MEDICAL ENTOMOLOGY AND VECTOR CONTROL IN LATIN AMERICA

ROBERT J. TONN[1, 2]

Pan American Health Organization, Washington, DC 20037

ABSTRACT. Career opportunities in medical entomology are scarce in the Americas. Malaria and other vector control activities within Ministries of Health are dominated by the medical profession. Consequently, there has been little emphasis in universities to provide adequate training in medical entomology. The philosophy that vector-borne diseases such as malaria or vectors such as *Aedes aegypti* can be eradicated, right or wrong, has influenced the amount and quality of research. Universities have tended to devote research to leishmaniasis and other diseases not under eradication by Ministries. Factors relating both to the vector and to man have produced serious control problems, and diseases such as malaria are on the increase.

INTRODUCTION

Although in reality these two subjects should not be separated, they frequently are and I have chosen to do so. Medical entomology will be discussed as an academic and research discipline while vector control will be an operational one. Fortunately, in the past few years the two disciplines are becoming more compatible in Latin America.

MEDICAL ENTOMOLOGY—TRAINING

There are few local-trained professional medical entomologists in Latin America. The majority of entomologists with training in economic entomology are employed in this capacity in universities or ministries of agriculture. In governments few opportunities are found for career advancement in medical entomology. Governments frequently bypass this problem by recruiting foreign entomologists or asking international agencies, such as the World Health Organization (WHO) to furnish them. This is a short sighted solution and must be changed.

Many Latin American universities have good courses in undergraduate zoology and biology but offer little in graduate work. Recently, with the assistance of the Centers for Disease Control (CDC), the "Universidad del Valle" in Guatemala established a "Licenciatura" Program in Medical Entomology. The University offered scholarships to the malaria personnel of the country but these students were expected to work full time as well and may not have received the full benefit of the course. Other problems observed during the course were lack of textbooks in Spanish and few career opportunities once the degree was obtained.

One of the successful medical entomology programs has been the annual short course given by Dr. O. P. Forattini at the School of Public Health in São Paulo, Brazil. A number of professionals from throughout Latin America have been sent there on Pan American Health Organization (PAHO) fellowships. Professional courses were offered at Manaus, Brazil and at the Institute of Oswaldo Cruz Rio de Janeiro, Brazil but neither has given routine training. In 1978, the Special Program of the UNDP/WHO/World Bank began negotiations to establish a master's level course in medical entomology in Venezuela, but to date no progress has been made and the Special Program is

[1] Regional Advisor in Medical Entomology and Vector Control, PAHO.

[2] Presented at International Seminar on Medical Entomology and Vector Control, 38th Annual Meeting of the American Mosquito Control Association, Sacramento, CA.

beginning to look into establishing it in other countries. Unfortunately, none seems to have the nucleus of professionals needed to provide acceptable training. The University of Panama is attempting to find staff to offer a master's degree by 1982 and it is hoped that they will be successful.

MEDICAL ENTOMOLOGY—RESEARCH

Early entomological research was largely descriptive with amateurs who collected insects and attempted to classify them. In Latin America one can still find lawyers, physicians and veterinarians serving as taxonomic authorities. This has produced few major museum collections outside of North America within the Americas, as material was kept in individual collections or sent to museums in the United States or Europe. Early descriptive entomology tended to be isolationistic, resulting in taxonomic problems especially of synonomy which still plague us today.

Workers associated with the "Mosquitoes of Middle America" project and others like Dr. J. B. Kitzmiller and his students working on genetics of *Anopheles,* or Dr. H. Lent working on the triatomes, have studied taxonomic groups and their distribution. A new generation of taxonomists using modern tools like isoenzyme techniques such as Dr. J. L. Petersen at Gorgas, Dr. W. W. M. Steiner working with Dr. Kitzmiller, Dr. S. P. Miles in Brazil and Dr. Tibayrenc in Bolivia are beginning to solve epidemiologic-distribution problems associated with vectors and disease.

Most of the early distribution studies were not done by entomologists but by epidemiologists who were forced into becoming familiar with vectors. These studies were devoted principally to finding relationships between the pathogen and the disease. Notable exceptions to this have been the excellent studies of the Rockefeller arbovirus program in the Americas, research by the Gorgas Memorial Laboratory and more recently by the NIH International Centers for Medical Research and Training in Brazil, Colombia, and Costa Rica; the Harvard/Welcome projects in Brazil, the Cornell University arbovirus studies in Central America and Mexico, the NAMRU in Panama, the "Mosquitoes of Middle America" project and others.

Ecological studies have expanded upon the information obtained from taxonomic research in the Americas. These studies have assisted in increasing knowledge of epidemiology and have been largely applied research. The elaboration of the jungle yellow fever cycle is one of the earliest examples. Others now deal with the invasion of the jungle vectors into semiurban areas, finding new potential jungle vectors and reservoirs of diseases and the determination of sylvan and urban vectors by blood source determinations, such as is being done by Dr. J. V. Scorza at the University of the Andes in Venezuela for vectors of leishmaniasis and Chagas' disease, and Dr. H. A. Christensen and his predecessors at the Gorgas Memorial Laboratory on a number of vectors. Excellent ecological studies are being done in Brazil associated with the construction of the Transamazon Highway, some of these were done in collaboration with the Walter Reed Army Institute of Research.

