PAST, PRESENT AND FUTURE OF *AEDES ALBOPICTUS* IN THE UNITED STATES[1]

D. B. FRANCY, C. G. MOORE AND D. A. ELIASON

Center for Infectious Diseases, Public Health Service, P.O. Box 2087, Fort Collins, CO 80522–2087

ABSTRACT. *Aedes albopictus* was first detected in Houston, Texas, in 1985. Since then it has spread to 17 states and 122 counties. This exotic species from Asia appears to have arrived in the U.S. in imported used tire casings. Public health concerns have been raised regarding the potential of this species to serve as a vector of arboviruses indigenous to the U. S., such as La Crosse encephalitis, and also for imported dengue. The Division of Vector-Borne Viral Diseases, Centers for Disease Control, has actively pursued a program to determine the distribution of *Ae. albopictus* in the U.S., monitor the spread of the species and implement procedures that would eliminate the risk of further importation of exotic mosquitoes in used tire casings. The latter goal was achieved in large measure in 1988 with a 98% reduction in imported used tires containing water. The ultimate consequences of establishment of *Ae. albopictus* in the U.S. is unknown; however, because of its biologic characteristics and broad viral susceptibility, it seems likely that this species will eventually become involved as an arbovirus vector in the U.S.

Aedes albopictus (Skuse) was first detected in Houston, Texas, in August 1985 by personnel from the Harris County Mosquito Control District (MCD) (Sprenger and Wuithiranyagool 1986, CDC 1986a) and reported to the Centers for Disease Control (CDC) on January 31, 1986. A survey conducted by Harris County MCD personnel found *Ae. albopictus* in about three-fourths of the containers inspected in the eastern half of Harris county. Used tire casings provided the major larval habitat, although many other container types were infested. The widespread distribution in Harris County and the reporting of a single specimen of *Ae. albopictus* from Memphis, Tennessee, in 1983 (Reiter and Darsie 1984) suggest that this species been established in the continental United States since at least 1983. Following the 1985 detection of *Ae. albopictus* in Houston, a major program was initiated by the Division of Vector-Borne Viral Diseases (DVBVD), CDC. Objectives were to determine the source and mode of introduction of *Ae. albopictus* into the continental U.S. and prevent future introductions, to investigate the distribution and monitor the spread, to study the biology of this species and its potential to serve as a vector of viruses of public health importance, and to develop effective methods for its control, both chemical and biological.

Concern regarding the establishment of the Asian Tiger Mosquito in the U.S. derives from its known ability to serve as a vector of dengue viruses in Asia and its potential to become involved in the transmission of one or more of the indigenous arboviruses in the U.S. (Jumali et al. 1979, Metselaar et al. 1980, Monath 1986, Shroyer 1986). Laboratory studies have shown that *Ae. albopictus* strains established in the U.S. are efficient vectors of dengue viruses (Mitchell et al. 1987, Boromisa et al. 1989) as well as La Crosse encephalitis (LAC) virus (Grimstad et al. 1989). Involvement of this species as a vector of dengue in the U.S. could occur as a result of their biting infected persons returning to the U.S. from other areas where they acquired infection with one of the dengue viruses, or during indigenous outbreaks such as occurred in Texas in 1980 and 1986 (CDC 1980, CDC 1987a). From 1977 through 1986 there were 1,561 such cases of dengue in the U.S. that were reported to CDC, 327 of which were laboratory confirmed (CDC 1987a).

The potential role of *Ae. albopictus* as a vector of LAC virus is based on laboratory demonstrated efficiency in transmitting LAC virus, its aggressive biting behavior, mammalian feeding preference (Colless 1959, Tempelis et al. 1970, Hess et al. 1968) and propensity for suburban habitats. Although the potential for *Ae. albopictus* to become involved in transmitting LAC virus is not dependent on becoming established in tree holes, its efficiency as a vector would be enhanced if it does, primarily by putting it in closer proximity to natural vertebrate reservoir hosts of LAC virus. The LAC virus has been shown to be efficiently transmitted vertically from females to progeny in the natural vector, *Ae. triseriatus* (Say) (Watts et al. 1973, Thompson 1981). Vertical transmission of LAC virus in *Ae. albopictus* has also been demonstrated, although mosquitoes were infected by intrathoracic inoculation rather than by feeding on a viremic host (Tesh, 1980). If vertical transmission rates in *Ae. albopictus* are similar to those in *Ae. triseriatus*, the potential for the former species to become an important vector of LAC virus would be considerably enhanced.

