

## Chapter XV

### OTHER RESEARCH AND CONTROL ACTIVITIES

#### TAXONOMIC STUDIES OF INSECTS OF MEDICAL IMPORTANCE

**Mosquitoes:** Before 1962 only about 59 species of culicine mosquitoes were recorded from Taiwan in addition to 17 anopheline species and two species of *Toxorhynchites*. Now the mosquito fauna of Taiwan contains 131 species, of which 27 species were described as new in 1967 and 1968.

**Biting midges:** Before 1961 only 92 species of biting midges in 11 genera were recorded from Taiwan. The fauna at present contains 162 species, of which 19 species were described as new to science.

**Blackflies:** Before 1961 only eight species were recorded to occur in Taiwan. At present 23 species are known to occur in Taiwan.

**Sandflies:** In 1940 only a single male specimen of *Sergentomyia sp.* was collected and recorded from Ilan county. In 1970 one species of *Phlebotomus* and 3 species of *Sergentomyia* were recorded from various localities, mostly in eastern Taiwan as a result of extensive field collection made by TAMRI staff members.

**Fleas:** Before 1961 only 11 species of fleas were recorded from Taiwan. Now the flea fauna of Taiwan includes 31 species, of which eight were described as new to science by a member of the National Institute of Preventive Medicine in collaboration with Dr. E. W. Jamson, Jr. of the University of California in Davis.

**Trombiculid mites:** Before 1961 only six species of trombiculid mites were recorded from Taiwan. At present some 30 species in various genera are known to occur in Taiwan.

**Entomology Museum:** More than 100,000 specimens of the above-mentioned groups of insects, together with rodent specimens and their ectoparasites (such as ticks), in addition to the mosquito specimens obtained through exchange or

collected from Indonesia, the Philippines, Malaysia, Singapore, Thailand, Vietnam, Hong Kong, Korea, Japan and Bolivia, were deposited in the entomological museum of the National Institute of Preventive Medicine, Department of Health, Executive Yuan.

### ECOLOGICAL STUDIES OF INSECTS OF MEDICAL IMPORTANCE

To investigate seasonal fluctuation of nocturnal species of culicine mosquitoes and biting midges, 18 New Jersey-type light traps were operated once a week throughout the night for a period of 17 months in four sections of the island representing urban, rural and foothill areas in northern, central, southern and eastern Taiwan. Seasonal fluctuation curves for the more important species of mosquitoes -- such as *Culex (Cx.) quinquefasciatus*, *Cx. tritaeniorhynchus*, *Cx. annulus* -- and biting midges -- such as *Culicoides arakawae* -- were successfully obtained and published.

Between September 1961 and November 1963 monthly periodical trapping of field rodents were carried out in the Pescadores Islands in order to study seasonal abundance of chiggers and to isolate rickettsia from the mites. Trombiculid mites, *Leptotrombidium (L.) deliense*, were shipped alive to the U.S. Naval Medical Research Unit No. 2 in Taipei for rickettsia isolation. Field investigation firmly established *L. deliense*, and not *L. akamushi* as previously reported, as the only external mammalian chigger mite on the islands. Chiggers were collected in the Pescadores Islands by recovery from trapped mammals, from sentinel mice and from bakelite plates. Seasonal abundances were determined. These have later been analyzed and found to correlate with temperature. Ground foci of chigger abundance, in order of highest yields, are *Miscanthus* grass, coral walls, *Leucaena*, sweet potato, peanuts, kaoliang, other fields. *Agave*, trenches, indoor and multiple sources. Other than *L. deliense*, only one mammalian chigger species was encountered -- an undetermined, intranasal species of *Doliosia*. Ten other species of trombiculid mites, including *Eutrombicula wichmanni*, were found on birds or reptiles. As isolation results, 45 of 142 *L. deliense* pools, tested by mouse inoculation, were positive. Of these, 27 of 70 pools from the shrew *Suncus murinus* were positive.

