fever in this country occurred more than half a century ago, and no cases of the disease have been reported on ships or other conveyances arriving at United States ports for more than 30 years, we cannot be assured of its continued absence from this country.

Activities directed toward preventing the introduction of yellow fever into the United States are being carried on at various ports of entry as a part of a broad quarantine program. These include:

- Requirement of a valid yellow fever vaccination certificate of any traveler from a yellow fever area who arrives in or is destined for the yellow fever receptive area within the incubation period of the disease.
- Medical examination of persons arriving from yellow fever areas and, if necessary, their surveillance or isolation.
- Inspection of monkeys and certain other primates coming from yellow fever areas, and requirement of immunization against the disease or retention in a mosquito-proof crate or

other structure for a minimum of 9 days immediately before arrival in the yellow fever receptive area.

• Disinsectization of aircraft and ships and the entomological surveillance of airports and dock areas (*13*).

Aedes aegypti Control Programs

For many years the control of *A. aegypti* and other mosquitoes has been an important part of the disease control program of the Public Health Service. During the latter years of yellow fever occurrence in this country, various sanitary measures, including mosquito control, often were employed on ships arriving at United States ports (*14*). With the advent of international aerial traffic, disinsectization measures were incorporated into the quarantine clearance requirements, particularly for aircraft arriving from foreign countries where yellow fever was prevalent. Supplemental to the disinsectization measures applied to aircraft and to some ships, an entomological surveillance and control program was put into operation and maintained at airports (*15*) and in dock areas having a southerly location and where international traffic is most active.

Prior to and during World War II the Public Health Service made other efforts to reduce the population of this mosquito in some of the major airport and seaport areas in the south. In the late 1930's the Division of Foreign Quarantine cooperated with certain counties in southern Florida in conducting mosquito abatement programs to reduce the *A. aegypti* population, particularly in areas of heavy international traffic. With the outbreak of hostilities the Service expanded these activities and, in collaboration with State health agencies, conducted a more extensive campaign in ports of entry in the south. These programs were directed toward reduction in the number of *A. aegypti*, as a means of protection against the introduction and establishment of yellow fever (*16*), and toward the training of available personnel, who could be called upon to assist in any part of the country, should yellow fever (or dengue) be introduced. Although the Public Health Service *A. aegypti* control program was discontinued after the close of World War II, other, more limited programs have been conducted by local health departments.

In July 1957 the Public Health Service appropriation provided limited funds for the Division of Foreign Quarantine and the Communicable Disease Center to collaborate in investigations of *A. aegypti* control in the United States, including an evaluation of the threat of yellow fever in this country. These investigations should enable the United States to comply more fully with the terms of article 20 of the World Health Organization International Sanitary Regulations (*12*), which state, "Every port and the area within the perimeter of every airport shall be kept free from *Aedes aegypti* in its larval and adult stages."

The Division of Foreign Quarantine's portion of this broader and more comprehensive program consists of the establishment of entomological units at Miami, Fla., Brownsville, Tex., and New Orleans, La. These units will survey their respective base stations, and other areas as directed, to determine the presence and abundance of the yellow fever mosquito on various types of conveyances and at airports, dock areas of seaports, and border-crossing points in the yellow fever receptive area. Control measures and cleanup campaigns will be carried on in conjunction with the surveys. It is expected that some investigations and observations will be made with respect to possible insecticide resistance, survey and control techniques, biology and behavior of *A. aegypti*, and other aspects of prevention of importation of yellow fever.

The Communicable Disease Center will make surveys and otherwise obtain information to determine the distribution and abundance of the urban vector of yellow fever throughout the yellow fever receptive area and will carry on a project in a coastal city to ascertain costs and methods involved in eradication of *A. aegypti* in a specific urban area and the applicability of similar programs in other urban communities in the receptive area. As resources permit, CDC will make other field and laboratory investigations apropos of an *A. aegypti* and yellow fever control program.