[1] Presented at a symposium, Current Status of *Aedes albopictus*, at the annual Meeting of the American Mosquito Control Association, Boston, Massachusetts, April 5, 1989. Titles and authors of presentations are given in Appendix 1.

In order to provide background for the presentations that follow in this symposium, it is useful to start out with a brief review of where we have been and where we currently stand. I will touch on a number of areas of accomplishment, some of which you will hear about in much more detail later in the symposium.

In March 1986, a meeting of medical entomologists, epidemiologists and other health professionals was convened in Houston, Texas, at the University of Texas School of Public Health to discuss the ramifications of the introduction and establishment of *Ae. albopictus* in the U.S. and to explore options for dealing with the problem. A general consensus emerged from this meeting that *Ae. albopictus* represented a potential public health threat, and that a major effort should be made to rapidly determine the current *Ae. albopictus* distribution in the U.S. and its potential to serve as a vector of viruses of public health importance. After the meeting, information about *Ae. albopictus* was distributed to national and international health and vector control agencies.

Almost immediately following the Houston meeting, *Ae. albopictus* was reported from New Orleans and in April and May (1986), it was found in parishes surrounding New Orleans and in Memphis, Tennessee. In June and early July, *Ae. albopictus* was reported from Gulfport, Mississippi, and Jacksonville, Florida. By early July 1986, *Ae. albopictus* had been discovered in 7 Louisiana parishes, 9 Texas and 2 Mississippi counties and one county each in Tennessee and Florida.

In June 1986, *Ae. albopictus* was reported from the 3 Brazilian states of Rio de Janeiro, Espirito Santo and Minas Gerais by the Brazilian government and PAHO (CDC 1986b). It has since been found in a fourth state, São Paulo. Studies at the University of Notre Dame comparing strains of *Ae. albopictus* from Brazil with those in the U.S. have shown the Brazilian strains to resemble those of tropical origin, while those in the U.S. are similar to strains from temperate regions (Hawley et al. 1989). These findings suggest that the introduction of *Ae. albopictus* into Brazil was independent of the U.S. introduction.

In July 1986, systematic surveys were conducted by the DVBVD, CDC in cooperation with state and local health and vector control agency personnel in Texas, Arkansas, Louisiana, Mississippi, Alabama and Georgia (CDC 1986b). Because of suspicion that the Asian intruder had been brought to the U.S. in used tires and observations that used tires were the major larval habitat, the survey concentrated on sources such as retreaders, tire dealers, salvage yards and scrap tire dumps, both legal and otherwise. Additional positive areas were found in Texas, Louisiana, and Mississippi; and both Georgia and Alabama were also shown to be infested.

Similar surveys were conducted from September 15 to 29 in Ohio, Indiana, Illinois, Missouri, Kentucky and Arkansas (CDC 1986c). *Aedes albopictus* was discovered in 2 of 17 counties in Indiana, 4 of 11 counties in Missouri, 2 of 11 counties in Illinois and 1 of 7 counties in Arkansas. No *Ae. albopictus* were found in Kentucky. Earlier in September a single positive site had been found at a retreading operation in Ohio by personnel of the Vector-Borne Disease Unit from the Ohio Department of Health; no further breeding was found in 5 other Ohio counties during the survey.

It was apparent that *Ae. albopictus* was much less common in the more northern tier of states surveyed than in the southern states. In Texas, Louisiana and Mississippi, *Ae. albopictus* was present in 89% of 37 counties surveyed, while in the more northern states, only 17% of 53 counties were positive. By the fall of 1986, *Ae. albopictus* had been shown to be present in 42 counties in 12 states (CDC 1986c).

In August 1986 the DVBVD, CDC in collaboration with the New Orleans Mosquito Control Board and Louisiana State University Medical Center sponsored a 2-day workshop on *Ae. albopictus*. The workshop was attended by a large group of international, state and local vector control specialists and health professionals.

