I. Arboviruses that have no apparent cytopathic effect in the mosquito. Am. J. Trop. Med. Hyg. 17:625–636.
Mussgay, M. and Suarez, O. 1962. Studies with a pathogenic and an attenuated strain of Venezuelan equine encephalitis virus and *Aedes aegypti* (L.) mosquitoes. Arch. Ges. Virusforsch 12:387–392.
Reed, L. J. and Meunch, H. 1938. A simple method of estimating fifty per cent end points. Amer. J. Hyg. 27:493–497.
Rozeboom, L. E. and Kassira, E. N. 1969. Dual infections of mosquitoes with strains of West Nile virus. J. Med. Ent. 6:407–411.
Schaffer, P. A. and Scherer, W. F. 1971. Stability of virulence and plaque size of Venezuelan encephalitis virus with passage in mosquitoes (*Aedes aegypti*). Amer. J. Epidem. 93:68–74.

SEASONAL ABUNDANCE OF ADULT *AEDES AEGYPTI* IN DJAKARTA, INDONESIA [1]

P. F. D. VAN PEENEN,[2] SOEROTO ATMOSOEDJONO,[2]
J. C. LIEN [3] AND SULIANTI SAROSO, J.[4]

ABSTRACT. Adult *Aedes aegypti* mosquitoes were collected systematically from houses in four areas of Djakarta, Indonesia during 1970–71. This species was easily collected from different parts of the city during all months of the year. There was considerable variation in monthly abundance of adult female *Aedes aegypti* from area to area, but there was no clearcut seasonal pattern, despite a distinct rainy season.

INTRODUCTION. Seasonal dengue outbreaks occur in Djakarta, Indonesia, often causing dengue hemorrhagic fever (DHF) in children (Kho *et al*, 1969). *Aedes aegypti* mosquitoes are presumed to be dengue vectors here, as they are elsewhere in Southeast Asia (Halsted, 1966; Russell *et al*, 1969). Studies of the distribution and seasonal abundance of this mosquito in Djakarta were therefore undertaken in 1970–71 with results noted herein.

METHODS. Preliminary surveys, and data from other entomological studies at this Detachment showed, as expected, that *Aedes* adults were active only during daylight, and were rarely collected out-of-doors. In addition, a peak of biting activity consistently occurred between 0900 and 1200.

Collections of *Aedes* were therefore planned in the mornings: a team of three men was trained to collect mosquitoes, and four areas considered representative of geographic and socio-economic sectors of the city were chosen. Each area was visited on the same day once weekly. The three men collected independently for 10 minutes in six different houses using a flashlight and aspirator tube commencing at about 0830. Afterwards, they worked for 5 minutes in each of another six houses in the area using sweep nets.

Data were kindly analyzed by Mr. Richard See, Head of the Department of Data Processing in Taipei, using IBM data cards and computer programs.

DESCRIPTION OF COLLECTING SITES. Djakarta, the capital of Indonesia, is a teeming city of almost five million people,

[1] From Research project MR 005.09.01 0121B6-HJ, Bureau of Medicine and Surgery, Washington, D.C. The opinions and assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the views of the Navy Department or the Naval service at large.

[2] Naval Medical Research Unit No. 2 Djakarta Detachment, APO San Francisco 96356.
[3] Naval Medical Research Unit No. 2, APO San Francisco 96263.
[4] Chairman, National Institute for Medical Research, Djalan Pertjetakan Negara I, Djakarta, Indonesia.

located on the lowland north coast of West Java (6° 10′ S, 106° 45′ E, elev. approx. 10m). Although there is a distinct heavy rainy season (Fig. 2), relative humidity (RH) and temperatures are almost constant throughout the year: the mean monthly RH for the study period was 79–83 percent and the mean monthly temperature varied from 26.6–27.8 degrees Centigrade. Area I, Grogol, is a middle class residential area. Houses are small, consisting of kitchen, bathroom, sitting room, and one to three bedrooms on the same level. There are small lawns and/or flower gardens, separated by fences, and houses in the area are supplied by pipes from a municipal water supply. Area II, Rawabangke, consists of crowded lower class houses lining concrete paths. Family units are distinct. Most have cooking areas, bathrooms, and darkened sleeping areas separated by plastered bamboo walls. Water supply is by indoor handpumps and wells. Area III, Karet Tengsin, is similar to Rawabangke, except that paths are mud and rock, and most water is supplied from wells covered by roofing, but located outside houses. Area IV, Rawasari, is slum-like. Homes are crowded together, and often share the same roof. Water supply is from indoor wells and pumps, or from community wells. During the rainy season, this area is often flooded.

