

MOSQUITOES AND MOSQUITO-BORNE DISEASES IN INDONESIA AND THEIR CONTROL

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INTRODUCTION. Indonesia, "The Isles of the Indies," was declared an independent nation by its people on August 17, 1945. For 350 years prior to this date, Indonesia was known as the Netherlands or Dutch East Indies and was governed as a Dutch colony. Today it is reported to have a population of some 82 million people. This establishes Indonesia, in population, as the sixth largest nation in the world. It is equally impressive in area as it includes approximately 3,000 islands and its boundaries extend from east to west some 3,000 miles and from north to south about 1,250 miles. Some of the larger islands in the archipelago are Sumatra, Borneo (Kalimantan), Java and the Sulawesi.

In origin, the people comprise several ethnic groups and it is reported that more than one hundred dialects were spoken when this country was founded. The island of Java, with its 52 million inhabitants, is one of the most extensive densely populated areas in the world, with an average of more than 1,000 inhabitants per square mile.

This country bordering both sides of the equator is a land of perpetual summer, generally with an abundance of precipitation, and a lush green vegetative cover. It is a paradise for mosquitoes, and, consequently, something less than a paradise for the human inhabitants. In this country of perpetual summer, with an abundant and varied mosquito population, which feed with impunity on the exposed masses of the people, certain mosquito-borne diseases not only occur, they are inevitable.

MOSQUITOES. Most of the scientific work on the mosquitoes of Indonesia has been done by Dutch scientists and the results have been published in the Dutch language. Surprisingly little work had been done by scientists of other nations in this

fertile area prior to 1945. In recent years many of the more important publications on mosquitoes, that were originally written in Dutch, have been translated into English. Other references in this field are still available only in Dutch. No information on mosquitoes from the more remote regions of this extensive country is available, and only fragmentary information is available from any specific part of the country. At present the anopheline mosquito fauna is much better known than are the other mosquito groups, since the anophelines have demanded attention as vectors of malarial parasites.

There are some 98 species of anopheline and 248 species of culicine mosquitoes reported as occurring in Indonesia. As mosquito studies continue in this country it is inevitable that additional species of anophelines will be recognized and undoubtedly a great many additional species of culicines will be added to the list.

Most of the common species are generally distributed throughout the islands. However, there are a few species that seem to be confined to certain localized areas. Many of the common species are extremely abundant and persistent in their attacks on man and other animals. Mosquitoes are generally more annoying at night but in many areas in Indonesia certain species will attack during the day time. No organized attempt is made in Indonesia to control pest mosquitoes.

VIRUS DISEASES. Malaria and filariasis are the most common and important mosquito borne diseases in Indonesia. Dengue also occurs; yellow fever is not reported as being present and mosquito borne virus encephalitides have not been confirmed as occurring in this country, although a few cases diagnosed as encephalitis have been reported.

It is a mystery to medical science why

yellow fever does not occur in Indonesia and associated areas in this part of the world. The climatic factors, the geographical position of the country, the abundance of the common mosquito vectors, and the presence of available human hosts that are apparently susceptible, make it difficult to explain why yellow fever is not present.

In the literature, a few isolated cases of encephalitis have been reported and most of them are clearly not the result of a mosquito borne virus. In the literature that was examined, there is no record of anything resembling an outbreak of mosquito borne virus encephalitides. This does not exclude the possibility that the disease is there and that outbreaks may have taken place. The difficulties of accurate diagnosis of this disease are well known to those who study these elusive viruses. The study of encephalitides in Indonesia is an open challenge at present. A modern and well equipped laboratory is available at the University of Indonesia for this purpose for anyone who would like to study these viruses in this country.

A disease, probably dengue, was first reported in Batavia (Djakarta) by van der Scheer in 1901. Since then dengue, or a similar disease has been reported in other parts of Indonesia, particularly on the islands of Java and Sumatra where more intensive studies of diseases of man have taken place. Both *Aedes albopictus* (Skuse) and *Aedes aegypti* (L.) have been reported as vectors of dengue in Java and Sumatra. These species are relatively abundant during certain seasons of the year in areas where dengue has been reported. Other species of mosquitoes that are recognized vectors of dengue are present in Indonesia and may be involved in the transmission of this disease. No specific mosquito control measures have been employed in the control of dengue or dengue-like diseases.

