The Medical Entomologist in Public Health

By E. HAROLD HINMAN, M.D., Ph.D., M.P.H.

In the period from 1897 to 1920, before the birth of medical entomology as a scientific discipline, the greatest discoveries in the role of arthropods in the transmission of human diseases were made by physicians, pathologists, bacteriologists, and others who had no basic interest in entomology. In 1879 Manson, a physician, discovered the part played by mosquitoes in the development of the filarial worm and later developed the mosquito theory of malaria transmission. Ross, another physician, tested this theory in 1897–98, and had his results confirmed promptly by British and Italian workers. Theobald Smith, a pathologist, with Kilbourne, in 1893 demonstrated that the cattle tick was the intermediate host of Texas fever of cattle.

In 1900 the American Yellow Fever Commission, consisting of Reed, Carroll, Lazear, and Agramonte, demonstrated the role of mosquitoes in the spread of yellow fever. In the early twentieth century, the role of fleas as vectors of plague was determined by Simond in 1898; of mosquitoes in the transmission of dengue by Graham in 1902; of ticks as vectors of relapsing fever by Ross and Milne in 1904; and Rocky Mountain spotted fever by Ricketts in 1906; and of body lice in the transmission of epidemic typhus by Nicolle et al. in 1909. The role of sandflies in pappataci fever and oroya fever, of mites in scrub typhus, and of deerflies in tularemia followed promptly. Most of these discoveries were made by physicians, pathologists, or bacteriologists, who "skimmed the cream" off the available knowledge of these arthropod-human disease relationships. Meanwhile, the entomologist was concerned primarily with the life history and control of various arthropods, but was rarely called upon, even as a consultant, in the prevention of these particular diseases.

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Medical Entomology, 1920–41

The two decades preceding World War II may be looked upon as the time of serious development of medical entomology. The parent science, entomology, had achieved some maturity by 1920, and in the United States such universities as Cornell, Minnesota, and California, with strong departments of entomology, had already established special courses in medical entomology. This gradually provided the nucleus of a small group of trained workers. The Bureau of Entomology (U. S. Department of Agriculture), the Public Health Service, and a few experiment stations employed an occasional entomologist for the study of vectors of human or animal diseases. A few special research institutes, such as the Gorgas Memorial Institute, retained a medical entomologist as a full-time staff member. The Rockefeller Foundation also employed a few medical entomologists. The Tennessee Valley Authority followed suit a number of years later.

Health departments were much slower than Government organizations and private foundations to accept the entomologist as a useful member of their professional team. In the United States, Dr. L. L. Williams, Jr., of the Public Health Service, developed the idea of a special

malaria control division in each of the southern State health departments and entomologists were given a prominent place. A group of engineers, entomologists, and medical officers were trained in malaria control during the summer of 1937 at the Rockefeller Foundation Malaria Station in Tallahassee, Fla., the Bureau of Entomology and Plant Quarantine (U. S. Department of Agriculture), the Public Health Service, and the Tennessee Valley Authority for employment in southern State health departments.

During these two decades, a great mass of medically important taxonomic, ecological, biological, and control data on arthropods was assembled. Three textbooks, by Herms, by Matheson, and by Riley and Johannsen, appeared in the United States. Numerous monographs and serial publications attest to the productivity of workers in medical entomology during this period. The Fourth International Congress of Entomology, held at Ithaca, N. Y., in 1928, had a section devoted to medical and veterinary entomology. By 1941 the science had truly come of age and the medical entomologist was recognized as a specialist by his fellow entomologists.

Despite these evidences of progress in establishing medical entomology as an important specialty, I seriously doubt that, with the exception of malaria control organizations, the average public health worker felt any spirit of kinship with the medical entomologist.

Another noteworthy exception to the recognition of entomological contributions was the utilization of entomologists in connection with mosquito abatement districts. Legislation in 1904 in New Jersey declared the mosquito to be a pest and directed boards of health to abate it. In California the law providing for the mosquito abatement districts was passed in 1915. In most instances these programs were directed against pest mosquitoes.

Medical Entomology, 1941 to Date

World War II drastically changed the status of the medical entomologist as a member of the health team. The Sanitary Corps of the Division of Preventive Medicine, Medical Corps of the Army, eagerly sought not only medical entomologists but general entomologists and even individuals with relatively little entomological training. Much of the early major fighting was in areas where malaria was often a greater problem than the enemy. Entomologists in research organizations also responded and were able to improve insecticides as well as techniques for the control of body lice, anopheline mosquitoes, and various other arthropods of medical importance. These newer tools gave the field man an opportunity to demonstrate the worth of entomologists. The Public Health Service, in discharging its responsibility for sanitation around military installations, organized the malaria control in war areas program. Its great success, plus the national downward trend in malaria cases, led them to embark upon an extended program and, subsequently, to undertake the national 5-year eradication program. The success of these campaigns may be ascribed in a goodly measure to the capability and devotion of their entomologists. Other notable malaria control campaigns, such as the *Anopheles gambiae* programs in Brazil and Egypt, and the programs in Venezuela, Sardinia, and Cyprus, have been planned and successfully executed due to the major contributions of entomologists. The yellow fever riddle (urban vs. jungle fever) was solved in a great measure by entomological and epidemiological investigations.

In the past 10 years the entomologist has made just as amazing progress in the laboratory as in field control operations. The screening of many thousands of substances for insecticidal, larvicidal, or ovicidal properties has not only developed new toxicants and formulations but also new "assembly line" techniques for rearing arthropods in the laboratory and for developing important new biological data. Anyone who has not visited the Orlando laboratory of the Bureau of Entomology and Plant Quarantine, or the Technical Development Services of the Public Health Service Communicable Disease Center in Savannah, has missed an opportunity to become acquainted with the ingenuity and industry of medical entomologists.

