The single *Cx. tarsalis* collected in the Great Swamp does not, in itself, represent a health hazard, but the species is known to be a major vector of both western equine encephalitis and St. Louis encephalitis (SLE). Although SLE in the eastern states appears to be restricted to an urban-suburban cycle, the establishment of *Cx. tarsalis* in the area could lead to its involvement in a rural transmission cycle of the disease in a manner similar to its role in the western states. The finding of *Cx. tarsalis* points to the need for further surveillance to document its continued presence and monitor its spread and potential as a vector species in the area.

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USE OF AN EXTERIOR CURTAIN-NET TO EVALUATE INSECTICIDE/MOSQUITO BEHAVIOR IN HOUSES

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In the Americas, vector control is largely being attempted through the use of chemical pesticides (World Health Organization 1983). The concept that malaria transmission can be interrupted by the use of residual insecticides has long been the basis for malaria eradication programs. However, insecticides may also influence mosquito behavior (Pampana 1966). When considering other aspects, including the repellent effect and long-term use of insecticides especially in DDT/malaria programs, mosquito behavior may change (Martinez-Palacios and de Zulueta, 1964).

In addition, variability in human behavior, traditions, migration patterns, types of housing, etc., may significantly contribute to the persistence of malaria in many areas. For example, in the state of Oaxaca, houses that were located on the periphery of the community and those that lacked or had discontinuous walls were found to be in the areas of highest malaria transmission (de Zulueta and Garrett-Jones 1963).

In the highlands of Mexico houses are usually constructed of adobe (solid walls) and tile or corrugated metal roofs. In contrast, the rural houses of the tropical coastlands are predominately small multi-roomed dwellings constructed of loosely fitting split bamboo or palm vein walls and palm thatch roofs. This type of construction is economical in terms of availability of materials and practical in areas of high humidity and rainfall, where natural ventilation is important. The evaluation of insecticides or vector behavior in coastal areas presents unique problems. Traditional entry/exit traps are not practical because of the many openings in the walls. One method of solving this problem is to surround the house with a curtain with the objective of creating an artificial wall. The curtain net or "Colombian Curtain" was first used by Elliott (1972) in Colombia. The procedure involved encircling the exterior of a house from the ground to roof with a cotton polyester mosquito net.

Elliott's method of using the curtain or drop net was to raise it for 30 minutes of each 2-hr period and then lower it. Resting mosquitoes were counted on the interior of the curtain and inside the house. Difficulties were, however, encountered with this technique. Even though mosquitoes were eliminated from the house at sunset and dawn, the number of mosquitoes intercepted leaving was 2–3 times greater than the number captured while entering. He concluded that by using the curtain in this way, it was a more efficient exit than entrance trap. Another difficulty was that when the curtain was up, it was not possible to evaluate mosquito movements as they were able to enter and exit freely.

A modification of the technique that is presently being used is one in which the curtain remains stationary in order to allow a more complete observation of mosquito migration in and out of the house, the feeding behavior, the duration of time in the house and the mortality. The curtains consist of several pieces of mos-

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quito netting that are sewn together to form a rectangle, 3 × 40 m. The borders are trimmed with cotton material to protect the edges of the curtain. The curtain is attached to the eaves of the roof of an occupied house and allowed to hang freely to the ground creating a small space between the house and the curtain. The ends of the curtain form an overlapping flap which allows the occupants to enter and leave without letting the mosquitoes escape.

In the evaluation of an insecticide at least two curtains should be employed, one for the treated house and another for a comparable nontreated house which will act as a control. To obtain baseline information, the curtains should be used for 4–6 weeks before the application of the insecticide. This information serves as a second control.

With the curtain in position and prior to starting the test, all the mosquitoes resting inside the house are collected and removed using an aspirator. Starting just after dusk (1800 hr) and continuing every hour on the hour, an inspection of the outside of the curtain is made. *Anopheles* mosquitoes are collected with an aspirator, counted, and identified and then classified as being fed or unfed. The unfed mosquitoes are then released inside the house. This collection and release is continued throughout the night until 0600 hr. An improvement in this technique is to capture a fixed number of unfed mosquitoes (approximately 150) from human-bait or corral collections and release them into the house instead of mosquitoes resting on the curtain. Since the release is made at one specified time, the length of time a mosquito stays in the house can be accurately determined.

Mosquitoes resting on the interior of the curtain are collected every hour on the half hour and separated into netted cups depending upon whether they are fed or unfed. These are held for 24 hr and observed for mortality. In order to improve the efficiency of the collection of dead or morbid mosquitoes, 1 meter wide white sheets are placed on the ground parallel to the exterior walls inside the house. A white sheet can also be placed on the ground between the curtain and the outside wall. The overall indoor mortality is calculated from the mosquitoes exiting the house along with those mosquitoes found on the sheets.

With the application of an insecticide it may be difficult to account for all of the mosquitoes released inside the house. A Recovery Index can be calculated by dividing the number of mosquitoes collected by the number released. When this is compared with the control house an indication of the immediate mortality of the insecticide can be determined. In order that valid results be obtained, care must be taken to maintain a high search efficiency for mosquitoes.

