exponent), depress label C; enter price per kilogram, depress label E; and perform calculations by depressing label D. The cradle will print each value entered with notation at right margin (L/S, MIN, PPM, Pr., Cost) and then print "Kilograms BTI =" followed by the number of kg required for treatment, price and cost of the treatment.

References Cited

Bean, H. S. 1971. Fluid meters, their theory and application. Am. Soc. Mechan. Engineers, New York. 273 pp.

Buchanan, T. J. and W. P. Somers, 1969. Discharge measurements at gaging stations. *In* Techniques of water resources investigations of the U.S. Geological Survey, Ch. A8, Book 3, 65 pp. U.S.G.S.

Fredeen, F. J. H. 1974. Tests with single injections of methoxychlor black fly (Diptera: Simuliidae) larvicides in large rivers. Can. Entomol. 106:285–305.

Fredeen, F. J. H. 1975. Effects of a single injection of methoxychlor black fly larvicide on insect larvae in a 161-km (100-mile) section of the North Saskatchewan River. Can. Entomol. 107:807–817.

Hammer, M. J. and K. A. MacKichan. 1981. Hydrology and quality of water resources. John Wiley and Sons, New York. 486 pp.

Hocking, B. 1950. Further tests of insecticides against black flies (Diptera: Simuliidae) and a control procedure. Scient. Agr. 30:489–508.

Hocking, B., C. R. Twinn and W. C. McDuffie. 1949. A preliminary evaluation of some insecticides against immature stages of black flies (Diptera: Simuliidae). Sci. Agric. 29:69–80.

Undeen, A. H. and L. A. Lacey. 1982. Field procedures for the evaluation of *Bacillus thruingiensis* var. *israelensis* (Serotype 14) against black flies (Simuliidae) and nontarget organisms in streams. *In* (D. Molloy ed.), Biological control of black flies (Diptera: Simuliidae) with *Bacillus thuringiensis* var. *israelensis* (Serotype 14): A review with recommendations for laboratory and field protocol. Misc. Pub. Entomol. Soc. Am. 12(4):25–30.

Wallace, R. R., H. B. N. Hynes and W. F. Merritt. 1976. Laboratory and field experiments with methoxychlor as a larvicide for Simuliidae (Diptera). Environ. Pollut. 10:251–269.

Wallace, R. R., A. S. West, A. E. R. Downe and H. B. N. Hynes. 1973. The effects of experimental blackfly (Diptera: Simuliidae) larviciding with Abate, Dursban, and methoxychlor on stream invertebrates. Can. Entomol. 105:817–831.

ARTHROPODS COLLECTED FROM AIRCRAFT AT PIARCO INTERNATIONAL AIRPORT, TRINIDAD, WEST INDIES.[1]

ASHTON LE MAITRE AND DAVE D. CHADEE

Insect Vector Control Division, Ministry of Health and Environment, P.O. Box 556, Port of Spain, Trinidad, West Indies

ABSTRACT. Insects were collected and identified from local and foreign aircraft entering Piarco International Airport, Trinidad, West Indies. Nine hundred and sixty-seven specimens were collected from 592 aircraft. The specimens collected represented eight taxonomic orders and 25 families. *Aedes aegypti*, an important vector of dengue and urban yellow fever, and *Anopheles albimanus*, a non-indigenous malaria vector were among those collected. *Musca domestica*, the house fly, was by far the most abundant insect in the collection, accounting for over 83% of the total catch. The need to maintain entomological surveillance at airports and seaports was encouraged.

INTRODUCTION

The Insect Vector Control Division of the Ministry of Health and Environment, Trinidad and Tobago, West Indies, has maintained entomological surveillance at Piarco International Airport since 1939. Mosquitoes and other arthropods have been collected from aircraft and ships at international airports and seaports in many parts of the world (Soper and Wilson 1943, Pippin et al. 1968, Evans et al. 1963, Fox et al. 1961, Eads et al. 1965, Hughes 1961, Campos et al. 1961).

It has been shown that airport and seaport surveillance is an important feature of vector control, since in many tropical countries the vectors of a number of diseases occur in airport environments. Because of this fact, and due to increases in air travel, the chance of introduction of disease and associated vectors from one country to another has been increasing (Laird 1951, Highton and Van Someren 1970).