MALARIA. Malaria is the most important disease in Indonesia. The three types of malaria parasites present are: *Plasmodium vivax*, *P. falciparum* and *P. malariae*. The

most common type appearing generally throughout the country is *P. vivax*. The other two types are more rare but are not uncommon in certain parts of the country.

Endemic malaria has been reported as occurring up to 5,000-foot elevations but more generally appears in the coastal areas and inland river valleys. The mortality rate for malaria in the low country of Java, before malaria control operations were established, is reported as 20/1000; in chronic areas 25-50/1000; and in epidemic areas as high as 400/1000. The spleen rate index in chronic endemic areas has been reported as high as 80-90 percent of the inhabitants examined.

The important anopheline vectors of malaria in Indonesia vary with the locality. The principal anopheline vector in the lowlands of western Indonesia is generally *Anopheles sudaicus* Rodenwaldt, and in the interior it is *Anopheles aconitus* Dönitz. Also reported as important vectors in certain specific areas are: *Anopheles maculatus* Theo., *A. hyrcanus* (group), *A. punctulatus* (group), and others.

The control of malaria in this part of the world has been recognized for centuries as the number one health problem. For many years anti-malarial drugs have been administered to suppress malaria in the human victims. Bed nets and insecticides have been used to protect man from the mosquito vectors. Even water management was attempted by the Dutch in some areas as a plan for source reduction of *Anopheles* mosquitoes and in certain areas larvicides were used as control measures.

Quinine was the first, and until recently, the most extensively used and produced anti-malarial drug in Indonesia. Quinine was regularly taken for many years by the Dutch and other people of Caucasian origin, stationed in or visiting Indonesia. The bitter quinine was frequently accompanied with a tall drink of gin presumably on the theory, if the gin did not disguise the taste of quinine the effect of the gin would make it easier to forget.

An extensive malaria control program

was started in Indonesia in 1955. It was sponsored by the Indonesian Government in cooperation with the United States International Cooperation Administration and the World Health Organization. At the end of 1957 some 17 million people in Indonesia were living in the area included in this control program. By 1957 the success of the malaria control program was evident in Indonesia as malaria had practically disappeared in the areas under control. In Djakarta, a city of some 3 million people where malaria was previously very common, new infections have become very rare. This was apparent from a study of the records of the Pediatric Ward of the 1,100-bed General Hospital connected with the Medical School in Djakarta. The chart (Figure 1) illustrates the decline of malaria in the children entering the hospital after 1955 when the control program was put into operation.

During 1958 an attempt was made to convert the malaria control program into a program of malaria eradication. The

proposed general plan of the program of malaria eradication involves the treatment of all dwellings in a designated area once or twice a year with an effective residual adulticide. These treatments are to continue for three years, accompanied by a close surveillance of the area for an additional five years after the insecticide program is terminated. In this period of surveillance, if sporadic malaria appears it is to be eliminated with anti-malarial drugs.

The eradication program will be introduced into designated areas of the country as facilities are available, rather than into all parts of the country at the same time.

The results of the 1958 malaria program are not available for inclusion in this paper but continued progress has been made during the year.

FILARIASIS. Filariasis is widely distributed in Indonesia and the incidence in man is generally remarkably high and is frequently present in an individual without visible clinical symptoms. Both

MALARIA CASES
DEPARTMENT OF PEDIATRICS GENERAL HOSPITAL
DJAKARTA
(15 days - 12 years)