An important factor in the evaluation of mosquito behavior in relation to insecticides and the use of the curtain trap is the conversion of indoor mosquito populations from unfed to fed. A decrease in the proportion of engorged mosquitoes indicates that the insecticide has interfered with the feeding success of the mosquitoes. For example, in the evaluation of the carbamate insecticide bendiocarb, in a small village in southern Mexico, posttreatment cumulative percent of exiting fed mosquitoes decreased by 14% when compared to pretreatment (Table 1). By October, 8 weeks after spraying the cumulative percent was 35% lower than pretreatment levels. In November, the feeding success returned to pretreatment levels.

In the evaluation of insecticides, it is useful to compare exit/entry patterns and duration of time in the house between treated and untreated houses. These data can be used to determine if there is a repellent effect. Hourly comparisons can be made to determine differences. Table 2 gives results of entering and exiting patterns of *Anopheles albimanus* Wiedemann in pre- and posttreatment houses sprayed with bendiocarb. During August, September and October, 2.5 months postspray, mosquitoes tended to leave houses earlier as compared to prespray levels.

The overall mosquito mortality is also important in order to determine insecticide efficacy. The combined mean mortality of fed and unfed mosquitoes (including dead mosquitoes collected from the floor) was 90% immediately following application and remained higher

Table 1. Cumulative percent of fed exiting *Anopheles albimanus* collected hourly from the curtain in houses sprayed with bendiocarb.

	Hour					
Treatment and month	2000	2200	2400	0200	0400	0600
Prespray	2.9	12.9	21.9	37.0	49.6	62.8
Postspray (Aug.–Sept.)	0.8	8.1	20.9	34.8	42.1	48.7
Postspray (Oct.)	1.2	11.1	16.2	22.0	25.6	27.5
Postspray (Nov.)	0.0	18.6	33.9	49.2	64.5	69.6

Table 2. Cumulative percent of exiting *Anopheles albimanus* collected hourly from the curtain in houses sprayed with bendiocarb.

	Hour											
Treatment and month	1900	2100	2300	0100	0300	0500	2000	2200	2400	0200	0400	0600
Prespray	5.3	39.1	78.2	86.2	95.5	100.0	5.1	21.2	41.4	63.3	80.8	100.0
Postspray (Aug.–Sept.)	10.9	39.0	61.4	85.0	95.4	100.0	4.1	26.2	52.4	72.5	85.6	100.0
Postspray (Oct.)	14.6	50.8	82.0	92.8	97.7	100.0	7.8	37.2	68.1	86.8	94.8	100.0
Postspray (Nov.)	11.1	57.8	72.2	79.9	96.6	100.0	1.7	23.7	44.0	60.9	79.5	100.0

Table 3. Percent mortality of *Anopheles albimanus* collected from the curtain in houses sprayed with bendiocarb.

Treatment and month	Fed	Unfed
Prespray	0	0
Postspray (Aug.–Sept.)	82	98
Postspray (Oct.)	60	95
Postspray (Nov.)	63	83

than 70%, 2.5 months postspray (Table 3). Unfed mosquitoes were found to have a higher mortality than fed mosquitoes indicating that they have a higher susceptibility to insecticide intoxication or rested longer on treated surfaces than fed mosquitoes.

The use of the curtain trap as it is described can be extended to the study of other aspects of mosquito behavior. This could include using engorged mosquitoes resting on the exterior of the curtain for bloodmeal analysis. In addition, mosquitoes could be analysed to determine parasite infection rates as related to epidemological studies.

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FIRST RECORD OF MALARIA AND ASSOCIATED *ANOPHELES* IN EL GARA OASIS, EGYPT[1]

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Oasis malaria is an epidemiologically unique form of this disease since it usually occurs in isolated populations living under extreme conditions. Historically, the five major Egyptian oases were endemic for malaria, including *Plasmodium vivax*, *P. falciparum* and *P. malariae* (Halawany and Shawarby 1957). Early surveys by Barber and Rice (1937) showed that *Anopheles sergentii* (Theobald) was likely the major oasis malaria vector, as in other oases throughout the Middle East (Farid 1956). Although *An. sergentii* from the Egyptian oases has never been found infected with sporozoites, control programs focusing on this species in Siwa Oasis substantially reduced malaria prevalence from 19% to less than 1% (Halawany and Shawarby 1957). Malaria, primarily *P. vivax*, persists at a low rate in Siwa Oasis, but there have been no recent reports of malaria from the other major oases.

[1] This study was supported by research contract No. AI 22667/NIH-NIAID, entitled: "Epidemiology and Control of Arthropod-Borne Diseases in Egypt" between Ain Shams University (Research and Training Center on Vectors of Diseases), Ain Shams University, Abbassia, Cairo, Egypt, and the National Institute of Allergy and Infectious Diseases (NIAID), National Institutes of Health (NIH), Bethesda, Maryland, USA.

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