Not much has been done with the use of computers in ecology, but Dr. Rabinovich at IVIC in Venezuela has been working on models for Chagas' disease and onchocerciasis. One of the best ecology studies done in Latin America was the cooperative USDA-CDC work in El Salvador which lead to the sterile male release for *Anopheles albimanus* control.

PAHO has had a role in developing interest in medical entomology through its research programs. The one on insecticide resistance in malaria vectors first was located in El Salvador and Nicaragua before moving to Tapachula, Mexico. Current research is designed to study possible differences in malaria in various agricultural situations and to develop

control strategies aimed at resolving local problems. Dr. G. P. Georghiou at the University of California is cooperating with the project by studying genetics related to insecticide resistance and its relationship with agricultural pesticide use.

The PAHO project in Maracay, Venezuela studies primarily the natural history of Chagas' disease but has studied *Aedes aegypti* control and distribution of leishmaniasis vectors. In Bogotá, Colombia an *Ae. aegypti* project has been testing the efficacy of insecticides and equipment in control and recently, with help from the government of The Netherlands, *Ae. aegypti* ecology and distribution is being studied. Recent developments have been locating *Ae. aegypti* breeding at 2200 meters elevation in Colombia and noting the presence of *Ae. aegypti* in isolated rural areas. The Caribbean Epidemiological Center in Trinidad has studied the biology, ecology, and control of simuliids in Guyana and the ecology of *Haemagogus* in Trinidad and with the assistance from the British Medical Research Council, has studied filariasis along the northern coast of Trinidad. The Human Ecology Center in Mexico is investigating urban/rural problems including pesticides and their toxic effects. PAHO also is involved in providing specialized courses and fellowships in medical entomology and vector control.

Medical entomology research in Latin America is dominated by a few individuals doing outstanding research. Many of the countries have the equivalent of the US National Science Foundation and the US National Academy of Science with funds to support a variety of entomological studies. In addition, funding may come from bilateral agencies, foundations and the UNDP/WHO/World Bank Special Program.

Research in Latin America is badly needed on the following: 1) insecticide resistance, especially in the cotton areas of Mexico and Central America, 2) exophilic nature and vectorial capacity of *Anopheles,* 3) improved control methods for *Aedes aegypti* and malaria, 4) taxonomy and distribution information on most vector species using modern taxonomic tools, 5) effect of dams, hydroelectric, irrigation projects as well as other environmental manipulation on vector ecology, (Dr. R. S. Panday in Suriname has made some good studies here), 6) identification of jungle yellow fever and leishmaniasis vectors, 7) effect of human migration into new areas on Oropouche virus disease, leishmaniasis, and other arthropod-borne diseases, and 8) urbanization and its role in the epidemiology of vector-borne disease.

VECTOR CONTROL

Some of the most intensive early attempts at vector control have been in the Americas. For example, General W. C. Gorgas in Havana and Panama; Dr. F. L. Soper, his Rockefeller colleagues and country counterparts on *Aedes aegypti* and *Anopheles gambiae* eradication; and the Tennessee Valley Authority on malaria control in the United States. Many of the earlier successes centered on environmental management. New optimism was expressed with the introduction of DDT and the early spectacular results of its use for malaria vector control in Guyana by Dr. G. Giglioli and in Venezuela by Dr. A. Gabaldon. These successes along with the earlier confidence of Dr. Soper and his colleagues that species eradication was possible, produced a commitment of the PAHO member countries towards eradication of *Aedes aegypti* and malaria. Unfortunately, by the time countries were making these resolutions, resistance to DDT was already appearing and other program problems began to occur.

This commitment to eradicate produced one serious drawback, which was a philosophy that entomological research is unnecessary. For years the only role of the entomological technician in eradication programs was species identification. As insecticide resistance increased, these technicians began to do insecticide susceptibility testing with WHO field test kits. A search of the literature on malaria

vectors and *Ae. aegypti* in the Americas will produce few papers on biology, ecology and distribution, while in Asia and Africa, foreign experts and their national counterparts are outproducing their Latin colleagues in these fields. Latin scientists are active, but are directing their efforts to Chagas' disease, leishmaniasis, filariasis and onchocerciasis and other vector-borne diseases without eradication commitments.

Although few national vector control programs have professional entomologists, an attempt is being made to establish cooperative projects with the universities. The fact that over US$140,000,000 was spent on malaria, *Aedes aegypti* and Chagas' disease control programs in 1979, calls attention to the need to train and hire entomologists in these programs.

Since 1976 there has been a 56.6% increase in malaria cases with 598,594 cases registered in 1980. The budget for 1980 for malaria control was $131,429,259 which was an 18.1% increase over 1979.

