PROCEEDINGS AND PAPERS

OF THE

NINETEENTH ANNUAL CONFERENCE

OF THE

California Mosquito Control Association

AT

Citrus Experiment Station,
University of California
Riverside, California

AND

Mission Inn, Riverside, California
March 11-14, 1951

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Mt. Vernon Mosquito Abatement District
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Northern Salinas Valley Mosquito Abatement District
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Sacramento-Yolo County Mosquito Abatement District
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San Jose City Health Department
285 South East Market Street, San Jose 17
Sheridan Mosquito Abatement District
Sheridan

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University of California Citrus Experiment Station

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FIRST SESSION

Monday Morning, March 12, 1951

The Music Room of the Mission Inn

At 9:00 A.M. through the courtesy of the Standard Oil Company of California there was presented their film "Water".

The meeting was called to order at 9:35 A.M. by Mr. J. H. Kimball, President of the California Mosquito Control Association.

Mr. Kimball: I welcome you to our 19th Annual Conference of the California Mosquito Control Association. We in souhern California are quite proud to have the conference in this part of the state for the first time. Before going into the formal papers and discussion we want to express our appreciation to the Standard Oil Company for the excellent film just shown. Also we would like to introduce the various groups that we have here today. I would like each of you to stand as I introduce you. I have the pleasure of introducing the immediate past President of the American Mosquito Control Association, Mr. Lester Smith. Mr. Smith is also the Executive Secretary of the Middlesex County Mosquito Extermination Commission of New Jersey. Mr. Smith, we are glad to have you way out here. (*Applause*). The new president is Dr. Don M. Rees of the University of Utah at Salt Lake City, who is also President of the Utah Mosquito Control Association. (*Applause*) I don't think Mr. Alphonse Kelley from New Jersey is here yet. We also have Dr. F. C. Bishopp of the U. S. Department of Agriculture who has just come in (*Applause*). You know you need no introduction, but Dr. Bishopp is Assistant Chief of the Bureau of Entomology and Plant Quarantine. Mr. Crandall, who was to be with us from Ohio, has sent a telegram saying that he will be unable to be present, and gives his best wishes for a very successful conference. We also have Mr. Arthur Lindquist, in charge of the Bureau of Entomology and Plant Quarantine Station at Corvallis, Oregon. (*Applause*) I don't think Dorothy McCullough Lee, Mayor of Portland, Oregon, has arrived as yet, but she has always taken considerable interest in our proccedings. Are there any other out of state representatives here that I have not recognized?

The next group that I would like to recognize are the trustees of our mosquito abatement districts in California. Will they please stand as a group? (*Applause*). Now, will the managers of the mosquito abatement districts please stand up? (*Applause*).

Mr. Gray, do you have some special guest here this morning?

Mr. Gray: Not at present.

Mr. Kimball: I now take pleasure in introducing Dr. Gordon S. Watkins, Provost of the University of California at Riverside.

Dr. Watkins: Mr. President, members of the Association. You may not be certain what a Provost is. In the University of California, we don't know how to pronounce that word. At U. C. L. A. we call is Provost. At Santa Barbara, which is a little high-brow, we call it Provost. At Berkeley, they call it Provost and at Riverside because we are rather sensitive to Politicians we call it a Provost too. The president lives in Berkeley, but at U. C.L. A., the members of the Faculty have a quite realistic conception of this occupation of mine. They define a Provost as a person who is a member of the Faculty not especially interested in being a good teacher and not sufficiently bright to be a research man. You see my position in the University is a very humble one, and I'm merely speaking on behalf of Dr. Batchelor. Dr. Batchelor is somewhere in the great state of Texas. I was going to say the wilds of Texas, but there may be someone here from the state of Texas. I'd like to welcome you on behalf of Riverside as a city, the University of California in general, and the College of Agriculture and the Citrus Experiment Station in particular. I'm not a citrus scientist, as you may know. I belong to a profession known as economists, but it is an honor to mingle with disting-

guished scientists such as you are on this occasion. Dr. Batchelor would talk to you in your language and that I cannot do.

I should like to say just a word about the new branch of the University of California at Riverside. This is our youngest campus in a sense, and one of the oldest campuses in another sense. We have had the experiment station here since 1913. Since 1917 it has been devoting itself to scientific research with which you are deeply interested. In 1949, the University under the direction of the State Legislature decided to build a new College of Letters and Science in Riverside. That new college is being built on the site of the Citrus Experiment Station and we will have a generous sum as is typical of California, the sum of six million dolltrs of which to begin to construct this new college of arts and sciences. That is why I am here and why I'm in this position in this city and the University.

As to mosquitoes, I've always kept away from them as much as possible. I notice that a distinguished colleague in Great Britian is proposing to use a new discovery for mosquito inhibition. The proposal is to make radioactive the waters in which mosquitoes develop; then they become radioactive themselves and go back and do the dirty work on the rest of the mosquitoes. As far as I am concerned they are free to bombard the rest of the mosquitoes ad infinitum.

I know you are going to have an excellent program. Your contributions in the fields of science and the field of public health is something of which we are all proud, and I'm especially proud that you have come south for the first time. You have lived nineteen years and it has taken nineteen years to find the city of Riverside. When we build this new college in Riverside, we shall have accomodations for you to visit the campus for as often as you wish to come. May I say again for the University and the College, for the Station and for the city, we are happy to have you here. Come again, and we hope that the next three days will prove that the climate of Riverside is conducive to elimination of mosquitoes. (*Applause*).

Mr. Kimball: Thank you very much, Dr. Watkins. We are looking forward to our entire day on your campus tomorrow. I call for any announcements at this time. Does anyone have an announcement to make?

Norman Ehmann thereupon made general announcements relative to the schedule of the conference.

Mr. Mulhern made announcement relating to accomodation for slides to be projected with the papers.

Mr. Gray: I would like to have the Resolutions Committee, consisting of E. Chester Robinson, Ted Raley, Bob Peters and Norman Ehmann meet with me at lunch time, if possible.

Mr. Kimball: Thank you, Harold Gray. I suggest that sometime during the conference the various regional groups get together and elect their regional representatives to the Executive Committee for the following year. This can be done either during the business meeting or after the business meeting. If you can do it before, it will help the Executive Committee to get together that much sooner.

We certainly have been looking forward to Stanley Freeborn every year and we have had the pleasure and opportunity of meeting with him at Berkeley, and he had anticipated being with us this morning and present "The Continuing Interest of the University of California In Mosquito Control". Dr. Freeborn hasn't been able to make the trip south. We have asked Dr. Reeves to present Dr. Freeborn's paper; his full title is Dr. W. C. Reeves, Associate Professor of Epidemology in the School of Public Health at the University of California at Berkeley.

Dr. Reeves: Inasmuch as I have not received Dr. Freeborn's paper, I am unable to present his sentiments.

Mr. Kimball: Well, will you check the mail by 11:00 o'clock and we will postpone the paper until then. We will proceed to the next paper and you will notice on your program we have a complicated title. I won't attempt to repeat it as you are familiar with the speakers. We are looking forward to hearing this review of progress in mosquito control and cooperation. It is by Mr. Stead and Mr. Dahl, Mr. Stead is Chief of the Division of Enviromental Sanitation of the State Department of Public Health.

Mr. F. M. Stead: Thank you, Jack. Since Mr. Dahl and I are going to try to get both of us on and off in a twenty minute period, I'll cut short any preliminary remarks. In times past, several of us from the State Department of Public Health have addressed your meetings from the standpoint of a State Department speaking to you as members of local agencies. Today, because of the subject, I think it timely that we speak together as members of the same family of governmental agencies. I would like to mention two points. It seems to me that since mosquito control falls in the general field of environmental control, I should try to pass on to you two thoughts that I think are general and that apply throughout the field, and are just as true in the field of mosquito control as they are in the field of food sanitation, water supply, waste disposal or air pollution. The first of these is that any environmental sanitation measure cannot be successfully added to an already fixed environment. It must be woven in from the beginning. I think this is selfapparent. Stop and think a moment in your own field; it is not possible to take a fixed development let us say in the central valley, and through the magic of DDT or any other chemical accomplish mosquito control after the stage has already been set. I think that's self-apparent. The main thought, however, is how to accomplish this weaving in of the enviromental control measure into the segment of the environment that we've concerned with. It seems to me that this must be done by a special department or agency of government asking for and getting a chair at the planning table. That means that for a state department like ours, we must sit down with the agencies planning water resources in the central valley for example, and as will be related by Mr. Dahl, I think that it means for departmental agencies such as you're connected with that you must take your place at the planning table of the particular area in which you work. The second general thought that I would like to leave is this: How does a governmental agency, and we are thinking of ourselves as governmental agencies, accomplish a program in the field of environmental control? How do you get it over to the landowner, the taxpayer, John Q. Public? We have heard many times the idea expressed that in putting across a governmental program there is a choice of two alternatives. On the one hand, persuasion and the gentle and mild method of education, and on the other hand and in contrast, an enforcement program, or as is usually said, the policeman's approach. I would like to suggest to

you that those are not alternatives. Those are merely the two ends of the same spectrum of administrative thinking. I think that a program is put across with a three-prong approach. First of all, if we're talking to a taxpayer, landowner or member of the public, we explain and discuss with him the benefits that he will get as an individual from the program in question; actual, financial or satisfaction benfits. For example, in mosquito control, I think that we can point out to a farmer that the proper management of land and the proper management of water from the standpoint of mosquito control yields him additional benefits, larger crops, greater weight production on his cattle, greater comfort for him and his family. Now, if you can get that idea across, you've accomplished the most for the dollar of governmental money spent because the suggestions are adopted if they are convincingly put across. Secondingly, I think of the appeal to this individual landowner as a citizen and as a member of a community. We explain and visualize and think through with him the benefits which his community will receive from the program in question, and we appeal to his community citizenship instinct to cooperate and come along and support such a program. Here, again if you do that successfully you accomplish a great deal per dollar of time expended. The third part of this three-prong approach is what we might call the exercise of the police power. The police power of governmental agencies is that authority which they have to accomplish programs in the interests of public health, public safety and general welfare, where the public interest must supercede the interests of the individual. Here again you do not necessarily proceed by issuing citations or arrests. You proceed usually by the power of regulation and rule making. It may be that the penalty involved if for not complying with a rule or regulation; it is a financial penalty, not a criminal penalty. For example, you can see that in a mosquito abatement district, a landowner who failed to cooperate with a rule or regulation reasonably adopted would have the work done by the agency and the cost of the excessive work would be a legal cost assessible against the land. You still haven't labelled the man a criminal, you have asked him to pay for his failure to cooperate. At the far end of the spectrum there is the issuance of an actual order or legal notice, and that is important because if per chance there is a small percentage of the people in the area who will not cooperate, you are carrying through in an enforcement manner with them, which is of value not because it is punitive to them, but because they are required to keep faith with the 99% who cooperate, The next cylinder of this two cylinder approach is Mr. Dahl. (*Applause*).

Mr. Dahl: I came with a number of publications, a prepared paper, and supplemental notes which would require more than a good half hour to present. Rather than follow them I think the stage is set for some solid thinking, and I'd like to tie the philosophy that has been presented by Mr. Stead into the subject assigned. "Progress in mosquito control and cooperation with other agencies". For the record I have statistical data to give to the Secretary for inclusion in the proceedings, so that you will have a complete record of the mosquito control activities in California during the past year. In fact 1949 wasn't included in the 1950 proceedings, so it covers the past two years.

I'd like to first of all stimulate you into a little self-analysis and I think everyone can follow me in this reasoning whether you work in a mosquito abatement district, for the State Health Department, for the U. S. Department of Agriculture, a private chemical company, or someone else. What do we mean "Progress"? What does it constitute? Can we analyze ourselves? Let's take the four principle periods we have to think about. With respect to our own positions, i.e., as a manager of a mosquito abatement district or myself as Chief of the Bureau of Vector Control.

1. *"The idea period"*

First, mosquito control started because of an idea. Somebody had a desire. There was real need for it, some good reason. The forming of a desire is the reason you're in your work.

2. *"The organization period"*

The second thing that occurs in the organization of an agency (e.g., a district) to fulfill that desire. You read in the newspapers that we have a new mosquito abatement district in Monterey County—that district has been organized, it has appointed its Board of Trustees, and a Manager. That's development, a second step; they're just getting their staff together, everything is rosy, they are moving ahead, they are making progress.

3. *"The Initial Operation Period"*

The next step is that the new Manager gets his staff, he gets his DDT, and gets his other material, and he starts to work knocking off the hot spots, really showing progress. That progress period of the initial organization and initial development bring you through the period of ariginal entry into the community; you are accepted, you are one of them.

4. *"The Come of Age Period"*

Then you enter into the fourth period of development. This is a long continuing period. You come of age and I call it "Of Age Period". What does that mean? As far as mosquito control is concerned, it means that you are at the age where you realize that repetitive treatment is not the sole answer nor an adequate answer to your problems. You begin to thing of a basic program which will coordinate administration and operations, entomology and engineering. You are a part of the community, and your planning must be considered as a part of all community planning. Actually, we have recorded what has been done to show progress in the districts and in the state as a whole. I suggest that the progress of the mosquito abatement districts of the state recorded in the proceedings of the California Mosquito Control Association is the perfect record of the progress of mosquito control in the state.

Since I have been working on Civil Defense I've had a lot of time to sit on a plane or train and think about our problems, and reread some of those proceedings. I have been thinking of Harold Gray's article on industrial problems. Chet Robinson's developments in the East Side District with relationship to the irrigation district, of reports by Bob Portman, Paul Jones and others. When I re-read all these things there as one disquieting feature about the continuity. I think it is tied in with this "Coming of Age Period" Are we really a part of our community? I think that it can be stated somewhat as follows: There is a very weak or almost a lack of a centralized theme which provides continued coordination of the demonstrated progress recorded in your preceedings. To me this is inextricably tied in with "Cooperation by other Agencies" and that's the second part of my topic. What about cooperation?

I would like to refer you specifically to the proceedings in 1949 when four papers were presented, and I think they are just as applicable today as they were then. The first is by Dr. Herms, who looked back over forty years to give you some guidance. You ought to go back and look at those ideals and ideas, where he portrayed his career to that time. Those are key guiding points. The second paper that was of real importance was given by Dr. Freeborn; his title on that day was "The Relationships of Mosquito Abatement to Other Agencies of Government". That's part of my title today. Why don't you go back and read that paper. What he talks about there is the realism of recognizing the relationship between the approach Mr. Stead presented of Regulation vs. Service and Education. Let's go back and read that article. The third major article was presented by Dorothy Nyswander, the very outstanding health educator. She presented to you some key points on approach. What were those? One was that you should not have a haphazard approach, but a positive approach. In every field of education when you're trying to reach somebody be sure that you are reaching them through capably and qualified technical administration and guidance. I think you should go back and read that one. The fourth paper was a project proposal presented at that conference are still applicable.

Now then, after thinking of those four papers, I'd like to ask: "Where does that leave us? Where do we go? Where do we as the Board Members, as Managers, as Operators or any one else, go from there? What are we thinking about?" We've made progress, we're definitely showing it. However, there are these other factors that indicate an unstable situation, but, I don't think it is a hopeless situation at all. I feel that in the field of cooperation by private or public responsible individuals, companies or agencies we can give support and leadership. I think this philosophy of inter-agency, inter-group and inter-individual leadership is something that all of us have to accept as a part of our responsibilities in mosquito control.

In general, I'd like to point out why one single specific approach cannot be followed. Last year in cooperation with the Turlock Mosquito Abatement District a special study was carried on (you'll hear more about that today in a special report by the staff who worked on it). There was one check that was irrigated seventeen times and each time a terrific brood of mosquitoes was produced. Looking at that field, you'd see there was no immediate possible correction of that situation. The engineering involved would be terrific, so there had to be a continuation of the present repetitive program, yet there was over-irrigation definitely many times. I think that presents some very specific thoughts which we might follow as to the types of agencies involved. I think you know them as well as I do; the individual farmer, the irrigation district, the farm advisor, the soil conservationists and others. All have some interest in and connection with such problems. This sums into one thought, the idea that there is a void relative to getting all of these agencies interested in the problems of the mosquito abatement agencies in order to arrive at a mutual solution of these problems. Actually, this not only involves agencies, but individual farmers and citizens.

In analyzing the foregoing, probably the mosquito abatement district has the greatest economic interest and continuing service responsibility to coordinate this leadership for the community which it serves. It is our feeling that this is an increasingly important responsibility which mosquito abatement districts should recognize and that they should initiate plans of some sort in the coming year to follow this lead. Increasing mosquito resistance to organic insecticides makes many of us question *major* emphasis on the use of repetitive programs.

As a final shot at this problem of progress in mosquito control, and cooperation with other agencies, I have to assure you again that I don't think it's hopeless. The key thought we would like to leave with you has already been expressed; adopt a blueprint whereby the mosquito abatement district leadership can assure continuing effort to obtain eliminative work in support of your operations. To obtain this, we feel that possibly a central water policy control committee within each county may be the solution. In some counties this may not be possible, and I've spoken to many of the Managers and they have presented this case, but certainly there should be some auxiliary agency or committee whereby the interests of the mosquito abatement program can be incorporated into the community welfare. We talk about leadership, but you can't give leadership without putting something into it. Therefore, we feel that to assure cooperation by other agencies each mosquito abatement district must expend a portion of its resources toward the continuing support of some sort of organization which will promote the inclusion of mosquito control interests in all of the water control policies of the area which it serves. (*Applause*).

Mr. Kimball: Thank you very much, Arve Dahl and Frank Stead for your twosome paper on a subject which is of primary interest to our Board Members as well as to the Managers and to all personnel. We'll continue with the symposium—"Legal Problems of Concern to Mosquito Abatement Districts". Our moderator will be Harold F. Gray.

Mr. Gray: I would like the gentlemen who are to take part in this symposium to come forward and be introduced, Mr. Walter Chandler and Mr,. Gordon Winton. Mr. Jean Morony and Mr. Swenson are unable to be present, but we have between us parcelled out a few legal questions which the moderator will propound to our legal luminaries, on my right, and they will answer. The first series of question are matters of inter-departmental relationships following along the line of the idea of cooperation so ably expounded by Frank Stead and Arve Dahl. That will give us a good starting point. The first question I would like to ask Mr. Winton is, "What are the relationships between Boards of Trustees and the Boards of Supervisors, particularly in relation to the matter of preparation and adoption of annual budgets"?

Mr. Winton: I think some of you are probably familiar with Merced County and its Board of Supervisors and Board of Trustees. We have an acute problem in our County, particularly in relation to budgets. In the past, two years ago, we requested, I think, about a 23c budget and if most of you are familiar with the Health and Safety Code you know that up to a tax of 15c per $100 assessed valuation which the Board of Trustees request, the Board of Supervisors have no alternative but to allow it. However, any tax over 15c has to be approved by the Board of Supervisors too. Our Board of Supervisors don't quite see eye to eye with

our Board of Trustees, and for two years in a row now have held us to the 15c tax rate. I think in that little statement I have covered the legal situation in California. The Board of Trustees in cooperation with their Manager prepares the annual budget, and submits it to the Board of Supervisors of the County. The Board of Supervisors of the County then has the authority to set the tax rate. This tax rate must be at least 15c per $100 if you request it; they can't cut it below 15c. However, on any excess over that the Board of Supervisors has the final word. In the last two years although the Mosquito Abatement District has requested over 15c, the Board of Supervisors has not allowed it. So, primarily, I think this comes back to Mr. Dahl's and Mr. Stead's statements. It's a matter of cooperation between the Board of Trustees and the Board of Supervisors is required to levy taxes for county purposes. This generally means the 15th day of July. But if the Board of Supervisors asks for submission of your budget at an earlier date, it is advisable to comply with their request, as a matter of good relations with the Board of Supervisors.

Mr. Gray: What in general are the relationships between mosquito abatement districts and irrigation and drainage districts?

Mr. Winton: One of the purposes of mosquito abatement districts as set forth in the Health and Safety Code is drainage where necessary to abate mosquito problems. The mosquito abatement districts have the authority, if necessary, to condemn property in order to accomplish drainage. Legally, there is no tie in between irrigation districts and drainage districts with the mosquito abatement districts. Actually, it is a matter of cooperation. If you can cooperate with the drainage district and you can get them to do the work, that is excellent: otherwise you would have to start condemnation proceedings. Naturally everyone is better satisfied, the people whose property is drained, the John Q. Public whose property you want to put a drainage ditch across; if he can get in a drainage district and accomplish that drainage through the district without having an abtement district start a condemnation proceeding to get the ditch, why he's going to be a lot happier, the district's going to be a lot happier, and the lawyer is going to be a lot happier because he isn't going to start those condemnation proceedings. The same is true with the irrigation districts. It is really a question of cooperation. Now, where the irrigation district allows excess water to form mosquito breeding places which under the Code we would have authority to abate, you're getting into a rather technical problem as to whether the mosquito abatement district would have authority to proceed against another public body and compel them to abate the breeding places which they are causing. Actually, we have to work together. This is something I feel would be much better accomplished by cooperation rather than legal action.

Mr. Gray: I agree very much with the last statement. Now then, we'll let Mr. Winton take a rest for a moment, and ask one or two questions of Walter Chandler. One of the things that he has been causing a little difficulty recently has been the question of the Loyalty Oath. What procedure should be adopted concerning Loyalty Oath records and certification of payrolls and expense accounts including the Trustees' "in lieu of expense" accounts?

Mr. Chandler: Every employee, and everyone who receives anything for personal services, whether they be in lieu or otherwise, is required to sign a Loyalty Oath. I can suggest no better procedure than that which is followed in most of the counties. As to general county employees, the law requires that the Loyality Oath shall be kept on file in the County Clerk's office. Actually, in many counties, it's kept in the Auditor's office for the simple reason that as a matter of law, it is required that the County Clerk must certify to the County Auditor the employees who have taken the Loyalty Oath and who are qualified to receive their payrolls for the current month. As a matter of expediency and simplicity, it's much simpler to have those Oaths kept in the Auditor's office. The procedure which is followed in many counties is to have each employee sign a duplicate Loyalty Oath. One is put in the County Auditor's office and one is put in the County Clerk' office. As a matter of practice, each mosquito abatement district should have in their own files and in their own office, their own loyalty Oaths and that at the time the monthly payroll is made up that a procedure be followed analogous to that required of counties; that the manager or other person having responsible charge of the payrolls will certify to the Board of Trustees at the time that they pay the payroll that each employee receiving compensation has on record in the District office at that time a Loyalty Oath. I suggest as a matter of practice that if your County Auditor has no objection a similar Oath should be placed on record in the County Auditor's office. Some of your County Auditors may even take the position that they are the ones that are required to have the Loyalty Oaths there rather than in the office of the mosquito abatement district. To obviate any question at all, I suggest that your Loyalty Oaths be made in duplicate for each employee, that one be placed in the Auditor's office, and one be placed in the mosquito abatement district office. Of course, that doesn't take care of the situation when the Auditor says "I don't want the doggone thing, you keep it". When that happens, you keep it, but where it is permissible and where the County Auditor has no objection, I suggest that you file duplicates. It's a matter of good practice, it's a matter of substantial compliance with the law and it certainly takes the edge off the grand jury.

Mr. Gray: There's where you get advice from both an attorney for a mosquito abatement district and a district attorney, and is it probably doubly satisfactory for that reason. Another question which has come up on many occasions is the matter of Civil Service status of mosquito abatement district employees. I ask Mr. Chandler this question; "Can districts set up Civil Service methods and tenure, or is employment solely in the discretion of the Board of Trustees?"

Mr. Chandler: My answer to that is qualified by the promise that if you go back to your home counties and tell your district attorney what I said, and if he argues that I'm all wet, you'll agree with him and not with me. (*Laughter*). It's my belief, based on investigations in our county and my observation of other counties, that the mosquito abatement districts may set up Civil Service methods, but they may not establish Civil Service tenure. The State of California has a very broad and a very comprehensive Civil Service System applying to State employees. We have special types of Civil Service regulations applying for instance to counties, which are allowed to have a limited Civil Service. There are some special districts in California

which are allowed under the law to have Civil Service. One is a particular type of fire protection district; another is a municipal utility district. However, generally speaking, the establishment of a Civil Service system whereby employeees obtain rights to positions based upon their employment and upon probation or service, is not one of the inherent powers of employees working for public sub-divisions. Therefore, for that reason, it's always been the premise of those who are familiar with Civil Service that unless you can find a specific act, a specific authority from the legislature authorizing districts to have Civil Service, they cannot establish that system as such. I do not mean to say that the districts may not establish standards for various positions or that they may not establish examinations as a prerequisite to employment nor as a pre-requisite to advancement, but to go all the way with Civil Service to the point where an employee attains a permanent status from which he can be displaced only upon a complaint and only after a hearing is in my opinion not within the power of districts.

Mr. Gray: Thank you very much. That is one of the most succinct statements of the two phases of Civil Service that I think I've heard. Districts have a right to establish qualifications and perhaps even to give examinations but that does not confer any vested interest in the job after you've got it. I'm going to give Mr. Chandler a rest for a few mements. We'll come back to him again. I'd like to ask Mr. Winton a question which comes up on a number of occasions; I think even in his district this has occured. " Is it necessary to have a quorum at all meetings of Boards of Trustees?"

Mr. Winton: I can give you a very succinct answer to that, Harold. Yes. If you don't have a quorum, you cannot transact business. Of course, the question arises as to what is business. In our district, we have six incorporated cities in the district and under the Health and Safety Code you have one Trustee from each incorporated city which is in the district, plus one from the county. In our district, being six cities plus one from the rural area, we have seven memebrs. The Code, Section 2253, provides that a quorum of the Board of Trustees is the majority thereof, so the districts with five members, you would have three, and the districts with such as ours, seven members to the Board of Trustees, you should have four, and of course that's simple mathematics, and you can figure it out for your own district. Then the question is, what is business? Naturally, the payment of any bills is business, the authorization of the manager to purchase anything out of the ordinary course of business of the district, that is something unusual or out of the ordinary, the acceptance of any bids, the sale of any property, all of that is business, and before that can be transacted you must have a majority of the Board present, or a quorum. There are several ways in which you can act if a quorum is not present at your meeting. One is to postpone, to adjourn the meeting from time to time. We generally meet on the second Thursday of each month, but if we don't have aquorum, and if there is something that has to be done right away, we can adjourn our meetings say to the following Tuesday, and the manager contacts the members of the Board of Trustees and gets them there.