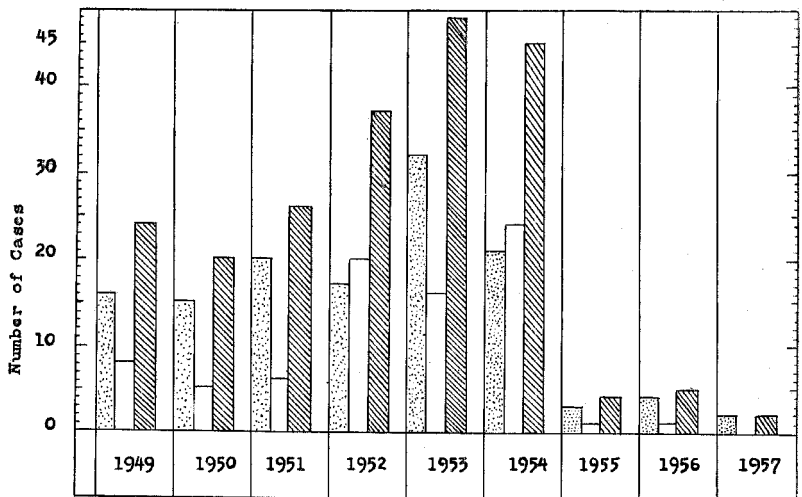


FIGURE 1

Wuchereria malayi and periodic *Wuchereria bancrofti* are present, sometimes in the same locality. Both species occur principally in the coastal regions and inland waterways.

Wuchereria bancrofti is more generally distributed in West Irian (New Guinea) and in other parts of eastern Indonesia. It appears more sporadically and less frequently on the more western islands. *Wuchereria bancrofti* is reported to be commonly associated with elephantiasis and hydrocele in West Irian and on the island of Buruh. In a recent extensive blood sampling and mosquito survey conducted in Djakarta by Dr. Lie, Kian Joe, and others, the incidence of *W. bancrofti* in 5,141 blood samples taken from man was 23 percent and of the 24,271 *Culex quinquefasciatus* Say (= *fatigans* Wied.) mosquitoes dissected during this survey, 1.8 percent were infected with *W. bancrofti* micro-filariae. Only one case of recognizable elephantiasis was located in Djakarta during this survey although hydrocele was common.

In Djakarta, *Culex quinquefasciatus* seems to be the principal vector, but in other parts of Indonesia other species of mosquitoes are reported with a high natural infection incidence: *Anopheles bancrofti* Giles, *Anopheles farauti* Laveran, *Anopheles punctulatus moluccensis* Swellengrebel, et al., *Armigeres obturbans* (Walker), *Aedes kochi* Dönitz, *Culex annulirostris* (Theo.), *Culex bitaeniorhynchus* Giles. Some fourteen additional species have been experimentally infected in the laboratory with *W. bancrofti* organisms.

Wuchereria malayi is more generally distributed throughout western Indonesia extending east to the island of Ceram. It occurs in rural areas and is frequently associated with elephantiasis of the lower extremities and recurrent lymphangitis. In a blood and mosquito survey conducted recently in Bengkulu, Sumatra, by Dr. Lie and others, in which 6,608 human blood samples were examined, 39.3 percent were positive for *W. malayi*. In a dissection of many thousand possible mos-

quito vectors during this survey, 1.4 percent were positive. In some of the villages surveyed, as high as 20 percent of the human adults had visible elephantiasis, and reports of lymphangitis were equally common.

The principal vectors of *W. malayi* are apparently species of the genus *Mansonia* including the following: *Mansonia annulata* (Leic.), *Mansonia annulifera* (Theo.), *Mansonia longipalpis* (Van der Wulp.), *Mansonia uniformis* (Theo.), *Anopheles barbitrostris* Van der Wulp., (= probably *A. vanus* Venhuis), and *Anopheles venhuisi* Bonne-Wepster.

Three other species of mosquitoes have been reported as experimentally infected with *W. malayi*.

It is evident from recent investigations that filariasis constitutes an important health problem in Indonesia because of its high incidence and wide distribution. It is difficult to evaluate the disabling effects but the losses caused by filariasis in the efficiency of labor, man work days lost, and the care required for those suffering in advanced stages of filariasis and associated afflictions, create an enormous economic and social loss to the people of Indonesia.

The control of filariasis in Indonesia has not been attempted to date, although the more recent investigations of this disease by Dr. Lie and others represent the attempted beginning for such a control program. If malaria eradication succeeds, as expected, the control of filariasis in Indonesia will be next in importance as a mosquito borne disease. It is assumed that the equipment and trained personnel of the Malaria Eradication organization could then be employed for the control of filariasis. With this organization and the use of "Hetrazan" such a program might possibly become a program of "Filariasis Eradication" rather than a program of filariasis control.

Reference

LIE, KIAN JOE, AND REES, DON M. Filariasis in Indonesia; distribution, incidence, and vectors. Proceedings of Sixth International Congress on Tropical Medicine and Malaria. September, 1958. Lisbon, Portugal.