In January 1987 another meeting was convened at CDC in Atlanta, Georgia. Consultants from state health departments and universities were invited by the Director of CDC, James Mason, to evaluate the program on *Ae. albopictus* which DVBVD had been pursuing and which was proposed for the coming season. Representatives from state health agencies, regional and national vector control organizations, universities and the tire industry attended. Widespread support was expressed by the consultants and the conference attenders for a continued and expanded effort to learn more about the spread of *Ae. albopictus*, its potential importance as a vector, and methods of suppression or eradication where feasible.

Surveys conducted by state and local agencies in 1987 found *Ae. albopictus* in Delaware, Maryland, Kentucky and North Carolina (CDC 1987b). The most northern infestation was discovered in Chicago, Illinois, by personnel from the Clarke Outdoor Spraying Co. (Rightor et al. 1987). *Aedes albopictus* was also intercepted in Oakland, California, in large heavy equipment tire casings from Hawaii where *Ae. albopictus* occurs; however, the infestation apparently never became established on or spread from the tire importer's premise. The surveys along with reports by state and local agencies brought the number of infested states to 16. Information on

the distribution and spread through 1987 has been summarized by Moore et al. (1988).

In July and August 1987, 8 cities known to be infested with *Ae. albopictus* were surveyed in detail by DVBVD using university staff and students. Two types of sampling were used. One concentrated on high risk premises such as retreaders, scrap tire dealers, salvage yards and scrap tire dump sites. When positive sites were found, perifocal surveys were conducted within a 1-mile radius of the infested site. The other survey method used random sampling of the community. The intent of the investigation was to determine if *Ae. albopictus* was spreading in areas previously surveyed, and if so, in what manner. A further objective was to assess the suitability of each city for control demonstration projects. Although the demonstration projects were not funded, important information about *Ae. albopictus* and other container breeding mosquitoes was obtained and will be presented in detail by Chester Moore (Moore et al. 1990).

An *Aedes aegypti* surveillance program begun by CDC in 1981 was expanded and modified early in 1986 to include 39 cities, 10 of which were known to be infested with *Ae. albopictus.* In each participating city, 15 ovitraps (Fay and Eliason 1966) were operated, and oviposition strips were sent weekly to the DVBVD for egg hatching and larval identification. During 1987 the program was expanded to 59 cities, and in 1988 there were 47 cities in the program. *Aedes albopictus* was discovered in 8 new cities as a result of this surveillance program.

A research program on the biology and control of *Ae. albopictus* was begun by DVBVD, CDC in 1986 in collaboration with the New Orleans Mosquito Board, which continues through the present. This research program is headed by Jerry Freier, and findings resulting from that productive collaboration will be covered later in the symposium by Dr. Freier (Freier 1990). The efforts of the New Orleans research program have been and continue to be directed at those aspects of *Ae. albopictus* biology important to assessing vector potential and the control of this species. The program also includes very promising research on biological control of *Ae. albopictus* and other container-inhabiting mosquitoes using cyclopoid copepods, which is being conducted by Gerald Marten, a National Research Council Senior Fellow from the DVBVD, CDC.

It was originally hypothesized that *Ae. albopictus* had most likely come to the U.S. through importation of used tire casings from Asian countries because of prior interceptions of this species in used military tires returned to the U.S. in 1946 and 1972 (Pratt et al. 1946, Eads 1972). This hypothesis gained credence when it was shown that the importation of used tire casings from Asian countries, primarily Japan, for retreading in the U.S., was a major business (Reiter and Sprenger 1987). The demonstration by Hawley and coworkers at the University of Notre Dame that the Houston *Ae. albopictus* strain resembled those from temperate regions rather than strains from the tropics (Hawley et al. 1987) further corroborated the hypothesis that *Ae. albopictus* in the U.S. were from northern Asia.

