to the water. The pool becomes stagnant, and soon the entire top will be covered with larvae and pupae, and adult mosquitoes will soon be seen all around the area. Our program is to spray the pool with a fly spray formulation and plant *Gambusia*. The zone operator records this place in a book and inspects it every two weeks until the home is occupied, after which it is no longer scheduled for routine inspections.

Plastic pools are frequently a problem. There is no way to drain the water from these pools except to let it run out on the ground.

Finally, I might mention that the Orange County Mosquito Abatement District operates an exhibit at the County Fair each year. Our theme is "Mosquitoes Can Develop in Your Back Yard." We have a motion picture, "Life Cycle of the Mosquito," which is shown every 15 minutes. We also show a Walt Disney color film. At the exhibit we have the various stages of the mosquito life cycle, from egg to adult, and we demonstrate mosquito fish in action. Incidentally, we also take service requests.

ESSENTIAL SAFETY MEASURES IN APPLYING MODERN INSECTICIDES

JACK FIORI
San Joaquin Mosquito Abatement District

Mosquito abatement personnel working with insecticide sprays, such as the organic phosphates, must be very cautious when handling and applying these toxic materials. It is most important that operating personnel be guided by rigid rules and regulations, and that they be provided proper equipment for handling these kinds of formulations. Spray equipment should be in top working condition and should have proper hose connections to prevent any leakage which might result in the exposure of humans or animals. Vehicles should be fully equipped to carry insecticides with complete safety to and from the field, both concentrates and emulsions. Each vehicle should be equipped with a pair of heavy-duty rubber gloves and plenty of soap. The gloves should be inspected periodically for small cracks or holes.

Some districts using parathion only find it satisfactory to carry emulsions in their field units. This eliminates extra handling and reduces the possibility of operators becoming contaminated. Under these procedures it is necessary to establish sub-stations throughout the district equipped with large tanks for filling. There are undoubtedly both advantages and disadvantages in this system.

In the San Joaquin Mosquito Abatement District, we have been using organic phosphates, mainly parathion and malathion, for several years. During this period we have been very fortunate not to have any serious accidents. The District has strict rules and regulations which it expects operators to follow in handling and applying these insecticides. A simple but thorough training program to demonstrate correct methods for handling and loading insecticides is basic to any responsible abatement program. It is very important for district administrators and supervisors to be completely aware of the work habits of all personnel. When a group of men are handling insecticides, there is always the possibility that someone will become careless. This is the reason most accidents occur, and such individuals require close supervision; they should be observed while loading their spray tanks, while checking their equipment, and even to see that they wash after loading.

Clean clothing is very important. During the larviciding season, spray operators should be encouraged to change clothing and shower daily.

Everyone working with insecticides should be taught the importance of reading labels carefully before handling or applying these toxic materials.

It is most important to have proper facilities for the disposal of empty containers. Under no circumstances should empty containers or bags be left in the field.

Each man should know exactly what to do in case of accident. For example, a hose may break, spraying the operator with emulsion, or he may spill concentrates on his clothes. Office personnel must also be thoroughly briefed on what to do in case of an emergency. Proper antidotes should be available at all times. The district should make arrangements with several physicians, as well as with local hospitals so that any emergencies due to insecticide poisoning can be met without delay. In our agency blood tests are given to employees before each spray season and again mid-way through the summer in order to detect any possible significant changes in cholinesterase levels.

When operators are spraying in the field, there are many potential dangers. Each man must be certain that his spray equipment is in good condition. Proper nozzle arrangement and proper pressure are important considerations, and will reduce the possibility of overdosing. It is very important that the operator possess a thorough awareness of surrounding crops, as well as poultry and other livestock. The presence of beehives in the area will, of course, require special precautions.

If one uses common sense and follows directions when handling and applying insecticides, he can expect to remain healthy. It is the individual who becomes careless, or thinks it unnecessary to follow rules and regulations, who is apt to create a problem.

CONTROL OF TREE-HOLE MOSQUITOES IN ALAMEDA COUNTY

THOMAS BRANNAN
Alameda County Mosquito Abatement District

The tree-hole mosquito, *Aedes sierrensis*, is one problem that most of us here have in common. There is no question about this being a high priority control need in the San Francisco Bay Area.

In Alameda County, in the late 1940's and early 1950's, it became apparent that a large percentage of our service requests were for tree-hole mosquitoes. We tried a number of control techniques; the best at

that time appeared to be one of filling the holes with sand and cement. The project started with the tree-lined streets of Alameda, Berkeley, Oakland and San Leandro. It was not long, however, before we determined that this was not the answer. First, this procedure took too much time, and also we began to find that the holes continued to decay around and under the concrete and breeding was as bad as ever in many of the holes.