## FILARIASIS CONTROL

In 1937 Tanaka first reported *Wuchereria bancrofti* (*W. bancrofti*) infections among 229 conscripts in the Pescadores, with a rate of 16.3% positive for microfilaria. In 1939 Yokogawa *et al.* found *W. bancrofti* infections among 2,843 natives in the Pescadores, with a rate of 8.58% positivity for microfilaria. Dissection of 13 *Cx. quinquefasciatus* mosquitoes resulted in one positive with filarial larvae. In 1943 Huang (then known as Ko) reported completely negative results in attempts to find the infection among 5,627 native inhabitants in Wantan and Liuchiu townships in Pingtung county. In 1953 Fan *et al.* first discovered 3 endemic foci of bancroftian filariasis as a result of blood surveys in 8 townships located in southwestern Taiwan. The foci are Jenteh in Tainan county, and Kangshan and Fengshan in Kaohsiung county. Out of 9,801 military immigrants from mainland China after World War II, 380 (3.87%) were found infected with either *W. bancrofti* or *Brugia malayi*. In 1955 Wu and Fang and Fan and Hsu reported microfilaria positivity rates of 9.38% of 8,848 evacuees and 7.10% of 4,774 evacuees from the Tachen islands, respectively. The majority were found infected with *B. malayi*. In 1957 Chuang *et al.* found a new endemic focus of bancroftian filariasis in Hsinhua in Tainan county. In 1958 Hsieh and Lien reported positive infections with filarial larvae in 1.6% of 626 *Cx. quinquefasciatus* mosquitoes collected at random and 14.09% of 447 mosquitoes of the same species collected from the known microfilaria carriers' houses in Hsinhua town in Tainan county.

Between November 1956 and March 1958, mass surveys and treatment of filariasis infections among the military and civilian populations in Taiwan were conducted jointly by TAMRI, SGO and JCRR. A total of 181,478 service men in Taiwan proper and 58,779 civilians in the Pescadores were examined. The survey resulted in the detection of 1.34% positivity for the former and 6.63% for the latter. More than 90% of the microfilaria carriers detected underwent a week or more of hetrazan administration.

A four-year filariasis control program in Taiwan was launched in July 1958. The program was sponsored by TAMRI through financial assistance from ICA/CUSA. The program included (1) an active control operation with combined antiparasite and antimosquito measures in the Pescadores, and (2) detection of endemic foci, if any, in Taiwan proper, by means of sampling surveys covering suspected areas of the whole island, and elimination of the foci mainly with drug control in order to prevent further spread in Taiwan proper. The total expenditure during the first five years (FY1959 - FY1963) amounted to NT\$4,170,098, of which

NT\$3,140,400 came from the U.S. Agency for International Development (USAID), the rest from the government. In FY1964, USAID discontinued its aid. The government budget allotted for FY1964 was only NT\$230,970. Since then the scope of operations had to be sharply cut. Microfilaria carriers were treated daily with 6 mg of diethylcarbamazine per kg of body weight for one to four courses. During the period between 1958 (pre-control) and 1975 (17 years post-control), the gross microfilarial rates obtained in the mass and sampling blood surveys carried out in the known endemic foci dropped gradually as follows: 8.36, 6.01, 3.02, 2.32, 1.36, 0.78, 0.48, 0.22, 0.15, 0.22, 0.14, 0.06, 0.03, 0.03, 0.02, 0.03, 0.013, 0.003. Since then a similar operation has been continued. At present filariasis does not constitute a public health problem in Taiwan.

#### JAPANESE ENCEPHALITIS (JE) CONTROL

Occurrence of the disease called "summer encephalitis" or "epidemic encephalitis" has been recognized in Taiwan for many years. The febrile illness, with encephalitis symptoms and a high mortality rate, attacks primarily young children during the summer season. Except for some suggestive serological evidence, there had been no definite proof until 1958 that the disease in Taiwan was caused by the Japanese encephalitis (JE) virus. The virus was first isolated from an eight year old girl who died. She had lived in a rural area near Taipei. Subsequently the virus was also isolated from mosquitoes -- *Cx. tritaeniorhynchus* and *Cx. fuscocephala*. The annual cycle of infection in humans was shown to be correlated with the appearance of infection in pigs. In 1969 the mosquito *Cx. annulus* was first incriminated as a vector of JE in Taiwan. Since 1962, 40 pools of *Cx. tritaeniorhynchus*, 37 pools of *Cx. annulus*, two pools of *Cx. fuscocephala* and one pool of *Cx. quinquefasciatus* have been recorded as positive for JE virus isolation by various workers. The positive isolations were made exclusively from the mosquitoes collected between June and September, but most frequently from those obtained in June and July. The percentage of the occurrence of JE cases by month during the period 1960 -1964 was highest (38.89%) in August and lowest (0.04%) in February. The August peak of the incidence of JE cases coincided with the population peak of the vector mosquitoes.

