

are using. First of all, the terms "permanent control" and "semi-permanent control" have been used. They may be good but they don't exactly represent what is intended. "Eliminative approach" is another. I believe that the terms which come nearest are either "mosquito source reduction" or "mosquito source minimization.."

In selecting our topic, we decided that it was in order to present the panel in two parts. I prevailed on our immediate past president, Ed Smith, to take the second half of our panel discussion, and I think that I have perhaps the easiest part. The first part of the program is "What is now being done in California in the way of source reduction programs." But in order to have a basic understanding of what we are attempting to do today, it is in order that we have an historical review, and we prevailed on Harold Gray to present this. I introduce Harold F. Gray, the Engineer-Manager of the Alameda County Mosquito Abatement District, to present the "Historical Highlights of Mosquito Control in California."

HISTORICAL HIGHLIGHTS OF "PERMANENT" MOSQUITO CONTROL IN CALIFORNIA

By

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The rather considerable preoccupation of mosquito abatement workers in California in recent years with the problems of mosquito control through the use of the new chlorinated hydrocarbon insecticides, of which DDT is a type, has possibly caused some in this audience to think that the rather sudden interest in so-called "permanent" control measures is a new or at least recent change in ideas. On the contrary, that type of control which seeks to reduce to the least practicable extent the water available for larval habitats is the earliest and still the most basic concept in mosquito control operations in California.

The first mosquito control operations in California were performed in the vicinity of San Rafael in 1903, and near San Mateo and Burlingame in 1904 and 1905. Ditching of the salt marshes to minimize the pools which were producing *Aedes dorsalis* and *Aedes squamiger* by the billions, was almost the only idea involved, though it was recognized that the use of oil as a supplementary larvicidal measure might be helpful to a limited extent. In the period from about 1909 to about 1935, N. M. Stover most successfully applied this basic idea to the salt marshes in San Mateo, Marin and Contra Costa counties, though it must be admitted that from about 1930 to the last few years, when Paul Jones took over, Marin County practically abandoned the ditching concept and substituted oil spraying, with such poor results as to give mosquito control a "black eye" in the opinion of many people.

In 1910 began the first anti-*Anopheles* malaria control work in California, first at Penryn in Placer County, followed by Oroville in Butte County and by Bakersfield in Kern County. These campaigns, supported by voluntary contributions from private citizens, and greatly limited by meagre funds, were directed almost strictly against *Anopheles freeborni*, and were among the earliest "species sanitation" campaigns—in fact, they began long before Swellengrebel coined that term. Although they were limited as demonstrations, and considerable oil spraying was done, nevertheless drainage was not lost sight of, and was recognized as the basic measure when combined with care in the use of irrigation water. In fact, as early as 1911 Herms was warning against the excessive application of irrigation water, not only because it helped to increase malaria,

but also it destroyed agricultural land by alkali. The area around Traver became a fine "horrible example" of failure to heed such warnings, and to this day has not recovered.

If you will look at page 263 of the Fourth Edition of "Medical Entomology" by W. B. Herms, you will see a picture of a ditch put in to drain an *Anopheles* producing marsh near Penryn. That ditch was dug in 1910 by a young man named Gray, who also took the picture. He is still proud of his handiwork. Being naturally lazy and averse to unnecessary repetitive work, he put the ditch in at the cost of a lot of sweat so as to avoid frequent spraying of that swamp. He also did not see why the local farmers should make his job harder than necessary because they let their irrigation water run on and on, long after the ground had given obvious evidence that it was saturated. So he expostulated strongly with the farmers about this careless practice, just as some of you are beginning to do today—and with about the same effect. The next year he was at Oroville, still wedded to the idea that a round point shovel was mightier than the spray can, and still expostulating with irrigators. For the next two years he went up and down the state, alternating with W. B. Herms on the Agricultural and Horticultural Demonstration Train, preaching the necessity of conservation of irrigation water, and the imperative need for drainage, if malaria and mosquitoes were to be controlled in California.