Mr. Gray: I would like to put this specific question. I have seen the minutes of certain districts where is was obvious on the face of it that a quorum was not present at that particular meeting, and yet they have paid salaries and paid bills and transacted business. I understand that in some cases they feel that this legal deficiency is cured by approving, at the next meeting when there is a quorum, the proceedings and transactions of the previous meeting when there was not a quorum. Do you think that that is a defensible and safe procedure?

Mr. Winton: Our district his done that. I believe that if the business tranacted is of any importance that is not a defensible procedure. However, in routine business there is one other thing that we do in our district which does not show on the minutes; we often find by telephone that members of the Board cannot be present, and then we get their authority over the telephone to act on certain matters. Then they're morally obligated to approve our action at the next meeting they attend, but we would really be on the spot if at the next meeting the Board of Trustees, having a quorum present, would refuse to approve the actions of the previous meeting without a quorum. Mr. Gray mentioned payrolls and claims. All claims for purchases must be presented to the Board of Trustees. In some districts, the manager is apparently given authority by the Board of Trustees to authorize purchases and probably pay claims without the specific authority of the Board of Trustees. I'm not sure that this is done, but it shouldn't be done; no bills should be paid without specific authority of a majority of a quorum of the Board of Trustees. However, there is a question about payrolls. I just spoke briefly to Mr. Chandler aout this a minute ago, and I believe that it is not necessary for the Board of Trustees to authorize the usual payroll payment. They have already authorized that a man be hired, and they've set up a certain number of positions to be filled by the manager, and the salary is set up by the Board of Trustees for the various positions; in other words, they have approved in advance the hiring and payment of these men. I believe it then becomes routine matter which does not necessitate action by the Board of Trustees to approve that payroll every time. Sometime this might become important. Suppose you cannot get quorum; your men are working, their pay is due; it might become embarrassing to hold their pay over for a time until you get a majority of the Board to constitute a quorum to vote on that payroll. I think that salaries are continuing expenses of the district that have been set up and approved by the Board of Trustees to be paid without specific action by the Board of Trustees. I think it's good practice for the Board of Trustees to approve the payrolls; our district does; but I do not believe that the approval of the payroll warrants is legally necessary.

Mr. Gray: However, Gordon, you have qualified that by saying that these positions are specifically set up in the budget and approved by the Board of Trustees as to amount. In our district, we have a slightly different procedure under the step system; we have automatic annual increases in the first five years. We don't have to have specific approval of the Board of Trustees for these automatic increases because they have already pre-approved the increase and the date on which the increase in salary becomes effective. I would like to ask Gordon Winton one other question. I think it follows along somewhat from this question of quorum. "To be perfectly legal, what items should the minutes of the Board

of Trustees show?" I'm asking this question for a specific reason. I know that in some districts the minutes of Board Board of Trustees have been rather carelessly kept and sometimes were not preserved.

Mr. Winton: Naturally, the first thing that the minutes should show is who is present at the meeting. That is perhaps the only proof that you do have a quorum present. If you do not show who is present at the meeting and go ahead and transact business there may be a presumption that there was a quorum there. It would take evidence, if someone wanted to upset the proceedings, to prove that the quorum wasn't there. However, the only safe way and the only logical way is to have the minutes show who of the Board of Trustees are present and who are absent. Naturally, the minutes should record all motions, whether they are carried or lost, and should record the vote, listing by name the ayes and nayes on each motion. The minutes should list all claims that are paid or rejected, and the votes thereon. Our minutes of our district are quite complete. There are a lot of matters in the minutes that are not legally necessary, but are informative though because those minutes are preserved. We have our minutes mimeographed, and they are sent to the members of the Board of Trustees shortly after the meetings so that they have a copy before they attend the next meeting, and they can look the minutes over and suggest any changes or corrections. To recapitulate, the minutes should carry the members present, who are absent, the votes on all motions and the text of the motions, whether they are carried or lost; they should also carry the names of and listing of all claims paid, and the votes on those claims; a listing of all claims rejected and the votes on that; any other business that necessitates motions or resolutions should also be reported in the minutes with the votes thereon. I think that briefly covers it.

Mr. Gray: Now I'm going to ask Mr. Chandler one or two questions. These are going to concern themselves with certain problems of purchasing, and the first questions I would like to ask you is, "When is it necessary to call for bids for furnishing commodites and services?"

Mr. Chandler: As a matter of law, no mosquito district need obtain bids for the supply of any commodities or materials or for the construction of any building or for the doing of any work. That is rather a peculiar situation because the county itself, every county, must obtain bids when the cost of construction is over a certain amount. Under certain conditions there are exceptions where you have a purchasing agent, or some exceptions where you have road commissioners, but generally speaking as a basic rule counties must comply with the bidding statutes unless there is a few exceptions and then only in certain isolated cases. The specific exemption. All school districts must do so with very bidding statutes require that they obtain bids for the doing of work or supplying of materials, in some cases, above $400, and in others $1000 and in some cases $3000. But there are many special districts, such as fire protection districts, mosquito abatement districts, sanitary districts, etc.; the list is quite extensive. Generally speaking, unless the law requires these districts to have competitive bids they need not obtain competitive bids for furnishing any commodity or the doing of any work for the district. Now, I say that's the law. But I think you'd be very, very foolish if in the construction of permanent improvements such as buidings, or in the doing of extensive reclamation work, or the doing of engineering work generally, if you do not obtain competitive bids. In the furnishing of supplies, I think it's a matter of discretion—you just have to use good judgment. Sometimes, of course, it is desirable to have bids for the simple reason that you get better prices. Sometimes it's desirable to have bids as a mater of pulic policy; you won't be accused of giving your particular trade or patronage to one group or to one establishment, a man in town or a man out of town. Also, your citizens and your taxpayers think you have to advertise for competitive bids and they're a little startled when they find that you are going out buying $10,000 worth of insecticides, $5,000 worth of jeeps, or other supplies, without competitive biding. I suggest to you as a practical matter that you had better fall in line pretty generally with the prevailing practices in your community in that regard. Sometime Grand Juries have a very peculiar attitude of looking at what they think things ought to be, rather than what the law is.

On the other hand, I suggest that the fact that you do not have to advertise for competitive bids on many supplies and commodities is a great advantage to you, particularly during the rise in prices as they are in the field of insecticides. But I certainly want to suggest to you that the fact that the law does not require you to have competitive bids should be used to your District's advantage, and not to the disadvantage to the district or the taxpayers.

Mr. Gray: That is an important point and a very interesting point, but following along the same general idea, here is a problem that came up recently. I'm going to ask Mr. Chandler this specific question: "If a Trustee of a District is an employee of a certain business or a member of a firm, can his company sell to the District?"

Mr. Chandler: The answer, and I mean this as a matter of law and a matter of fact, is no, very emphatically. It's not only just common sense to protect yourself against criticism, it's also one of the fundamental laws of the State of California that one who has the power to enter into a contract or to influence a decision whether or not a certain contract should be made, shall not have anything to do with the profit, nor shall he gain any advantage from it. It isn't a question of whether he did or did not gain, it is a question of whether he *might* have gained from it, and that gain may be indirect. In other words, a man, for instance, might be employed as a service station manager for Shell Oil Company, and only have work in connection with retail sale of gasoline, and not with the sale of insecticides. You might think that as long as he doesn't stand to gain in any way from it as a personal matter, what difference does it make if he's on the Board of Directors of your District; if he wants to take part in the voting on it, what's wrong with it? He can't possibly gain from it. You don't have to aruge over the answer to that question; the law says that he can't do it. That's the end of it. In other words, the law looks to the protection of the taxpayer's money, and has said: "Well, that may be true, but the Shell Company might get an indirect advantage, it might give him some profit or a better set up in his own operations, if they feel that through rewards to him they will gain contracts from the district and gain profit from it. It makes no difference whether that connection is direct or indirect, whether he actually shares directly in the profit made from the contract, or whether he's merely an employee of a corporation, or whether he's

a partner in a partnership. The answer is very, very emphatically that the district should not under any conditions make a contract from which any member of the Board may have any possible benefit. Now, I want to limit that rather narrowly; you notice that I said a member of the Board.
It should also apply, generally speaking, to your administrative and managerial personnel. As a practical matter, if one of your seasonal jeep drivers might stand to have some indirect advantage (perhaps when he isn't working for the district he's working for some company) and you buy supplies from them, I don't think you'd be precluded there, but insofar as managerial employees are concerned they can have no interest or connection, directly or indirectly, with any firm or business which sells any commodity or any product to, or does any work for, the District. I realize that in small communities and counties that is rather a hardship; sometimes they are hard put to find a supplier who doesn't have some connection with the District, direct or indirect. It's just a practical matter and just good sense—you're keeping yourself above criticism. You're keeping your skirts clean, so to speak. It's very proper that you should comply with the law.

Mr. Gray: That is a very interesting opinion because I happen to know of one case in which bids were taken from a number of firms to furnish a certain article; the bids ranged from about $80 minimum to nearly $300 maximum; the law bid was submited by a firm of which one member was a Trustee of the District.

I would like to throw the meeting open now to the floor, and if you have a specific question which you would like to have answered, will you direct it to either Mr. Winton or to Mr. Chandler. Who has the first legal question that you would like to have answered?

Mr. Preuss: Is this prohibition against selling to a District found in the Health and Safety Code sections?
Mr. Gray: Mr. Chandler, is this provision that the Trustees shall not sell to a District in the Health and Safety Code provisions relating to mosquito abatement districts?

Mr. Chandler: No, it's not in the mosquito abatement act; it's part of the fundamental organic law of the state. It's the general law which applies to all contracts made by all political subdivisions. You don't have to find the law tha tsays it's illegal. If you went into court with such a contract, or if a taxpayer went into court on a suit to have the contract voided, the court would void as being against public policy.

Mr. Gray: Now, who has the second question?

Mr. Coburn: I ask if it is permissible, I don't think it's good judgment, but is it permissible for the Board of Trustees to enter into a five year contract with any outfit that supplies any particular item at that particular time? I would also like to know if the District wants to sell anything that they have on hand, which is surplus or excess, if it is necessary to advertise for bids?

Mr. Winton: The first question is in contracting with a company over a long period of time. The District cannot contract for over two years with anybody. Now, that again is not in the Health and Safety Code. That is in your general fundamental law. A governing body of any political subdivision cannot contract for a longer term than the term of the members thereof, and you'll find under the Helath and Safety Code that the term of the membrs of the Board of Trustees of a mosquito abatement district is two years. The theory of that is that one Board cannot bind its successors to any contract. In other words, your present Board serves for two years; they may be quite happy to buy gasoline from some particular company; their successors who come on in two years may not like that, and they might want to buy from somebody else; therefore, this present Board may not enter into any contract which would extend for any period longer than their term, which is two years. I think that answers that.

The second question is on the sale of personal property. You do not have to advertise for bids. In the Health and Safety Code there is a specific provision which says for districts to sell any *real* property you have to advertise for bids; I think it is Section 2270 (g) of the Health and Safety Code, and Section 2204 prescribes how you're to give notice. But that procedure is only for the sale of *real* property which the District might own. Personal property you do not have to advertise for bids. But I would say again that it is only good practice, if you're selling any considerable amount of materials, to advertise for bids. The public expects it, they expect any political subdivision, when it sells any property, to advertise for bids. About two years ago in the Merced County district we sold a considerable amount of personal property. We had accumulated it over a period of time. We advertised for written sealed bids. It included some old jeeps, some old trucks, old oil drums, etc.; the list was quite lengthy, but we consolidated it into one advertisement and advertised for sealed bids and got sealed bids and accepted them. I think it is only good practice. However, if you have only a small item of personal property, you don't need to go to the trouble and expense of advertising for bids.

Mr. Frisbie: Does a two year limitation on contracts apply to insurance? Most of the policies on fire insurance run three years, or more.

Mr. Chandler: I would say that your answer is "yes" with a qualification. Most of your fire insurance policies are for three and some of them are for five years, but they are subject to cancellation by the Boardof Trustees. In other words, they are terminable policies. If the new Board come in and wanted to cancel, they could, and they could get a return on the premium; actually I think if you wanted to you could make the fire insurance company return the premium on a pro-rata basis rather than what they call a short-term basis. It's only good business to write those policies on a three or five year basis. Your present Board can do it, and since the policies are subject to cancellation by the Board of Trustees at any time, I think you could get away from the time limit provision.

Dr. Grant: We have two districts which have jointly employed the same manager, and most of our activities go under a joint cost. At the present time a quorum of the Board of Trustees for each district must be present for the transaction of business. Is this a necessary procedure?

Mr. Chandler: The Code sets up a method for consolidation, but as long as there are two separate districts, and the taxes are raised sparately, you should a quorum of both boards present, and you would have to have a majority of

both quorums voting to authorize business. Does that answer it?

Dr. Grant: Yes. Does that apply to the joint district?

Mr. Chandler: Well, yes. Any business is the individual business of each district. If you can segregate your business for a district, then that particular district would have to have a quorum of the Board of Trustees present and majority of that quorum would have to approve that business. I can see that you could run into some problems there. Suppose you have a joint piece of business, and one Board approved it and the other one doesn't. What do you do?

Dr. Grant: We don't.

Mr. Chandler:You're good neighbors. (*Laughter*).

Mr. Gray: I would like to ask Mr. Chandler, as a district attorney, whether some of these difficulties they are having in San Mateo County could not be handled more simply under the what is known as the "joint exercise of powers" act.

Mr. Chandler: There is some question as to whether or not the particular provision that you are talking about is applicable in this case. As a practical matter and as a legal matter you'd better stick to Mr. Winton's thought and your present procedure, which is to have each of your districts act separately. The best illustration is the fact that you're simply using these two districts to buy things together, and to employ certain employees jointly. Other districts do that also, but your confusion comes in where you have to get your two Boards together at the same time at the same place. Madera and Merced Districts join in joint purchase of materials and supplies to get cheaper prices, and I think several of the districts jointly use entomologists who work part-time for one District and part for another, but you meet separately, you employ separately, and you authorize separately so that the confusion doesn't arise. There shouldn't be any confusion even when you meet jointly, provided that your minutes show that your Boards are meeting separately as separate boards for separate districts.

Mr. Gray: We are running close to the end of our time, but I think we have time for one more question. Who has it?

Dr. Murray: I would like to ask a question about embarrassing relationships between the manager and the Board of Trustees, when they are not able to get along in perfect harmony. Particularly, should the manager call to the attention of the Trustees any actions which he believes are illegal or ill-advised?

Mr. Chandler: You bring up the question of embarrassing relation between the manager and the Trustees. I'd like to call to your attention that more often the Trustees don't get along with each other either. I think that I've attended several meetings of Boards of Trustees, when I was a members of the Board of Trustees for our own District in Madera County, and I certainly didn't see any evidence of unanimity or agreement on anything, and sometimes we were hard put to get the payroll signed. But going back to this point about personal relations; we're talking about things that aren't in law books. They're common sense and, of course, a man can always answer a question like that a little bit better after he goes through a political campaign, and unfortunately neither the managers nor the Trustees have to run for office, but as one who has gone through political campaigns, I would suggest to you that as a matter of policy if not good politics, when there is not good relations between the manager and all the Trustees I would let somebody else discover poor public policy rather than be the one to bring up the point. Of course, there may be instances where things are being done illegally; you know there may be criticism over it, there even may be litigation, and there may be claims about it. You can be certain that when the axe falls, the Boards are going to duck, and the manager is going to have his neck out. I, therefore, suggest that for your own protection and for the protection of the Board of Trustees that you try as much as possible to utilize the functions of either your district attorney, or in counties where you have county counsels, the office of your county counsel. Some Districts have their own attorney to whom such matters should be referred. As a practical matter, if something is *being* done that is obviously irregular and illegal, either a manager or a minority Trustee had better debate a long while whether he should allow the practice to continue without protest. If it means the manager may have to change his employment as a result of maintaining his views, or a Trustee should resign his appointment, he should make his position so clear that the issue will be clear cut, not only for the protection ofthe District, but for his own future as a man who is interested in mosquito abatement work and wants to make it his life's career.

Mr. Gray: Mr. Winton, have you got a point that you would like to elaborate on.

Mr. Winton: We were speaking about illegal purchases from a supplier who is connected with a Board of Trustees. That was brought home to me very forcefully a few years ago. I am City Attorney for one of the cities in Merced County, and one of our city councilmen supplied some services through an employee to the city. A taxpayer's suit was instituted, and that city councilman had to return the money. In other words, the city got the work for nothing. If you're hard pressed for money in your district that might be an idea. But in other words, on that situation it's really the Board of Trustees' neck that is out, if the manager calls it to the Board of Trustees attention that they are buying illegally. There is no financial responsibility on the manager, but there is definite financial responsibility on the Trustee who supplies directly or indirectly, and a taxpayer's suit may force him, or some company with which he's connected to return all funds paid to them on that illegal contract.

Mr. Dahl: This ties in with one point that has brought up by Mr. Chandler and implied here, and that is the relationship to the grand jury. Could this one further point of the legal relationship to the grand jury be discussed briefly. I think most of us are not too familiar with it.

Mr. Gray: Mr. Chandler, can you discuss the relationship of the county grand jury to the Districts?

Mr. Chandler: I don't claim to be an authority on this point, but before I became a district attorney I represented a superintendent of schools in our county who was charged with twenty-three counts of grand theft and forgery by our grand jury. I'm happy to report that he was acquitted on all counts. A grand jury is a general inquisitorial body established by law and appointed by and through your

superior court judges or judge as the case might be. It has general inquisitorial authority to investigate, to check up, to report on all activities of all county employees, all county departments and all districts, school districts, and all other types of special districts including mosquito abatement districts. They have the power to summon any employee of a District, any member of the Board of Trustees, any manager to bring in your records and testify concerning the activities. They have the duty, not only a right but a duty, to investigate the activities of each and every District of the county, including mosquito abatement districts. If they are doing their duty they should at an appropriate time during their term have a committee wait upon the Board and discuss with the Board its general obligations, its duties, what they feel about the situation and whether they have any suggestions or criticism. You are entitled to go before them as manager, and particularly as Trustees, to make suggestions and recommendations to them. Don't feel that because you aren't a general part of the county government (that is, a special district) that you have any immunity. The Grand Jury is specifically authorized and directed to make your business their business and the public's business.

Mr. Gray: Thank you very much. In our district each individual member of each Grand Jury, after he is appointed, receives a copy of our most recent annual report and each receives also copies of our monthly report, and we specifically tell the Chairman of the Grand Jury that we are happy at any time to furnish him with any information that the Grand Jury may desire. We have now run long enough on this symposium; it was tremendously interesting, and I want to express the thanks of all of us to Mr. Chandler and Mr. Winton for the valuable contribution they have made. (*Applause*).

Mr. Kimball: I think Mr. Chandler and Mr. Winton have offered a lot not only to aid our own Board Members that are here, but I certainly wish that our entire Board could have heard this discussion. We have another sort of discussion devoted to Trustees and their interest in the district activities, and miscellaneous other problems which are of direct concern to mosquito abatement districts. Our discussion leader will be Mr. Preuss, the President of the Board of Trustees of the Consolidated Mosquito Abatement District located in Selma, California.

Mr. Preuss: As a board member I was particularly interested in some of these legal problems that confront the Boards and the managers, entomologists and employees of mosquito abatement districts. Of course, there are other problems that we are faced with from time to time, such as personnel, purchase of equipment, the establishment of definite procedures in making purchases, and some of the practices mentioned by our legal advisors which may be questionable. They mentioned the possibility of not having a quorum to conduct business. I thought I would like to mention the manner in which we have our meetings in the Consolidated District, as it may be of interest to some of the other board members and perhaps to the managers; in particular as it may help in getting board members out to attend meetings. We have been having our meetings as a luncheon meeting. Generally any time after about 11:30 A.M,. I get pretty hungry, and I think a lot of the other board members do too, so we ary very glad and indeed anxious to get together at a luncheon meeting. Immediately following the luncheon, we conduct our regular business meeting. We've had a wonderful response from our Trustee members and I think we have a better response by having a luncheon meeting rather than an evening meeting, because so many of us who are serving the Districts as board members generally are interested in other organizations and we just do not have nights enough during the week to be able to attend the many functions that are required of some of us. I was very glad to see that the mosquito abatement districts now have given recognition to the board members, in that we had a breakfast this morning, and at this particular breakfast we were able to discuss some of the problems that we are constantly faced with. Some were legal, others were policy, and I think that out of this meeting we had this morning at breakfast time and a little more discussion here, perhaps we will be able to bring together some of our problems, our opinions and some questions, and we may be able to solve, perhaps not today but at some later meeting, some of our problems. At least, we can mention them here and get the opinions from some of the other Districts, so that our actions and our work will be more or less uniform throughout the state. One of the questions that came up this morning was fly control. Should we as mosquito abatement districts enter into fly control? There are, of course, two sides to that questions. The first, we might say, is more or less that the fly control is aproblem of the improper handling of garbage and excrement, and this is a definite function of our county and city health departments. Yet if we look at it from another angle, our mosquito districts are set up with certain types of personnel and equipment that probably can handle some phases of this problem in a more economical manner than a health department could. Arve Dahl mentioned that since mosquitoes have built up more or less a resistance to various insecticides, it has created an immense problem and that, of course, seems to be coming true with flies also, and it naturally will raise a question again, that if we are having so much difficulty with our mosquitoes, should we attempt to branch out and enter into another field of control such as fly control and run up against these same headaches that we are having with our mosquitoes, or should we wait a bit longer until we have discovered or stumbled upon new insecticides. I would like to have a discussion from the group, from the various districts throughout the state as to what your problems may be in regards to fly control. Are you interested in branching out in fly control? Have you been approached to do that? Or, don't you have a fly control problem within your area. Perhaps some of the districts have made an approach upon that subject and it may have worked out well, and they may be able to convey that information to the others of us here that may be interested. I would be glad to hear from some of the members that may have entered into fly control work, or some that are situated like we are that would like to have more information. So, I'll throw it open at this time for general discussion. Does anybody care to say anything, make any remarks in regards to the possibility of fly control by our mosquito abatement districts?

Mr. Gray: We have considered in our District, on several different occasions, the possibility of going into fly control, at one time into termite control, and others have been discussed. As concerns fly control and the operations of mosquito abatement districts, it more or less assumes the application of insecticides either as residuals or aerosols pri-

marily for the purpose of control of the adult on-the-wing flies. However, to my way of thinking, it is utterly senseless, uneconomical and completely illogical to attempt to control files, that is the common house fly. *Musca domestica,* upon the basis of residual sprays and aerosols and at the same time permit unlimited production of the immature flies or maggots in decaying garbage, manures and other organic materials. The only satisfactory, possible and economical solution of your fly problem is your basic sanitation, the proper handling, removal and disposal of organic refuses in which they develop. You're getting the cart before the horse, you are backing in the wrong way, to try to go at it as an insecticide operation. Therefore, I strongly protest against saddling fly control, on an aerosol and residual spray program basis, on the mosquito abatement districts. You're getting yourself a useless headache, you're spending needless money, I think you're wasting money. Let fly control remain where it belongs, in the Division of Sanitation in your Health Departments. Traditionally, it is there, practically it is there. I do not maintain that we should not upon special occasions take over an emergancy or a spot fly control problem, but I would do that in cooperation with your Health Department which has the primary responsibility. (*Applause*).

Mr. Preuss: Thank you, Harold.

Dr. Tinkham: I would like to say a few words about fly control. We have an interesting problem in the Coachella Valley Mosquito Abatement District. Our fly problem there is one that has developed more or less along with an attempt to control the gnats. In an attempt to control gnats, we have set out electric traps, and each year that is grown in size. I don't know how many dozens of traps we bought last year. We have one trapper who does nothing but bait there electric traps with rotten meat bait, which until last August was what we were using in our trapping program is studies on gnat control. We now have developed a new bait which is far superior, but we have about 200 of these electric traps as a result of the expansion of the program last year and our big problem is, are we out for fly control, or are we out for gnat control? This is slightly a different aspect to the control of flies that Harold Gray mentioned. We are not using any chemicals of any sort. It is just a trapping program that has expanded. We haven't tried to find out how many flies we're killing, but are responding to the demand of the public. These traps are put around the houses and corrals, and I'm sure they do a great deal of good as they are electrocuting thousands of flies daily. The traps are controlling fly breeding because as the flies are killed off, the females are prevented from ovipositing.

Mr. Kimball: Mr. Preuss' time has only about three minutes left, can we take this up when you have your paper on gnat control?

Dr. Tinkham: I won't say anything more, but we are debating as to whether we should carry on with fly control or get rid of it.

Mr. Preuss: Thank you, Dr. Tinkham. Is there anyone else who would like to say anything briefly. We have a few moments left.

Mr. Stead: They say there wouldn't be such a thing as a horse race unless there is some variation of opinion. Not in reply to Harold's statements but to place some ideas alongside with him, I'll just make two observations. Health departments have an interest in mosquitoes and in flies. Both mosquitoes and flies are vectors of human disease. In both cases, the backbone of the program may be basic sanitation as it is termed broadly. In both cases, that basis sanitation program may be supplemented by chemical attack. So, it seems to me we should not consider that these problems are fundamentally different and a responsibility of different types of working groups. I don't draw any conclusion, I just make some points.

Mr. Preuss: Thank you, Mr. Stead. In closing, I believe from a meeting of this particular type, where we have the opportunity to discuss our problems and listen to others that may have the same difficulties, we perhaps may arrive at some solution. I hope that the opportunity may again present itself so that we may be in a position to go into these problems further and havemore thorough discussion. By doing that we will know just where we stand as a mosquito abatement district in so far as it may pertain to the abatement or control of other pests, such as flies, and even ants. We've had a few requests for control work on ants.

Mr. Kimball: Thank you very much, Mr. Preuss. I really wish we had about an hour or two to discuss the many problems that we have not discussed this morning. We have our last fifteen minutes before lunch and we're certainly glad to be able to present Dr. F. C. Bishopp, Assistant Chief, Bureau of Entomology and Plant Quarantine, Department of Agriculture. He is out here from Washington and we are looking forward to his remarks on "What Next in Mosquito Control?"