[1] Published with approval from the Ministry of Health & Environment, Trinidad, and Tobago, West Indies.

This paper reports on the collection of arthropods from aircraft at Piarco International Airport, Trinidad, W.I. during 1965 to 1974.

MATERIALS AND METHODS

During 1965 to 1974, a total of 89,863 aircraft were examined for insects at Piarco International Airport. Aircraft belonging to 10 airlines were examined as follows: Air France; British Airways (BA), British West Indian Airways (BWIA), Royal Dutch Airlines (KLM), Pan American Airways (Pan Am), Antilles Dutch Airlines (ALM), Arawack Airlines, Leeward Island Air Travel (LIAT) and Venezuela International Airline, South America (VIASA). A number of private aircraft were also examined.

Health Control Officers attached to Insect Vector Control Division entered aircraft as soon as the crew and passengers disembarked. A conscientious effort was made to capture all insects using flashlights, nets, forceps and killing jars. Collections were made in the passenger cabins, cockpit, toilets, galleys and baggage and cargo compartments.

All insects collected were placed into pill boxes and transported to the Insect Vector Control Division Laboratory for identification.

RESULTS AND DISCUSSION

Nine hundred and sixty-seven specimens representing 8 orders (Diptera, Coleoptera, Lepidoptera, Dermaptera, Orthoptera, Trichoptera, Hymenoptera and Araneida) were collected during this survey (Table 1). The specimens from the eight orders were identified as representing 24 taxonomic families and 39 species. Only species of medical and/or veterinary importance will be discussed in this paper.

From a total of 89,863 aircraft inspected during this study, 592 aircraft belonging to 9 airlines were found carrying arthropods.

Eighty-three percent of the insects collected were house flies (*Musca domestica* Linn.). As domestic and foreign house flies cannot be distinguished by morphology, it was not possible to determine the origin of the house flies.

Mosquitoes constituted 5.3% of the arthropods collected. The mosquitoes collected included *Aedes taeniorhynchus* (Wied). *Ae. aegypti* (Linn.), *Aedes* species, *Anopheles albimanus* Wied., *An. aquasalis* Curry, *Culex quinquefasciatus* Say, and other *Culex* species.

Culex quinquefasciatus was the most abundant mosquito species collected, with a total of 28

Table 1. A summary of arthropods collected from local and foreign aircraft from 1965 to 1974 at Piarco International Airport, Trinidad, W. I.

Order	Family	Species	Last port	No. collected
Diptera	Culicidae	*Aedes aegypti*	Brazil, Guadeloupe	2
		Aedes taeniorhynchus	Puerto Rico, Venezuela.	3
		Anopheles aquasalis	Grenada	2
		Anopheles albimanus	Puerto Rico	2
		Culex quinquefasciatus	Brazil, Barbados, Venezuela, Grenada, Martinique, Surinam, Colombia.	28
		Culex sp.	Grenada, Barbados, Colombia, Martinique, Puerto Rico.	13
	Tabanidae	Unknown species	Haiti, Guyana.	4
	Muscidae	*Stomoxys calcitrans*	Barbados, Grenada, Venezuela, Guyana.	17
		Musca domestica	Barbados, Brazil, Venezuela, Curacao, Guyana, U.S.A., Surinam, Grenada, Haiti, St. Vincent, St. Lucia, Martinique, Marquetia, Mexico.	791
		Unknown species	Guyana, Grenada.	3
	Misc. Families		Venezuela, Grenada, Guyana, Barbados, Colombia.	38
Hemiptera	Reduviidae	Unknown species	Haiti.	1
Orthoptera	Balattellidae	*Blattela germanica*	Portugal, Venezuela, Brazil, Grenada.	20
		Misc. Family	Barbados	1
Araneida		Unknown Araneida	Barbados, Grenada, Venezuela.	3
Trichoptera			Guyana, Barbados.	4
Hymenoptera			Grenada, Guyana, Venezuela.	7
Coleoptera			Brazil, Venezuela, Grenada, Barbados.	14
Lepidoptera			Barbados, Guyana, Grenada, Venezuela.	14
			Total	967

specimens. A number of mosquitoes were collected but 10 specimens were damaged and could not be identified. The interception of *Anopheles albimanus* represents a non-indigenous mosquito species and the introduction of an important vector of malaria into Trinidad. Of particular interest were 3 malaria cases, possibly infected near Orly Airport and de Roissy Airport by anopheline mosquitoes carried to France by aircraft (Gentilini et al. 1981).