In 1912 the Los Molinos Land Company in Tehama County was going bankrupt because an epidemic of malaria in this new irrigation project caused purchasers to throw their farms back on the company. The company appealed to Herms, who sent a young fellow named Gray up there to see what could be done. The problem was simple, and the cure obvious: too much irrigation with no provision for drainage. No wonder malaria and *Anopheles* flourished! Although oil as a larvicide was recommended as an immediate relief, stress was put on drainage and greater care in the use of water. As soon as the manager, T. H. Means, put these recommendations into effect, malaria faded away and the project became successful.

Also in 1912, San Diego asked for help with their affliction of *Aedes taeniorhynchus* and *Aedes squamiger*. The presence of swarms of these mosquitoes did not promote the tourist business. Again Herms sent Gray down there, and again the logic of the local situation called for emphasis on salt marsh ditching, with supplemental oiling. In this case, however, the advice was not followed; they sprayed rather futilely, and did little ditching, and it was many years before the mosquito nuisance was even passably reduced.

In the fall of 1917, the Anderson-Cottonwood Irrigation District went into operation in Shasta County, and in 1918 the area had a terrific epidemic of malaria. Leakage from the new canals and laterals provided hundreds of acres of shallow seepage water ideally suited to the production of *Anopheles freeborni*. Gray, who was then State District Health Officer, reported to the State Board of Health on the need for drainage to control the seepage water (also measures to reduce the seepage). But on a visit in 1937, with Dr. L. L. Williams, Jr., of the U. S. Public Health Service, Gray observed several of the original seepage areas still undrained and still producing a moderate amount of *Anopheles freeborni*.

It is interesting to examine the Proceedings of this Association since 1930, when they began to be recorded. In practically every year you will find articles and discussions on drainage as a means of eliminating larval habitats, and from the discussions it is apparent that drainage was considered to be a basic factor in mosquito control in California. A cursory examination of these proceedings also indicates that excessive application of irrigation water was also a primary headache to the "mosquito man" of those days. Two quotable quotes struck my eye—in 1930 Gray stated "The airplane cannot supplant drainage but

can possibly be used economically as an adjunct to drainage"—and in 1932 C. G. Hyde said "Temporary measures result in permanent taxation."

After about 1943 our Proceedings appear to show a marked obsession with DDT and its analogues. This obsession with a new idea or gadget is not peculiar to "mosquito men," but we seemed to have acquired it in a particularly virulent form. But in spite of the disease, I find that there was one paper in 1948 by Campbell on "permanent control." In 1949, at our joint meeting with the American Mosquito Control Association, I took occasion in my Presidential address to enter a protest against the then current obsession with temporary and insecticidal methods of control. I thought this protest had passed almost unnoticed, but the next year (1950) I was asked to speak further on the subject, which became the paper given in those Proceedings and known to you as "Which Way Now?" That same year we began to have papers and discussions again on water management and control, and Mulhern conducted a symposium on eliminative control measures, which was participated in by Kimball, Jones, Sperbeck, Portman, Murray, Ed Smith, Russell, DeWitt, Rolland Henderson, Bob Peters and Gray.

Last year John Henderson presented an excellent study on irrigation as related to mosquito control problems, and again this year we have this symposium on "mosquito source reduction." Possibly we have at last come up with a better descriptive phrase for our basic necessity in mosquito control, and until a better term or phrase is coined, I am willing to go along with it. But I think it should be pointed out that the logic of events is inexorably forcing us to a re-acceptance of the fundamental idea that the "shovelologist" and his works are the foundation on which successful and economical mosquito

control must be built. If mosquito tolerance to the chlorinated hydrocarbon insecticides has again compelled us to re-examine and re-use this old but perennially young concept, then it has been a valuable lesson. But above all, let us eschew unnecessary work. The constant repetitive application of insecticides is generally useless, unnecessary work, when the application of common sense and a little public education and the application of engineering ingenuity to our problems, through water conservation and drainage, can reduce unnecessary repetitive work to a minimum. This will in the long run redound to the benefit of the taxpayer, the farmer, the business man and the public generally, and we will receive better recognition for a job well done at minimum effort and worry on our part.