Dr. Bishopp: Members of the Association and friends, it's a delight to be here with you today. I've tried for a number of years to attend one of your meetings. Two years ago when the American Mosquito Association met in Berkeley I had everything set to come out, but was unavoidably detained in Washington, and therefore missed, I understand, a very fine meeting, and a bit of your very unusual and slightly inclement weather. Now, much that I shall say in the next few minutes may not apply specifically to conditions here in California. I want to emphasize though that we do not want to get in a rut. I've been inclined to feel that many times we lay out a program of insect control, and then we forget about the possibilities of improving that program, of bringing in new ideas, and new methods. Therefore, I'm going to raise informally a few points for your consideration. First, how far should we go in mosquito control; what is our ultimate goal? I have a feeling that the public is going to place higher and higher standards on our efforts, and may be disappointed if we don't ultimately attain 100% control of pests, such as mosquitoes. I'd like also to raise a question as to whether we shouldn't begin to shift some of the responsibilities for mosquito control, and this applies to many other insect pests, directly to the public. We're spoon-feeding a lot of the people and incidentally the governmental agencies are getting a good deal of criticism for this and the only way to change that is put the saddle on the other horse.I think more and more we should tend to throw responsibility on the general public. That means, of course, education of the public. There are many things that we have been interested in, in the way of improving our work, and I think we should strive to realize those more fully. First, take cooperation of various public

agencies such as highway departments, irrigation and drainage agencies and the waterway improvement groups; I feel that we should get more complete cooperation and understanding of their activities and ours, so that they fit together. There's also the need for better relations, I think, with the private developmental agencies. We see too many instances where real estate men, for instance, will lay out a new addition, and fail to recognize in the initial developmental work the need for considering the mosquito problom as one of the things they should be vitally concerned with. I was impressed with that in Chicago the other day to see a number of blocks that had been laid out for development. The sidewalks were two to five feet above the surrounding ground, and water was held on each block, producing a potential serious mosquito breeding situation.

Some of the previous speakers have said we've got to give more attention to methods of mosquito control by other means than the use of insecticides. This has been forced upon our attention with the development of resistant forms of insects such as the house fly, some of the mosquitoes and other insects. It is also forced upon our attention by the possible hazards involved in the use or misuse of toxic materials in relation to foods of man or domestic animals. It has been emphasized by certain individuals that there is a shortage of certain insecticidal materials and then there is the problem of continuing high costs of mosquito control by the use of insecticides where there is a failure to develop more permanent types of mosquito control.

We've got to consider this question of water cntrol both from the standpoint of irrigation, and of drainage. I'm inclined to feel that decided improvement in crop production and the abatement of mosquito nuisances can be obtained through modification of our irrigation systems and methods. The question of flood control, of development for power, and of navigation must of course receive more attention from the standpoint of mosquito control. We've had a very good illustration of course over at T. V. A. where these things have been kept in balance, and the mosquito problem has been the dominant factor in all of their development. We're going to feel keenly the loss of our good friend and co-worker, Dr. E. L. Bishop, who has directed that work for many years. The Army, as you know, is concerned with a lot of large scale impoundment projects. They are debating this question of how they can reduce the cost of these projects from the standpoint of mosquito abatement, and here again we've got to give serious consideration to ways in which we may attack the mosquito problem and reduce cost to the taxpayer. We have been wrestling with these problems in Washington, among them the development of the Columbia River Basin, and the Red River and Arkansas River Basin. If we can build into these developments the idea of mosquito control and other insect control right along with the design we may save ourselves a great deal of money in the long run as well as give people better service. In order to meet this insecticide resistance question, we must find other ways of controlling mosquitoes besides repetitive methods of using insecticides. We've got to emphasize research. I have a feeling that we should do a lot more in general surveys. Every state should have a more complete knowledge of mosquito problems throughout the state that is basic to effective control. We must make ecological studies, such as some of the work that is now being done so fully in your state. If we understood more completely the relationship between the surroundings and the mosquito development, we might do a better job of fighting those pests. We need more work on flight studies and the methods of marking mosquitoes, of collecting mosquitoes and evaluating the problem of the distance that mosquito control must be carried out in order to give a community adequate protection. We've got to study irrigation and drainage methods. Water is getting scarce as probably some of you folks know. I understand your water shortage is becoming quite a problem here in the southern part of California. We ought to find ways of better utilizing water.

Now, along the line of insecticide research, it's imperative that we find alternative insecticides. Another thing is the question of the development of accurate, in fact, exact methods of analyzing insecticides from the residue point of view. That may have a very important bearing on the development of new insecticidal materials in the future. We need more laboratories engaged in insecticide research, the development of new and alternative materials, and the development of better analytical methods. The matter of synergists should receive more attention, that is getting materials that may step up the insecticidal action of materials already available. I think perhaps we've got to give some attention to the question of detoxicification of insecticides to avoid some of the side effects on wild life. Naturally, the question of the mechanism of resistance of insects to insecticides needs more study. We need to do more study on the question of storage of various insecticidal materials. How they can be kept in effective condition? We need to develop suitable containers for their storage and shipment. The question of specifications and standardization of insecticidal materials is very important and should receive attention. One of the most vital things we need right today is additional work on the toxicology of insecticides to higher animals. We've got to get industry people to do more work, and certainly there ought to be ways of getting private research institutions interested in these very important problems from the overall public view point. The matter of biological control should receive more attention. Certainly in the equipment field there are a lot of problems. We need better methods of dispersing insecticides to accomplish the greatest good with the least materials. Along that line, we need improvement of protective devices such as clothing and respirators, gas masks and so on that are essential when certain insecticides are used.

In some areas they've done such a good job of controlling mosquitoes, in Sardinia and Cyprus, that they're giving thought to how they're going to keep certain species of disease bearing mosquitoes out of the areas after they have eliminated those species from those areas. It is a question of better methods of disposing of insects that may be riding on or in airplanes and ships, and thus being reintroduced after they have spent a great deal of money in eliminating these pests from the regions.

This question of public relations is one that needs further emphasis. I notice that in your meetings each year you have given it good deal of attention. I think it is perhaps more critical now than ever before. We've got to carry the public along with us in our work. Many of us I think are inclined to go ahead and do our job, do it well, but we don't let the people know what we are doing, but that is a very important part of our work if we're going to continue to get the support of the public and avoid the criti-

cisms that are now being thrown about promiscuously. In our own work, we've got to observe all the safety rules. We must avoid the accidents that have appeared during the last few years in handling insecticides. If we can't use our own tools safely, we certainly can't recommend them to anybody else; when we get in trouble with illness or even death it casts a reflection on our ability and also causes the public to look askance upon all our insecticidal activities. We've got to respect other interests. We must consider the wild life interests; we've got to consider the general interests of the health authorities, the dairymen, the farmers generally, and the bee people. We've got to avoid criticisms, and often criticism can be avoided by good public relations.

An investigation is now under way in Washington under a Resolution passed by the House of Representatives which set up a special committee to consider food contamination, and they're giving a very prominent place to contamination by insecticides. That Committee is having hearings in Washington; some of them are being held here in the West covering a broad field, and I think that it's very important to every one of you to take a good deal of interest in this matter because it does involve your work.

I think we must have organized mosquito control work to do an effective job both in killing mosquitoes and in getting public interest in that work. I think we need more of these organizations throughout the county, and you people here in California certainly have shown the way and can be very helpful to other states and communities in getting effective organizations established.

I don't know whether I've answered many of these questions "What Next in Mosquito Control?" It's very difficult to even guess what is next. Things are changing very rapidly, but I'm sure of this, you people out here in California are going to have a lot to do with these changes and modifications and this progress, and that you're going to be right out in front in mosquito control work showing leadership to the rest of the country in many different lines. Again, I want to tell you that I appreciate the opportunity of being here with you and participating in your very interesting program. (*Applause*).

Mr. Kimball: Thank you very much, Dr. Bishopp. It certainly has been a privilege to have you come to California and give us this tremendous view of what's going on in the country. Before we adjourn for lunch, there are several short announcements. I ask Dr. Reeves to present Dr. Freeborn's paper tomorrow morning. Second, I ask the regional representatives who are putting on this afternoon the review of mosquito control in California to be sure to get your slides and motion pitcures to Archie Perkins as soon as possible so that he can set up the equipment during the noon hour. It will help things to run smoothly this afternoon. We have one more announcement.

Mr. Rolland Henderson: I would like to have a meeting immediately after lunch of the San Joaquin Valley Districts so that we can elect our representative.

Mr. Kimball: The San Joaquin Valley Regional meeting will be held right after lunch at the southwest corner of this room. Mr. Pangburn is calling a meeting of the San Francisco Bay region for the same time, so we'll put them in another corner. Are there any other announcements before we close? If not, we'll adjourn until 1:30.

(The Conference reconvened at 1:30 P.M., Mr. Kimball presiding)

Mr. Kimball: The first part of the afternoon is set aside for a review of the "Highlights of Mosquito Control in California During 1950". For those who aren't too familiar with this year's setup in the Association's Executive Committee, the state has been divided up into four regions, and each region elected its own regional representative to the Executive Committee of the Association. So for this presentation the program chairman has requested the regional representatives from each of the four regions of the state to review the activities that have gone on during the past year in their region. In other words, they'll present a composite of activities in their own region. In order to correlate these papers Ted Raley, Manager of the Consolidated Mosquito Abatement District will be the moderator. (*Applause*).

Mr. T. G. Raley: Mr. President, members of the Association, I have been asked to moderate this part of the program. I'll be very moderate in my part of the program. So moderate that I will ask Pete Pangburn, Manager of the Solano County Mosquito Abatement District to present the highlights of the San Francisco Bay Area mosquito control problems.

HIGHLIGHTS OF MOSQUITO CONTROL IN THE SAN FRANCISCO BAY REGION DURING 1950

By H. C. PANGBURN, Manager
Solano County Mosquito Abatement District

The nine Mosquito Abatement Districts of the San FranciscoBay Region were originally formed to combat the countless numbers of mosquitoes which each year emerged from the salt marshes of that area. That the people of the area have had a mosquito problem for may years is indicated by the fact that the first of these nine districts was organized in 1915 and the last in 1930. The history of mosquito control in the Bay Region goes back even further than that; in fact, to 1903 when the first salt marsh mosquito control in California was undertaken in Marin County.

Due to the vast acreage of salt marsh in our area the only feasible means of any degree of control was soon seen to be permanent control measures instead of larvicidal work. I think that's true in every district. Probably the first instrument that all of us in this region remember will ,as a basic start to mosquito control, is the square point shovel.

As the problems of all the bay area districts are very much alike, I will not attempt to discuss each one separately but to just touch some of the points of interest. First of all, mosquito annoyance in the area, from all reports, was greater than it had been for some time. There was less trouble in the South San Francisco Bay Area with *Aedes squamiger,* more trouble with that species in the San Pablo Bay Area. *Aedes dorsalis* seemed to equally abundant throuhout the area and seemed to appear from nowhere. The question of "Particular Handicaps to Work" was asked of the various Mosquito Districts back in 1937. The answer to this in nearly every case was: "Invasion by mosquitoes from outside the District." The answer to that question today would probably be the same. At any rate, it should be as good an alibi as it was in 1937.

Aedes dorsalis had such a mysterious way of putting in appearance during the summer months that considerable snooping was done in adjacent Districts by District Managers or other employees. I have the confession of some of

these managers that they were snooping in my District; and they hereby have my confession that I was snooping in their Districts.

Harold F. Gray of the Alameda County District had a lot of trouble with *Aedes squamiger* during April and May. A small flight of *A. squamiger* entered his District during the first week of July, about three months later than the usual Spring flight. It is interesting to note that Mr. Gray had to rudely put a stop to a University of California project. The project needed a lot of mosquitoes and they were collected from some garden pools in Berkeley without the knowledge of the Mosquito Abatement District. Apparently the students had no conception of just how many mosquitoes a few garden pools will produce. *Culex pipiens,* in one section, gave Mr. Gray a bad time. They were emerging from an abandoned quarry, which was being filled and the fill material polluted the water to the right degree for *pipiens* production. Control was very difficult due to several circumstances.

The Alameda County District probably has more trouble with *pipiens* than the other Bay Area Districts because it has more people. People are the sole reason for the existence of *Culex pipiens*. Another mosquito that gave Mr. Gray and myself a bad time, and new to the Bay Area, is *Aedes nigromaculis*. I don't think we can tell the boys of the Central Valley anything aout this one.

Paul Jones of the Marin District had his trouble with Spring flights of *A. squamiger* and Summer flights of *A. dorsalis*. Paul had more trouble with another one of the *Aedes* than any of the other Bay Districts. That one was *Aedes varipalpus,* the tree-hole mosquito. While Mr. Gary has more people in his District. Mr. Jones has more trees. To further complicate the problem there, business people of San Francisco are finding beautiful home sites across the Golden Gate Bridge in Marin County. Every home has its quota of live oak trees.

The Contra Costa and Solano Districts probably have a greater flood problem than the other Bay Districts. This is due to the great amounts of water which flow down the Sacramento and San Joaquin Rivers at the time of year when mosquito production is at the peak. When the water coming down the rivers meets an exceptionally high tide at the Carquinez Straits, Ernest Campbell of the Contra Costa District and I are in trouble. There are about one hundred duck clubs in the Solano District that flood their ponds, consisting of 80,000 acres, on or after October 1st of each year.

Following the July tides of last Summer, I made an aerial check of the marshes and from all appearances duck season was in full swing. We just about used our budgeted funds in aerial spraying and still didn't get all the *dorsalis*. The bad feature of these summer floods is not so much the immediate effect but the after effects. Each flood does some damage to drainage systems, usually to levees and tidegates. It is not always possible to obtain the services of a dredger on short notice to make necessary repairs, with the result that several floodings may occur on any property where a levee or tidegate has failed.

William Rusconi, who has taken over the wheel for the Napa County District on the retirement of our long time friend and associate. Arthur "Ham" Emerick, also had some flood trouble. However, as there is more farming of reclaimed land in Mr. Rusconi's District than in some of the other Districts, drainage works are maintained to a higher degree than they are in the duck club areas.

E. L. Smith, of the Sonoma County District, really has a problem of invasion from outside his District, but this is because the Sonoma District is not large enough to cover the really bad mosquito producing areas. One of the worst areas adjacent to the Sonoma District, and not a stone's throw from the Marin District, is the Petaluma Marsh. The Petaluma Marsh has long been known to produce countless *Aedes* mosquitoes and in 1934 a complete report of mosquito breeding and recommendations for control was prepared by D. B. Krimgold and H. P. Herms. The Board of Supervisors of Sonoma County allowed Ed Smith about $2,400.00 last year to control about 20,000 acres of the Petaluma Creek salt marsh. There is no doubt but that Ed did kill a great many *squamiger* when he used an aeroplane to spray about 300 miles of drainage ditches. There was no money left to control *dorsalis* the rest of the year.

The Pulgas and Three Cities Districts in San Mateo County, under the above leadership of Donald Grant, had a successful year. Those Districts, as well as the Matadero District in Santa Clara County, had less trouble with *squamiger* than usual. This, according to Gordon Mapes of the Matadero District, was due in part to less than normal rainfall. These Districts in the South San Francisco Bay Area also have problems, drainage being the worst. That end of San Francisco Bay has filled with silt to such an extent that the lands which are protected by levees are below the level of the land on the Bay side of the levee. As even Don Grant hasn't been able to make water run up hill, and the cost of pumping is great, considerable more larviciding is necessary than if the drainage were not so restricted. The excessive amount of rainfall in the Bay Area, during this past Winter, will, no doubt, give all of us from the Costal region a few more gray hairs, but I think this is the only part of California that hasn't had a peak of rainfall this year.

Mr. Raley: From its beginning in the Bay Area, mosquito control has grown in California. California is a big state. It's so big that our great Central Valley must be divided into two parts. We have one region in the Sacramento Valley area, and the highlights of 1950 for that region will be presented bv Bob Portman, Manager of the Butte County Mosquito Abatement District.

HIGHLIGHTS OF MOSQUITO CONTROL IN CALIFORNIA DURING 1950

SACRAMENTO VALLEY AREA

By ROBERT F. PORTMAN, *Manager,*

Butte County Mosquito Abatement District

MOSQUITO BREEDING

The mosquito breeding season started in the Sacramento Valley in the middle of February and continued into November. The periods of extremely hot weather which occurred during the summer was very conducive to the

breeding of most species of mosquitoes except *Anopheles freeborni.*

In the southern portion of the Valley the spring overflow and back waters of the streams again resulted in the production of flood water *Aedes* which started the control programs of the Sacramento-Yolo and Sutter-Yuba Mosquito Abatement District off with a bang.

Culex tarsalis was more abundant than in several previous years and continued to be so throughout the season. This prevalence was accompanied by a high incidence of virus encephalitis cases.

Aedes dorsalis and *nigromaculis* were produced in great numbers in short periods of time by the hot weather and accompanying heavy irrigation, throughout the summer and early fall.

Aedes varipalpus, instead of having a single spring brood, as cited in the literature, had several spring broods and was a severe pest in areas heavily treed with stands of old trees. Where sprinkling systems were used instead of irrigation in olive groves these mosquitoes continued breeding into July and occurred in large enough numbers to be a serious local pest.

Anopheles freeborni were not as numerous as usual in the rice fields during the summer and in some areas were not as numrous at the end of their rice field breeding season, which coincides with the drainage of the rice fields. During the adult fall dispersal flight they seemed to be in smaller numbers than usual. They were fairly prevalent throughout the winter in shelters and collecting stations.

The flooding of the duck club areas in the fall produced many more *Aedes dorsalis* than in previous years. These mosquitoes dispersed over a wide area making their control difficult.

Throughout the late fall and winter *Culex tarsalis, Culiseta inornata* and *Culiseta incidens* breeding was more prevalent than usual. *Culex apicalis* was occassionally found in adult collections.

RESEARCH

The Sutter-Yuba Mosquito Abatement District carried on a plane spraying test to determine if it was possible to spray the rice fields with an emulsion several times during the latter part of the season and eliminate the fall brood of *Anopheles freeborni.* The emulsion sprays gave good kills but reinfestation occurred after each spraying. Present indications are that it would take three or more plane larviciding applications to obtain the desired results. This is not economically feasible in view of the tax revenue derived from the rice fields.

The Sutter-Yuba Mosquito Abatement District has found that it may be possible to reduce to a minimum, if not eliminate, the *Aedes dorsalis* which are produced by the initial flooding of the rice fields in the spring. Few if any of the *Aedes dorsalis* larvae have appeared in many of the rice fields in which wettable powder DDT has been sown with the seed rice for several years.

The Rice Field Research project conducted by the Bureau of Vector Control and the Sutter-Yuba Mosquito Abatement District provided preliminary indications and laid the ground work for aresearch program that should in 1951 provide some of the much needed answers as to the habits, breeding and possible new methods of control of the rice field mosquitoes, *Anopheles freeborni,* and *Culex tarsalis.*

The research work conducted by the Butte County Mosquito Abatement District and the Biggs Rice Experimental Station for the control of the rice field shrimp, *Aedes dorsalis* larvae, and giant water scavenger beetle larvae by means of wettable powder DDT sown with the seed rice was very successful. Many rice growers in Butte, Glenn, and Colusa Counties will utilize this method and toxicant in 1951 both as a control measure and as insurance against the shrimp and scavenger beetle larvae. This will also control the *Aedes dorsalis* larvae produced by the initial flooding of the rice fields.

Applying a DDT residual spray to the dry soil before flooding or applying DDT as an emulsion to the flooded fields were equally successful.

CONTROL

The control activities which started as early as February reached a peak in July and August when the hot weather and heavy irrigation produced so many mosquitoes so fast that the Districts were constantly on the jump. Even the Districts in the northern end of the Valley felt the efforts of the good mosquito breeding year.

This larviciding demand was accompanied by an aerosoling demand that was often difficult to meet. On the whole the atmospheric conditions were not favorable for proper aerosoling. The periods of atmospheric calm were usually too hot and interspersed with breezes and winds. There was little dew during the season and the mornings were often too warm or windy.

On the whole it was a good year for the mosquitoes and not for the control activities.

M. M. Miller fo the Anderson Mosquito Abatement District reports that they had a very good year with exception of a few farmers who irrigate too extensively on their permanent pastures, which developed an excessively large number of mosquitoes.

Grace Agee of the Pine Grove Mosquito Abatement District reports that W. A. Carpenter is now Superintendent and that Grace Agee is Secretary of the Board of Trustees. Their budget has been increased by $6,000.00 to provide higher wages and more insecticide. They have had more and different species of mosquitoes, *Aedes dorsalis* and *nigromaculis.* The drip method of larviciding has been used with success and it has eliminated a lot of hard back pump spraying, but it is more expensive.

Joe Willis of the Redding Mosquito Abatement District reports that they have had to control more mosquitoes outside of the district during 1950. They annexed the Pacheco School District area and carried out control activities for which the people were very grateful. During July and August the daily maximum temperature was usually between 100 and 112 degrees. In spite of the high tempea-

tures in August few larvae or adults were found. By the middle of September the larviciding season was over and winter maintenance work had started. The District had a good control season and the adults were kept to a minimum.

The Oroville Mosquito Abatement District purchased a jeep and outfitted it with a vehicle venturi and a compressed air power sprayer making a very nice rig. Superintendent Harry Flood is still fighting the dredger rock piles as was done when the District started nearly forty ears ago when Prof. Herms and Harold Gray started the work in the area.

Little has been heard from Orion Murphy, Clear Creek Mosquito Abatement District's one man crew, except that he is still fighting mosquitoes.

The activities of the Cottonwood Mosquito Abatement District have been carried out by Superintendent Ralph Jamison. His activities and prolems parallel those of the Anderson Mosquito Abatement District, the neighbor district.

Los Molinos has a new superintendent and a change in the Board of Trustees.

The Sacramento Bee would hardly be complete unless it had an article about the Sacramento-Yolo Mosquito Abatement District or George Umberger, the District's Manager. George's big projects are the use of prison labor in cleaning ditches, a spring blitz attack on the *Anopheles freeborni,* and trying to get the by-pass area drained or kept dry. Jack Fowler, Entomologist, is still plugging along and hard at it.

Dick Sperbeck, Manager, and Herb Herms, Entomologist, of the Sutter-Yuba Mosquito Abatement District are still looking for a feasible way to control the *Anopheles freeborni* and *Culex tarsalis* in the rice fields. They are giving all out cooperation to the reasearch project on rice field mosquitoes that the Bureau of Vector Control is carrying out in their District. The District has annexed some more area which expands their program.

The Butte County Mosquito Abatement District added more equipment and personnel to increase the service rendered, as the District is still in the process of expanding its program. With the other Mosquito Abatement Districts in the lower Sacramento Valley it was glad when the season was over and is hoping for a cooler summer and shorter season in 1951.

Last but not least the Durham Mosquito Abatement District is still battling it out with Bill Bollerud at the helm and D. C. Crandall assisting. Along with Harry Flood and Orion Murphy they are the old timers in the skeeter chasing business.

Mr. Raley: That was a very good report. In the interests of projection equipment, we're chainging the sequence as shown in the program. Surprisingly, with all its glories, Southern California does have mosquitoes. The relative number no one can ever say. I had my beginning in Southern California, I cut my eye teeth in mosquito control work in Southern California, and I have been able to compare that area with the northern country. I won't say any more on that. I'll let Norman Ehmann, Entomologist, with the Los Angeles City Health Department tell you what Southern California has done with their mosquito control problem.

MOSQUITO CONTROL IN SOUTHERN CALIFORNIA IN 1950

By NORMAN EHMANN, *Entomologist, Los Angeles City Health Department*

There are those in the audience who do not know what mosquito abatement south of the Tehachapi consists of. Therefore, rather than to attempt to outline a spectacular series of advances in mosquito control during 1950, it will be my object to introduce to you the agencies actively engaged in mosquito control in Southern California and to briefly outline the types of problems with which they are dealing.

The Southern California Section of the California Mosquito Control Association consists of more than thirteen component agencies and has held four meetings since last March, two of which were at the Orange County District office, one at the San Diego District office and one at Dr. Tinkham's office in Coachella Valley. Five of these thirteen agencies are Mosquito Abatement Districts and eight are Health Departments.

Four of the big cogs in mosquito control in California originate from Southern California and from this town of Riverside in particular.

Ted Raley started by licking the mosquito problems in the Santa Ana River bottom lands way back in 1940; Art Geib attended Riverside schools at approximately the same time as Ted Raley and made his start in public health in the late thirties; Bill Reeves still claims Riverside his home and while attending school here was quite a track star; and Gordon Smith also considers Riverside to be part of his stamping grounds.

The largest and also one of the newest of the five districts in Southern California is the Orange County Mosquito Abatement District. It has an annual budget of 80,000 dollars, hires fourteen men all year around and has a board consisting of twelve trustees.

The Ballona Creek Mosquito Abatement District headed by Mr. Eugene Bumiller is located on the coast between Santa Monica and Playa del Rey. It covers 24 square miles and has an annual budget of between 14,000 and 24,000 dollars. Its main problem is a thousand acres of marsh which is now under good control due to a program of ditching, draining, diking and installation of tidegates. It began operation in 1945 and now employs four men all year around.

The Compton Creek Mosquito Abatement District, whose Manager is J. O. McDonald, is located between Los Angeles and Long Beach, covering an area of 25 square miles. It has been in existance for twenty-two years Its main problems are sloughs dams and fishponds. So much permanent control has been done in this district that citizens' complaints have been cut down to only several each year.

Coachella Valley Mosquito Abatement District was formed some thirty years ago for the eradication of gnats primarily. Recently an active program of mosquito abatement was instituted under the guidance of Sherman Thomas. Several unique features are observed in this area First of all, due to the weather, heavy densities of mosquito larvae can be found throughout the month of January. Secondly, large desert areas are going into agriculture—100,000 acres of

cotton have been authorized by the government—and there is no provision being made for drainage ditches to lead away the irrigation water.

