waters of the Sacramento River system traded for waters from the San Joaquin; we see the desert made to bloom where man has provided water in areas overlooked by nature; and now the engineers are causing water from the Sacramento River system to run uphill over the Tehachapi Mountains to serve the needs of the arid areas to the south. We can, if we will, apply some of this engineering know-how in removing the excess water from pastures and other irrigated areas before the mosquitoes can complete their life cycles.

We must look beyond the confines of the individual fields for the overall solution. Just as the Water Resources Department of the state must consider all supplies and all present and prospective needs in planning the ultimate systems, and the irrigation district must consider its entire delineated area as a unit, taking into account the effects of the adjacent similar units, so also mosquito control agencies must ultimately elevate their sights to take into account the comprehensive handling of all troublesome sources of mosquitoes which exist within their jurisdictions, taking a leading role in encouraging the development of area-wide drainage systems where there are none.

Examination of the soil maps of the most troublesome pasture areas shows that they are generally located on soil types that cannot be expected to take water readily, which is well known by the farmer who tries to irrigate them and by the mosquito workers who must try to control the mosquitoes produced on such lands. Study of the corresponding contour maps shows that most of these troublesome pasture areas have a natural hydraulic gradient or slope of five ft/mile or more – quite sufficient for the drainage of water in prepared channels, although too flat for good distribution of in-field water by strip check pasture irrigation. From observed samples, it is evident that only relatively simple engineering is necessary to design systems of area-wide or basin-wide drainage for these troublesome pastures. Getting the excess water out of the irrigated fields and into a drainage system when irrigation is complete may be more difficult, particularly in the poorly leveled fields that are characterized by low areas scattered over the field – but it is equitable that the landholder accept primary responsibility for the handling and removal of excess water from his fields before mosquitoes can develop.

The papers and discussions at this meeting have emphasized the immediate and urgent need to broaden the base of mosquito control to the status of "comprehensive mosquito contol", applying all of the available technology of naturalistic control, prevention or source reduction, and chemical control, each in appropriate situations. We are all in agreement with the concept but since naturalistic control through the use of fish has been the subject of several other papers, and chemical control has been discussed by many, the principal emphasis of this panel has been restricted somewhat to prevention and source reduction, allowing however for considerable overlap into the other aspects of mosquito control.

We are fortunate in having here a battery of capable speakers to briefly summarize highly successful results which have been obtained through prosecution of action programs involving prevention and source reduction. Their contributions gain in importance because they are not merely theoretical but instead are in essence reports of successful operational programs which have contributed substantially to the success of the respective districts. We believe that the wider use of the technology presented can contribute importantly to comprehensive mosquito control.

A LONG-TERM SOURCE REDUCTION PROGRAM, NOW IN THE MAINTENANCE PHASE

E. Chester Robinson

Alameda County Mosquito Abatement District, Oakland

The Alameda County Mosquito Abatement District was formed in 1930, not because of malaria or encephalitis, but primarily due to annoyance caused by mosquitoes from the salt marshes along 85 miles of the bay front areas of Alameda County, plus those around Richmond in Contra Costa County. These mosquitoes, primarily *Aedes dorsalis* and *Aedes squamiger*, frequently moved into Berkeley and Oakland and on south through what is now Fremont. Those who travel the Nimitz Freeway toward San Jose will note that there are few old houses anywhere in this southern area although there are many new ones now. This area was then so full of mosquitoes that even jack rabbits left for the hills in the spring when the mosquitoes emerged. Later, during the depression period when labor was available the district did a lot of drainage work.

Originally Alameda County MAD was in a sense also a Drainage District. In the early years very little attention was paid to what we now call the backyard problem or the problem catch basins, tree holes, etc. The work was directed primarily toward the control of mosquitoes by salt marsh ditching, putting in levees and tide gates, and filling. This was a very successful program and enhanced not only the value of the property but also the areas around so that people were able to live there.

Transition has been a slow but interesting process. Most of that land has now been filled. We have sold our dragline, and we are not far from selling our tractor. Instead of large

heavy trucks with oil tanks, we are now using small jeeps with 50-gallon tanks. Our primary effort is now in the residential areas where we have thousands of catch basins, fish ponds, swimming pools, etc. The salt marsh problem has been almost eliminated, the areas having been filled and now occupied by industry and warehouses. Land values in these areas are up to $15,000 or $20,000 per acre. This development has increased the assessed valuation of the district so that in the last 15 years the tax rate has gone from $.015 per $100 valuation down to $.008. Larviciding costs have been reduced from some $12,000 per year 15 years ago to about $6,000 in 1970 in spite of greatly increased unit costs of these materials.

We cannot go it alone, but with cooperation from flood control, water conservation, etc., we are able to give the people of Alameda County an outstanding mosquito control program. With the insecticide-resistance problem, all of us must place a greater portion of our effort on source reduction. We must get the cooperation of the landowners, even though they are being called upon to pay even heavier taxes on their property.

ACCEPTANCE OF RESPONSIBILITY FOR AREA–WIDE DRAINAGE IN AN AGRICULTURAL AREA

Howard R. Greenfield

Northern Salinas Valley Mosquito Abatement District, Salinas

The Northern Salinas Valley Mosquito Abatement District has been involved in a drainage program since 1952. This responsibility was undertaken when the Monterey County Board of Supervisors and the City of Salinas expressed the desire that the District do so. These governing bodies presented the idea that the primary drainage responsibility should be the rehabilitation and maintenance of a system of drainage ditches that had been the responsibility of a long defunct drainage district known as Reclamation District 1665. In 1916, the District had constructed approximately 23 miles of main channel and 12 miles of lateral drains. In the ensuing years, the Reclamation District paid its bonds and the interest on the bonds, and having done this, ceased to function physically although continuing in existence as a legal entity.

In the preliminary discussions between the three agencies (county, city and mosquito abatement district), the county and city representatives vigorously expressed their interpretation of the Health and Safety Code governing mosquito abatement districts: i.e., that becoming involved in a drainage program was not only legal, but was also a valid mosquito control technique.

After due consideration, the Board of Trustees accepted the responsibility, and in due course approved the purchase of a 5/8 yard dragline, a position of "heavy equipment operator", and said, "Let us begin". Approximately 2½ years later the initial cleaning and regrading work on the main channel had been completed. Then the District embarked upon another drainage project which eliminated approximately 2,200 acres of salt marsh mosquito breeding area and at the same time reclaimed approximately 1,200 to 1,400 acres of slough land for agricultural usage.

It was at this point in time that important complications developed. Agricultural interests began to apply pressure to influence the Board to clean private drainage systems. Also, in the main channel, which had been cleaned 2½ years before, regrowth of weeds (tules, cattails, and hemlock) had become so dense that mechanical cleaning had to be reprogrammed unless an alternative could be found. The District Board of Trustees then reviewed its drainage accomplishments and made two very important decisions which I believe are worthy of reporting:

The first decision was to establish a policy relative to the entire drainage program. That policy statement first acknowledged that the drainage program had proved to be a valid mosquito control technique. Therefore, in the future any drainage (water management), program initiated by the District must meet the following conditions:

1. It must improve a recognized source of mosquitoes.

2. Costs of the drainage project should not materially exceed the costs of temporary chemical control over a five year period.

Upon fulfilling those two conditions, any drainage project contemplated by the District would be included in the operating budget in the same way that chemical or other control techniques are budgeted. In addition, the Board of Trustees recommended that other means of controlling unwanted plant growth be explored which might be less expensive than mechanically removing the weed growth. Eventually the District became involved in a fully integrated and planned program of weed control on those drainage systems