RESULTS. Adult *Aedes aegypti* were most abundant in darkened rooms. They were caught resting under beds, on walls, and behind hanging clothes and furnishings. More were collected by aspiration than by sweeping (Table 1)—although more time (10 minutes per house versus 5) was spent using aspirators, trials showed that more than five minutes sweeping per house was unproductive. The monthly abundance of female *Aedes aegypti* by area is summarized in Figure 1. Figure 2 summarizes the monthly abundance of females from all areas, and shows the rainfall for Djakarta during this study.

TABLE I.—Total numbers of *Aedes aegypti* collected from all test areas of Djakarta, by aspiration and by sweeping, August 1970–August 1971.

	Numbers of *Aedes aegypti*			
	Aspiration		Sweeping	
Month	Males	Females	Males	Females
August 1970	...	157	5	56
September	...	398	48	183
October	...	276	71	68
November	...	306	70	79
December	...	333	161	141
January 1971	...	321	81	62
February	...	270	87	92
March	...	444	106	140
April	...	341	86	128
May	...	331	56	100
June	...	187	43	72
July	...	168	81	129

DISCUSSION. A recognized dengue epidemic did not occur in Djakarta in 1970–71, although clinically diagnosed cases were reported from all four collecting areas, and were most frequent during the rainy season, particularly between January and April 1971. In 1968–69, when an epidemic was reported, cases were similarly distributed in space and time (Kho *et al*, 1969).

In this study, the monthly abundance of *Aedes aegypti* females in Djakarta was found to vary widely. When data were analyzed by the chi-square test, seasonal variation was the same for all four areas, even though the graph for Karet Tengsin (Figure 1) appears distinct. The numbers of female *Aedes aegypti* collected per man-hour were compared by area. Total mean numbers showed no significant differences. However, when compared on a monthly basis, using t-tests, it was possible to combine Grogol and Rawasari to make a "low" group, and Rawabangke and Karet Tengsin to make a "high" group. These combined groups did show a consistently significant difference in numbers collected on a monthly basis.

Scanlon (1966) reported that in Bangkok, Thailand, *Aedes aegypti* was the

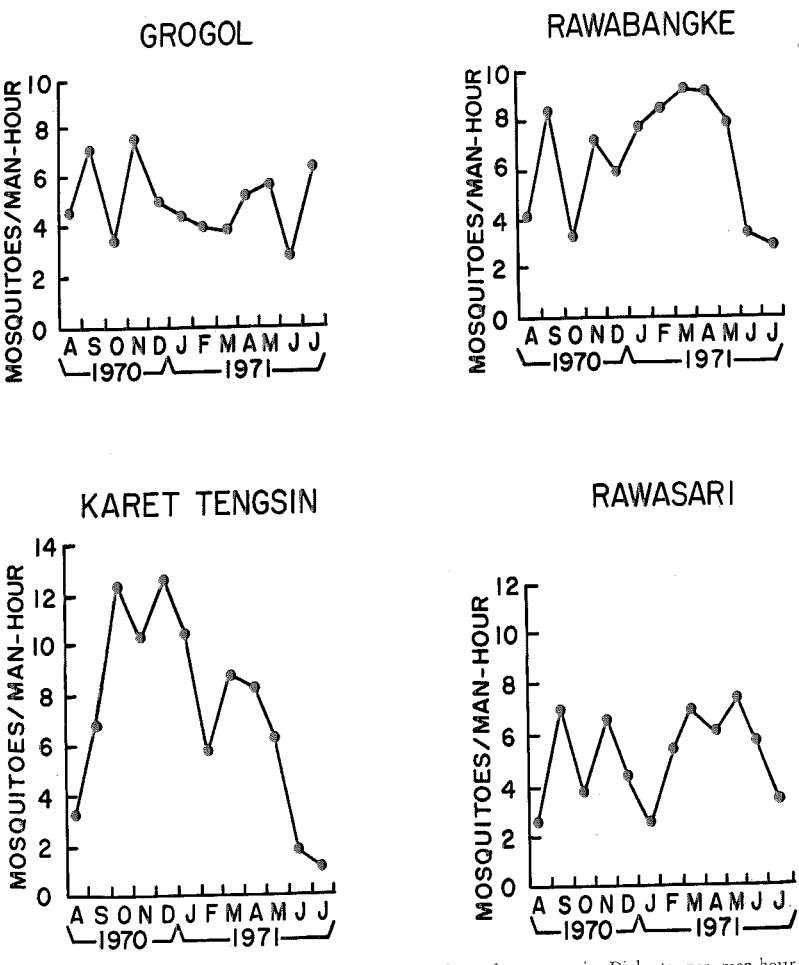

FIG. 1.—Numbers of female *Aedes aegypti* collected from four areas in Djakarta per man-hour, by month.