The Carpinteria Pest Abatement District, operated by F. W. Thomas, is located between Santa Barbara and Ventura and deals mostly with irrigation problems in the foothills during the summer, coastal salt marshes during the spring, and smaller swamp-like areas during the rainy season.

Of the health departments engaged in mosquito control the two largest are the San Diego City and County, and the Los Angeles City Health Department.

The Mosquito Control efforts in San Diego are directed by Dr. J. B. Askew, Health Officer, with Vince Dorneden, Entomologist, as the technical consultant, generator and spark plug of the over-all program.

The major problems encountered are:

1. Eight sloughs totaling approximately 8,000 acres which were natural watersheds to the ocean but have been cut off by railway and highway right-of-ways;
2. 4,000 acres of salt marsh in an area known as Mission Bay, as well as several smaller marshes to the south;
3. 114 dairies, many sewer farms, the never ending roadside pools caused by irrigation of truck crops, duck clubs, sand pits, packing plant sumps, and 1400 fish ponds.

The program of control is still in the phase of primary survey, but a great deal of permanent control is being done by the installation of tidegates, ditching, diking and filling.

The Los Angeles Health Department Mosquito Control program is under the direct supervision of Mr. C. K. Stewart, Director of the Pest Control Division. The speaker is technical consultant to Mr. Stewart and works directly with Mr. Duclus, the Supervisor of Mosquito Control, and his crews. Last year's activity was highlighted by a comprehensive species habitat survey, and by a complete control survey. Mosquito larvae were picked up, identified and recorded each time control personnel visited a larval habitat. Each larval habitat in the city (some 450 square miles in area) was sized up and the following information gathered:

1. Complete description of habitat
2. Feasibility of ultimate permanent control
3. Agency having jurisdiction over area involved, e. g.
   Park department
   Street Department
   Railroad
   Private Industry, etc.

Data on the amount of materials and man-hours expended during the last three years was compiled for each habitat.

The total information was sifted and grouped. Those habitats demanding immediate engineering action for permanent control were referred directly to the engineer who has already accomplished permanent and semi-permanent control which will save the department several thousand dollars in the coming year.

For example, the Los Angeles River, which previously has been relatively inaccessible to control personnel, was cleaned of its tules and weeds for long stretches and the water was confined to a central channel instead of meandering over the entire bed.

Another group of habitats was referred to district sanitarians for control by written notice under the city ordinance.

One of the main problems that is developing into serious proportions is that of disposing of lawn irrigation run-off from new housing tracts.

The dairy drainage problem is being brought under complete control as will be pointed out in conjunction with the slides. We have also developed an extensive fish distribution program whereby sites are selected in various parts of the city, to which the public, stimulated by newspaper announcements, flock to obtain *Gambusia* for their fishponds and watering troughs.

Although the Inyo County Health Department is located as far north as Fresno, it is east of Mt. Whitney range and is considered to be in the Southern California Section because one of the principal land owners of the area is the Los Angeles City Department of Water and Power. Since the area is a watershed for the Los Angeles City Water Supply, the practice of spreading of water to build up the underground supply creates the major problems. Treatment is generally limited to a five mile radius of towns and cities.

The Mosquito Control activities of the Long Beach Health Department are under the supervision of Frank Hallman. The area consists of 36 square miles and employs six men on a year around basis. The most important problems are drainage ditches, sloughs, fish ponds and gutters.

The Santa Barbara and Ventura County Health Departments, the Pasadena City Health Department, the County of Riverside Health Department and the City of Riverside Health Department are all active in mosquito control on a smaller scale. Their object is to aid the people in comprehending their problem and in many cases, solving it by individual effort.

(Note: Mr. Ehmann illustrated his talk with lantern slides)

Mr. Raley: The San Joaquin Valley activity for 1950 will be presented by Rolland Henderson, Manager of the Tulare Mosquito Abatement District.

SAN JOAQUIN VALLEY AREA

By ROLLAND HENDERSON, *Manager*
Tulare Mosquito Abatement District

Mr. Henderson: Before I give my report, is Mr. Ray Ryckman in the audience? I received some information just a few minutes ago regarding an exhibit at the School of Tropical and Preventive Medicine at Loma Linda, and I wonder if you will take a moment to explain the exhibit.

Mr. Ryckman: The School of Tropical Medicine of Loma Linda was founded in 1948. At the present time we are active in several fields of tropical medicine, and we are quite cognizant of the fact that mosquitoes are very important in this field. We have at the present time the Winthrop Sterns Exhibit. There are three of them in the United States. This exhibit is on display at the college and you are welcome and invited to come and see it. The mosquito is about three feet long and shows all of the working parts and all the internal anatomy of the mosquito. We also have a series of exhiits on the life cycle of the plasmodium of malaria, and other exhibits on tropical medicine which we would be happy to have you examine.

Mr. R. Henderson: Thank you, Mr. Ryckman.

If you combine the problems of all the areas that have shown here previously, you perhaps would cover the problems within San Joaquin Valley, and we could add a few besides.

We don't like to brag, but we have the biggest and best of exerything in the San Joaquin Valley and mosquitoes are not excepted; we have plenty. We have had a large expansion in the area comprised in mosquito control districts in the valley. We have about fourteen districts, and they range in area from a few square miles up to about two thousand square miles within one district. There are terrific problems of mosquito control, and it's a lot of work, hot work and hard work. Several districts at this time are carrying on experimental work of great interest. However, I don't thing this is the time to talk too much about this. At a meeting this fall, when some more conclusive evidence is brought out regarding some of that work, it will be a better time to bring it up and so you'll hear more about it at that time.

I am going to have shown a moving picture. The picture is a general picture that has been made up through cooperation of the mosquito abatement districts of the central valley, showing in a general way the problems and the types of control that the districts use in their operation. It was instigated by a move of the Public Relations Committee of which you will hear more aout at the next session. (Mr. Henderson then presented the motion picture.).

Mr. Raley: I wish to thank the several men who have presented this regional description of problems and operations. I think this has been our first attempt on the regional basis. We hope that that can be expanded and increased in the future.

Mr. Kimball: That certainly was a fine review of what's going on inCalifornia. This has certainly outdone last year's review of what the various districts are doing.

We have not provided for a recess at this time, primarily to impress upon everyone in attendance that the session for the rest of the afternoon is not intended for just the designated representatives of the various districts, at our Association business meeting. We urge all of you to attend the rest of the afternoon, because the business that does go on is your business even though our Association is so set up that each district has just one vote. You're welcome to participate in the discussion.

We have four chairs over on the right hand side of the stage here which are reserved for the four regional reprsentatives. Rolland Henderson, Pete Pangburn, Norman Ehmann, and Bob Portman. We also have Mr. Preuss, who is the Trustee member on the Executive Committee, our Vice-President Ed Smith, our Secretary-Treasurer, Ted Aarons, and our Past President Ed Washurn, who is doing the job of recording our proceedings.

Harold Gray, Editor of the proceedings, has agreed to edit the material and has been authorized to hire stenographic help to type them out. It will be a big job and we certainly want to thank Ed Washburn, Mr. Gray and Dick Peters on the job that is to be done.

We'll call the business meeting to order and request that the Credentials Committee present their report on the designated representative of each district.

Mr. Gray: Mr. President, I request that the Secretary present the report of the Committee on Credentials.

Mr. Aarons: At the last Executive Committee meeting held January 10, all districts were requested to send a letter to the Secretary letting him know who the designated representatives of that district would be at this meeting. I have replies from twenty of our thirty-five corporate member districts and these will be on hand here in the event of any questions in regard to the individual who is the designated representative.

Mr. Kimball: We have the report from the Credentials Committee and I will ask the Secretary to go through the roll to get an official count of who is here and who is going to represent each district.

(The Secretary-Treasurer then called the roll of designated representatives. There were present in person or by proxy 21 designated representatives.)

Mr. Kimball: Thank you very much, Ted. I have been given an opportunity to review the work of the Association during the past year.

PRESIDENT'S REPORT FOR 1950

JACK H. KIMBALL, *Manager*
Orange County Mosquito Abatement District

On looking back over the Association's activities for 1950 I have been greatly impressed by the time and energy expended by so many persons toward a common objective.

The sincere desire for additional knowledge in mosquito ecology and control techniques was apparent at the many local meetings held within the four Regions of the State. It is my sincere belief that these Regional Mosquito Forums, as they are called, were largely responsible for this year's progress, and will be the key to future Association accomplishments. Consequently, I feel that a review of the activities of the four Regional Groups is appropriate at this time.

The concept of the Regional Mosquito Forum was first introduced during the regime of our Past President G. Edwin Washburn, and several meetings of the San Joaquin Forum were held during the fall of 1949. Soon thereafter the Sacramento Valley and the San Francisco Bay Regions organized similar mosquito forums, and at the 1950 Annual Conference the Regional concept was included within the Association's Constitution. It was provided that each of the four regions within the State would select its own representative to the Executive Committee of the Association. The comments and suggestions expressed at the regional forums are then relayed to the Executive Committee by their regional representatives.

Six meetings were held by the San Joaquin Valley Regional group during 1950.

On March 16, 46 persons representing 19 Districts gathered at Fresno to discuss irrigation problems and plans for inter-agency cooperation.

On April 20th, 175 persons attended a field demonstration at Merced on control techniques and problems, followed by an inter-agency panel on mosquito problems created by irrigation.

On May 18th, a large group visited the Hooper Foundation research laboratory on Encephalitis, located at Bakers-

field, and then reviewed the *Culex tarsalis* control program.

On July 20th, the forum was held at Lodi to witness the river bottom permanent control project.

On October 19th the day was spent at Turlock to review the progress being made in the *Aedes* pasture studies.
The last meeting of the year was held at Madera on December 7th, with 20 persons representing 11 Districts. Existing and potential problems resulting from the irrigation of cotton was the topic of the meeting.

The Sacramento Valley Region heald five meetings during the past year.

The first meeting was held at Redding on February 22nd, with 26 persons representing 10 Districts. Local operations were reviewed and the Rice Field Control problem discussed.

Forty persons gathred at Biggs on April 11th, where the problems resulting from irrigation and drainage practices were presented by various agencies.

On June 7th, this group met at Sacramento, where the springtime control program in rice fields and other projects was made.

On November 16th, thirty-two persons from 6 Districts met at Marysville to review the progress on the rice field studies and to evaluate the years control operations.

On January 18th of this year the forum was again held at Redding, with 20 persons atending, representing 8 Districts. A talk covering problems involving users of insecticides and the survival of fish in lakes and streams was presented by a representative from the State Division of Fish and Game.

Two meetings were held by the San Francisco Bay Region.

On March 31st, the group met at Oakland and organized their *Aedes squamiger* flight range study.

On November 10th, the group met at Burlingame to review the results of the study and to discuss plans for a proposed ecological study on this species.

The Southern California Region was not organized until May 15th, when 37 persons representing 10 Districts and local health departments met at Orange County.

The second meeting was also held at Orange County with 41 persons from 12 agencies. At this forum the use of the Section Principle as a guide to California Mosquito Control was presented.

The group met at San Diego on December 15th, when the County Health Department's program was reviewed and problems created by industrial waste disposal were discussed.

A fourth meeting was held at Indio on January 24th, where the Coachella Valley gnat studies and the mosquito problems were reviewed.

Your Association's Executive Committee was well aware of its responsibilities in coordinating the efforts and contributions of these Regional Forums. It was also aware of the difficulties involved in coordinating the state wide programs desired without first tuning up its own machinery. Consequently, the Executive Committee has concentrated its energy during the past year to this end. Four quarterly meetings have been held since the last Annual Conference. Three of these meetings have been held jointly with the regional forums held at Fresno, Sacramento and Orange County on March 16th, June 6th and September 21, 1950 respectively. The fourth meeting was held at Oakland on January 10, 1951. The excellent attendance by local District personnel at all of these meetings permitted representative discussions and suggestions on all Association problems requiring Executive Committee action. I am convinced that the major decisions made by th Executive Committee, namely to recommend incorporation, to recommend revision of the Constitution and By-Laws, and to hold the Annual Conference here at Riverside, reflect the wishes and best judgment of practically all the Districts.

Before proceeding any further it may be well to once again evaluate the part our Association should take in the mosquito control activities within California.

Two years ago Professor Herms reviewed for us the chronological development of mosquito control in California, and his paper "Looking Back Half a Century for Guidance in Planning and Conducting Mosquito Control Operations," is printed in the Proceedings and Papers of the 17th Annual Conference. You may recall that it was in 1910 that Professor Herms, assisted by Harold F. Gray, first demonstrated malaria control at Penryn, but it was not until 1915 that the California Mosquito Abatement Act was approved by the State Legislature. I was particularly interested in Profe:or Herms' account of a special meeting called by the Commonwealth Club of San Francisco to hear a report from a committee on malaria. Professor Herms reported the following: "Two recommendations were made by the committee; first, that mosquito control districts be formed which shall cover all malaria-infested areas in California and that this be done as rapidly as possible; second, that if by the end of the year 1916 this plan be found ineffectual or unsatisfactory, the legislature should appropriate funds to be used by the State Board of Health to employ a sufficient number of inspectors to undertake the field work of malaria extermination under the then authority of the State Board of Health."

However, this plan for local autonomous districts did succeed and there are now 48 active districts in California covering a total of 20,800 square miles and expending local funds totaling more than $1,700,000 annually.

At the close of World War II the State Legislature again gave a boost to mosquito control by providing $400,000 in State moneys to be allocated by the State Department of Public Health on a matching basis to local mosquito control agencies threatened by endemic virus encephalitis and/or malaria. The Bureau of Vector Control was soon organized to administer this responsibility along with that Department's other vector control services. During the succeeding four years the post war controlled area of 7,000 square miles has increased almost 300% to the present 20,800 square miles. This was done by the enlargement of old districts and the formation of new ones. The $400,000 of subvention funds have been provided each year and are

presently allocated in varying amounts to twenty-one districts and three local health departments. The total budgeted expenditure for mosquito control in California for this fiscal year is over $2,100,000.

It is my belief that the people of California have recognized mosquito control as an economic public service because of the successful integration of the interests and "know how" of the University of California, the State Department of Public Health, and the individual and collective mosquito abatement districts.

The results of this integration of purpose is well demonstrated by this 19th Annual Conference. The continuing pioneer work by the University of California on mosquitoes and mosquito control will be presented by personnel from the four campuses located at Berkeley, Davis, Los Angeles and Riverside. Technical and professional guidance by the State Department of Public Health, Bureau of Vector Control will be demonstrated by the reports of current studies on mosquito ecology and control methods. The California Mosquito Control Association is the coordinating link between all agencies interested or concerned with mosquito control. It contributes to the state wide picture through the regional meetings of district personnel, through the Annual Conference, through the publication of its proceedings and through the continual activity of its committees. I earnestly hope that this Association will continue to follow the objectives and purposes so clearly stated in the Constitution.

Mr. Kimall: Now we'll let Ted Aarons present the report of the Secretary-Treasurer.

Mr. Aarons: The report of the Secretary-Treasurer will be brief inasmuch as much of it will be elaborated on in some of the other Committee Reports. The membership status of the California Mosquito Control Association at present is that there are thirty-five corporate members and one sustaining member. The Minutes of the Association are in the hands of all the members and copies are in the permanent files of the Association. The status of our financial condition is that as of today we have $2,414.44 in the treasury. The detailed report is here presented in written form for filing.

Mr. Washburn: Mr. Chairman, I make a motion that we accept the report of the Secretary-Treasurer. (The motion was seconded by E. Chester Robinson, and passed by unaminous vote.)

Mr. Washburn: I move we approve the Minutes of the Executive Committee for the past year. (This was seconded by Mr. Domecq from Turlock and passed by unanimous vote.)

Mr. Kimball: Art Geib is Chairman of the Auditing Committee.

Mr. Geib: I request that the Secretary present the report of the Auditing Committee.

Mr. Aarons: It has been the practice of the California Mosquito Control Association Executive Committe to go over the records at six month intervals and make the findings known to the Membership. We've carried out this plan during the past year. All corporate Members receive a complete financial statement.

FINANCIAL STATEMENT OF THE
CALIFORNIA MOSQUITO CONTROL ASSOCIATION
JANUARY 1950 - JULY 1950

BALANCE - DECEMBER 31, 1949			$ 3,509.80
INCOME		$ 285.96	
Contractual Payments	$ 170.00		
Decalcomania Sales	14.96		
Publication Sales	15.00		
Contributions	50.00		
Conference	36.00		
EXPENDITURES		1,962.90	
Correspondence	$ 134.82		
Secretarial Service	522.50		
Publications	553.62		
Conference	685.36		
Herms' Award	35.00		
Herms' Plaque	51.00		
Bank Exchange Service	.10		
Income less Expenditures - Deficit January - July 1950			1,676.94
BALANCE - JUNE 30, 1950			$ 1,832.86

FINANCIAL STATEMENT OF THE
CALIFORNIA MOSQUITO CONTROL ASSOCIATION
JULY 1950 - DECEMBER 1950

BALANCE - JULY 1, 1950			$ 1,832.86
INCOME		$ 1,731.58	
Contractual Payments	$ 1,700.00		
Decalcomania Sales	1.58		
Publication Sales	30.00		
EXPENDITURES		1,150.00	
Correspondence	$ 98.45		
Sound Recorder, Eicor Tape Recorder	304.37		
Publications	747.18		
Income less Expenditures July - December 1950			581.58
BALANCE - DECEMBER 31, 1950			$ 2,414.44

Mr. Gray: I move that we accept the report of the Auditing Committee with the provision that each member of the Association be provided with a copy in due course. (This motion was seconded by Dr. Grant and passed by unanimous vote.)

Mr. Kimball: Mr. Peters will now present the report of the Publications Committee.

Mr. R. F. Peters: The Publications Committee has functioned for the year 1950 and up to the present in 1951 with its usual three activities. The Publications Committee consists of Harold F. Gray, Ed Washburn and myself. We have the three activities: the proceedings and papers of the 1950 Conference have all been distributed and I trust that everyone was happy with them; the Operations Manual has been added to, to the extent of four or five inserts; and the "Mosquiton Buzz' has gotten out twelve issues since the last time I reported to you.

Mr. Kimall: Thank you. Dick, for your short report. I'll entertain a motion to accept the Report of the Publications Committee. (Motion by Dr. Grant, seconded by Mr. Jones, and passed by unanimous vote.)

Mr. Kimball: Our next Committee Report will be from the Operational Investigation Committee, Ed Washburn, Chairman.

Mr. Washburn: I've been instructed by my hecklers to the side to make this brief.

OPERATIONAL INVESTIGATIONS COMMITTEE REPORT

1. *Objectives of Operational Investigations Committee*

(a) To review the present needs of the active mosquito control agencies in the State of California for research dealing with mosquitoes.

(b) To instigate investigational projects which may be conducted by any agency or cooperative group of agencies, the Universities and Colleges, departments of health, local agencies, federal agencies, and other interested parties which will meet the above needs.

(c) To compile and coordinate reports or to instigate the compilation of reports of research on mosquitoes which will be of most value to abatement agencies.

(d) To review sources of funds for furthering activities of presently existing operational research projects and needed projects and recommend and further the activities of these and other worthwhile projects which meet the *needs* of (1) through active efforts to see that funds are made available.

(e) To regularly search for, receive, and interpret for use of control programs, such progress reports, published reports, or other reports as may come to the committee and to prepare concise memoranda, in cooperation with, or through the Bureau of Vector Control, for distributing useful results of operational research to active mosquito agencies.

2. *Recommendations*:

(a) The Operational Investigations Committee recommends that the California Mosquito Control Association Executive Committee urge the Bureau of Vector Control, of the California Department of Public Health, to allocate certain subvention funds for the purpose of continuing the operational investigations upon mosquitoes for FY 1951-52 according to the following schedule:

(1) To, and through, the Sutter Yuba Mosquito Abatement District for continuation of investigations of Rice Field Mosquitoes	$ 8,900.00
(2) To, and through, the Kern Mosquito Abatement District for continuation of Insecticide and mosquito Resistance Investigations	6,100.00
(3) To, and through, the Fresno Mosquito Abatement District for continuation of the Irrigated Pasture Mosquito Investigations which have in past been carried on in Turlock	9,200.00
(a) As an adjunct to the above for embryological and ecological studies of mosquitoes in cooperation with College of Pacific	800.00
Total	$ 25,000.00

(b) That the following resolution be adopted by the California Mosquito Control Association: Whereas; the Operational Investigations Committee represents the California Mosquito Control Association in connection with cooperative studies dealing with the biology and ecology of California mosquitoes and with toxicants for their control, this committee wishes to recommend to the Executive Committee of the California Mosquito Control Association to wit:

That reports of the several projects in which member districts are associated or with which they cooperate, be made available to all mosquito abatement agencies in California, as oral reports at regular meetings of the various regional forums, as well as the committee meetings of this and other committees, and as written reports as often as is possible to have such reports available without interfering with the work of the projects. At the present, we include in the study projects the following:

1. Rice Field Mosquitoes Investigations at Sutter-Yuba
2. Irrigated Pasture Mosquito Investigations at Fresno
3. Toxicological Investigations at Bakersfield
4. Insecticide Resistance Investigations for the Kern District likewise

(c) The Operational Investigations Committee hereby wishes to express its deep appreciation to the many mosquito control agencies, the Bureau of Vector Control, the Public Health Service, and other agencies, and individuals who have so generously given of their time and substance toward the furtherance of these investigations whereby we will all gain more knowledge of the habits and controls applied to mosquitoes. It is indeed gratifying that such an excellent spirit of cooperation has prevailed throughout the entire personnel of all parties involved in the studies.

(d) It is the further recommendation of this committee that when the California Mosquito Control Association becomes a non-profit corporation that it take the necessary steps and procedures to acquire ownership of the operational investigations equipment and supplies which have been or will be purchased by the districts through the special subvention funds allotted for these investigations; the same to be inventoried and a system of issue and credits be established so that all interested parties may have use of knowledge of the various equipment that may be available for investigational purposes.

(e) It is recommended by this committee that an equipment pool (on an inventory basis) be established by the California Mosquito Control Association in order that all persons and/or agencies involved in operational investigations may be apprised of what kind and amounts of scientific equipment suitalbe for research or field studies are severally owned by the mosquito control agencies in the State of California. This would greatly facilitate the operations of certain projects and could serve as, not only a cooperative enterprise, but an economical one also.

(f) That the California Mosquito Control Association continue this committee as an active standing committee of this association.

3. *Conclusions*:

All persons engaged in long range mosquito control activities have come to realize that biological investigations have their place in the mosquito control program and it is with a progressive outlook toward the future of mosquito control in California that these cooperative studies have been established and through which it is believed that greater efficiency in California Mosquito Control will result.

Respectfully submitted,

OPERATIONAL INVESTIGATIONS COMMITTEE

G. Edwin Washburn, *Chairman*
Theodore Aarons
Herbert Herms
Gordon Smith
E. Chester Robinson
D. C. Thurman
John Shanafelt
W. Donald Murray
Harvey Magy
Basil Markos

Mr. Peters: Mr. President, I move the acceptance of this Committee's report. (This was seconded by Mr. Domecq and passed y unanimous vote.)

Mr. Gray: Mr. Chairman, that Committee report included a recommendation for a resolution. As Chairman of the Resolutions Committee, I request that the Chairman of the Operational Investigations Committee furnish the Resolutions Committee with a copy of that resolution.

Mr. Kimball: That is true. Mr. Washburn will please furnish the Resolutions Committee with a copy of the suggested resolution. I will now call for the report of the Committee on Irrigation and Water Development, Mr. Portman, Chairman.

REPORT OF THE COMMITTEE ON
IRRIGATION AND DEVELOPMENT OF WATER RESOURCES

It is recognized that all projects and programs involving the use or disposal of water may produce aquatic conditions in which mosquitoes develop. Many of these may be avoided or reduced by adequate planning. Also careful appraisal of existing conditions can lead to the elimination or reduction of these mosquito sources.

There is ample evidence that consultation between the organizations concerned with water projects and mosquito abatement agencies may avoid the creation or the continuation of mosquito production and may also obviate the necessity for expensive abatement measures which are costly to the taxpayers.

Therefore this committee recommends that:

1. All organizations and agencies concerned with the development, use or disposal of water in California

(a) be informed of the importance of mosquito control in relation to public health and the economy of California, and the locations, names and addresses of the mosquito abatement agencies,

(b) be requested to consult with the local mosquito abatement agencies when planning new projects or the extension or alteration of existing facilities involving the use or disposal of water in order to avoid or reduce water conditions in which mosquitoes may develop.

2. The California Mosquito Control Association provide this information to and request the cooperation of the following agencies:—

(a) Federal Agencies both through the Regional Director of the U. S. Public Health Service, and directly.

(b) State Agencies both through the State Health Officer to the Governor of California, and directly.

(c) State Organizations directly.

(d) Local Agencies and Organizations directly, through the assistance of the local mosquito abatement agencies

3. The request to the various agencies for cooperation bedrafted in the form of a letter as follows:—

"The California Mosquito Control Asociation, an association of mosquito abatement district, other agencies and individuals working towards the morst effective and economical control of mosquitoes in the State of California respectfully request the cooperation of your _____ in minimizing mos-
Organization or Agency
quito problems.

All projects and programs involving the use or disposal of water may produce aquatic conditions in which mosquitoes develop. Many of these conditions may be avoided or reduced by careful planning. Also careful appraisal of existing conditions can lead to the elimination or reduction of mosquito sources.

There is ample evidence that consultation between organizations concerned with water problems may avoid the creation or continuation of mosquito production and may also obviate the necessity for expensive abatement measures which are costly to the taxpayer.

The California Mosquito Control Association recommends that such review or counsel as may be required be obtained from the local mosquito abatement district (s), the local health department (s), or if such agencies do not exist in the area involved, the Bureau of Vector Control, California State Department of Public Health."

4. Attached to the aforementioned letter be

(a) a map showing the names and locations of the mosquito abatement district and agencies.

(b) a list of the names and addresses of the mosquito abatement districts and agencies,

(c) and a statement of pertinent facts emphasizing the importance and necessity of mosquito control. (i.e. attached)

5. A request be made to the California State Department of Public Health for a statement similar to the statement on a "National Water Resources Policy" which was submitted to the President's Water Resources Policy Commission. This statement with a follow-up, cover letter be sent to each agency.