A DVBVD program to inspect used tire casings from Asia at ports of arrival in the U.S. was established in 1986. Of more than 22,000 tires individually inspected, 25% contained water when arriving in the U.S. In October, *Ae. albopictus* larvae along with those of 4 other mosquito species were found in tires arriving at the Seattle, Washington, port from Tokyo, Japan (Craven et al. 1988). Following these findings, a federal regulation was implemented by CDC that required all imported tires from Asian countries to arrive in the U.S. dry and to have a certificate of treatment by an approved method for killing mosquito ova. Inspection of over 6000 tires imported from Asia following implementation of the regulation demonstrated that less than 2% of the tires contained water, and then usually very small amounts. Don Eliason will present the details of the program on imported tires later in this symposium.

On August 27–28, 1987, the DVBVD sponsored a workshop on scrap tire utilization and disposal in Ft. Collins, Colorado, bringing together representatives from federal, state and local governmental agencies, universities, public health and vector control agencies, and several tire retreading industry groups. The following public health issues related to scrap tire disposal were identified: 1) There is a need to increase awareness in the tire industry, the community and government agencies regarding the public health consequences of improper storage and disposition of scrap tires. 2) Used tires should be stored under roofed structures to reduce or eliminate mosquito breeding where possible, and where this is not feasible, insecticide treatment of stored tires may be necessary. 3) If local governments close landfills to scrap tire disposal before alternative methods are made available, the number of illegal dump sites will continue to proliferate and substantially increase the potential to produce disease transmitting mosquitoes such as *Ae. albopictus*, *Ae. triseriatus*, *Ae. aegypti* and *Culex pipiens* Linn. s.l.

The winter of 1987–88 was unusually cold in the midwestern U.S. Whereas over 50% of nondiapause eggs exposed over the winter in 1986–87 survived, only 5% of eggs in diapause prior to exposure during the winter of 1987–88 survived (Hawley et al. 1989). The severe winter was followed by a major drought throughout

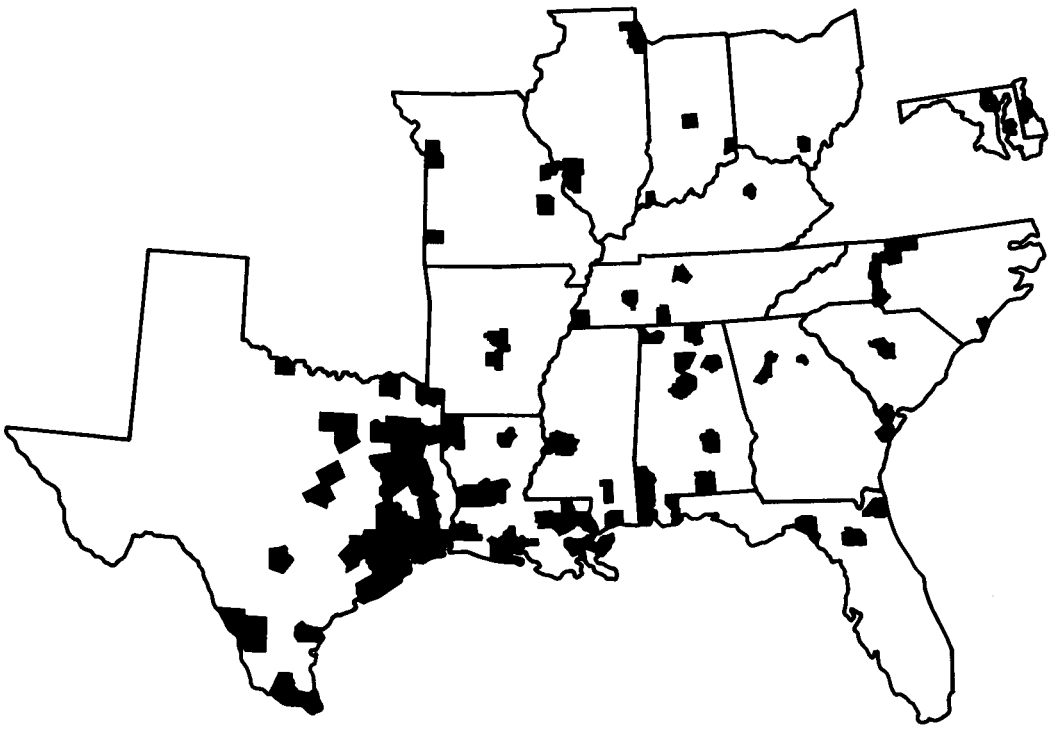

Fig. 1. Distribution of *Aedes albopictus* infected counties in the U.S.

much of the midwest which persisted well into the summer. Despite these adversities, *Ae. albopictus* survived and persisted in the most northern areas of its U.S. distribution. These circumstances provided the acid test for the ability of this species to persist in regions endemic for LAC virus.

