

There is one thing I want to tell you that I think is very valuable. If we cooperate with our various officers in the county and they cooperate with us, we are cleaning up the town in general of cans' garbage, and things of that kind. We find that by going to the door and letting them know that we are there, that we represent the mosquito district, and tell them of their responsibility in this work, that we are taking a picture of their place because of the hazards they have on their place, which we will turn over to the Health Department, why next day the place is cleaned up.

Mr. Raley: The next paper will be on "Cemetery Control with Aerosols," by Ted Aarons.

Mr. Aarons: I think I'll just follow the precedent of some of the others, and present this paper for publication in the Proceedings.

CEMETERY MOSQUITO CONTROL BY AEROSOL

By THEODORE AARONS

Entomologist, Alameda County Mosquito Abatement District

A mosquito source peculiar to most mosquito abatement agencies is the cemetery. Degree of maintenance, size, and proximity to population are factors which determine the relevance of the cemetery as a mosquito source.

During the summer of 1941, under the direction of Professor Herms, Thomas F. Kelley, Pedro Galindo, and the speaker, conducted a mosquito survey involving over thirty cemeteries. The group, starting in Sacramento, worked south through the Central Valley to Los Angeles and then north along the coast to the Ventura-Oxnard region.

The cemeteries surveyed varied in size, ranging from those of the larger cities such as Sacramento, Fresno, and Los Angeles, which often included hundreds of acres, to others of various Valley communities which were a few acres in extent.

A striking relationship was noted between the degree of maintenance of a cemetery and the mosquito density of the area. Due to the continual watering of many cemetery grounds throughout the summer, a water level was maintained in the flower containers which became the immediate larval sources. Frequently this situation made available the only surface water within a large territory.

Often cemeteries within or adjacent to metropolitan areas presented the greatest fault in mosquito control neglect. Finding 50% of the water-filled flower containers in the larger cemeteries positive for larvae was not unusual.

Three types of flower receptacles are in common use. The reversible container is essentially one can unit within another, the larger of the two being sunk into the ground. The inner unit flower container can be reversed when not in use. The second, the ordinary heavy can type, was the most numerous, and also sunk into the ground, so that the opening is even with the surface. Glass jars, cans, and vases were found both sunk into the ground and on the surface. Larvae were found in all containers. There was no illustration of a type preference.

The Alameda County Mosquito Abatement District has for a number of years been aware that some of the 18 ceme-

teries in or near the control area were sources of appreciable numbers of mosquitoes. In the past other more serious problems had to be met. Also, the District felt that it was not desirable to make any special attempt to handle the situation, particularly in view of the type of public sentiment involved. It was formerly believed that no public health problem existed; however, when the excellent mosquito survey of three Alameda County cemeteries was completed in the fall of 1941 by Thomas F. Kelley and Pedro Galindo, it was noted that certain species were present which had been implicated as highly probable disease vectors of one or more of the virus encephalitides.

The various material and man-power shortages during the war necessitated a delay in approaching the problem.

For the purpose of this paper, one cemetery will be discussed. Basically the problem in all the cemeteries was the same, namely that of mosquito larvae pupating and emerging as adults from the flower containers.

The cemetery is situated in the center of a large residential neighborhood and contains over 80,000 graves. Throughout the grounds are some 27,000 flower containers, all potential mosquito sources. The cemetery, which is the largest in the county, can be divided into two sections, since it contains newer and older parts.

While the grounds as a whole are well watered the entire year, thus providing a ready medium for larval forms in the flower containers, it is apparent that the graves in the newer plots are more frequently watered. Accordingly, a higher larval density is found in the newer parts. Graves in these plots are placed close together, often lack upright headstones, and occupy less space per grave, thus increasing the potential number of breeding containers in a given plot.

The most common species collected was *Culex pipiens*, which represented about 70% of all the larvae. For the most part, it was found in containers with clear water.

Culiseta incidens represented about 25% of all collections during the summer. During the winter months of December through February, this species was frequently the only one encountered.

Culex stigmatosoma and *Culex tarsalis* in the larval form were found only occasionally.

The general topography of each individual plot plays a part in determining the potentiality of the plot as a mosquito source. Those plots located on the slopes of the hills hold considerably less water than those on level ground. Surface runoff removes a considerable portion of the water sprinkled on those situated on the slopes. Occurrence of larvae is generally more common at the foot of the hill, where most of the surface water accumulates.

Water sprinkled on plots situated on very flat ground normally accumulates in the containers, so that practically every one has some water in it, thus greatly increasing the potentialities of the plot as a mosquito source.

In the past the District on occasion sent crews into the cemetery to oil the containers. This proved to be a painstaking job and was not satisfactory for more than a few weeks at a time. Oiling or spraying DDT by hand into the containers was not feasible. The effectiveness of the insecticide would tend to be destroyed as a result of frequent waterings the year round, and in the winter season the additional rainwater would also have to be considered. As a result, frequent hand spray applications would be necessary, and the cost of labor and materials would mount ex-

cessively over a period of time while still failing to provide a permanent solution to the problem. In one section of the cemetery there are actually some 7,600 containers which are kept full of water most of the year.