In 1956 this, plus the movement of so many people into the Oakland and Berkeley hills, made it obvious we had to come up with a more efficient and effective control program. We divided the area into three parts, each to be treated every three years. Starting with the areas from which the most service requests had been received, we dusted the holes with 50% wettable DDT powder. This resulted in good control, but on windy days it was a hazard to have the powder blowing in the operator's face. Next we tried pellets. They, too, gave good control, but could not be readily seen in the tree-holes. This made it almost impossible to avoid some duplication of work. The next material tried, and the one still in use, is a special 100-mesh 50% wettable granular DDT. This material does not blow around so easily and can be seen in the tree-holes.

We found *Aedes sierrensis* breeding in almost all types of trees, as well as in tin cans, watering troughs, old tires, pits, boats, and many other interesting locations, including a nature camp. The worst breeding in the hill areas is found in the second growth *Eucalyptus* stumps.

Each operator is furnished a pair of coveralls with letters, three inches high, spelling "Mosquito Control", on the back for identification. Also furnished is a canvas bag, a tablespoon to measure applications, and a stick about three feet long to clean the debris out of holes. This is all the equipment that is needed for this type of mosquito control.

We have had good control for three years in all areas but one. This area had been burned and we found breeding the second year after treatment. We find that this type of control operation for the hill areas (where you have to be part monkey and part mountain goat to cover the area) works very well. In 1957 we did not receive a single service request in the area treated, and last year received only two.

Each operator can treat about 250 holes a day. Last year we treated over 20,000 holes, using 700 pounds of 50% DDT.

On the tree-lined streets where we formerly used sand and cement, we have found the best control to be a 25% DDT emulsion, applied every three years. Equipment includes a 25-gallon compressed air tank and a 15-foot aluminum wand with a swivel, nondrip nozzle. With the operator standing in or on the truck, and with a pressure of 15 to 20 psi, we can reach a spray height of 25 to 30 feet.

This spray program has become quite standardized and does not change very much from year to year. The residential areas are extending out further into the hills each year, however, so we just move our tree-hole treatment operations out enough to keep up with this expanding problem.

THE USE OF *GAMBUSIA* FISH IN THE CONTROL OF RICE FIELD MOSQUITOES

JACK FOWLER
Sacramento County-Yolo County Mosquito Abatement District

Fish husbandry is older than the written word. It was practiced in China more than 4,000 years ago. Of particular interest, the Chinese incorporate fish raising with rice growing in the rice paddies. With each rice harvest a substantial yield of fish per acre is also harvested. As a result, if the supply of fish from rice fields were suddenly cut off, the diet of millions of people would be severely affected.

The technology of mosquito abatement has benefited in another way through the use of fish *(Gambusia affinis)* in rice fields. The result has been a means of naturalistic control of mosquitoes. It is possible that *Gambusia* may offer some additional advantages, such as providing a source of fertilizer for rice production.

The present goal of the Sacramento-Yolo District is to control mosquito breeding in rice fields through the exclusive use of mosquito fish. During the past year we greatly expanded this phase of our control program. Our only limitation was the number of fish available for planting. We believe this to be the most desirable method for control of mosquitoes in rice culture. During the 1963 season approximately 35% of our rice fields were planted with an estimated total of 1,257,300 *Gambusia*. This program has been an outgrowth of a more limited effort by the District dating back to 1957.

There are several factors which have influenced our decision to intensify the use of fish in rice fields for mosquito control. Prominent among these considerations has been the desire to (1) minimize chemical spray operations, (2) reduce costs by eliminating repeated chemical treatments, and (3) provide the most effective control possible.

In our increasingly complex environment the elimination or substantial reduction of chemical insecticide use, whenever possible, is a desirable goal. In the hot rice growing regions an enormous adult mosquito population can usually be anticipated. Larval counts can increase rapidly, necessitating repeated chemical applications. In the Sacramento-Yolo District we have sprayed many rice fields five times or more in one season. When a rice field is inspected and the larval count justifies treatment, there are often by that time four stages of mosquitoes present.

Our experience has shown that in fields adequately planted with *Gambusia*, large mosquito populations do not develop. For example, of 83 rice fields planted with *Gambusia* in 1963, only five developed an average larval density of as much as 0.5 per dip during the long rice growing season. Although mosquito larvae were found in some of our fish-planted fields, pupae were very rarely seen. This maximum of 0.5 larvae per dip was observed once in each of four fields surveyed and twice in a fifth field.

Successful control using mosquito fish in rice fields is contingent upon two important factors: (1) elimination of significant mosquito sources adjacent to the