During 1988 *Ae. albopictus* was discovered in South Carolina to bring the total number of infested states to 17 and the number of counties in which *Ae. albopictus* has been found at one or more sites to 113 (Fig. 1). The chronology of detection of *Ae. albopictus* and, at least to some degree the spread of this species in the U.S., is summarized in Table 1. Although precise information on rates and modes of spread is unavailable, there is considerable circumstantial evidence implicating used tires as the major mechanism for spreading this species.

Prior to 1988 the southernmost documented U.S. infestation of *Ae. albopictus* was Jacksonville, Florida. It had been hypothesized that because the U.S. strain was of temperate origin, it might not be adaptable to more tropical areas (CDC 1987b). Doubts regarding the ability of *Ae. albopictus* to spread south, at least in Texas, were resolved in 1988 with the finding of *Ae. albopictus* in several south Texas border communities and in Matamoros, Mexico. Surveys conducted in March 1989 demonstrated that *Ae. albopictus* successfully overwintered in South Texas and are once again active. More recent reinspection by Mexican health officials of the area in Matamoros, Mexico, in which *Ae. albopictus* was previously found failed to detect the continued presence of *Ae. albopictus*. Given the great adaptability of this species, however, it is likely a matter of time before it is found again and spreads within Mexico.

Table 1. Detection of *Aedes albopictus* infestations in the U.S. since 1986.

Date	Positive states	Positive counties
March 1986	1	1
July 1986	5	22
Aug. 1986	7	35
Oct. 1986	12	42
Oct. 1987	16	75
Oct. 1988	17	113

Currently *Ae. albopictus* has a wide but spotty distribution in the U.S. Within cities such as East St. Louis, Illinois, in which *Ae. albopictus* was limited 2 years ago to a few industrial/commercial used tire processing sites, *Ae. albopictus* has spread throughout adjacent urban/suburban areas (G. B. Craig, unpublished data). The decreasing interest in this problem on the part of local, state and federal health agencies will likely result in the continued spread and establishment of the species, primarily through

commerce in used and scrap tires. In urban areas such as New Orleans, Louisiana, *Ae. albopictus* is widespread and has become the principal pest mosquito responsible for most of the complaint calls to the New Orleans Mosquito Control Board (E. Bordes, unpublished data). In many parts of New Orleans, *Ae. albopictus* has replaced *Ae. aegypti*; however, the latter species has persisted in those areas with dense housing and sparse vegetation (J. Freier, personal communication). Very little information is currently available on the ability of *Ae. albopictus* to compete with *Ae. triseriatus* in the treehole habitat in regions endemic for LAC encephalitis.

The public health consequences of the presence and spread of *Ae. albopictus* in the U.S. are unknown. Its ability to adapt to a wide variety of urban, suburban and rural habitats, its feeding behavior and its susceptibility to a number of arboviruses make it likely that this species will eventually become involved as an arbovirus vector in the U.S. Independent of the public health consequences of the establishment of this species in the U.S., the presence and spread of *Ae. albopictus* will provide fascinating study for population ecologists for some time to come.

REFERENCES CITED

Boromisa, R. D., K. S. Rai and P. R. Grimstad. 1987. Variation in vector competence of geographic strains of *Aedes albopictus* for dengue 1 virus. J. Am. Mosq. Control Assoc. 3:378–386.

Centers for Disease Control. 1980. Dengue—Texas. MMWR 29:451.

Centers for Disease Control. 1986a *Aedes albopictus* introduction—Texas. MMWR 35:141–142.

Centers for Disease Control. 1986b. *Aedes albopictus* infestation—United States, Brazil. MMWR 35:493–495.

Centers for Disease Control. 1986c. Update: *Aedes albopictus* infestation—United States. MMWR 35:649–651.

Centers for Disease Control. 1987a. Imported and indigenous dengue fever—United States, 1986. MMWR 36:551–554.