The Future

Some four or five years ago there was considerable sentiment among certain public health

workers, whose reputation placed them in the category of so-called elder statesmen, that DDT, BHC, and possibly some undiscovered insecticides would spell the doom not only of malaria, but probably of most other arthropod-borne infections. I was informed that there was no future in malaria control or in medical entomology.

As more adequate testing and large-scale control programs got under way, the potency of DDT and other toxicants was attested to; however, a number of problems, some of them administrative and some apparently due to the fact that arthropods have not "read the book," have lead us to the conclusion that the panacea is still not yet available.

Resistance to DDT was first noted in houseflies, then in culicines, subsequently in anopheline mosquitos, and later in body lice and in several other species of public health importance. This development of resistance to insecticides impresses upon us the need for more detailed studies on the physiology and general biology of disease vectors by the entomologist.

I believe it is now generally recognized as only a temporary illusion that residual sprays alone would permanently eradicate malaria or any other arthropod-borne disease. Certain biological factors can usually be found to account for the inadequacy of residual sprays, such as unusual resting habits and development of resistance. However, I believe the newer toxicants have more firmly than ever established the need for the medical entomologist.

The extensive routine adoption of the use of synthetic toxicants in the control of household or premise pests of man has tremendously increased the possibility of introducing poisonous materials into the food or drink or air taken in by man or his animals. The frequent opportunities for human contact with these materials has emphasized the importance of entomologists trained in toxicology.

Another development that may be anticipated in the future, on the basis of recent trends, is an increased interest in the role of arthropods in transmission of such diseases as encephalitis, Q fever, tularemia, and plague, and in the part played by muscoidean flies and roaches in the transmission of salmonellosis and shigellosis. Because of these trends, I feel confident that medical entomologists will be sought after and will continue to play an important role in public health along with other workers in that field.

Administrative Problems

In the evolution of public health work, emphasis originally was placed upon the control of epidemics. Gradually other communicable disease control activities began to receive more attention. In all of this work, physicians properly assumed leadership. It was also quite natural that doctors of medicine in public health should turn to able nurses in this program. As the role of the environment became better recognized, sanitary engineers and other sanitation workers established their positions in health departments. Public health laboratories had to be organized to execute a program of communicable disease control and environmental sanitation. Health education later became a "respectable" aspect of the public health program.

Medical entomologists are really the "Johnnie came lately" people in public health. The 1937 organization of malaria control teams placed them in State health departments for the first time. But had not the MCWA and its extended program and the CDC eradication program evolved, the entomologists probably would have completely disappeared even in the southern State health departments. Originally, a malaria division was established either in the bureau of sanitary engineering or as a part of the division of epidemiology. Because the practical application represented control of the environment, the medical entomologist usually ended up under the administrative direction of the State sanitary engineer. In the current transitional stage of the malaria eradication program, the entomologist is holding his own since the problem is largely one of surveillance. In one southern State health department, a subdivision of entomology has been organized within the division of sanitary engineering and is responsible for licensing and supervising pest control operators. In another State health department, a separate bureau of vector control has been established within the division of environmental sanitation. This bureau in 1946 was given the responsibility for the administra-

tion of a $400,000 subvention for local mosquito abatement work. Whether this pattern of placing pest mosquito control under supervision of State or local health departments will be widely adopted is not known because certain experiment station programs have become deeply involved in mosquito abatement. Similarly, the supervision of pest control operators has varied in its administrative allocation. In any event, the interests of the State health departments must be recognized in both disease control and environmental sanitation.

Training for Health Work

In a few of the branches of our Federal service, we find a sharp demand for the highly trained and specialized medical entomologist. I believe this will rarely be the case in State or local health departments. In the latter, there is much more likely to arise the need for a well-trained biologist with some special emphasis in medical entomology, in rodent ecology, in herpetology, in limnology (for stream pollution), in snail ecology, and in parasitology. The organization of the biology section within the Southern Branch of the American Public Health Association was a long-delayed recognition of the important contribution that biologists have made and are making in public health. Health departments below the Federal level have placed much greater emphasis upon operations than upon research. They have long worked upon the principle of teamwork and demanded versatility of the members of the team. If medical entomology is to make its maximum contribution in public health, its representatives will probably need to participate in vector control (rats included), in aquatic biology in connection with stream pollution problems, in pest mosquito control activities, and may possibly need to represent the health department in relations with commercial pest control operators.

Public Health Nursing Study

A study to determine the amount and kind of nursing services required to meet minimum public health nursing needs in local health departments was begun recently by the Division of Public Health Nursing, Bureau of State Services, Public Health Service. A 17-member committee, composed of national leaders in public health nursing, specialists in social research, and State and local health officials, is serving in an advisory capacity.

The study is attempting to answer such basic questions as (1) how much additional nursing service is needed in the rapidly expanding defense areas; (2) how can the available nursing supply be "stretched" to meet increasing needs; (3) how can practical nurses or other aids be used most advantageously in public health programs. It will supplement the over-all functional study being made by the American Nurses Association.

The shortage of nursing personnel, particularly public health nurses, has reached the acute stage. The presently accepted ratio of one public health nurse for every 5,000 population would require an additional 17,500 nurses. To supply 1 nurse for every 2,000 population, a ratio which has been suggested to meet increasing needs for nursing care of the chronically ill and aged patients, 40,000 to 50,000 nurses would be required.