Mr. Peters: I don't know whether I gained this thought listening to Harold, or whether it's been something that's come as a consequence of thinking about this subject for awhile, but perhaps the slogan which a flour company uses may have a certain amount of practical application, "Eventually, why not now?" I think that history indicates that we are again facing the same issue. "Eventually, why not now?"

I would like to impress on the remaining participants that we have had quite a bit of information in the past on what individual programs are actually accomplishing in this state. In this presentation I prefer that the members of the panel approach the subject from this standpoint: What is your problem? Secondly, why have you proceeded as you have to overcome your problem? And third, what have been your methods and your tools to accomplish your end? The first topic that we are going to consider is "Drainage for Source Reduction," and I have asked Edgar Smith, Manager of the Merced County MAD to initiate the discussions.

DRAINAGE FOR MOSQUITO SOURCE REDUCTION

EDGAR A. SMITH

Manager, Merced County Mosquito Abatement District

It would appear to be obvious that any type of drainage which removes standing water from a field or roadside and carries it to a drainage channel or natural stream is of necessity performing a mosquito source reduction function. This simple fact is the basis of the policy and practice of the Merced County Mosquito Abatement District in regard to "permanent" or "eliminative" control which we prefer to call mosquito source reduction.

Our mosquito source reduction program in Merced County has many facets. First is actual performance of the drainage work (at cost or less) as an aid to the individual farmers concerned and as a demonstration for other farmers to see. Second is cooperation with other agencies also interested in drainage problems. Third is a public relations and education program designed to acquaint the farmers with the advantages of drainage and inform them as to the help obtainable in solving drainage problems through the mosquito district and other agencies.

The Merced County Mosquito Abatement District is in the drainage business, at present owning and operating a Fordson tractor and ditcher, an Allis Chalmers HD-7 tractor and dozer with two ditchers and a pull-type grader, and a Link-Belt Dragline with ½ yard bucket. All of this equipment is handled in the same way. Individual farmers or groups of farmers contract with the District to have drainage construction or maintenance work performed. The District enters into such agreements only when such work will eliminate or reduce an actual or potential mosquito hazard as shown by the District records; specifically the inspection-treatment record card and the section

survey map sheet. These cooperative drainage projects may involve only one farmer or they may involve as many as twenty or more property owners. Most of the projects carried out by the District so far have involved installation of drainage systems in irrigated pastures. These are usually designed to carry off the excess irrigation water at the lower end of the checks to a drainage channel where the mosquito larvae can be eaten by mosquito fish or can be more easily sprayed if necessary. This type of drainage after successful completion of a project of this kind is exemplified by the statement made by Mr. Elmer Murchie, Manager of the Crocker-Huffman Land & Cattle Company of Merced. Mr. Murchie credited the Merced Mosquito District's drainage program with three positive benefits to them: 1) Relative absence of mosquitoes in the area with drainage systems making it possible for irrigators to work and for cattle to eat unmolested; 2) Increased yield of pasture grass; 3) Consequent increase in the weight of beef cattle.

In addition to contracting with the farmer to do the drainage work at cost, the Mosquito District helps the farmer in other ways. Some of the projects are promoted by the District on its own initiative while others are requested, but in both cases District personnel perform the "leg-work" necessary to get all the property owners involved interested. The District sponsors meetings of such groups and provides free legal and engineering advice. Any surveying necessary is done by the District with no charge. If hand work is needed the District provides a crew of rehabilitation center labor with no charge. If easements are needed, the District handles the negotiations. If concessions are needed from other governmental agencies the District makes the arrangements. All in all the Merced County Mosquito