In view of the ever increasing need of the members of this association for obtaining the cooperation of the agencies and organizations involved in the use and disposal of water this committee urges that these recommendations be given approval and that this committee be aided by the membership of the association in carrying out this project, also that the succeeding committee be charged with its continuation.

Respectfully submitted by the,
Committee on Irrigation and Development of Water Resources

Robert F. Portman, *Chairman*
Edgar A. Smith
W. Donald Murray
Thomas D. Mulhern
Harvey I. Magy
G. F. MacLeod
Wm. J. Buchanan

MOSQUITO FACTS

A. Mosquitoes must have water in which to complete their development to the winged pests and disease vectors so familiar to all of us.

B. Mosquitoes are vectors of such dangerous human discases as malaria and encephalitis and are also vectors of encephalitis in horses and heart worm in dogs.

C. It has been estimated by one mosquito abatement agency that 90% of the mosquito breeding sources within its boundaries are created by man and that 70% are as a consequence of agricultural practices *

D. There are about 6,000,000 acres of irrigated land in California; many hundreds of miles of poorly graded ditches of all types; innumerable septic tanks, cesspools, borrow pits, sumps, sewer farms and other places where mosquitoes are produced in tremendous numbers.

E. Good mosquito control is practically synonomous with good conservation agricultural practice. Land levelling, application of water so that it does not remain on the surface for more than three days, drainage of such tailwater accumulations as may occur and maintenance of headgates, ditch banks etc. to prevent leakage and seepage are beneficial to the farmer and keep mosquito production at reduced levels.

F. Many of these other sources may be prevented or remedied insofar as mosquitoes are concerned without causing any detraction from any other sources.

G. Forty-three mosquito abatement districts and a number of other local agencies are obliged to expend more than 2,000,000 dollars of tax money annually to control these insects and to make life safe and more comfortable for an estimated 5 million people in California.

H. The State of California Department of Public Health, the University of California, the U. S. Public Health Service, and others recognize the importance of these activities and actively support them.

**Proceeding and Papers of the 18th Annual Conference of the California Mosquito Control Association, p. 85 (DeWitt)

Mr. Ehmann: Mr. President, I move the adoption of the report of the Committee on Irrigation and Water Development. (This was seconded by Dr. Murray, and passed by unanimous vote.)

Mr. Robinson: Were the various railroads included in the report?

Mr. Portman: The list given is brief, but it is proposed that when it is put in operation the local mosquito abatement districts shall furnish a lish of those agencies to which this information and request of cooperation should go.

Mr. Kimball: We will now have the report of the Committee on Survey Methods and Ecology. W. Donald Murray, Chairman.

Survey Methods and Ecology Committee Report

For 1950

1. This committee reports the completion of the manuscript on "The Section Survey Concept" and its inclusion in the Operations Manual. The committee urges that all mosquito abatement districts study this memorandum and incorporate its basic concepts into their programs in so far as applicable.

2. Two years ago the Survey Methods Committee recommended a carefully analyzed plan for entomological surveys to the California Mosquito Control Association. This plan was published in the Proceedings of the 17th Annual Conference of the California Mosquito Control Association, but in part is is again presented to you for ready reference.

1. Survey Aims and Values

   A. Survey methods, techniques, and equipment should be standardized insofar as is possible, with due consideration for varying mosquito control conditions throughout California. Use of information obtained through survey methods will be a primary objective, as this information is essential in organizing the control program.

   B. Standardization of survey methods will act to further stimulate a scientific approach to the problems of mosquito abatement and in this manner aid in contributing to the economic soundness of control operations.

II. Types of Surveys

   A. Initial Survey

      1. Objective: To determine the most efficient and economical methods that can be employed to achieve control.

      2. Fundamental Information
         a. Determination of species in the area.
         b. Relative abundance of various species.
         c. Sources of various species.
         d. Distribution of the important pest and vector species.

      3. Procedure: Conduct a program of systematic sampling of larvae and adults from all types of sources throughout the survey area. This would include the establishing of a series of resting stations that could be maintained throughout the first full mosquito season. The first records from these stations could be incorporated in the initial survey data. The number of these stations required for a district could be determined on the basis of area as follows: A minimum of ten stations would be required for districts having an area of 500 square miles or less; districts having an area greater than 500 square miles would add one station for each additional 50 square miles.

      4. Description of Terrain
         a. This will require study of available maps and aerial photographs. A certain amount of gross mapping may be necessary.
         b. Consideration must be given to changing conditions brought about by man-made alterations.

      5. Evaluation of the effects of seasonal change in relation to mosquito problems.

      6. Relative importance of mosquito species.
         a. This must be based on a reasonable knowledge of ecology (relationship of a mosquito to the environment).

      7. Personnel Requirements: Unless the initial survey is conducted in a thorough manner and the data obtained properly analyzed and interpreted, the end results may be entirely misleading. It was therefore recommended that competent, experienced professionad personnel who have a thorough working knowledge of mosquito ecology be employed to render those services. Such a service might be obtained either on a permanent or on a consulting basis.

   B. Routine Surveys

      1. First Season of Operation: Weekly collections from a series of permanent adult resting stations will probably be needed for a period of one year only.

      2. Second Season of Operation: By the beginning of the second season a district should have a procedure established whereby records of all inspections should be kept systematically. This would require routine larvae and adult inspections. The summary of data could include information from biting records, adult resting stations, light traps, etc. A summary of these data could be made a part of the regular monthly report and recorded as indicated below.

	Number of Inspections	Number of Samples Identified	Species in Order of Abundance
Larvae			
Adults			

By using this procedure the number of permanent collecting stations could be reduced. It is believed to be desirable to reduce the number of permanent collecting stations after the initial survey, in that it is generally recognized that such records do not represent a true statistical sampling and are difficult, if not impossible to interpret as an index to control accomplishment.

a. Collections: Larvae and adults should be collected by foremen and inspectors as part of their routine work. Specimens should be submitted to the laboratory accompanied by the following information:

1. Collector's name
2. Date
3. Locality
4. Type of harbor
5. Approximate density

3. Mapping
   a. Section survey maps.

It was the intention of the Survey Methods Committee that this plan should be recommended by the Executive Committee to the Bureau of Vector Control and that the Bureau of Vector Control consider it as a more valuable requirement than the present generally disliked requirement on adult collection stations. However, the plan was never discussed by the Executive Committee and was never presented by them to the Bureau of Vector Control.

The present Survey Methods and Ecology Committee recommends that the California Mosquito Control Association as a body formally approve the plan as presented and submit said plan to the Bureau of Vector Control with a recommendation that it be adopted and included in the entomological requirements of districts requesting subvention.

Many districts are now following this plan for their own benefits, and it should not be difficult for all districts interested in carrying out a sound program to prepare and analyze information in the manner recommended in the plan. It is understood that the adoption of this plan will probably mean for most districts a reduction of the permanent adult collecting stations as now required by the Bureau of Vector Control, and the development of other survey methods, especially larvae records, on the basis of the Section-Survey Concept.

W. D. Murray, Chairman
Committee on Survey and Ecology

Theodore Aarons
T. G. Raley
E. A. Davis
Howard Greenfield
J. R. Walker
D. D. Grant

Dr. Murray: I have prepared a Resolution, relating to this report, which I believe will be brought up by the Resolutions Committee.

Mr. Preuss: I move acceptance of the report of the Survey and Ecology Committee. (Motion seconded by C. D. Grant, and passed by unanimous vote.)

Mr. Kimball: The next report will be from the Public Relations Committee, Rolland L. Henderson, Chairman.

Mr. Rolland Henderson: A few days ago I turned in a report of our Committee, and I forgot what I turned in. However, the Committee during this past year, with the approval of the Executive Committee, tried an idea of monthly news releases to the districts, of pertinent facts and information. Due to circumstances beyond the control of the Committee, we didn't get the material into your hands. However, almost a member by member poll believes that it is an extremely good idea if it can be done. Whether or not it can be done is a question. However, I will recommend the continuation of the monthly new release idea to the incoming Public Relations Committee. You saw the motion picture a short while ago representing the operations of the valley districts. This picture was stimulated by our Committee. Opportunity was given to all of the districts to participate in the making of that film. Whoever had film were asked to send it to the Public Relatons Committee, so that they might edit it and take the material that we felt could be used in making a film of general interest to all mosquito abatement districts. The districts that responded were the districts of the valley. The film was made with the idea that any district outside of the valley that wish a copy of the film at the same price that we're paying could have a copy to edit themselves, and include in it any other material of their own choosing of their own district activity. They could thus make it their own and personalize it to their own district.

To Gus Auguston of Madera goes a lot of credit for helping us make that film. His abilities were used, his men were used, and even though he griped an awful lot, we still got the film out and, personally, I think it's a good film. The film is being distributed by a firm in Hollywood which has made copies of the original for anyone who culd like it at made copies of the original for anyone who would like it at own use we would like to have your order as soon as possible so that we can get back the original film that Hollywood has now, because there are pieces all over the Madera laboratory that have to be put back together and sent to the different Districts which originally owned them.

The publicity on the Convention has been done to some extent by the Public Relations Committee. We have set up a booth of exhibits in the lobby. It was standing next to a fellow and I said have you seen our exhibit, and he said "where?" and he was looking right at it. I hope everyone will examine it.

Harold Gray has taken the responsibility of the radio releases that are going to be made for local consumption. Bob Peters has consented to digest the papers of the meeting and release thm to the newspapers. Miss Esther Husman of the Riverside County Health Department Public Rlations Division has been a great help in newspaper releases in preparation for this Convention.

The Public Relations Committee cannot take any credit for the printed program and the publicity material sent you prior to the meeting. The Orange County Mosquito Abatement District has its own print shop, and John Shanafelt is responsible for saving the Association considerable money and producing the finely printed program and other publicity you have been given, so I'm going to give the credit for all of this material to Jack Kimball and he can pass it out wherever he wishes.

Mr. Washburn: I move the report of the Public Relations Committee be accepted. (Seconded by Dr. Tinkham, and passed by unanimous vote.)

Mr. Kimball: We will now have he report of the Legislative Committee, Chester Robinson, Chairman.

Mr. Robinson: The Legislative Committee of the California Control Association wishes to report that all legislation proposed by the member districts has been presented to the State Legislature. Assemblyman Ralph Brown of Stanislaus County has presented the following Assembly Bills to the State Legislature:

Bill No. 296, an act to amend Section 2248 of the Health and Safety Code. This Bill increases from $5.00 to $10.00 the allowance for Board members expenses for Board of Trustees meetings.

Bill No. 297, an act to amend Section 650-6 of the Vehicle Code. This Bill is the one permitting the use of red lights on vehicles for aerosol purposes.

Bill No. 298, an act to amend Section 2206 of the Health and Safety Code. This is the Bill to extend to 1953 exemption of the provisions of the District Investigation Act. We do not recommend passage of this Bill unless Bill 299 can not be passed.

Bill No. 299, an act to amend Section 2206 of the Health and Safety Code. This Bill eliminates mosquito abatement districts from the provisions of the Act.

From our investigation we do not anticipate any difficulty in the passage of these Bills, but recommend that member districts contact their State Assemblymen and Senators requesting their active support in the passage of these Bills. These Bills have been unanimously approved by the Executive Committee and we recommend that the Association endorse their passage.

Respectfully submitted,

E. Chester Robinson, Chairman
Legislative Committee,
Harold F. Gray
Thomas M. Sperbeck
Edward D. Davis

Mr. Robinson: Mr. President, I move that the report of the Legislative Committee be accepted. (This motion was seconded by Mr. Domecq and passed by unanimous vote.)

Mr. Kimball: I now ask Mr. Gray to report on the William B. Herms Award.

Mr. Gray: We hereby report for the Committee on the William B. Herms award for 1950.

The sum of $35.00 was made available to the Berkeley-Contra Costa Area Council of the Boy Scouts of America, to assist one or more Boy Scouts to attend summer camp. On the advice of the Scout Executive, Mr. Victor Lindblad, Scouts Dong Chan and Ronald Hirano, members of Troop 11 at the California School for the Deaf in Berkeley, were helped to attend Camp Wolfboro in the high Sierras on the Stanislaus Raver for two weeks. Both boys are deaf and dumb. The Chairman of this Committee has examined both boys for the Public Health Merit Badge in the Boy Scouts of America, and can assure the members of this Association that the choice was well deserved.

Your Committee recommends that a similar amount be made available to it for this purpose in 1951.

Respectfully submitted,
Richard F. Peters
Harold F. Gray, Chairman

Mr. Gray: Mr. President, I move the acceptance of the report of the Committee on the W. B. Herms Award. (The motion was seconded by Mr. Coburn and passed by unanimous vote.)

Mr. Kimball: I will also ask Mr. Gray to report as coordinator on Mosquito Control Training for Military Personnel.

Mr. Gray: Chief Mitchell and Chief Estes who are part of the teaching staff at the Enviromental Sanitation Training Unit at Oak Knoll (U. S. Naval) Hospital in Oakland are attending this Convention. This after noon they do not happen to be present, but they were here this morning and will be here tonight and tomorrow. I would like very much to have you get acquainted with them, as from time to time different districts will be requested to assist in this Navy training program. The following is the report of the undersigned for 1950 as "Coordinator" on Mosquito Control Training for Military Personnel.

Letters offering the services of this Association for the purpose of giving field training in mosquito control methods have been sent to the medical officers in charge of the 11th and 12th Naval Districts and to the 6th Army. Replies of appreciation have been received from each.

In addition, we have been in direct personal communication with th Chief of Preventive Medicine, Surgeon-General's Office, Navy Department, Washington, D. C., and have been advising the Enviromental Sanitation Training Unit now being conducted at the U. S. Naval Hospital in Oakland, California. One group of nineteen enlisted men from the Unit received field training on February 21st in the Alameda County Mosquito Abatement District, and the use of certain other districts for this purpose is being considered.

No contact has as yet been made with the U. S. Air Force, but will be attempted later.

Respectfully submitted,
Harold F. Gray

Mr. Gray: I move the acceptance of the report, Mr. President. (This motion was seconded by Mr. Preuss and passed by unanimous vote.)

Mr. Kimball: I think you are familiar with the Report of the Association's Ways and Means Committee, copies of which have been sent to all districts. Ed Smith is Chairman and will carry on from here.

Mr. Smith: The Ways and Means Committee has prepared and submitted to all Members of the California Mosquito Control Association Proposed Articles of Incorporation for the California Mosquito Control Association.

At the California Mosquito Control Association's Executive Committee Meeting of January 10th, 1951, at Oakland, California, the Committee unanimously accepted the proposal of the Ways and Means Committee to submit the proposed Articles of Incorporation to a roll call vote of the entire Association at the Annual Business Session of the Association, March 12, 1951, at Riverside, California.

The Ways and Means Committee wishes to propose adoption of the proposed Articles of Incorporation by the California Mosquito Control Association.

Respectfully submitted,
Ways and Means Committee
Edgar A. Smith, Chairman
T. G. Raley
Theodore Aarons

Mr. Smith: In order to put this before the meeting, I move the adoption of the Articles of Incorporation for the California Mosquito Control Association. (After discussion, this motion was amended to approve the proposed Articles of Incorporation and direct the Executive Committee to proceed to incorporate the Association. This amended motion was seconded by Mr. Raley.)

Mr. Kimball: Is there any discussion before we have a roll call vote?

Mr. Coburn: Under the proposed Articles of Incorporation apparently the Board of Directors can sign notes, buy property and incur various obligations. With this unlimited power, I wonder whether any Manager or any Board of Trustees is going to put himself into the position of being obligated to pay for such actions of the Board of Directors of the Association, for if you incur an obligation some one has got to pay it. What limitations are there on the power of the Board of Directors to incur debts for the District to pay?

Mr. Kimball: I think that's a good question, and it's worth taking time to explain.

Mr. Smith: One of the important reasons for incorporating at the present time is that each individual district is probably liable to the full extent of its resources for the actions of the California Mosquito Control Association. Under incorporation only the Association itself would be liable, and not the individual districts. The Association would be liable only to the extent of that amount in the Association treasury. Does that answer your quettion?

Mr. Coburn: That is well taken. It it's that way, I will be perfectly willing. In other words, at present we'd be responsible for the $2,300 we now have in the Treasury.

Mr. Smith: These Articles of Incorporation were drawn up by our attorney, Mr. Winton, who was on the program this morning. He went into the matter very thoroughly. He has incoroprated I think about thirty-five non-profit organizations in he Merced area the last couple of years, so he has had considerable experience in drawing up this type of Articles.

Mr. Jones: A question that bothers some of the Boards is whether the Executive Committee of the Association is actually going to go out and borrow money and do a lot of these things that are stated in the proposed Articles of Incorporation. That's the question that came up at our Board, and we had the Articles of Incorporation and the propsed Constitution and By-Laws turned over to the District Attorney, and his opinion was that our district was only liable for the amount of the dues as stated in the Constitution and By-Laws under the present set-up and they wouldn't become liable for any other money or any other things unless they accepted such liability.

Mr. Smith: The question appears to be whether the fact that these Articles of Incorporation make a lot of general statements about things that the California Mosquito Control Association can do means that the California Mosquito Control Association will be doing them. Our attorney explains that the Articles of Incorporation should be a general statement, giving an organization as much leeway as possible, because it is permanent. If at any time you change your Articles of Incorporation it's going through a long involved procedure and it's quite a bit of red tape because this ecomes a permanent document filed with the State of California. The Constitution and By-Laws, on the other hand, are specific statements of things that the Association now authorizes itself to do, and these can be changed at the will of the Association itself by amendment of the Constitution and By-Laws.

Mr. Jones: If the proposed Articles of Incorporation are adopted will the Constitution and By-Laws which temporarily are being used constitute the By-Laws that will accompany the Articles of Incorporation?

Mr. Smith: The Articles of Incorporation as such do not affect the Constitution and By-Laws, except to require that we establish By-Laws to govern the Association. I think that there are a few minor changes in wording that should be made in the Constitution and By-Laws if we do incorporate and I believe Mr. Gray has some amendments ready.

Mr. Jones: I understand that if you have Articles of Incorporation, that they are an enabling act, and you also have to have a set of By-Laws, which limit and govern the operations of the Association under the Articles for Incorporation. Such By-Laws would have to match the Articles of Incorporation.

Mr. Smith: With a few minor changes in wording there's nothing in the Constitution or By-Laws that conflict with the Articles of Incorporation. If we do incorporate, we have to change the name of the Executive Committee to the Board of Directors. That's one of the minor changes and there are a couple of others of that type.

Mr. Coburn: I wonder if I can get my original question answered as to a District's liability?

Mr. Smith: Perhaps the point that you brought up originally is the best explanation there that under the present setup each Corporate Member is individually liable in case of any law suit or in case of any litigation. You may recall that in one of the Committee reports it was recommended that the Association become the owner and custodian of certain pieces of property for experimental purposes. Without being a legal entity we wouldn't be able to hold title to that property. Incorporation would enable that type of activity. It is simply a protection. Incorporation is not essential, but it is a protection to each individual district.

Mr. Gray: For Mr. Coburn's information, our District Attorney is of the opinion that there is doubt whether a mosquito abatement district can contract with an unincorporated voluntary association. So long as a taxpayer doesn't raise the question, we are probably safe to pay dues to this unincorporated Association, but if there were a successful taxpayer's suit you might have to pay back into the County Treasury all the monies paid out to the Association.

Mr. Coburn: This brings up one of the points that the attorney brought out here. We're making a contract for an unlimited period of time.

Mr. Smith: No, it's on a yearly basis. Each individual district contracts with the Association on a yearly basis only. Incorporation doesn't change that.

Mr. Washburn: I don't think it's the intent of the Executive Committee at this date or at any future date to obligate the Association to unlimited expenditures.

Mr. Kimball: We have a motion to instruct the Executive Committee to proceed with incorporation, and this will be on a roll call vote.

Mr. Aarons: Will the designated representatives answer yes or no when the name of the District is called?

DISTRICT	*VOTE*	*REPRESENTATIVE*
Anderson	Abstained	J. D. Willis
Redding	Yes	J. D. Willis
Pine Grove	Abstained	J. D. Willis
Merced	Yes	E. A. Smith
Hanford	Yes	J. H. Brawley
Sutter-Yuba	Yes	T. M. Sperbeck
Delta	Yes	W. D. Murray
Los Molinos	Yes	G. D. Haynes
Consolidated	Yes	T. G. Raley
Turlock	Yes	J. Domecq
Madera	Yes	G. F. Auguston
Orange County	Yes	J. H. Kimball
City of Les Angels	Yes	N. R. Ehmann
Corcoran	Yes	L. S. Haile
Durham	Yes	Wm. Bollerud
Butte County	Yes	R. F. Portman
Fresno	Yes	E. Davis
Tulare	Yes	R. L. Henderson
East Side	Yes	E. C. Robinson
Alameda County	Yes	H. F. Gray
Contra Costa	Yes	E. Campbell
Solano	Yes	H. C. Pangburn
Marin	Yes	G. P. Jones
Pulgas	Yes	D. Grant
Three Cities	Yes	D. Grant
N. S. Joaquin County	Yes	Robert Peters
Coachella	Abstained	Dr. Tinkham

Mr. Aarons: Mr. Chairman, the vote is 24 yes, 3 astaining, and no dissenting votes.

Mr. Kimball: I believe that's an unanimous vote. Therefore the Executive Committee is directed to proceed with incorporation of the Association. I will now call for the Constitution Revision & Membership Committee Report, Ed Washburn, Chairman.

Mr. Washburn: At the last annual conference, the Constitution Revision & Membership Committee was instructed to go over the Constitution and By-Laws to bring them up to date, and make any corrections that were needed. That we have done. We met twice, once on March 12, 1950, and again with Executive Committee at a meeting on January 10. At the last meeting on January 10, it was the opinion of the Executive Committee that this Committee completely revise, consolidate and shorten the Constitution and By-Laws as they stood. On February 9, you were sent copies of the new proposed Constitution and By-Laws as one complete unit, not two separate documents. I trust you had time to consider these. There are no major changes over the old Constitution and By-Laws under which we are operating under the present time. This is the first year, you may remember, that we have operated under a Constitution and By-Laws. I move that the new Constitution and By-Laws as a consolidated unit be adopted at this annual conference.

Mr. Kimball: Before we put that motion, we should have a motion to accept the Committee report. (Motion by Washburn, seconded by Preuss, and passed by unanimous vote.)

Mr. Washburn: I now move that we adopt the proposed Constitution and By-Laws as a consolidated unit. (Motion seconded by Dr. Grant.)

Mr. Gray: Before you put that motion to vote Mr. President, I would like to make certain remarks and suggestions.

The proposed Constitution and By-Laws were drawn up primarily for an unincorporated Association. Mr. Moroni and other attorneys have offered some suggestions as to them. One is that an incorporated association normally has a Board of Directors, and the Executive Committee is a management fragment of the Board of Directors. Therefore it would be desirable in these By-Laws to change the words "Executive Committee" to "Board of Directors". We also find that there is no provision in Section 2 of Article V for the control by the Board of Directors of applications for membership in all classifications, and a section should be added covering that. The Article VIII concerning financial responsibility is of dubious legality for an incorporated association. To cover these points I have prepared the following substitute motion which I will present for your consideration.

It is moved that the preliminary copy of the "Constitution and By-Laws of the California Mosquito Control Association", as prepared by the Committee on Constitution Revision and Membership, (G. Edwin Washburn, Chairman) which has been presented to the Executive Committee of this Association and is now before this annual meeting of the California Mosquito Control Association for adoption, be amended as follows prior to adoption:

1. That whereever in the preliminary copy the word "Constition" appears it shall be stricken out, and in particular as follows:
   (a) On page 1, line 1, in the title, strike out "Constitution and";
   (b) On page 7, line 4, strike out the words "Constitution and";
   (c) On page 13, line 15, strike out "This Constitution" and substitute "The By-Laws";
   (d) On page 14, line 3, strike out "Constitution and";
   (e) On page 14, line 6, strike out "this Constitution and"; and insert "these".

2. That wherever in the preliminary copy the words "Executive Committee" appear, the words "Board of Directors" shall be substituted therefor, and particularly as follows:
   (a) On page 3, lines 3, 9, 11, 18, and 21;
   (b) On page 4, lines 4, 6-7, 10-11, 15, 17, 18, and 21;
   (c) On page 5, lines 5-6, 6, 10, 12, 15, 16, 18, 23, and 27;
   (d) On page 5, line 9, strike out the words "Executive Committee Duties" and insert the words "Duties of the Board ofDirectors";
   (e) On page 5, lines 20 and 21, strike out the words "Committee" and insert the words "Board of Directors";
   (f) On page 6, lines 3, and 8-9;
   (g) On Page 7, line 19;
   (h) On page 8, lines 9-10;
   (i) On page 9, lines 1, 5, 8-9, 13, and 17;
   (j) On page 10, lines 15 and 20;
   (k) On page 12, lines 1-2, 7, 9, and 13-14;
   (l) On page 13, lines 20-21.

3. That on page 7, after line 15, insert the following sub-section to be designated sub-section "K" in section 2 of Article V.

   "(k) To accept or reject applications for membership in all clasifications of membership in this Association, except Honorary Membership, and to prescribe rules and procedure in relation thereto."

4. On page 10, Article VIII, lines 2 to 7 inclusive, after the words "Section 1" strike out all the words in lines 2 to 7 inclusive, and substitute therefor the following:

   "The Board of Directors shall require a bond covering financial responsibility of the Secretary-Treasurer, and may require similar bonds of other officers or employees of the Association. The Board of Directors may also provide for suitable general liability insurance. The premiums on such bonds or insurance shall be paid by the Association."

I offer this amendment in written form, and submit with it a copy of the original By-Laws with these changes shown directly on them. I move the adoption of the substitute motion. (Seconded by Mr. Washburn.)

Mr. Kimball: You have heard the substitute motion by Mr. Gray, seconded by Mr. Washburn, to amend the By-Laws as specified. Is there any discussion on Mr. Gray's proposal. All in favor? Aye. Opposed? None.

The next motion we have before the house is the adoption of these proposed By-Laws as amended. The ballot will be on roll call.

Mr. Bollerud: I would like to have you read what the provisions are for nominating Officers under there By-Laws.