Since July 1955 the Taiwan Provincial Health Department requested that physicians report cases of encephalitis, and a surveillance program was instituted by the former Taiwan Provincial Institute of Infectious Diseases (now National Institute of Preventive Medicine). Table 60 shows, by year, the number of reported cases with

incidence rate (per 100,000 population) between 1956 and 1979 period. During the same period, the fatality rate dropped from 43.4% to 9.4%.

**Table 60**  
*Japanese Encephalitis in Taiwan, 1956 - 1979*

Year	No. of Cases*	Rate Per 100,000	Year	No. of Cases*	Rate Per 100,000
1956	76	8.23	1968	610	4.46
1957	146	1.53	1969	502	3.56
1958	169	1.70	1970	577	3.98
1959	89	0.86	1971	355	2.39
1960	220	2.04	1972	270	1.78
1961	463	4.15	1973	205	1.33
1962	472	4.09	1974	248	1.58
1963	699	5.87	1975	94	0.59
1964	444	3.62	1976	148	0.91
1965	611	4.83	1977	159	0.95
1966	819	6.29	1978	224	1.32
1967	1,024	7.66	1979	186	1.07

\* Number of cases reported.

The lowering of JE incidence may be due to certain measures which have been taken by the health authorities in recent years. Since 1968 children between the ages of 15 months and 2 years/3 months have been vaccinated twice at one- to two-week intervals during the period March 1 - May 31 each year. Those who missed the first vaccination or had only one vaccination were revaccinated twice the following year; children six years old were vaccinated once again at school.

Insecticide spraying was also performed in villages with incidence of JE in the previous two years. Ten percent Sumithion EC (emulsion concentrate) was water-diluted to 0.5% and applied annually to the outdoor potential harborage of vector mosquitoes at a rate of 25-50 ml/m<sup>2</sup> of surface area during the period between June and August.

Investigation of sera from swine in slaughter-houses in 10 localities more or less evenly-spaced on the island has been carried out annually to detect the time when positivity of antibodies to JE in pigs reaches 50% of the pigs sampled. Warning of the danger of infection is then delivered to the public for prevention of such infection.

## DENGUE FEVER CONTROL

Dengue outbreaks had occurred in Taiwan proper and in the Pescadores in 1901, 1915, 1922, 1931 and 1942 prior to the more recent outbreak in 1981 on the offshore island of Liuchiu and in a portion of Tungkang, a town on the southwest coast of Taiwan proper. About 80% of the inhabitants on Liuchiu were infected with dengue type two virus. The outbreak was quickly brought to an end with insecticide fogging in the affected areas. Another outbreak was detected in November 1987, which was due mostly to dengue type one virus, with a small number of dengue types two, three, and four virus cases. In the following year reported cases amounted to 10,420, with 1,740 confirmed. A dengue emergency control center covering seven specialties was then organized.<sup>6/</sup> As an emergency measure, ultra low volume (ULV) spray of 3.6% water-base permethrin was applied to the interior of all houses within a 50-meter radius of the house in which a case was found (Figs. 101 and 102). As warnings of risk, monthly reports on the *Aedes* indices of the more important localities were distributed to the relevant units for reference and action. During the *Aedes* surveys, the adult mosquitoes in the houses within the outbreak area were collected by sweep-netting, and were processed for virus isolation. The mosquitoes were classified by species and sex. Dengue type two virus was isolated from nine pools of female *Aedes aegypti*, among the 12 species of mosquitoes collected in 1988.

Local transmission of dengue ceased by February 1989; however, occasional importation of cases from abroad still continues.

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<sup>6/</sup> The Department of Health is responsible for five units covering epidemiology, entomology, insecticide application, virology, and medical care, while the Department of Environmental Protection is responsible for work on source reduction and public relations.

Fig. 101:  
Indoor ULV spraying  
for dengue control





Fig. 102: Outdoor ULV spraying for dengue control