only mosquito showing density and distributional correlation with DHF outbreaks; but Tonn *et al.* (1969) concluded that dengue outbreaks in Bangkok could not be explained by increases in this mosquito's densities. In the present study, the abundance of *Aedes aegypti* showed little seasonal variation with the technics used. This may be because, although there is a marked rainy season, most mosquito breeding seems to be indoors. Every house in Djakarta has large open concrete water containers, mandis, in bathrooms, often containing *Aedes* larvae. In addition, many homes, particularly those without city water supply, have "tempajan," or large clay pots, for water storage in the kitchens. These, also, not uncommonly harbor mosquito larvae. Water filled ant-guards, as found in Bangkok (Tonn *et al,* 1969), are not used in Djakarta.

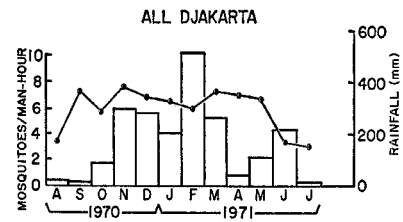

FIG. 2.—Monthly abundance of female *Aedes aegypti*, all areas combined, Djakarta. Bars show monthly rainfall. Measured by number collected per man-hour.

A further reason for the apparent lack of distinct seasonal patterns of abundance may be related to technics used. Inadequate length of time spent collecting biting mosquitoes, and attention only to indoor collections, may have biased collection data. However, collections were uniformly conducted throughout the year; and checks on peaks of man-biting activity were made periodically. It is therefore unlikely that important seasonal changes in densities were missed, particularly of sufficient magnitude to correlate with the seasonal changes in DHF morbidity in Djakarta.

Literature Cited

Halsted, S. B. 1966. Mosquito-borne haemorrhagic fevers of South and Southeast Asia. Bull. Wld Hlth Org. 35:3–15.

Kho, L. K., H. Wulur, A. Karsono and S. Thaib. 1969. Dengue haemorrhagic fever in Djakarta. J. Indonesian Med. Assoc. 19:417–437.

Russell, P. K., D. V. Quy, A. Nisalak, P. Simasathien, T. M. Yuill and D. J. Gould. 1969. Mosquito vectors of dengue viruses in South Vietnam. Amer. J. Trop. Med. Hyg. 18:455–459.

Scanlon, J. E. 1966. Bangkok haemorrhagic fever investigations: the 1962–63 mosquito collection. Bull. Wld Hlth Org. 35:82–83.

Tonn, R. J., P. M. Sheppard, W. W. MacDonald and Y. H. Bang. 1969. Replicate surveys of larval habitats of *Aedes aegypti* in relation to dengue haemorrhagic fever in Bangkok, Thailand. Bull. Wld Hlth Org. 40:819–829.

LABORATORY THERMAL AEROSOL TESTS OF NEW INSECTICIDES FOR THE CONTROL OF ADULT MOSQUITOES

C. B. RATHBURN, JR. AND A. H. BOIKE, JR.

West Florida Arthropod Research Laboratory, Florida Division of Health, Panama City, Florida

The West Florida Arthropod Research Laboratory conducts tests of candidate insecticides of low mammalian toxicity in a continuing program to develop new mosquito adulticides for the Florida mosquito control program. Those which show promise in laboratory tests and which are or will be commercially available are further tested in the field. The following report contains the results of laboratory thermal aerosol tests conducted with nine insecticides and compares their effectiveness to malathion as a standard.

METHODS. All tests were conducted using a laboratory thermal aerosol generator (Figure 1) developed at the West Florida Arthropod Research Laboratory (Rathburn, 1969). One-half milliliter of the insecticide solution, diluted to predetermined concentrations in Number 2 diesel oil or kerosene, was sprayed at 15 psi into a heater operated at a temperature of 850 ° F. The aerosol was drawn through the wind tunnel, which contained the 6-inch diameter screened test cages, at an air velocity of 3 mph. Check or control mosquitoes were exposed in the same manner to an aerosol of only diesel oil or kerosene.

Each test cage contained 25 female mosquitoes and each concentration of each insecticide, including the check, was