Mr. Kimball: Mr. Secretary, will you read the section in question?

Mr. Aarons: *"Article VI — Election and Nomination of Officers.* Section 1. At least 60 days prior to the annual meeting of this Association, the President shall appoint, subject to approval by the Board of Directors, a Nominating Committee consisting of designated representative of five (5) Corporate Members of this Association. Section 2. The Nominating Committee shall determine its nominees for the elective offices of this Association, except Regional Representatives. It shall, ten (10) days prior to the Annual Meeting, send to each memer agency, through the Secretary of this Association, th names of the nominees selected. It shall also receive before the beginning of the second session of the Annual Meeting, nominations made in writing and signed by not less than three (3) Representatives of Corporate Members, for any elective office in this Association. Nominations may not be made in any other manner"

Mr. Bollerud: I feel that in an organization of this type or almost any other type no eligible person should be barred from running for any office. Therefore, I feel that these restrictions upon nominations are out of place in an organization that pretends to be democratic. I feel there should be provision here for nominations from the floor at any time that we elect Officers. Therefore, I move to amend so that we remove the words "Nominations may not be made in any other manner" and state that nominations may be made from the floor at the time of election. (This motion was seconded by Dr. Tinkham.)

Mr. Kimball: Is there any discussion, before we have a voice vote? All in favor, Aye: Opposed, No..

Mr. Gray: A roll call vote appears to be desirable.

Mr. Kimball: A roll call vote has been requested; we'll ask the Secretary to call the roll on the proposed amendment.

Mr. Bollerud: Mr. Chairman, I am satisfied from the sounds that my motion was defeated. There's no need to call the roll.

Mr. Kimball: If that is satisfactory to the rest we will declare the motion lost.

Mr. Gray: Mr. President, for the information of Mr. Bollerud may I suggest that at the next annual meeting he bring up a motion to amend along the lines he suggests. But let us proceed now without too many difficulties in getting these By-Laws in operation.

Mr. Kimball: If there's no further discussion we'll put the motion to accept the proposed Constitution as amended. The Secretary will call the roll.

Corporate Member	Vote	Representative
Anderson	Yes	J. D. Willis
Redding	Yes	J. D. Willis
Pine Grove	Abstained	J. D. Willis
Merced	Yes	E. A. Smith
Hanford	Yes	J. H. Brawley
Sutter-Yuba	Yes	T. M. Sperbeck
Delta	Yes	W. D. Murray
Los Molinos	Yes	J. D. Willis
Consolidated	Yes	T. G. Raley
Turlock	Yes	J. Domecq
Madera	Yes	G. F. Auguston
Orange County	Yes	J. H. Kimball
City of Los Angeles	Yes	N. R. Ehmann
Codcoran	Yes	L. S. Haile
Durham	Yes	Wm. Bollerud
Butte Co.	Yes	R. F. Portman
Fresno	Yes	E. Davis
Tulare	Yes	R. L. Henderson
East Side	Yes	E. C. Robinson
Alameda County	Yes	Harold F. Gray
Contra Costa	Yes	E. Campbell
Solano	Yes	H. C. Pangburn
Marin	Yes	G. P. Jones
Pulgas	Yes	D. Grant
Three Cities	Yes	D. Grant
Matadero	Yes	D. Grant
West Side	Abstained	R. H. Coburn
No. San Joaquin Co	Yes	R. H. Peters
Coachella	Yes	C. Tinkham
Kern Co.	Yes	A. F. Geib

Mr. Kimball: The motion has been carried by a vote of 28 ayes, 2 abstaining, and no noes. We now have our new revised By-Laws in effect, as follows:

By-Laws Of The California Mosquito Control Association

Article I. Name

Section 1. This association of mosquito control agencies in California shall be known as the "CALIFORNIA MOSQUITO CONTROL ASSOCIATION."

Article II. Purposes

The objects and purposes of this association shall be to promote cooperation among those directly and indirectly concerned with and interested in, mosquito control and related work, the development of improved methods and techniques to mosquito control and the dissemination of information in relation thereto, and the advancement of mosquito control in the State of California and elsewhere.

Article III. Membership

Section 1. Membership in this association shall consist of four classes: Corporate Members, Associate Members, Sustaining Members, and Honorary Members.

Section 2. Corporate Members shall be Mosquito Abatement Districts, Pest Abatement Districts concerned principally with mosquito abatement, and other local governmental agencies directly engaged in mosquito abatement in the State of California. Each Corporate Member agency shall have one vote, to be cast by its designated representative.

Section 3. Associate Members shall be individuals, agencies or other oganizations interested in or concerned with mosquito abatement. Associate Members shall have no vote in this Association.

Section 4. Sustaining Members shall be those individuals and/or organizations who desire to contribute to the furtherance of mosquito control through this Association. Sustaining Members have no vote in this Association.

Section 5. Any individual who has performed some outstanding service in the interest of mosquito abatement in the State of California or elsewhere shall be eligible for election to honorary membership upon recommendation of three (3) or more Associate or Corporate Members. After at least ten (10) days notice in writing to all Corporate Members, such recommendation shall be presented at the annual meeting of the Association and such individual become an Honorary Members of the Association upon election by a two-thirds majority vote of the Representatives of Corporate Members. Honorary Members, as such, shall have no vote in this Association.

Section 6. At all meetings of this Association, all members of the Association, irrespective of type of membership, shall be permitted to take part in the discussions and proceedings.

Article IV. Officers and their Duties

Section 1. The officers of this Association shall be a President, a Vice-President, a Secretary-Treasurer, and the members of the Board of Directors. At the time of their nomination and election, each officer shall be either a member of a governing board of a Corporate Member or a designated Representative of a Corporate Member.

Section 2. The President shall preside at all meetings of this

Association, annual and special, and at all meetings of the Board of Directors. He shall maintain and exercise general supervision over the affairs of the Association, subject to the authority of the Board of Directors, and shall discharge such other duties as usually pertain to the office of President.

Section 3. The Vice-President shall exercise the powers and perform the duties of the President in the absence or disability of the President or in case of a vacancy in the office of President. He shall also perforem such duties as may be assigned to him by the Board of Directors.

Section 4. The Secretary-Treasurer shall keep full and correct minutes of all meetings of this Association and of the Board of Directors. He shall be responsible for the maintenance of all membership records, conduct the correspondence of this Association, and issue all notices of meetings. He shall collect and receipt for all dues, contractual payments, assessments and other income. He shall deposit promptly all funds of this Association in such depositaries as shall be approved and designated by the Board of Directors. Checks in payment of obligations of this Association shall be signed by the Secretary-Treasurer. He shall, under the direction of the Board of Directors, pay all bills of this Association and make such other disbursements as are necessary and incidental to the operations of the Association. He shall, at the annual meeting of this Association, and if directed by the Board of Directors at special meetings, make full and true report of the financial condition of this Association. He shall perform such other duties as are usually incident to the office of Secretary-Treasurer and as may be asigned to him by the Board of Directors. He shall receive such compensation, and employ such assistance, as shall be authorized by the Board of Directors. The Secretary-Treasurer, with the approval of the Board of Directors and with the assistance of the Publications Committee, shall publish and distribute the proceedings and other publications of this Association.
Section 5. The Board of Directors shall consist of (a) the President, Vice-President and Secretary-Treasurer of this Association (b) the immediate past President of this Association; (c) one member of a governing board of a Corporate Member; (d) a Trustee or employee of a Coroprate Member shall be elected to represent each of the geographical regions of the State of California as follows: Sacramento Valley Region, San Francisco Bay Area and Coast Counties Region, San Joaquin Valley Region, and Southern California Region. The boundaries of these regions shall be prescribed by the Board of Directors. Such regional members of the Board of Directors shall be elected as prescribed in Article VI, Section hereof.

Article V. Duties of the Board of Directors

Section 1. The Board of Directors shall meet upon the call of the President, or upon request in writing of three (3) or more members of the Board of Directors directed in writing to the Secretary-Treasurer. At least ten (10) days prior notice in writing shall be given by the Secretary-Treasurer to all members of the Board of Directors as to any meetings of the Board of Directors; the time and place of such meetings shall be designated by the President. Not less than (5) members of the Board of Directors shall constitute a quorum for the transaction of business, and action by the Board of Directors shall be upon the vote of a majority of those members present at any meeting of the Board of Directors at which a quorum is present.

Section 2. The Board of Directors shall manage the affairs of this Association, and shall have power:

(a) to fill any vacancy among the officers of this Association, including the membership of the Board of Directors;

(b) to appoint or employ an Executive Secretary of this Association, with duties to be defined by he Board of Directors;

(c) to appoint a Publications Committee of not more than five (5) to assemble, edit and cause to be published the proceedings of the annual meeting of this Association, and of such special meetings as the Board of Directors shall direct;

(d) to appoint an Auditing Committee of three (3) who shall audit the accounts of this Association and report thereon at the annual meeting of this Association;

(e) to appoint a Program Committee of not less than three (3) for each annual meeting and for any special meetings. The Secretary-Treasurer shall be ex-officio a member of any Program Committee;

(f) to appoint such other committees as it may deem to be necessary or useful in conducting the business of the Association;

(g) to prescribe the duties of officers of this Association not otherwise prescribed in the by-laws of this Association;

(h) to prescribe rules and regulations for the conduct of the affairs of this Association, as are not inconsistent with the provisions of the By-Laws of this Association;

(i) to prescribe the boundaries of the geographical regions of the State; to-wit; Sacramento Valley Region, San Francisco Bay Area and Coast Counties Region, San Joaquin Valley Region, and Southern California Region;

(j) to determine the number and price of each publication which shall be distribuated to the various members of this Association, and to others; to approve lists of non-members who may receive publications without charge;

(k) to accept or reject applications for membership in this Association, except Honorary Membership, and to prescribe rules and procedure in relation thereto.

Article VI. Nomination and Election of Officers

Section 1. At least 60 days prior to the annual meeting of this Association, the President shall appoint, subject to approval by the Board of Directors, a Nominating Committee consisting of designated representatives of five (5) Corporate Members of this Association.

Section 2. The Nominating Committee shall determine its nominees for the elective officers of this Association, except Regional Representatives. It shall, ten (10) days prior to the Annual Meeting, send to each member agency, through the Secretary of this Association, the names of the nominees selected. It shall also receive before the beginning of the second session of the Annual Meeting, nominations made in writing and signed by not less than three (3) Representatives of Corporate Members, for any elective office in this

Association. Nominations may not be made in any other manner.

Section 3. Regional representatives on the Board of Directors shall be elected, one from each geographical region, by a quorum of designated representatives of the Corporate Members in each region prior to or before the conclusion of the annual meeting of this Association.

Section 4. Officers of the Association shall be elected at the annual meeting of this Association, and shall serve until the next annual meeting following their election or until the election of their successors.

Article VII. Meetings

Section 1. There shall be an annual meeting of this Association, for the election of officers, the presentation of papers and discussions on mosquito abatement and related subjects, and such other business as may properly be brought before it. Such meetings shall be held at such times and places as the Board of Directors shall prescribe. At least thirty (30) days prior notice in writing shall be given as to the time and place of the annual meetings.

Section 2. Special meetings of the Association may be held wherever the Board of Directors deems such meetings necessary, or whenever five (5) or more Corporate Members shall make a written request thereof, presented to the Secretary-Treasurer. Such requst shall be peresented to the Board of Directors, which shall designate a time and place for such special meeting. The Secretary-Treasure shall give written notice of all special meetings of the Association to all mmbers, at least ten (10) days prior to the date of such special meeting. With the approval of the Board of Directors, special meetings of limited membership in this Association, for consideration of technical or administrative matters, field demonstrations, or similar matters, may be held at times and places to be determined by the Board of Directors.

Section 3. A simple majority of designated Representatives of Corporate Members of this Association shall constitute a quorum for the transaction of business at any annual or special meeting of this Association, and any actions taken at such meetings shall be by majority vote.

Article VIII. Financial Responsibility

Section 1. The Board of Directors shall require a bond covering financial responsibility of the Secretary-Treasurer, and may require similar bonds of other officers or employees of the Association. The Board of Directors may also provide for suitable general liability insurance. The premiums on such bonds or insurance shall be paid by the Association.

Article IX. Revenues

Section 1. The revenue of this Association shall be derived from contractual payments for services rendered by this Association to Corporate Members and others, from dues paid by Associate Members, from contributions of Sustaining Members, from the sale of publications and advertising, from donations, and from such other sources as may be approved by the Board of Directors of this Association.

Section 2. Payments by Corporate Members shall be made annually for each fiscal year on or before the last day of June in such fiscal year, according to a contract between the Corporate Members and this Association in the general form prescribed by the Board of Directors. The amount of such annual contractual payment shall be as follows:

Local Budgeted Funds for mosquito abatement		*Annual Contract Payment*
From	*To*	
$75,000	over	$100.00
50,000	75,000	90.00
40,000	50,000	75.00
30,000	40,000	60.00
20,000	30,000	40.00
10,000	20,000	25.00
Under	10,000	10.00

Section 3. The dues of other Members shall be as follows:

(a) The dues of Associate Members shall be three dollars ($3.00) per annum, payable on July 1 of each year.

(b) Dues of Sustaining Members shall be not less than twenty dollars ($20.00) per annum.

(c) Honorary Members shall not be subject to the payment of dues.

Section 4, All dues or contractual payments shall be paid to the Secretary - Treasurer of this Asociation.

Article X. Reports and Publications

Section 1. An annual report of this Association shall be published each year. This report shall contain the proceedings, papers, and business transacted at the annual meeting. It may include any other matters deemed by the Board of Directors to be essential to the general welfare of the members of this or other associations engaged in or interested in mosquito abatement.

Section 2. Reports of special meetings, and other information, may be published by this Association with the approval of the Board of Directors.

Section 3. Within the limits of general policy set by the Board of Directors, the Publications Committee shall edit and prepare for publication the proceedings, papers, discussions and other matters in connection with any annual or special meeting of this Association, and reports or publications upon any matters authorized by the Board of Directors.

Article XI. Committees

Section 1. Resolutions.

On the first day of each annual conference, the President shall appoint a Committee on Resolutions, which Committee shall consist of not less than five (5) Representatives of Corporate Members in attendance at the annual meeting.

Except resolutions of courtesy, commendation, appreciation or condolence, no resolution expressing the opinion or policy of this Association on any question shall be considered or discussed by the conference, unless it has been first submitted to, and reported on, by said Committee on Resolutions. All such resolutions shall be submitted to the Committee on Resolutions before the beginning of the regular business session of the Association.

Section 2. Credentials.

It shall be the duty of the President, on the morning of the first day of the annual meeting to appoint a Credentials Committee of three (3) Representatives of Corporate Members. In case of dispute is shall be the duty of this Committee to determine the right of a member to vote.

Article XII. Amendments

Section 1. Amendments

These By-Laws may be altered or amended, in the manner provided in this Article, at any meeting of this Association called for that purpose. Any amendment proposed by three (3) or more Representatives of Corporate Members shall be considered when submitted in writing to the Secretary-Treasurer, who shall, under the direction of the Board of Directors, advise each Corporate Member of the terms of the proposed amendment. At least thirty (30) days prior notice shall be given of any such meeting.

Section 2. At any meeting duly called in accordance with Section 1 of this Article, and in accordance with the By-Laws applicable thereto, and at which a two-thirds (2/3) vote of the Representatives of Corporate Members present signify their approval of the adoption of a proposed amendment, these By-Laws shall be amended accordingly.

Mr. Kimball: We'll go right on to the Resolutions Committee, and I will ask Mr. Gray to present that report.

Mr. Gray: The Resolutions Committee met this noon and presents for your consideration the following Resolutions, which should be voted on one at a time in order not to get ourselves tangled in procedure.

The following Resolution was submitted by Don Murray, Chairman of the Committee on Survey and Ecology Methods and has been approved by the Committee on Resolutions:

Resolution No. 1

Whereas a plan for entomological surveying and reporting has been prepared by the Committee on Survey and published on pages 24 and 25 of the Seventeenth Annual Conference, 1949, now therefore

Be It Resolved that the California Mosquito Control Association adopt this plan as a guide to be used by Mosquito Abatement Districts for entomological surveying and reporting ,and

Be It Further Resolved that the California Mosquito Control Association recommend this plan to the Bureau of Vector Control, to be used by them as the basis for their entomological survey requirements.

The Committee moves the adoption of this Resolution.

(Mr. Washburn seconded the motion, which was passed by unanimous vote.)

Mr. Gray: The Committee proposes the following Resolution:

Whereas, the arrangements for the Nineteenth Annual Conference of the California Mosquito Control Association have been particularly satisfactory and adequate, now therefore

Be It Resolved, that we hereby express our appreciation and thanks to all who have participated in making arrangements for and otherwise contributing to the success of this meeting, and that the Secretary-Treasurer of this association is hereby directed to send letters of appreciation and thanks to those who have so participated or contributed, and in particular to the following:

The management of the Mission Inn
The Director of the Citrus Experiment Station
The Provost of the University of California at Riverside
The Riverside Chamber of Commerce
The Riverside County Health Department
The Local Arrangements Committee
The Program Committee
Orange County Mosquito Abatement District for printing the program and several other services
The several contributions to the Hospitality Hour
The Bureau of Vector Control for assistance with exhibit material, and many other services and assistance.
The Bureau of Entomology and Plant Quarantine USDA for authorizing attendance and participation by personnel, especially Dr. F. C. Bishopp

I move the adoption of the Resolution, (This motion was seconded by Mr. Robinson, and passed by unanimous vote.)

Mr. Gray: The Committee offers the following Resolution:

Resolution

Whereas, Richard F. Peters has for five years been Executive Secretary of the California Mosquito Control Association, during which period he has performed a valuable service and accomplished a great amount of work for this Association, of particular note being the publication of our "Proceedings," the "Manual", and "Mosquito Buzz", now therefore

Be It Resolved, that the members of the California Mosquito Control Association assembled at our Nineteenth Annual Conference in Riverside, California, do hereby express our appreciation to Richard F. Peters for his valued services to this Association over many years, and in particular for his recent services as Executive Secretary.

Mr. Gray: Mr. President, I move the adoption of this Resolution by a standing ovation. (Seconded by. Ed. Washburn.)

Mr. Kimball: Will all those in favor, please stand? (applause) Dick, I won't let you say one word, but will you please stand so that we can all see you. Thanks, Dick.

Mr. Gray: As Kolb and Dill used to say in the old vaudeville days, "That was from the heart out".

We have another Resolution, Mr. President, reading as follows:

Resolution

Whereas, A. M. Emerick has recently retired as superintendent of the Napa County Mosquito Abatement District after more than thirty years service and

Whereas, during much of this period A. M. Emerick took an active interest in this Association and served as its President in 1935, now therefore

BE IT RESOLVED, that we extend to A. M. Emerick our felicitations on many years of fine public service and our wishes for his continued health and happiness.

Mr. Gray: I move the adoption of the Resolution.

Mr. Kimball: Seconded by Paul Jones. All in favor- Aye Opposed? None.

Mr. Gray: Now, Mr. President, with a moment of informality, I would like to ask the Members of the Resolutions Committee who have not been consulted on this following Resolution, presented by Mr. Washburn in his report, if they are agreeable that we shall approve this Resolution in regard to the Operational Investigations Committee. The Members of the Committee that are here; are there any objections to presenting it? Hearing no objections from the Committee, I move the adoption of the following Resolution:

"WHEREAS, the Operational Investigations Committee represents the California Mosquito Control Association in connection with cooperative Committees dealing with the biology and ecology of California mosquitoes and the toxicants for their control, therefore we recommend to the Board of Directors of the California Mosquito Control Association that reports of the several projects in which member districts are associated or with which they cooperate be made available to all mosquito abatement agencies in California."

(This motion was seconded by Mr. Washburn, and passed by unanimous vote.)

Mr. Ehmann: I would like to move that the chemical companies that contributed so generously to our hospitality hour, part of which took place last night and part of which will take place tonight, be given sustaining memberships in lieu of their contribution.

Mr. Kimball: Did you put that as a recommendation to Board of Directors? I don't know whether that's in order or not. It would be more in order to recommend this to the Board of Directors because that is their job to approve membership. So if it's all right with you, I'll entertain that motion as recommending that the Board of Directors grant sustaining memberships to these contributing benefactors, for the year 1950. Will you accept that amendment, Norm?

Mr. Ehmann: I guess I'll have to. (Laughter)

Mr. Kimball: Is there a second to that motion as amended? Seconded by Don Grant. All in favor of that recommendation say "Aye"; opposed, none. Carried.

Is there any other new business to come before the Association at this time that requires immediate action before we take up our Nominating Committee Report.

Dr. Grant: I was wondering if any action is to be instigated at this time concerning possible motions about the restriction of expenditures by the Board of Directors?

Mr. Kimball: I think that is purely Board of Directors matter, but it's a question as to whether or not we want to set any restrictions on the Board of Directors for next year. If anybody wants to follow that up, you have the opportunity. I think it would be well to bring that up in our Regional Meetings, to explain the workings of the Association under this new setup. If there is no other business, we'll give the final call to Harold Gray for the report of the Nomination Committee.

Mr. Gray: Mr. President, your Nominating Committee consisting of Norman Ehmann, A. F. Geib, Mr. R. H. Peters and Mr. J. D. Willis, took several ballots, a preliminary and a secondary ballot for nominations for the four Officers that are generally elected by the entire Membership at the Annual Meeting.

There was not quite agreement on the first ballot. There was agreement fairly well on the second. We, therefore, nominate as Officers of the California Mosquito Control Association for 1951, the following:

President, Edgar A. Smith
Vice-President, Rolland L. Henderson
Secretary-Treasurer, Theodore Aarons
Trustee Member, Adolph F. Preuss

Mr. Kimball: I think it will be in order if we first accept this report of the Nominating Committee. You move the acceptance of the report, I assume. (Seconded by Mr. Robinson. All in favor? Aye. Opposed? None. Carried) Have you received any further nominations through your Committee?

Mr. Gray: No furthr nominations have as yet come to the Committee as a whole, in writing or in any other way.

Mr. Kimball: Has the Secretary received any further nominations?

Mr. Aarons: Mr. President, the nomination of Arthur F. Geib for the position of Secretary has been made by three Corporate Members and posted according to our Constitution. That's the only addition that has been received. I'd like to say that due to recent changes in our own District program which have developed since the Nomination Committee made this report, it will be very difficult for me to continue in this position during the following year. Therefore, I request that my name be withdrawn from nomination for the office of Secretary-Treasurer.

Mr. Kimball: I don't know what action to take on a Candidate withdrawing. Does that take official consent? Who is our parliamentarian in a case like this?

Mr. Gray: In this particular case, a motion would be in order to accept the withdrawal of Mr. Aarons as the official nominee. And the occasion which he refers to is partly a request on my part due to some unforeseen situations which have arisen in our district which will make it desirable that more time of our Assistant Manager be available for certain research problems that we find ourselves faced with, particularly in connection with toxicity and spreading qualities of petroleum oils, a factor which is quite important to us. Mr. Aarons is taking this step largely at my request. I make the motion that his withdrawal be accepted.

Mr. Kimball: Second to that motion? Seconded by Mr. Preuss. All in favor? Aye. Opposed? None. The motion is carried.

We now have the report of the Nominations Committee with Art Geib substituted for Ted Aarons as Secretary-Treasurer. We have one candidate for each office. We,

therefore, are not in a position where we need a roll call vote or a secret ballot.

Mr. Coburn: I move that the Secretary be instructed to cast the unanimous ballot for the following nominations: For President, Mr. E. A. Smith; for Vice-President, R. L. Henderson; Secretary-Treasurer, A. F. Geib; and for Trustee Member, A. F. Preuss. (Seconded by Mr. Raley.)

Mr. Bollerud: Not having seen this paper, I would like to know who the represetative or Corporate Members were that signed it. Is that out of order?

Mr. Kimball: It's not out of order at all. Ted, will you please read the names of the Members who signed by Secretary nomination?

Mr. Aarons: The proposal for placing A. F. Geib on the ballot for Secretary-Treasurer was posted on the door just prior to noon, I believe, and I think it's still there. It has the signatures of three Corporate Member Representatives: Raley; Robinson and Henderson.

Mr. Kimball: Is there any other discussion on the motion to cast an unanimous ballot fo rthe nominations? If not, all in favor, say Aye; opposed, None, Carried.

Before calling the new Candidates to take over, I want to emphasize the amount of work that everybody has done throughout the various districts in California; your standing Committees have certainly reflected in their reports the amount of interest and effort that has gone on through the past year.

Our 19th Annual Conference Committee certainly needs to be commended not only on the amount of work they have done, but for getting on the job early. Way back in March of last year, they started working on the program and the local arrangements and it was through their continual effort that they have been able to work things out to what I consider a satisfactory Conference. Tommy Mulhern and his Program Committee; Norman Ehmann as Chairman of the Local Arrangements Committee and his sub-committee have worked out these details and presented something that we in Southern California are proud of. Our particular appreciation and thanks also go to Leonard Miller, Chief of the Sanitation Division of the Riverside County Health Department, who has taken over the duties of registration; to Dr. Ralph B. March of the University of California who has taken care of all the local details for tomorrow in our visit there; to Rolland Henderson and his Public Relations Exhibit, radio talks and newspaper releases; to Gordon Smith for our evening last night and the repeat which we are looking forward tonight; To Basil Markos who conducted our Entomologists' Breakfast; to Mr. Frisby on the Trustee's Breakfast, who pinch hit for our Trustee, Mr. Preston, who was confined at home by his doctor's orders; to Archie Perkins, none other than Archie could get all these facilities together at the right time and the right place; and I already mentioned our own Entomologist, John Shanafelt, for his tickets and helping to sell the tickets and keeping track of the money and for doing all that printing. Only those Committeemen under Norm Ehmann will know of all the details, planning and coordination that has gone on during the last four months, but everyone knew evactly what the other one was doing and when he was supposed to do it.

I certainly want to express my appreciation to Harold Gray for allowing himself to be forced into all the various Committees. First, he accepted without comment, but the last three he accepted under protest. I told him that about five-thirty this afternoon he could really feel like he had done a job of work.

Ted Aarons as Secretary-Treasurer does the work and burns the midnight oil; I want to express my deepest appreciation to Ted for getting things lined up all this past year.