In light of these 3 malaria cases in France and the importation of *Anopheles albimanus* into Trinidad during this survey, it leaves little doubt as to the value of quarantine measures against the importation of insects of medical importance.

Miller et al. (1947) and Evans et al. (1963) reported that approximately 10% of mosquitoes which gain access to aircraft were apt to be collected by aircraft inspectors. This seems likely when considering the cabin area, as detection is very difficult in these locations because of the seats, curtains and other equipment

During this survey mosquitoes were captured from flights originating in Brazil, Guadeloupe, Puerto Rico, Venezuela, Grenada, Barbados, Suriname and Colombia.

Cockroaches were frequently collected and the species most commonly collected was *Blatella germanica* Linn. Since live cockroaches are difficult to capture in lighted cabins, it is suspected that the cockroach population may be higher than that collected. In addition, it is difficult to determine whether there was an established cockroach population aboard the aircraft or if the species collected were transported into the cargo ducts by luggage, cargo in transit or in food modules.

The stable fly, *Stomoxys calcitrans* Linn., is a major pest of livestock throughout the world. Seventeen specimens were collected from aircraft arriving from Barbados, Grenada, Venezuela and Guyana. A number of specimens were captured from the aircraft cabin.

The results of this study illustrate the need for a continuation of the preventive program to meet the potential threat of entry of insects of medical and agricultural importance. The number of insects transported by aircraft illustrates the point that without aircraft surveillance, serious damage to crops and to human life may be the consequence.

ACKNOWLEDGMENTS

We wish to thank the Health Control Officer attached to Insect Vector Control Division for the collection of the insect specimens. Special thanks should go to Mr. E. C. Peru (Chief Laboratory Superintendent) for assisting in the identification of the insects collected. In addition, we thank Dr. Roderick Dougdeen, Principal Medical Officer (Epidemiology) and Dr. Eugene Laurent, Principal Medical Officer (Environmental Health) for encouragement and assistance during this project. We also thank Dr. A. B. Knudsen and Mr. R. Aarons, Pan American Health Organization, PAHO/WHO, Trinidad W.I. for reviewing the manuscript.

References Cited

Campos, E. G., H. A. Trevino and L. G. Strom. 1961. The dispersal of mosquitoes by railway trains involved in international traffic. Mosq. News 21:190–192.

Eads, R. B., E. G. Campos and H. A. Trevino. 1965. Mosquitoes Recovered from Mexican ships entering quarantine at Brownsville, Texas, Mosq. News 25:64–65.

Evans, B. R., C. R. Joyce and J. E. Porter. 1963. Mosquitoes and other arthopods found in baggage compartments of international aircraft. Mosq. News 23:9–12.

Fox, I. and I. García-Moll. 1961. The *Culicoides* of the international airport, Isla Verde, Puerto Rico, as shown by light traps. Mosq. News 21:120–132.

Gentilini, M., J. F. Trape, M. Davis, D. Richard-Lenolde, G. Brucker and H. Felix. 1981. Imported malaria in a hospital in Paris. Trans. R. Soc. Trop. Med. Hyg. 75:455–460.

Highton, R. B. and E. C. C. Van Someren. 1970. The transportation of mosquitoes between international airports. Bull. W.H.O. 42:334–335.

Hughes, J. H. 1961. Mosquito interceptions and related problems in aerial traffic arriving in the United States. Mosq. News 21:93–100.

Laird, M. 1951. Insects collected from aircraft arriving in New Zealand from abroad. Zool. Publ. Victoria Uni. Coll. 11:1–3.

Miller, A., R. W. Burgess and S. J. Carpenter. 1947. Potentialities of transportation of exotic anophelines by airplane. J. Nat. Malaria Soc. 6:227–243.

Pippin, W. F., S. Thompson and R. Wilson. 1968. The interception of living larvae of *Aedes aegypti* (L.) and *Culex cinerellus* Edw. in aircraft. Mosq. News 28:646.

Soper, F. L. and D. B. Wilson. 1943. *Anopheles gambiae* in Brazil, 1930–1940. Rockefeller Foundation. New York.