ment made that "we do not plan to do any mosquito control this summer unless the mosquitoes get bad!" Yet, most of those communities, year after year have a mosquito problem. In most cases nothing is done until the Mayor receives a number of complaints from the "right" people, and then a rush, rush emergency program is placed into operation.

It has long been the opinion of our Department that money spent on surveillance is money well spent. With a little training a man can dip for larvae and determine when adults will be on the wing. It has been our experience that one of the biggest weaknesses in the average small community mosquito control program is the personnel problem. Very few municipalities hire personnel solely to work on their mosquito control program. In most cases the work is turned over to some city employee, usually the street commissioner or one of his men, often to a different employee every week.

In outlining some of the problems which one encounters in the small community mosquito control programs, I do not wish to imply that small community mosquito control programs should be dropped. We believe that mosquitoes are a definite public health hazard, and that it is the duty of the municipal government to protect the health of its citizens. However, we feel that more emphasis should be placed on small community mosquito control programs and that better educational programs should be initiated. Possibly a program of definite cooperation between equipment dealers, insecticide dealers and the State Health Departments could be arranged, which would help all the parties concerned.

A COOPERATIVE RESEARCH PROJECT ON THE EYE GNAT (*HIPPELATES*) PROBLEM

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The Coachella Valley is surrounded on three sides by mountain ranges and is approximately twelve miles wide and fifty miles long, ranging in altitude from approximately —240′ to 500′. It is 130 miles east of Los Angeles and is part of the great Colorado Desert.

The soil varies from gravel and coarse sand to fine sand to clay or adobe, with approximately 70,000 acres under intensive cultivation. Crops consist of dates, citrus, grapes, cotton, alfalfa, grains and winter vegetables. The Valley is known also as the golf capital of the world, with some fifteen golf courses located around Palm Springs, Palm Desert, La Quinta and Indio. The temperature range is 126° to 0°, with a mean temperature of 73.5.

The *Hippelates* eye gnat was first noticed in the lower end of the Valley around 1904 in a large Indian encampment which had a large flowing spring or well. As cultivated areas increased, the gnat problem likewise increased and in 1928 it was necessary to close several schools because of the prevalence of conjunctivitis. The people demanded that something be done and the District, embracing 2,080 square miles, was formed with the help of Professor W. B. Herms of the University of California.

The United States Department of Agriculture was induced to study the problem for a short time. The California State Department of Health also worked on the problem, but as there was little or

nothing known about the insect it remained uncontrolled.

Dr. R. W. Burgess, for his thesis in the 1930's, made a fairly complete study of the biology of the eye gnat that is still used and appreciated by men working in the field today. His opinion was that until some soil insecticide became available, trapping was the only hope. He designed a trap which used rotten liver as bait. Although this somewhat reduced the gnat population, it was costly, and, at best, it was a rather smelly job. It was finally discarded and the District then changed to the use of several hundred electric traps.

With the advent of chlorinated hydrocarbons at the end of World War II, a clamor to spray the Valley with DDT became insistent. The California Bureau of Vector Control was called in, and the District hired its first entomologist. Aerosols applied by aircraft and ground units were tried without success and the District used aldrin in a soil-larviciding program. For several years this proved the gnats could be controlled, if vast areas were treated at a cost that was staggering.

In anticipation of the work problem involved, the Board of Trustees of the District hired a manager. However, both the manager and the entomologist soon resigned because of ill health and other reasons, and the District was left with the problems of research and control.

After considerable study of the probable cost and time involved, and other factors, the Board of Trustees offered the Department of Entomology of the University of California at Riverside a grant in aid for a cooperative research project. As a result, a fruitful project has been in existence for the past six years. The legislature of the state of California, realizing the value of this project to the entire state, has included in the University budget two items for this research. It is obvious that a local district such as ours could not carry on a project of such magnitude in addition to the control measures for gnats and mosquitoes that are also required.

The research program initiated by the University of California on *Hippelates* eye gnats was based on long-range objectives. Studies on the biology, ecology and population trends of eye gnats yielded pertinent information which formed a basis for the development of various types of control measures.

Laboratory colonization of *Hippelates* eye gnats at Riverside for the first time made it possible to screen and evaluate a large number of insecticides against the immature and adult stages. Promising materials were found, although few could be selected rapidly for field evaluation. It was also possible to study the tolerance of eye gnats to various insecticides. The eye gnats, as a general rule, were naturally tolerant to DDT, but they were highly susceptible to dieldrin and related insecticides. The use of aldrin in the Coachella Valley during 1951–55 resulted in the development of a high degree of tolerance in the eye gnats to dieldrin and related compounds.

Successful rearing of eye gnats in the laboratory also made it possible to know more about the insect under controlled laboratory conditions. Responses of adult gnats to light, temperature, moisture and wind velocity were studied. This information provided a basis for the design and development of a "merry-go-round" olfactometer used in the screening of attractants and repellents. A wealth of basic biological information has thus been accumulated.

Biological control studies were also made possible through the laboratory colonization. Large numbers of various life stages of the gnat could be readily exposed in the field for the recovery of natural enemies. Prior to colonization such exposures of gnats on a large scale would have been impossible. During the course of two years of work on the recovery of eye gnat pupae from soil in the field, only two or three pupae were found parasitized. However, exposure of large numbers of reared pupae and larvae in the field resulted in the recovery of several parasitized pupae within a few days.

At the outset, and for three years, the research program was directed at finding

ffective residual soil larvicides. Dr. Mir . Mulla, who headed these studies, con-luded that gnat larvicides alone in wide-pread and heavily infested areas would ot reduce gnat populations below the olerance level of the average resident. herefore, efforts were directed to develop ther control measures which might be ore effective than the larvicidal treat-ents, to supplement existing control easures.

Experiments on the food requirements f eye gnats in the laboratory revealed at these insects need over one-half of ne percent organic matter for successful eeding. This idea was tested in the field, d two years of research conclusively monstrated that cultural control or urce reduction measures yield almost mplete reduction in eye gnat breeding. he cultural control measures consist of eping perennial crop fields such as date, apes, citrus and other fruit orchards ean from weed and cover crop growth means of herbicides or frequent tillage. on-cultivation of weeds or cover crop so produced good control of the eye ats.

The results obtained with these cultural ntrol measures were so spectacular that is appears to be the most effective control t discovered for eye gnats. Our Dis-ict, in cooperation with the University at verside, and other agencies concerned, is dying the mechanics of implementing ese measures within the scope of the istrict's operational programs.

Another interesting development as an tcome of the cooperative research pro-gram between the University and our District was the exploration of gnat adulticides. Soon after laboratory colonization, eye gnats from our District were found to be naturally tolerant to DDT as well as malathion. Prior to these studies, it was assumed that DDT and malathion were the two most highly effective insecticides. However, studies revealed some materials, such as parathion, dimethoate and others to be twenty to fifty times as effective as DDT.

Adulticides can be successfully used for gnat control in limited areas. Over large areas, however, the use of adulticides without baits is not practical. Intensive studies on the evaluation of lures against eye gnats are conducted by a team of chemists and entomologists at the University of California in cooperation with the United States Department of Agriculture.

Biological control studies have just been initiated and it is too early to predict their outcome.

Due to the complex nature of the *Hippelates* problem, it is not expected that gnat populations can be suppressed by any single control measure. Source reduction measures, such as those developed by Dr. Mulla, certainly bring another effective weapon into the fight against eye gnats in California. Supplementary use of gnat larvicides and adulticides in selected areas, should bring us considerable relief. The benefits and results of the excellent cooperative research arrangement between the University of California and our District have been most gratifying.