At this time we might call for reports for the regions that have elected their Regional Representatives. I believe the San Joaquin Valley has held their meeting. Rolland Henderson, would you report on that?

Mr. Henderson: By unanimous vote, Ed Davis is now representative on the Board of Directors from the San Joaquin Valley Region.

Mr. Kimball: Ed Davis, will you please come forward?

Mr. Pangburn: At our meeting at noon, we appointed G. Paul Jones from Marin County as the representative of the San Francisco Bay Region by unanimous vote. (*Applause*).

Mr. Kimball: Mr. Jones, will you please come forward?

Mr. Portman: The Sacramento Valley Region has appointed Mr. Joe Willis to represent them by unanimous vote. (*Applause.*)

Mr. Kimball: Welcome, Mr. Joe Willis. The Southern California Region has not yet met, but with that exception I think we have all the new officers up here, so I will turn the gavel over to our new President Ed Smith. (*Applause.*)

Mr. Smith: Thank you very much, Jack, and thank all of you for your support. It has been amply pointed out that all our Committees have done a terrific amount of work during the past year, but I notice that each year most of the Committees at the end of their term of office have been listing ever increasing numbers of this for their succeeding Committee to do, so I think there's plenty of work cut out for me. However, I think the biggest job that I'll have next year is simply the job of following Jack Kimball. He deserves a round of applause for the work he has done this year, and the performance of a truly sound administration of the Asociation. Are there any anouncements?

Mr. Ed Davis: There's something that I would like to bring up at this time. It might be a little premature; however, it's concerning the location of the Convention for next year. I have a letter from the President of Fresno State College inviting us to hold our meeting at Fresno. I would like to read this letter to the Members. "Dr. Bryant Ress tells me there is a possibility the California Mosquito Abatement Association could arrange to hold its spring meeting in 1952 on the Fresno State College Campus.

I should like to indicate that the Association is most cordially invited to make use of our facilities. Certainly we will cooperate fully in this matter. I shall be very glad to have you invite the Association to Fresno State College for its convention meeting place next year. Signed: A. E. Joyal."

We do have the facilities there to handle such a meeting. The Cafeteria as well as the big meeting rooms some of

you are familiar with at Fresno State. The Cafeteria would be available to the Members, and then we have adequate hotel facilities for such a meeting. I'm just putting in a bid for the next meeting at Fresno.

Mr. Kimball: Thank you very much, Ed. Please turn that letter over to our new Secretary, Art Geib.

Mr. Robinson: Is there any limitation as to dates and use of the College facilities?

Mr. Davis: Between semesters would not be too good. That's about the last week in January to somewhere about the tenth of February.

Mr. Smith: Thank you very much, Ed. Is there any new business?

Mr. Raley: I would like to make an invitation to the group, from Madera District, the Fresno District and Consolidated District to be their guests at Fresno on April 20th, for a Spring meeting of the Association. We will have a sectionalized meeting, one section for Entomologists and Inspectors, another Section for Mechanics and maintenance men, another Section for Administrative Assistants and Clerical help, and of course, a Section for Managers. The meetings planned at this time for Friday, April 20, and all districts are invited.

Mr. Smith: Thank you, Ted. Are there any further announcements? If not, we will stand adjourned until tomorrow morning.

The members and guests were then entertained at a Hospitality Hour, followed by a buffet dinner in the Mission Inn. After the dinner ,the members and guests enjoyed an evening of dancing in the Lea Lea Room in the Mission Inn.

TUESDAY, MARCH 13, 1951

University of California Citrus Experiment Station, Riverside

The meeting convened at 9:15 A. M. in the Faculty Club of the University of California Citrus Experiment Station, President E. A. Smith presiding.

Mr. E. A. Smith: Dr. Robert L. Metcalf is representing our hosts today, The Citrus Experiment Station of the University of California here at Riverside. I take great pleasure in introducing Dr. Metcalf.

Dr. Metcalf: We are very pleased that your Association decided to meet with us here at the Riverside Campus of the University of California. A number of us have been quite busy hlping to do all that we could to make your stay enjoyable and instructive. Particularly, Dr. Ralph March of the Division of Entomology, and Mr. Myron Winslow, the Senior Administrative Assistant of this Station, have gone to a great deal of effort. Dr. March spent a lot of his time arranging a tour through the Division of Entomology and the Division of Biological Control at this Station. I'm sure that if you can stay for it this afternoon, you'll find it very much worth while. Mr. Winslow has arranged to supply coffee to you all at noon, free of charge. We've prepared a mimeographed sheet outlining the personnel and projects of the Division of Entomology and a resume of some of the things you'll see on the tour this afternoon. Dr. March and Mr. Winslow will pass these out to you.

Since this is the first time in some twenty years that this group has foresaken the Berkeley Campus, you might like to know a little about this institution. At Riverside we have eight hundred and seventy-one acres on the Campus, about four hundred of which are under cultivation. Represented are citrus, walnuts, peaches, figs, olives and a number of other crops. There are approximately two hundred and sixty employees at the Station, of which sixty are academic staff members of the University of California, that is, persons with a Ph.D. degree or the equivalent. We have seven divisions, Entomology, Biological Control ,Soils and Irrigation, Plant Breeding, Orchard Management, Plant Physiology and Plant Pathology. It's a rather well rounded Experiment Station group. The original scope of this Station was primarily in citrus culture; however, agriculture in southern California has become much more diversified, and we now have investigators devoting themselves to a wide range of agricultural problems. In Entomology we have a total staff of forty-four. In Biological Control, a division which works quite closely with Entomology, there are twenty-two people. Therefore we have sixty-six people at present spending full time in research on different phases of Entomology. We have a very fine physical plant, which you will see this afternoon. I think I'm safe in saying that Riverside has come to be known over the entire world as a major center for entomological research.

As you know, from practical experience in combating insects, one has to stoop to all sorts of mean and scurvy tricks. It's analogous to human warfare. You investigate anything you think might have possibilities for inflicting damage on the enemy. Therefore, some of our projects might seem a little strange to you if you haven't given a great deal of thought to practices to be followed and new ideas to be developed in insect control.

A few of the things we do are a little outside the province of the Entomologists who used to be thought of as carrying a cyanide jar and a bug net wherever they went. We have a group engaged in the chemistry of insecticides under Dr. F. A. Gunther. We have five chemists working in the Division of Entomology at present. They have many and unusual problems. The number of new insecticides has increased by leaps and bounds. Before any of these materials can be satisfactorily used on citrus or other fruit crops, we must have a great deal of information about the possible toxic residues remaining on the fruit at the time of harvest, and in the processed citrus products. This demands a tremendous amount of chemical information .This group, for example, has made as many as four thousand separate analyses in a year of residue determinations on such insecticides as DDT and Parathion. That represents an almost unimagineable amount of preparatory work We have two young ladies who spend a good share of their time peeling and processing fruits, extracting juices, grinding up ears of sweet corn and things of that type. then the products must be taken to the laboratory, and rather delicate chemical determinations of residues running sometimes to as low as one part per million or less must be made. Another thing that these chemists spend considerable time doing is developing new analytical methods. Having a new organic chemical without a method

for detecting it makes it very difficult to obtain any information on the amounts present on produce. That has, indeed, held back the development of a number of these new chemicals. Therefore, our staff has been working hard on analytical methods and they have in the past several months developed new methods for detection of such materials as Dieldrin, and beta-chloroethly-beta'-p-tertiary butylphenoxy-alpha'-methyl-ethyl sulfite, which are satisfactory for residue determinations. These will be of help not only to us in our citrus problems but to agriculturists and entomologists working on pests all over the world.

In the development of new organic chemicals, we have a rather unique setup, at least for a University group. We've been convinced for a long time that pests of citrus fruits which are locally important here, in Arizona, in Texas and in Florida, but not elsewhere in the United States, are not receiving full attention from commercial concerns who are developing new organic chemicals. This is quite natural because these commercial people are not in a position to test their chemicals against citrus pests, which are difficult to work with and are hard to culture. Since we have facilities for doing that here, we have atempted to collect as many new organic chemicals as possible and put them through a screening program in order to obtain information as to their toxicity to citrus pests. During the past four years we have screened approximately 3400 compounds in this way. Of these new organic compounds quite a few have shown unusual possibilities for the control of citrus pests. We have found from doing this work that just because a chemical is not toxic to a house fly does not mean that is not effective against red scale, for example, and that has proved the big justification for this type of program. We don't duplicate much of the work that has been done elsewhere. We merely have asked for samples of chemicals that have shown promise against some type of insect.

Another phase of the work that one doesn't ordinarily think about in studies of entomology is virus research. We have several important citrus problems in Southern California, particularly the "quick decline" virus of citrus, which has very seriously damaged the citrus industry. It has been found just recently by Dr. Dickson of our staff that it is transmitted by the melon aphid which is very common on citrus, melons, and cotton. This brings up a possibility of controlling the spread of the virus, although I realize that most attempts to control such insect vectors of viruses by chemicals have not been overly successful. However, before this time we have suffered with the "quick decline" virus for three or four years and had no idea what insect was spreading it or were we even certain that it was insect spread. Therefore, we were absolutely stymied as to means of control. We're also very busily engaged at present in investigating the new systemic insecticides. These are materials which have been shown to be taken up by plant foliage either through the roots or through the leaves. They render the sap of the plant toxic to certain insects. When you consider that almost all of the citrus pests are exclusively sucking insects, what a golden opportunity this gives the entomologist to develop new and unique methods of control for these insects. I'm referring, of course, to pests as thrips, mites, and scale insects. We have found that some of these systemic materials have unusual promise on citrus, and therefore we have become rather deeply involved in basic studies in the movement and uptake of chemicals by citrus plants, of the conversion by enzymes in citrus into toxic materials and decomposition of toxic products to non-toxic materials. In carrying out this work successfully, we found that it was necessary to go into radioactive tracing materials. You will see some of the experiments we're doing in this work this afternoon.

In conclusion, I hope I have given you some idea of the diversified type of activities that we are doing here. It is a pleasure to have you with us and we hope that you will enjoy your stay. (*Applause.*)

Mr. E. A. Smith: For the past several years, we've devoted a part of our program on this Conference to a resume of what is going on in mosquito control in other parts of the country. We have now a review of the various other mosquito control associations. The first one is the American Mosquito Control Association, Lester W. Smith, the President of the American Mosquito Control Association and Executive Secretary of the Middlesex County Mosquito Extermination Commission of New Jersey, who is going to tell us something about the activities of the American Association.

Mr. L. W. Smith: Mr. President, Members of the California Meeting, I bring the greetings of the President of the New Jersey Association, Mr. M. M. Stallman. He wishes that you have a very, very enjoyable meeting and that much will be gained from it. Tommy Mulhern wrote me a letter and asked me to say a few words on the difficulties of organizing a National Association such as ours. If you were to write the whole thing it would take a week to read, so I picked one subject which is just about a page and a half and need not take too much time. We had a very sucessful meeting in Chicago. We had a hundred and sixty odd registered plus those who didn't register but attended. We had four, I think, foreign countries represented and probably half the States in the Union, so we did have a very successful meeting.

SOME OF THE PROBLEMS OF ORGANIZING A NATIONAL ORGANIZATION

By LESTER W. SMITH, *Past President*
American Mosquito Control Association

Having been a party to the organization of a number of business vetures I believed that the formation of a National Association, on a corporate basis, might be somewhat similar. In business, it is often possible to assemble the three or more parties to an incorporation, together with their attorney, and complete all the matters relating to the objectives, charter, By-Laws, officers, salaries and other operating procedures without delay. In a matter of a few days organization can be completed and the venture put in operation. This is no doubt due to the corporate practice of loosely defining their objectives, establishing a broad and all inclusive charter and approving By-Laws based on broad, expedient legal practice.

In the organization of a National Association, with scientific objectives, such as ours, the task is made difficult because of two basic factors; namely, the character of the incorporators which is greatly influenced by their back

ground, training and experience, and the factor of distance and the resultant inability to meet and resolve questions of policy without undue delay.

Scientific or technically trained individuals are apt to be perfectionists. The broad, loose framework that characterizes the usual business corporation is beyond their comprehension. In their minds every contingency must be anticipated and set forth in detail.

A National Association, consisting of such membership, located over the 48 States and several countries involves the problem of communication due to travel time and expense. Consequently, except for purely local committees, all interchange of thought requires extensive correspondence.

In the case of the American Mosquito Control Association, we were fortunate in having one member who took the initiative and prepared a suggested plan for incorporation. This was presented to a committee by mail. The thoughts, corrections and differences of opinion were mailed to the Chairman by each committee member with copies to all other committee members. Occasionally side communications and cross-arguments were exchanged by several members without the knowledge of the entire group.

With the assistance of Mr. Stallman of Essex County, New Jersey, the corporation papers were filed and an Interim Board undertook the management of the Association.

The preparation of the By-Laws was a more exacting task which involved massive cossespondence and committee meetings over a period of almost two years before an acceptable compromise could be reached. Here, as in the preparation of the charter papers, the i dotting and t crossing plus the necessity of performing all the business by mail were responsible for the long drawn out negotiations.

A conclusion that may be drawn from our three years of labor in perfecting the organization of the American Mosquito Control Association, Inc., is that should such a task again become necessary the matter should be placed in the hands of a capable attorney to draw the necessary plan and leave the correction of minor details for future amendment.

I am very happy to state that the operations of the American Mosquito Control Association are now in the hands of the President and the Board of Directors which were elected at our Chicago Meeting this month in accordance with our new By-Laws. (*Applause.*)

Mr. Gray: Mr. Chairman, I think we ought to make a correction to that. I thought we had voted Dr. Rees in as President.

Mr. E. A. Smith: I was just coming to that. I notice that our program is already out-dated. I read the program instead of looking at the person. We will now have Dr. Don Rees, the newly elected President of the American Mosquito Control Association, look into the future for us.

Dr. Don M. Rees: Mr. Chairman, Members of the California Association, friends. It's a pleasure to be here at these meetings. I always have a very enjoyable and pleasant time when visiting here in California. I've also been asked to extend to you from the Members of the National Association greetings and congratulations for the successful meetings you have held in the past and to wish you success in this meeting, and from the Utah Association, likewise, we extend similar greetings, and expressions for your success.

PLANS FOR THE AMERICAN MOSQUITO CONTROL ASSOCIATION

By DON M.REES, *Salt Lake City, Utah*

To predict the future of the American Mosquito Control Association would require a clairvoyant mind or a crystal ball, and unfortunately, I possess neither. I am more like the old country store philospher who was always bragging about his ability to predict the weather. "Why," he would say, "these government weather prophets are always making mistakes and me, I ain't made a mistake in my weather prediction in the last forty years. I used to though before I learned how to do it." When anyone asked him how he did it he would say,"Them dern government fellers they always predict it for tomorrow, and nobody can do that and be right all the time. Now me, I always predict it for yesterday."

I can speak with some assurance about the history and development of the American Mosquito Control Association, but I can only speak with confidence concerning its future. I say confidence, because what has been accomplished in this organization during the short period of its existence leads me to firmly believe that it has a great and secure future.

The American Mosquito Control Association was organized in 1944, but had its early beginnings in what was known as the Eastern Association of Mosquito Control Workers, a group that had vision enough to see the need for a great organization, wherein those engaged in this work could exchange ideas for the purpose of improving mosquito control methods and receive assistance in applying these methods to their own particular problems. Since this comparatively recent beginning the association has acquired members in practically every state in the United States, in Hawaii, Alaska, Canada and some 31 foreign countries. Ten regions have been established, 8 within the United States, one for Canada, and one for Central and South America thus assuring representation in the Association from all of these areas. Additional regions will be created in foreign countries as the membership increases.

Mosquito News has been established as the official publication and this quarterly journal is already recognized as the outstanding publication concerning mosquitoes and their control.

To plan the future for the American Mosquito Control Association we must first examine the nature and purpose of the organization, in other words find out what makes it tick, and then make our plans accordingly. What are some of the essential principles upon which an organization of this kind is dependent?

First, the duration is dependent upon the need for its existence and the principles upon which it is founded. We are going to attempt an increase in membership. A great many people are not aware of the organization, its functions, achievements, its purposes, and we're going to request that the members endeavor to bring that information to them. There's a great possibility there. In Mosquiton News, the editorial board has decided to make certain changes to include some practical information along with the technical papers. That's extending the usefulness of this journal. We ask the members to acknowledge to the various companies when they make purchases from them that they are aware

that they are advertising in the journal. Therefore, we hope to increase the distribution, sales and revenue from that source. We also have a Committee that is working with some of the major Foundations in an attempt to obtain assistance to subsidize the activities of the organization, especially for providing miscellaneous publications. One that will be out very soon pertains to ground equipment used in mosquito control work; others will follow. We hope to have an educational service with films and displays that can be circulated among the membership and to others interested in organizing this work. We will apprecate any ideas any members have pertaining to anything that they consider might be helpful in developing this work.

Second, the rapidity of growth and stability of functioning is determined largely by its officers and directors, and Third, its strength and influence for good depends upon the loyalty and integrity of its individual members.

Lets us briefly examine these three points as they refer to the American Mosquito Control Association. One, if duration is dependent upon need, the American Mosquito Control Association should live forever. As long as we have mosquitoes an enlightened public will demand that they be controlled, and for effective control, under ever changing conditions, workers in this field must have an organization that will provide for the exchange of ideas and for the discussion of common problems. As to the principles upon which this organization is founded, and therefore the motives upon which it operates, I quote from the Constitution, "The purpose of the Association, a non-profit, technical, scientific and educational organization, is to promote closer cooperation among those directly or indirectly concerned with, or interested in mosquito control and related work; to disseminate information about mosquitoes and their control; to work for understanding, recognition and cooperation from public officials and from the public. . .", etc. The association, therefore, has every reason to endure and continue its existence.

Concerning the second point in which it was stated that the rapidity of growth and stability of functioning is largely determined by the officers and directors of the Association, this is a generally recognized fact. I am in no position to dwell on this point but we can all review with satisfaction the rapid growth of the organization, the stability of its operation, and the harmonious relationships that exist in the organization under the previous capable leadership of its officers and directors. I sincerely hope we will be able to make comparable progress in the future.

Now for the third point, which in my opinion is the most important, that the strength and influence for good is dependent upon the loyalty and integrity of its members. It has been ably stated that an organization is no better or stronger than that of the individual members of which it is composed. In this we have a decided advantage over most organizations because we all have a common purpose and there is no class distinction in the membership of this organization. Everyone engaged in this work accepts his purpose the control of mosquitoes. Anyone who has long been engaged in this work recognizes the importance of the men engaged in the different phases of this work. We no longer discuss whether an engineer, an entomologist or a practical business man should direct the control operations. We no longer question whether the research technician or the practical field worker makes the greatest contribution in developing most effective control methods. We recognize the necessity of all of these services and how indispensible they are to mosquito control work, but more significant than this, we recognize the importance of all of the men engaged in these different services and united by a common purpose. Out of this understanding the members develop a respect for this work, a loyalty to their associates and the Association founded to support this cause. We all believe implicitly in the integrity of purpose of this Association, for anyone who does not possess as an individual integrity of purpose has no place in this organization. We have a knowledge of the effectiveness of mosquito control work. If it endures we must gain confidence and respect for this work from the public which it serves, and this can only be obtained through the honesty and integrity of the mosquito control workers.

The future of the Association or some similar organization seems inevitable. The American Mosquito Control Association is making rapid and stable progress. The membership is united by a unity of purpose, strengthened by a diversity of training and experience, and their moral integrity is supported by a confidence in the possible achievements of this service. We have every reason to plan for American Mosquito Control Association a long and useful existence.

Finally, the 1952 annual meeting of the Association will be held in Salt Lake City next year March 24 to 27th. We cordially invite you to make preparations and plans to attend this meeting. We will try to provide entertainment and I'm sure your Program Committee will provide an excellent program.

Mr. E. A. Smith: That was one of the finest sales talks on the American Mosquito Control Association that I've ever heard, but you left one thing out. I'm sure that somebody here has some application blanks for membership in the American Mosquito Control Association. If any of you are interested. Tommy Mulhern will gladly relieve you of $5.00.

The next Association is the New Jersey Mosquito Extermination Association. Alphonse W. Kelley was scheduled to give this talk. He is a Past President, and a member of the Ocean County Mosquito Extermination Commission of New Jersey. However, we have a telegram from him from Mexico City saying Mrs. Kelley is ill, and so I'm asking Tommy Mulhern to read his paper.

Mr. T. D. Mulhern: Mr. Kelley is extremely disappointed in not being here. He has a daughter who lives here in Southern California, and other than that I know he was very interested in being at this meeting. He is one of the old time Board Members is one of the New Jersey Commissions, and he's been with mosquito work through two wars and an economic depression and he has seen the rise and fall and rise again of mosquito abatement programs.

25 YEARS OF PROGRESS IN MOSQUITO CONTROL

By A. W. KELLEY

Mr. President, and distinguished guests of the California Mosquito Control Association:

It is an honor for me to present this paper today and to bring to you the greetings and best wishes from the New Jersey Mosquito Extermination Association, which has just finished its annual meeting in Atlantic City, N. J.

While the title of your association mentions "Control", our N. J. Association went all out and dubbed ours "Extermination" Commission. Perhaps we were a trifle optimistic when the association was formed.

My hesitation to address such an outstanding group as this is overcome only by my anxiety to visit your wonderful state and to learn what youare doing in this important method of improving the health and comfort of your people.

California is a glamorous state, and has shown the world how to capitalize its many attractions, but I notice that no publicity has been given to the presence of mosquitoes within its boundaries, although, three things lead me to believe that you may have at times some annoyance from these vectors:

(1) The fact that this gathering of top scientists and health authorities have for several years held conventions in your state.

(2) The fact that you have come over to Jersey and selected some of the best trained mosquito control men after we had given them the field training; and

(3) The fact that in a few years of control work you have had in this state, the attention of such bodies all over the world has been focused on the work done by your state, and district control authorities.

In this paper I can only hope to contribute the view point of an untrained County Commissioner from the State which was the pioneer in such mosquito control.

Perhaps it would be best to divide my paper in three parts, like the colored preacher divided his sermons:

1. He said, "First I tells 'em what Ise gwine to tell 'em."
2. "Then I tells 'em."
3. "Then I tells 'em what I done told 'em."

Honest and public knowledge compels me to confess that New Jersey has been "infamous" for mosquitoes since Hendrick Hudson sailed into New York harbor, and historians early in the year 1700 describe these hoards of pests, near the waterways, which made the nights unbearable, and Daniel Webster later dubbed New Jersery as "The Mosquito State."

It was not, however, until the year 1900 that anything constructive was done about it, when Dr. John B. Smith completed his work on "The Mosquitoes of New Jersey" and effort was made to institute control measure in our state.

In 1902 the Legislature of New Jersey passed a bill appropriating the sum of $10,000.00 for the study of the mosquito problem, but it was a year later when the first appropriation was actually made and then it was for only $1,000.00 (a very modest beginning). In 1905 another act was passed providing State Aid to local municipalities to match money raised by them, for control fo mosquitoes, so the idea was slowly advancing. In 1904 THE DUFFIELD ACT was passed which encouraged the control of pests from local level, but it was not until 1912 that a law was enacted providing for non-paid mosquito Commissions, in every county in our state, who wished to create such commissions.

The 1912 Act still serves us with some amendments, and there are now commissions actually functioning in 16 counties out of the 21 counties in our state.

Under the 1912 Act these County Commissions were appointed by the Justice of the Supreme Court, and half of the members were required to be men with experience in Public Health work.

A few years ago, the law was changed so that new members of the Commission are now appointed by the Board of Chosen Free-holders of the counties in which they are situated. The funds are provided in the County budget, and the Act provides that each Commission must make up a request annually for the amount they need, together with the plans and estimates for each class of control work planned. This budget must also have the approval of the State Agriculture Experiment Station's Director. The law, however, makes it mandatory for the County to provide funds based on a one mill tax on ratables where counties have less than 25 million ratables and drastically cuts this mandatory amount to one quarter mill where total ratables are over 50 million.

In our County we have been favored by having one of the members of the Board of Chosen Freeholders as a member of our Commission for several years, and he has a clear understanding of the importance of our work, and the Freeholders have been quite fair in their appropriations to us.

CONTROL METHODS: The work on the County levels is divided into PERMANENT CONTROL and TEMPORARY CONTROL.

Permanent control methods consist of ditching and diking for preventing overflow by tides, and tidegates to permit the draining of meadows, but preventing the entry of high tides. Also filling in shallow pools that cause breeding.

Temoprary control consists of spraying low areas, catch basins and other spots not suitable for permanent control, also fogging and misting for adult control at peak breeding seasons.

For the past two summers the State has set up a fund of $50,000.00 to be used for airplane spraying for the counties adjacent to the low lands on the coast, and last year this money was divided among the 5 counties of Burlington, Atlantic, Cape May and Monmouth. This spraying program was conducted during first year under the direction of the Board of Health of New Jersey and last year under the direction of the New Jersey Agriculture Experiment Station.

The Experiment Station purchased the larvicides and attended to the proper delivery and mixture of same, and contracts were made with commercial airplane companies for spraying this mist at dates selected by the various Commissions. Three planes were used, flying abreast and covering a band of 300 to 500 feet where breeding was most apt to occur. The mixture was composed of DDT mixed with fuel oil and applied at the rate of 1/10 lb. of DDT

per acre. I have tables of the cost of this spraying which indicate some was done for 19.1 cents per acre, which is approximately half the sum estimated by contract method of buying the whole spraying service.

Special Machinery

The various counties have either built or developed special machinery with the assistance of the Experiment Station in planning, including special ditching machines that operate on crawler tractor and wide treads, and in our own county we have a machine capable of cutting 1200 feet of new 10 x 20 inch ditch per hour, while it can reclean more than 2700 feet perhour,and deposit the fill in macerated form on ditch banks to prevent it from blocking the ditches. Other Commissions have designed and built special dredges and mounted them on scows or barges for cleaning silt from rivers.

Other counties have used mole plows, and scavel plows at great saving, where conditions permit their use.