Centers for Disease Control. 1987b. Update: *Aedes albopictus* infestation—United States. MMWR 36:769–773.

Colless, C. H. 1959. Notes on the culicine mosquitoes of Singapore. VII. Host preferences in relation to the transmission of disease. Ann. Trop. Med. Parasit. 53:259–267.

Craven, R. B., D. A. Eliason, D. B. Francy, P. Reiter, E. G. Campos, W. L. Jakob, G. C. Smith, C. J. Bozzi, C. G. Moore, G. O. Maupin and T. P. Monath. 1988. Importation of *Aedes albopictus* and other exotic mosquito species into the United States in used tires from Asia. J. Am. Mosq. Control Assoc. 4:138–142.

Eads, R. B. 1972. Recovery of *Aedes albopictus* from used tires shipped to United States ports. Mosq. News 32:113–114.

Fay, R. W. and D. A. Eliason. 1966. A preferred oviposition site as a surveillance method for *Aedes aegypti*. Mosq. News 26:531–535.

Freier, J. E. 1990. Population dynamics of *Aedes albopictus* in New Orleans. J. Am. Mosq. Control Assoc. (in press).

Grimstad, P. R., J. F. Kibayashi, M. Zhang and G. B. Craig, Jr. 1989. Recently introduced *Aedes albopictus* in the United States: potential vector of La Crosse Virus (Bunyaviridae: California serogroup). J. Am. Mosq. Control Assoc. 5:422–427.

Hawley, W. A., P. Reiter, R. S. Copeland and C. B. Pumpuni. 1987. *Aedes albopictus* in North America: probable introduction in used tires from northern Asia. Science 236:1114–1115.

Hawley, W. A., C. B. Pumpuni, R. H. Brady, and G. B. Craig, Jr. 1989. Overwintering survival of *Aedes albopictus* (Diptera: Culicidae) eggs in Indiana. J. Med. Entomol. 26:122–129.

Hess, A. D., R. O. Hayes and C. H. Tempelis. 1968. The use of the forage ration technique in mosquito host preference studies. Mosq. News 28:386–389.

Jumali, Sunarto, D. J. Gubler, S. Nalim, S. Eram and J. Sulianti Saroso. 1979. Epidemic dengue hemorrhagic fever in rural Indonesia. III. Entomological studies. Am. J. Trop. Med. Hyg. 28:717–724.

Metselaar, D., C. R. Grainger, K. G. Oei, D. G. Reynolds, M. Pudney, C. J. Leake, P. M. Tukei, R. M. D'Offay and D. I. H. Simpson. 1980. An outbreak of type 2 dengue fever in the Seychelles, probably transmitted by *Aedes albopictus* (Skuse). Bull. W.H.O. 58:937–943.

Mitchell, C. J., B. R. Miller and D. J. Gubler. 1987. Vector competence of *Aedes albopictus* from Houston, Texas, for dengue serotypes 1 to 4, yellow fever and Ross River viruses. J. Am. Mosq. Control Assoc. 3:460–465.

Monath, T. P. 1986. *Aedes albopictus*, an exotic mosquito vector in the United States. Ann. Int. Med. 105:449.

Moore, C. G., D. A. Eliason, D. B. Francy and R. E. Bailey. 1990. Distribution and abundance of *Aedes albopictus* in eight U.S. cities. J. Am. Mosq. Control Assoc. (in press).

Moore, C. G., D. B. Francy, D. A. Eliason and T. P. Monath. 1988. *Aedes albopictus* in the United States: rapid spread of a potential disease vector. J. Am. Mosq. Control Assoc. 4:356–361.

Pratt, J. J., R. H. Hetrick, J. B. Harrison and L. Haber. 1946. Tires as a factor in the transportation of mosquitoes by ships. Military Surg. 99:785–788.

Reiter, P. and R. F. Darsie, Jr. 1984. *Aedes albopictus* in Memphis, Tennessee (USA): an achievement of modern transportation? Mosq. News 44:396–399.

Reiter, P. and D. Sprenger. 1987. The used tire trade: a mechanism for the world-wide dispersal of container breeding mosquitoes. J. Am. Mosq. Control Assoc. 3:494–501.