The most active phase of the *A. aegypti* control program carried out by Division of Foreign Quarantine workers has been confined largely to the more important international traffic areas

of Florida and Texas. During the period July 1957–June 1958, the Miami entomological unit made *A. aegypti* surveys in airports and dock areas in more than 25 localities in Florida, including Fort Pierce, Jacksonville, Miami, Pensacola, St. Petersburg, Tampa, and West Palm Beach. *A. aegypti* breeding was observed in 6 of the Florida airports inspected, with indexes as high as 4.0 percent. Breeding was also detected in 10 of the Florida docks inspected, with indexes as high as 9.0 percent. Outside Florida, similar surveys made during the spring of 1958 in a number of airports and dock areas along the Atlantic coast as far north as North Carolina revealed sparse breeding in one dock area in late June.

Most of the *A. aegypti* breeding was localized in overhaul and salvage areas of the airports inspected and was not observed in the active traffic areas. Comparable conditions existed in the dock areas. Control measures included application of DDT spray and, when feasible, removal or destruction of containers or making them unsuitable for supporting *A. aegypti* breeding. Port authorities and health officials in the area surveyed were apprised of the control problem and of results obtained in the surveys.

One finding of particular interest made by the Miami entomological unit was extensive *A. aegypti* breeding at the Key West, Fla., main city dock in water contained in old tires. This observation, made November 13, 1957, is particularly significant in view of the fact that this mosquito had not been reported on Key West since November 1948 (J. A. Mulrennan in personal communication, 1958). Although it is not known when or actually how *A. aegypti* returned to that island, continuous entomological surveillance is obviously necessary if costly and potentially dangerous health problems of this type are to be prevented.

During the early months of the program it has been possible to give only limited attention to the airport and dock areas in New Orleans with reference to *A. aegypti* breeding. However, no evidence of this mosquito has been found in the surveys. The program in this locality is being accelerated.

Negative results also were obtained in searches for *A. aegypti* at airports and in dock areas of several port cities in Texas, including Brownsville, Houston, Galveston, and Corpus Christi, during the year ending June 30, 1958. Numerous potential *A. aegypti* breeding places were inspected and treated.

Outside the continental United States, emphasis is being placed on extension of the control program to international traffic areas in Hawaii, where the mosquito is present, although apparently in diminishing numbers, and in Puerto Rico and the Virgin Islands.

The current intensification of *A. aegypti* control activities by the Public Health Service should provide exact knowledge on which to base plans, not only for eradication of *A. aegypti* from the United States, but for a continuing quarantine program to prevent reintroduction of either the virus or the vector.

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New PASB Appointments

Dr. Abraham Horwitz of Chile has been elected director of the Pan American Sanitary Bureau, regional office of the World Health Organization, succeeding Dr. Fred L. Soper, who will end his third term January 31, 1958.

The vote was taken October 1, 1958, in San Juan, Puerto Rico, at the Pan American Sanitary Conference, which is also the regional meeting for WHO members in this hemisphere. Dr. Horwitz's name will be presented to the WHO Executive Board in January 1959 for appointment.

The director-elect, who is on leave from his post as director of the School of Public Health of the University of Chile, is currently serving as assistant director of that country's National Health Service. He has been PASB consultant in training and education to various countries in the Americas. From 1952 to 1953 he was chief of the professional education branch at the regional office headquarters.

Dr. Horwitz received his doctorate of medicine from the University of Chile in 1936 and a master's degree in public health from Johns Hopkins University.

Harold R. Shipman has been appointed chief of the Pan American Sanitary Bureau's Branch of Environmental Sanitation.

Since he joined the World Health Organization's staff in 1952, Mr. Shipman has served in Turkey, Egypt, Austria, and the Americas. Previously, he was a sanitary engineer with the Minnesota Department of Health, the Farm Security Administration of the U. S. Department of Agriculture, and the American Red Cross in Korea.

Mr. Shipman holds a bachelor of science degree in chemical engineering and bacteriology and a master of science degree in sanitary engineering from the University of Minnesota. He is the author of various publications on sanitary engineering and is considered an authority on water supply and sewage disposal.