The problems are basically: 1) physiological resistance to insecticides, 2) resistance of *Plasmodium falciparum* to antimalarial drugs, 3) human migration and poor housing, 4) cost of operation and shortage of financial resources, 5) sociopolitical and cultural aspects of human behavior, and 6) lack of knowledge of vector biology and ecology, vectorial capacity of many species such as *An. nuneztovari.*

The *Aedes* situation is equally bleak with all 4 dengue serotypes now present in the Americas. A major dengue 1 epidemic beginning in Jamaica in 1977 reached the United States in 1980 and dengue haemorrhagic fever caused 158 deaths in Cuba in 1981. Most of the same technical and adminsitrative problems exist as in malaria control. In addition, *Ae aegypti* larvae are being found in a wider range of habitats and are frequently found in natural containers and in isolated rural areas. There is little consensus on procedures to follow for *Ae. aegypti* control. Each control situation is unique but there is failure to separate dogma from technical reality.

The only other vector-borne disease with a national control operation is Chagas' disease. There are programs in Argentina, Uruguay, Brazil, and Venezuela with some control activity in Chile, Ecuador, Peru and Paraguay.

Vector control receives a low priority in many Ministries of Health. After years of failure, one cannot blame this shift in priorities. However, the problems of vector related diseases are real and many of these diseases infect more people each year. The toll of these diseases on gross national output and other economic indicators can be significant.

PAHO has a unit of Malaria, Parasitic Diseases and Vector Control in Washington. The Americas for administrative purposes are divided into 6 areas and the English speaking Caribbean, with each having either an entomologist or a malariologist or an epidemiologist collaborating with national vector control programs. The PAHO staff may still be associated with individual national programs but their number is decreasing. There is an active consultant program to send experts into countries to evaluate operations or give expert advise. This exercise is frequently done in cooperation with WHO, AID or CDC.

PAHO coordinates border, area and regional meetings with directors of country malaria projects and cooperates in planning strategy for future actions. There is a small research grants program and an extensive fellowship program. The latter assists in sending participants to malaria and public health courses given in Venezuela, Colombia or Mexico. There are also traveling fellowships and larger grants towards advanced education. Many of these activities are in collaboration with WHO Malaria Action Program.

In *Aedes aegypti* control-eradication, a team of 4 in Colombia with an epidemiologist as project leader functions to advise member countries in *Ae. aegypti* eradication. There is a technical officer assigned to Central America and an en-

tomologist and technical officer assigned to the Caribbean. During the 1981 dengue activity this staff was coordinated by a task force of a virologist, epidemiologist and entomologist at the PAHO headquarters in Washington. At present there are 8 professional entomologists in PAHO: 1 in Haiti (malaria), 1 in Mexico (malaria), 1 in Brazil (malaria), 1 in Venezuela (Chagas' disease), 2 in Colombia (*Ae. aegypti*), 1 in Trinidad (*Ae. aegypti*), and 1 in Washington (vector control).

The majority of PAHO consultants on vectors collaborate on *Aedes aegypti, Anopheles* or *Triatoma* related problems, However, they are occasionally asked to evaluate urban vector-pest control activities, pesticide usage and toxicology, rodent biology and control, and in the Caribbean pest mosquito and sand fly problems.

There are limited funds to purchase insecticides and equipment for emergencies and frequently the Organization assists countries in making purchases using national funds.

Latin America has serious vector problems including: 1) over 500,000 cases of malaria per year, 2) over 500,000 cases of dengue in 1981, 3) about 20,000,000 cases of Chagas' disease and 4) cases of leishmaniasis, filariasis, onchocerciasis, plague, other arbovirus diseases, typhus, schistosomiasis and others which may become increasingly important.

Solutions are not easy. Many of these diseases only affect the rural inhabitants and the poor. Economics direct attention to the maintenance of a healthy worker in an industrial complex and not to the poor or the agricultural worker. The urban population has the political power and in most cases the wealth. Medical entomologists, even if available, probably would have little influence in changing the above. But their accumulative effort might make life a little healthier for those in vector-borne endemic areas.

THE UNITED STATES INVOLVEMENT IN OVERSEAS MALARIA PROGRAMS

EDGAR A. SMITH[1, 2]

Center for Public Health Research, University of South Carolina, McClellanville, SC 29458

Historically speaking, the United States' interest in malaria overseas could be said to have begun with the building of the Panama Canal. Then in the late 1930's came the first foreign assistance to malaria programs through the Institute for Inter-American Affairs which earmarked some several million dollars, specifically for the control of malaria. In the 1940's the Rockefeller Foundation was extremely active and successful in demonstrations of malaria control in various places, but notably in Brazil, where they eradicated the introduced vector of malaria, *Anopheles gambiae*. Later they attempted to eradicate the vector in Sardinia. Although this attempt was not successful in eradicating the mosquito, it certainly led the way for eradication of malaria in many places with methods which have been used ever since. By the late 1940's and the early 1950's the United

[1] Formerly, Office of Health, Agency for International Development, Washington, DC 20523.

[2] Presented at World-Wide Medical Entomology and Vector Control Seminar, 38th annual AMCA meeting, Sacramento, CA. April 19, 1982.