Rightor, J. A., B. R. Farmer and J. L. Clarke, Jr. 1987. *Aedes albopictus* in Chicago, Illinois. J. Am. Mosq. Control Assoc. 3:657.

Shroyer, D. A. 1986. *Aedes albopictus* and arboviruses: a concise review of the literature. J. Am. Mosq. Control Assoc. 2:424–428.

Sprenger, D. and T. Wuithiranyagool. 1986. The discovery and distribution of *Aedes albopictus* in Harris County, Texas. J. Am. Mosq. Control Assoc. 2:217–219.

Tempelis, C. H., R. O. Hayes, A. D. Hess and W. C. Reeves. 1970. Blood-feeding habits of four species of mosquito found in Hawaii. Am. J. Trop. Med. Hyg. 19:335–341.

Tesh, R. B. 1980. Experimental studies on the transovarial transmission of Kunjin and San Angelo viruses in mosquitoes. Am. J. Trop. Med. Hyg. 29:657–666.

Thompson, W. H. 1981. Old auto and tractor tires, common sources of La Crosse encephalitis virus. Program and Abstracts, Energy, Health and the Environment. 109th Annual meeting, American Public Health Assn., Los Angeles, California, November 1–5.

Watts, D. M., S. Pantuwatana, G. R. DeFoliart, T. M. Yuill and W. H. Thompson. 1973. Transovarial transmission of La Crosse Virus (California encephalitis group) in the mosquito, *Aedes triseriatus*. Science 182:1140.

Appendix 1. Symposium: Current status of *Aedes albopictus* (Organizer C. G. Moore).

1. Current status of *Aedes albopictus* in the United States. D. B. Francy, C. G. Moore, D. A. Eliason. Division of Vector-Borne Diseases, Centers for Disease Control, Fort Collins, CO.

2. Status of *Aedes albopictus* in the Midwest: La Crosse belt distribution. D. M. Wesson, G. B. Craig, Jr. Univ. of Notre Dame, Notre Dame, IN.

3. Distribution and abundance of *Aedes albopictus* in eight U.S. cities. C. G. Moore, D. A. Eliason, D. B. Francy, R. E. Bailey. Division of Vector-Borne Viral Diseases, Centers for Disease Control, Fort Collins, CO.

4. Effects of parasitism on population structure in *Aedes albopictus*. L. E. Munstermann, D. M. Wesson. Univ. of Notre Dame, Notre Dame, IN.

5. Population dynamics of *Aedes albopictus* in New Orleans. J. E. Freier. Div. of Vector-Borne Viral Diseases, Centers for Disease Control, New Orleans, LA.

6. Evolution of photoperiodism in *Aedes albopictus*. W. A. Hawley, C. B. Pumpuni, G. B. Craig, Jr. Univ. of Notre Dame, Notre Dame, IN.

7. Interspecific mating between *Aedes albopictus* males and *Aedes aegypti* females in the laboratory and field. R. S. Nasci, G. Hare, S. Willis. Dept. of Biological & Environmental Sciences, McNeese State Univ., Lake Charles, LA.

8. *Aedes albopictus* in the Americas: evolutionary genetics and vector competence to dengue. K. S. Rai , S. Kambhampati, W. Black, R. Boromisa. Univ. of Notre Dame, Notre Dame, IN.

9. Vector competence of North American *Aedes albopictus* for La Crosse virus. T. G. Streit, P. R. Grimstad. Univ. of Notre Dame, Notre Dame, IN.

10. International movement of *Aedes albopictus*, and efforts to prevent new introductions. D. A. Eliason, E. G. Campos, R. B. Craven. Division of Vector-Borne Diseases, Centers for Disease Control, Fort Collins, CO.

11. Regulation of scrap tires to control mosquitoes. J. C. Marlin. Illinois Pollution Control Board, Springfield, IL.

12. Control-related studies on *Aedes albopictus* in Harris County, Texas. D. Sprenger. Harris County Mosquito Control District, Houston, TX.

13. The *Aedes albopictus* eradication program in Ohio, 1988. R. L. Berry, M. A. Parsons, R. A. Restifo, M. G. Collart, G. M. Marciniak. Ohio Department of Health, Columbus, OH.