The Director of the cemetery association, while professing a desire to clear up the pest condition, was unable to bring about any changes in the established use of flower containers. The suggestion of the District was to urge the use of only the reversible type and request that the gardeners keep them turned upside down when not in use. The suggestion proved unworkable. It was necessary to interfere as little as possible with the established practices.

Mr. Harold F. Gray suggested that thermal ground aerosol be tested on the situation. An entomological survey revealed that as high as 20% of the water-filled containers in certain plots were positive for larvae. Three ground aerosol applications were made at 6-day intervals. Each application was carried out in the morning prior to 7:00 a.m. The reduction of adults was noted immediately; however, it was not until the third application that the number of positive containers was reduced to 2%.

A check in January of this year of the same observational plots gave a positive count of less than 1%.

Throughout this period another cemetery outside the District was checked for mosquito density. During the summer, 50% of the water-filled containers were positive for larvae. In January, 20% of the containers were positive for larvae of *Culex pipiens* and *Culiseta incidens*.

Prior to the application of aerosol, over two hundred man-hours were spent in spraying the cemetery with the use of hand equipment. Each aerosol treatment requires approximately one hour. The material used consisted of a 5% DDT emulsion in diesel oil.

This type of control measure has proved highly satisfactory both from a practical and public relations standpoint. In no way does it restrict or interfere with the practice of placing flowers on graves, nor does it otherwise offend public sentiment.

Mr. Raley: Next is "Three Years' Use of DDT," by E. C. Robinson from the East Side District.

THREE YEARS' USE OF DDT

By E. C. ROBINSON

We are organized under the Pest Abatement Act, but we are a mosquito abatement district. I want to get that correctly stated. We are a separate and distinct organization all our own.

I think most of you have available the proceedings of last year, when I gave a talk on two years' use of DDT. You can take that and change it to three years, and that talk ends my speech.

I might mention this, though, for those who haven't that talk available, that we plan on continuing on in the same way and plan to spray at least once a year the farm buildings in the entire area with residual spray.

Mr. Raley: Mr. Jones will now talk on "Marin County Mosquito Abatement District's Rebirth"—Mr. Jones.

MARIN COUNTY MOSQUITO ABATEMENT DISTRICT'S REBIRTH

By PAUL JONES

I'll try to make this snappy. Marin County has had a bad reputation as far as mosquitoes are concerned. People

around the Bay Area seem to think when they talk about mosquitoes that they come out of our county over there. Anyway, at the start of the 1947 fiscal year I have been given the responsibility of modernizing the district.

The Marin County Mosquito Abatement District was formed primarily as a pest-control agency. It has been the policy of the board to encourage farmers to reclaim and farm large acreages of former tideland. This encouragement was provided by the giving and installing of flood gates, and by their maintenance and replacement. There are still large areas of partially reclaimed land which are not properly drained or protected by levees. It is these sections, together with unreclaimed sections, which give us our trouble.

The drainage sloughs which carry the flood water out to the bay and the Petaluma Creek have been gradually filling in, and unless the sloughs are dredged, large pumps will have to be installed. The Board has been reluctant to go in with farmers on any program of ploughing and leveling of marsh lands because of the cost, and because the flood gates would probably not completely drain the lands.

The district's budgets have been modest, as these figures will prove: 1943-44, \$13,487.57; 1944-45, \$17,363.40; 1945-46, \$22,031.47; 1946-47, \$25,329.04.

At the start of the 1947 fiscal year the board appointed a working superintendent to investigate and install new techniques which could be adapted to the needs of the district. Prior to this time the secretary of the board acted as superintendent in his spare time. This district has changed from the use of diesel oil to the use of DDT and DDD emulsions in 1/2 of 1% strength as a larvicide. The results have been excellent. The district bought one jeep, and hopes to buy two more. Two power sprayers were purchased; one was mounted on the jeep, the other on a G.M.C. pick-up. Aerosol generators were placed on three of the trucks. A small office was built next to the warehouse. A hot-water shower was installed. The operators were put on a monthly salary of \$230 for a 5 1/2-day week. A survey is being made concerning a pension plan for the employees under the State Plan. A mapping system has been worked out showing the various large breeding places and the dates on which they are sprayed and checked. A monthly report of the activities in the district is prepared for the board, and a financial report grouping the expenditures and showing the budget balance.

That is about the extent of my report. However, before closing I would like to thank Mr. Gray, Mr. Robinson, Mr. Raley, and the many others who have given me valuable information, also Mr. Peters.

Mr. Raley: I think this is very gratifying to a good many people in California to know that Marin County is going through a rebirth.

The next paper will be "Aerosol on a Large Scale," by H. C. Pangburn.

AEROSOL ON A LARGE SCALE

By H. C. PANGBURN

After hearing all these excellent papers in the last couple of days I really haven't anything to offer. We are all fairly convinced that aerosoling is an economically sound way to control mosquitoes, and we certainly intend continuing.

Mr. Raley: The next report will be "Statistics and Reports," by Wm. J. Buchanan, from the State Health Department.