Field Conditions

In Counties in the coastal area of our state, marsh lands are frequently covered by high tides, and the problem in such counties is to create sufficient ditches so that the ordinary tides bring in sufficient small fish to destroy the larvae, and also to assist the runoff of water caused by such tides. Since there are some 46,000 acres of marsh land in Ocean County alone, we have completed about 9 million feet of 10 by 20 inch ditches, and have the ever increasing problem of maintaining these ditches.

Economic Importance of Control

Since the counties bordering on the bays and ocean in our state play host for hundreds of thousands of people from New York, Philadelphia, and other nearby metropolitan areas, it is a decided economic factor to control these mosquitoes in the summer season. These people are particularly interested in our control work, and we receive excellent cooperation from them.

Measured Results of Control

The density of the mosquito population and their species, is measured by installation of mechanical traps built by the Experiment Station and now in general use throughout the country. It is from the tabulations of the daily catch from these traps that we are able to furnish a definite seasonal and daily record of the prevalence of certain types of mosquitoes, and they furnish some definite proofs of the success of our control methods.

From Dr. T. J. Headlee's book we find that the tax ratables for the coastal counties from New York to Cape May have shown the greatest percentage of growth, since the beginning of a mosquito control program.

Tax Ratables 1900 in this area were $64.000.000.

Tax Ratables 1915 in this area were $248,000.000.

Tax Ratables 1930 in this are were $736,000,000.

Thus you see these assessed values have increased 11.39 times since 1900 to 1930 and without doubt have increased in a greater proportion for the past 20 years.

Since much of the 285,000 acres of salt marsh land in New Jersey is suitable for raising salt hay and since the ditching of these meadows retards the harvesting of this crop somewhat, it has, of course, required some tact and persuasion to secure the cooperation of the farmers in this control work. Apparently they prefer to be annoyed by the mosquitoes, rather than their creditors.

Sportsmens' groups have also made some objection to the work based on their belief that the ditching retards the breeding and refuge of wild ducks, but we have made some progress in bringing these two groups into the thought that we can work together.

The Commissioners Job

We long ago concluded in New Jersey that mosquito control could only proceed (under the present ligislation) as rapidly as the public became conscious of the results and demanded relief. The job of the Commissioner, therefore, is that of a liaison officers', and through our contacts with taxpayers, and visitors, we can show the need for increased appropriations, and we too can give our personal attention to the expenditure of funds, so that full value is received for all money received.

The Commissioners must also be prepared for some criticism when an occasional brood of mosquitoes gets "on the wing", or else arrange a hurried trip out of the territory till the brood dies off.

How Long Do They Serve

I have often wondered why men are willing to give so much of their time and energy to this cause, without any possible financial return. My belief is that once one becomes interested in the work, the associations formed, and the type of men one meets in this work, serve to stimulate further interest, and a desire to see this job completed.

In the Ocean County Commission, Mr. A. Carl Haag and myself have each served more than a quarter century, and Dr. A. K. Brouwer, our President, replaced his late father, Dr. Frank Brouwer, at his death, and altogether a period of more than 35 years has been dedicated to this work in this family alone.

Most of you are familiar with the work of our late Dr. T. J. Headlee and his book on "The Mosquitoes of New Jersey". To be associated with such men as Dr. Headlee and the many other authorities is certainly worthwhile.

You have associated with you in this work in California Mr. Thomas D. Mulhern, who received his training in this work under Dr. Headlee, and we in New Jersey feel that you have secured the services of one with thorough preparation, both in field work and laboratory and in down to earth methods of control.

Looking backward a quarter of a century, I can see great progress in this work and have reached the following conclusions:

(1) For a long time we will have some annoyance at intervals when our regular organization cannot expand fast enough to meet emergency conditions caused by weather and tides.

(2) We now know life cycle and habits of most of the types of mosquitoes and if we are given the personnel, and funds, we can destroy them on the ground.

(3) 25 years ago, we were like a boy shooting at a bat with an air rifle in the dark, but today we are proceeding, as Mark Twain said, with the calm, quiet confidence of a "CHRISTIAN HOLDING 4 ACES," and like General

MacArthur, we are prepared to give the enemy a very rough time.

Mr. E. A. Smith: The next report is from the Utah Mosquito Abatement Association. It was scheduled to be given by Robert A. Wilkins, Superintendent of the Salt Lake City Mosquito Abatement District. He could not make the trip, but James V. Smith, the Field Supervisor is here and is going to give us the report.

Mr. J. V. Smith: Mr. President, ladies and gentlemen before I begin the report of progress of mosquito abatement in Utah, I'd like to say that I really feel a distinct pleasure in coming to these excellent meetings and also to represent the Utah Mosquito Abatement Association. I couldn't suppress the urge, although it doesn't seem fitting, to make the statement that I've always believed that California was omitted by President Truman when he made the statement that the Marines had a propaganda machine comparable to that of Stalin's. (Laughter.) I think California runs a little better than a close second to the Marine Corps. However, after the beautiful weather that was ordered particularly for this occasion, if there's been any offense I guess I should apologize also.

PROGRESS OF MOSQUITO ABATEMENT IN UTAH

By James V. Smith, *Field Supervisor,*
Salt Lake City Mosquito Abatement District,
Salt Lake City, Utah

The Utah Mosquito Abatement Association is now entering its fourth year of operation as the adopted parent of the Mosquito Abatement Districts in Utah. We have held three annual meetings, each of which in our humble opinion has been a great success. Furthermore, the success of these meetings is measurable. First, Utah Mosquito Abatement, as a finger of the left hand, so to speak has been able to find out what the right arm is doing by having experts from other areas, as our guest speakers. Many of our guest speakers have been from California. We feel fortunate in being a close neighbor and we sincerely thank you for your interest and information in our behalf. Second, in many cases, Utah districts are adopting some of the ideas presented at our meetings, and are adapting them to Utah problems. The Utah Mosquito Abatement Association meetings for this year are scheduled for March 19th and 20th at the University of Utah in Salt Lake City. The program indicates that some very interesting papers will be presented. One of them is by the Past President of the American Mosquito Control Association, Lester W. Smith who will be our first guest from the eastern United States; other guests include Dr. F. C. Bishopp and we look forward to the occasion with distinct pleasure.

I am confident that all of the members of the abatement districts in Utah agree when I express our gratitude to Dr. Don M. Rees of the University of Utah for the work accomplished by the Utah Mosquito Abatement Association. Dr. Rees may rightfully be called the Father of Utah mosquito control — not for his age or being the founder of mosquito control in the State, but for his relentless and sincere energies expounded purely in the interest of mosquito control and public welfare. He has served as a member of the Board of Trustees of the Salt Lake City Mosquito Abatement for the last nine years, and as President of the Utah Mosquito Abatement Association since its organization in 1948. Dr. Rees spends a large amount of his valuable time explaining mosquito control work to the public, and is the man to whom most of the credit must be given for the organization of our control work. Dr. Rees also carries his enthusiasm into the classrooms at the University giving his many students the advantages of learning mosquito control from an expert. To emphasize his sincerity, his duties in mosquito control work, with which most of us associate him, are accomplished without monetary compensation. As you know, he is the new President of the American Mosquito Control Association, and we are confident he will do an excellent job in that capacity. We have four organized abatement districts in Utah, and all of them are members of the Utah Mosquito Control Association. By name they are the Box Elder Fly and Mosquito Abatement District, Weber County Abatement District, the Salt Lake City, and Magna Abatement Districts. Two additional districts are in the process of being formed. One of them concerning South Salt Lake County is nearly completed and should be in operation very soon. The other area interested in control is Davis County which holds a key position in mosquito abatement work in Northern Utah. Davis County is located between Salt Lake County and Weber County, and at the present serves as an excuse for both Weber and Salt Lake City when large numbers of mosquitoes appear in either of their districts. The formation of a Davis County Abatement District, which is imminent completes a chain of mosquito controlled land 110 miles long, bordered by high mountains on the east, and Great Salt Lake on the west. It will be interesting to observe the results of control work in this area after the formation of the new districts. In addition to the organized districts, several cities throughout Utah have realized the mosquito problems in their immediate surroundings and have appropriated funds for local abatement work. Such programs often serve as a nucleus for the formation of full scale organized mosquito control.

Many other advances are evident within the districts in Utah. The Salt Lake Mosquito Abatement is proud of its cooperative drainage programs, and after two years of operation, success of the program is assured. The program of cooperative drainage involves an agreement between the abatement district, Salt Lake City and Salt Lake County hereby each contributes ten thousand dollars to a joint fund to be used for drainage work. All drains in the valley are now studied with equal intensity as to their effectiveness. This eliminates discrepancies as to whether the drain belongs to the County, the City, or the mosquito abatement. New drains are dug where and when they are needed without the question of who should stand the expense of the work. There is also considerable relief to the Salt Lake City District in maintaining the drainage system. Last year over twenty-five miles of new or cleaned drains were completed by the heavy draglines of the new organization, in addition to the normal drainage accomplishments of the abatement district. It therefore seems apparent that the permanent control program has more than doubled its efforts and accomplishments with the work of cooperative drainage. Permanent control policies and practices in Utah have reclaimed hundreds of acres of ground since the inception of control work in 1922. The future of reclamation through drainage and other mosquito control

is even brighter in Utah today. The success of this work gives confidence to the Utah Association in urging the adoption of a similar program in the other Utah Districts.

Two districts in Utah made extensive use of the airplane in 1950. Both Weber County and the Salt Lake City Districts hired planes for aerial spray work, the latter treating more than 1300 acres formerly difficult to treat or completely inacessable to ground crews. The results were excellent and we feel that it is money well spent. Airplane work is new to us, and our program requires refinement to obtain maximum effectivness, but again we have the experience of others to guide us.

In general accomplishments of additional interest is the passage of an enabling act, by the Utah Legislature last week. This act enables retirement under the Federal system for all employees of mosquito abatement districts in the state.

The progress in Utah is gratifying, and we are looking forward to many more years of expansion and success.

Mr. E. A. Smith: Thank you very much, Jim. I had the pleasure last year of attending the Conference in Utah and I certainly endorse Jim's statements and recommend it for any of you who don't have budget troubles and can make the trip. The next series of papers on the program is designated as "New or unusual developments of the past year in various sections of the United States". However, this is going to be a quick run through as the first three on this section of the program, Oregon, Ohio and Texas were unable to make the trip. I think the question that I've heard most times at this Conference so far is, "Is Dorothy McCullough Lee going to be here this year?", and a good many of you heard that same question. Those of you who have heard her speak at our meetings in the past know the reason for it. She's certainly an excellent speaker. We have a letter from her saying that official business as Mayor of Portland requires her presence in Washington this week. But she has sent a report by Arthur Woody on their operations in 1950, which we will publish in our Proceedings.

A REPORT OF MOSQUITO CONTROL WORK IN PORTLAND AND VICINITY

1950

By ARTHUR H. WOODY, *Insect Abatement Supervisor, Bureau of Insect Control*

We regret that we are unable to attend your conference as we feel that the knowledge obtained from such conferences is of great value to us in our mosquito control work. Mayor Dorothy McCullough Lee has instructed us to submit a brief report on our activities this past year, which we hope will be of interest to you.

The first serious attempt at mosquito control in the Portland vicinity came in the middle 30's. In 1934, a study was made by the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine, with Entomologist H. H. Stage in charge. Results showed that the *Aedes,* or floodwater mosquitoes, were much more than a nuisance — their presence caused losses running into thousands of dollars through decrease in milk production in dairy herds, inability to hire or keep labor in the truck crop area, loss of tourist trade, etc.

With Federal aid, extensive brush clearing of mosquito breeding areas was done in 1935. When the flood waters passed over these areas, oiling crews sprayed diesel oil on water where larvae were hatched. Since this work was done by rowboat or on foot, it was impossible to treat all the hatching areas. Indeed, only an estimated 25,000 out of a possible 80,000 acres were treated.

The work was continued until 1938, when Federal aid was withdrawn. By that time residents of Portland and Multnomah County had become aware of the advantages of mosquito control and protested its discontinuance. So the City of Portland and Multnomah County consulted to see what they could do, and between them, they budgeted $10,000 per annum for the continuance of the work, and the same sort of control program was carried on, but without brush clearing and otherwise in a more limited way. During the war years, however, mosquito control bogged down owing to the limited budget and raising costs.

In 1944, a dump truck and a power pump were acquired for use in control work. The following year, Mayor Lee initiated steps to establish the Bureau of Insect Control with mosquito control as its major operation.

In 1946, three flights were made with an Army bomber experimenting with the dispersal of insecticide from aircraft. One thousand two hundred gallons of 25 percent DDT concentrate cut to 5 percent in diesel oil were used and a total of 3,000 acres was covered in 3½ hours of flight time, doing work it would have taken ten men 22 days to do by the usual method of spraying by hand from knapsack sprayers carried on backs. The results obtained were practically 100 percent control for this area.

The City of Portland, therefore, went ahead with plans to use this type of control in the future, and early in 1947 purchased two surplus trainer planes and equipped them with thermal exhaust aerosols and boom sprays from plans developed by the Tennessee Valley Authority and the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine.

During the past four years, through the use of aircraft and other scientific improvements, the mosquito problem in Portland and Multnomah County has become sufficiently well-controlled to result in fewer and fewer reports of the presence of mosquitoes, particularly of the *Aedes* species.

The areas of mosquito control extend over a total of approximately 150 square miles covering not only Multnomah County, but other counties which contract with the City for control. These counties in 1950 were Clackamas in Oregon and Clark in Washington. Control is carried on not only in all areas affected by the spring and summer run-off of the Columbia and Willamette Rivers, but also impounded water areas, drainage ditches, artificial water bodies such as duck ponds, and water hazards on golf courses. In the 1950 season, 78,000 acres were controlled by aircraft and 2,360 acres with ground equipment.

This year, it was necessary to carry on active *Aedes* control operations for a longer period than in prior years as the flood condition of the Columbia and Willamette Rivers continued for a period of 68 days, compared to a

normal period of 35 days. Seven complete coverages of the breeding areas in Multnomah County were required, using 27,180 gallons of oil and solvents and 16,121 pounds of chemicals. The Bureau aircraft flew a total of 456 hours and 18 minutes.

Due to the longer summer season, *Culex* and *Culiseta* mosquitoes were found in greater numbers than in prior years, indicating that climatic conditions play a large part in control operations. Because of the international situation which might cause a critical shortage in some of the necessary chemicals needed in control work, we deviated from our normal operations and carried on an experimental project under the supervision of C. M. Gjullin, Research Entomologist attached to the U. S. Bureau of Entomology and Plant Quarantine stationed at Corvallis, Oregon. In search of a chemical which could be used in place of DDT, in the event that DDT became unavailable; as of now we have no report from Mr. Gjullin as to his findings.

The principal chemicals used were DDT and Pyrethrum extract. These were blended in Aromatic Solvent 42, Diesel oil and black oil, not exceeding 5 percent DDT and 1½ percent Pyrethrum, dispersed at the rate of two quarts per acre. This combination gave a truly surprising control, both as a larvicide and adulticide. Complete toxicological data given by the manufacturers show Pyrethrum can be used in combination with DDT in these percentages without any added toxic hazard to human beings or warm blooded animals. The Diesel oil used meets Federal Specifications V-K-211A having a specific gravity between 0.824 and 0.795 at 60°F. Theblack oil used is a pure petroleum product free from fatty oils, fatty acids, resins, soaps or other non-hydrocarbons, sediments, and sludge. Aromatic Solvent 42 is a Methylated Naphthalene, specifications for which can be obtained from U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine.

There are 34 species of mosquitoes known to occur in Oregon. They belong to 5 genera; *Aedes, Anopheles, Culiseta, Culex* and *Mansonia.* Out of 34, we have nine species that are plentiful enough to warrant control.

They are:

A. 1. *Aedes vexans* (Meigen)
   2. *Aedes sticticus* (formerly known as *lateralis* (Meigen)
   3. *Aedes increpitus* (Dyar)
   4. *Aedes dorsalis* (Meigen)

These species are found in the overflow areas along the Columbia and Willamette Rivers.

B. 5. *Culex tarsalis* Coq.
   6. *Culex pipiens* Linn.
   7. *Culiseta incidens* (Thomson)

These species are found in semi-permanent and impounded bodies of water.

C. 8. *Anopheles punctipennis* (Say)
   9. *Anopheles freeborni* Aitken

These species are found in spring-fed lakes in both Multnomah and Clackamas County.

The equipment owned and operated by the Bureau is a North American AT-6 equipped with a 600 h.p. Pratt and Whitney engine, which has been converted to a spray plane. Controls and instrument panels were removed from the rear cockpit and a 96 gallon tank fabricated and placed in position directly in back of the pilot's seat in the front cockpit and resting one inch beyond center of the C/G line. A 12-volt electric driven pump was constructed and mounted on fuselage members directly beneath the tank. The boom is 42 feet long, mounted nine inches below the wing surface. It is attached 3½ inches behind the leading edge at the wing tip diaganally to a point directly beneath the fuselage at the trailing edge of the wing. Nozzles are spaced 12 inches apart, using Chicago Spraying System diaphram T-jet with 6510 tips. T-jet diaphram valves open at five pounds PSI. The operating pressure of the system is 40 pounds, with a dispersal rate of 18 gallons per minute at 133 miles per hour, applying two quarts to the acre at 50 to 75 foot levels. This plane was operated the entire season of 1950 without mishap or breakdown in the spray system, and has proved to be a very satisfactory airplane for the type of area that we control.

We also have a Boeing PT 17 equipped with a 220 h.p. engine with an exhaust stack five inches in diameter installed lengthwise of the fuselage. A 2½ inch venturi is attached to the end of the 17-foot stack, with two Monarch .0015 spray nozzles projecting into the venturi throat with a distributing rate of 5.5 gallons per minute at 70 miles per hour. A 70 gallon insecticide tank of tear drop design is mounted on bomb shackles beneath the fuselage of the plane with a wind-driven Overdorfer bronze gear pump mounted on the under-carriage. This airplane, while being very efficient in small level areas, has been very high on maintenance. A breakdown on operational costs between the Boeing and North American, this past season, showed that while the North American used much more gasoline it did three times the amount of work that the Boeing did. We disposed of the Boeing, and have recently purchased a Douglas A-25, which is an all metal airplane of approximately the same design as the North-American and will be equipped with the same type of dispersal system.

As we are operating from a fixed base at the Portland-Troutdale airport, it became necessary for us to purchase a tank truck, which is a Four-Wheel Drive truck with a 1,850 gallon tank. This is used to transport insecticide from our mixing plant to the airport. For our ground control work, we have a Lawrence Aero-Mist, a Hardy Sprayer, and a high-velocity Friend Duster.

We have found the following meterological data must be obtained before conducting spray flights:

1. Relative Humidity
2. Wind Velocity
3. Conversion and Inversion Temperature Conditions

Many commendations have been received this year from citizens of Multnomah County on the ever-increasing effectiveness of the mosquito control program. These have come not only from individual citizens but also from industrial and agricultural interests and from recreational leaders of this community.

The Bureau of Insect Control is working in close cooperation with state and federal agencies, particularly with the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine Experiment Station at Corvallis in the development of new insecticides and their application, and the most economical means of control are being used.

Throughout the winter months the Bureau carries on an educational program with films provided by the U. S. Public Health Service. These are shown at schools, granges, and garden clubs.

In July, 1950, the Bureau of Insect Control was selected by the U. S. Public Health Service and the Oregon State Board of Health as an in-service training school, where the control of flies and mosquitoes was taught to state and county personnel both from Oregon and from southwestern Washington.

The following list shows the names and titles of those who conducted the instruction:

Roy F. Fritz, Scientist, Communicable Disease Center, U. S. Public Health Service.

Ralph Barnes, Scientist, Communicable Disease Center, U. S. Public Health Service.

Milton H. Buehler, Jr., Sanitarian, Oregon State Board of Health.

S. B. Osgood, M.D., Epidemiology, Oregon State Board of Health.

Verne C. Reierson, Sanitarian, Oregon State Board of Health.

W. W. Yates, Entomologist, U. S. Department of Agriculture, Research Administration, Bureau of Entomology and Plant Quarantine.

Dr. Francis Gilchrist, Head, Department of Biology, Lewis and Clark College.

Arthur H. Woody, Supervisor, Bureau of Insect Control, City of Portland.

Starting last year, ground markers were placed indicating areas and swaths so the pilot can locate areas and treat them with minimum loss of time. Radios have also been installed in the aircraft so that they can be in communication with the tower and also with a Bureau automobile which, too, is equipped with radio, eliminating the necessity of employing flagmen. This arrangement provides an increased measure of safety, as in an emergency the pilot can communicate directly with the Bureau of and vice versa.

We have had a very successful mosquito control this past season and hope to achieve the same degree of control this coming year.

Mr. E. A. Smith: I also have a letter from Dr. Eads of Texas in which he states that he regrets very much that the original letter has been mislaid and didn't get his answer in time so that we could delete the name from the program. He says, "Unfortunately we have little progress to report in connection with our abatement districts during 1950. Several additional counties were surveyed and control plans and cost estimates were drawn up. However, no new districts were actually formed. We have been operating somewhat under wraps since the administrative head does not feel that this department should push the matter too vigorously. I'm sorry that the California trip cannot be justified this year as I have been looking forward to seeing your abatement districts in operation for sometime. Possibly I can attend your meetings next year. Sincerely yours, Richard B. Eads, Principal Entomologist."

We're going to have to make a few revisions in the program. As was stated yesterday, Dr. Freeborn could not get down and Bill Reeves is now going to present his paper.

Dr. W. C. Reeves: Stan was very unhappy that he couldn't be here for the meetings; he had to go to Washington, D.C. He had been looking forward a great deal to meeting Don Rees here.

THE CONTINUING INTEREST OF THE UNIVERSITY OF CALIFORNIA IN MOSQUITO CONTROL

By STANLEY B. FREEBORN, Ph.D., Sc.D.

Assistant Dean, College of Agriculture, University of California

I am very happy to have been given this assignment as it has been necessary to gather a lot of information not presently available in any one place. When the word "continuing" is used, it is assumed that you are discussing something that has been started already. This gives me a chance to back up for a running start and record briefly the University's past history in mosquito lore.

The story of work with mosquitoes at the University of California is the long shadow of Professor William Brodbeck Herms. His enthusiasm if not his drive for accomplishment was transmitted to colleagues and students over a period of nearly forty years.

However, before Professor Herms arrived on the California scene, Professor C. W. Woodworth, professor of Entomology at the University, in 1903, was interested in the salt marsh mosquito problem by Mr. Noble M. Stover, an engineering graduate of the University, ho had been asked to prepare plans for a mosquito control program in San Rafael, Marin County.

In 1904, H. J. Quayle, Assistant in Entomology, was detailed by Professor Woodworth to cooperate with Mr. G. A. Pope, President of the Burlingame Improvement Club, in devising a plan for the control of mosquitoes in the San Francisco peninsula from South San Francisco to San Mateo. A survey was made by Mr. Quayle and a group of students, who found that the chief problem was in the salt marshes from which hordes of *Ochlerotatus lativittatus* (*Aedes dorsalis*) were making the countryside almost uninhabitable. A plan of action was outlined, and in 1905, Mr. Quayle, who had now been made an Assistant Professor, directed a definite control program of

draining, leveeing, and oiling. *Anopheles,* although no malaria problem was involved, were also controlled by treatment of several fresh water ponds and swamps, and the straightening of drainage streams. An early migration of *Lepidoplatys squamiger* (*Aedes squamiger*) caused some difficulty, but the results on *dorsalis* were almost miraculous. In 1906 Professor Quayle wrote the first University of California publication on mosquitoes, Bulletin 178 of the College of Agriculture — Agricultural Experiment Station — entitled "Mosquito Control."

Professor William B. Herms came to the Entomology Division of the University in 1908 as Assistant Professor of Parasitology, and thus there was created the first chair of Parasitology in any American university.

In 1909, Mr. Harry Butler of Penryn, California, sought Professor Herms' advice as to how best this relatively new information that certain mosquitoes transmitted malaria could be utilized in ameliorating the ravages of malaria in the fruit producing country around Penryn and Loomis.

Professor Herms outlined an anti-malarial program based on *Anopheles* control, and in 1910, he with Harold F. Gray and other students undertook a draining, filling, and oiling project coupled with an intensive educational program in the schools and clubs. The rolling terrain and dry summers conspired with these pioneers, and their success was almost miraculous. Malaria practically disappeared from the area. It was a fortunate example which other communities were anxious to copy.

It was in the same year that work by Professor Herms and his helpers was started at both Oroville and Bakersfield. The writer is responsible with several others for the statement that this was the first anti-malarial campaign carried on by mosquito control methods in the United States. This statement was originally made publicly in California by Dr. L. O. Howard, who was the established historian of the early days of malaria control. However, it as doubtlessly qualified, or should have been qualified, at the time it was made, as later investigations have shown that this work in California was antedated by almost ten years. The palm for the first attempt to control malaria by anti-mosquito measures in Continental United States probably is held jointly by the town of Brookline, Massachusetts and the city of New York, both of which started anti-malarial mosquito control measures in the summer of 1901. Brookline had been carrying on anti-malarial measures by draining standing water for many years before the actual knowledge of mosquito transmission was made available, and they quickly capitalized on the information and organized their work into a mosquito control program. The Chronicle, a newspaper published in Brookline, carries in its August 31, 1901 issue, which is Volume 28, number 36, a lengthy report by Dr. H. Lincoln Chase on the mosquito nuisance and its relation to malaria and with the recommendations for control.

In 1903 Dr. Chase made a formal report of the early Brookline work in the forerunner of the J.A.P.H.A.—The Journal of the Association of Massachusetts Boards of Health (p. 190 - 201.)

It is interesting in retrospect to note that the employee designated to supervise this original anti-malarial campaign in 1901 was allowed one laborer at $1.75 per day; the itemized list of equipment consisted of:

1 hired horse and light wagon
1 outfit for collecting specimens
1 five-gallon oil-can
1 single-gallon watering-pot
1 brass spigot
2 galvanized iron oil dripping pans
1 pick (to open manholes)
1 funnel
50 gallons of light fuel oil

Beginning the work in September, they "hoped to destroyed the last mosquito larvae of the season, the ones that otherwise would have matured and lived through the winter, to produce the first brood of mosquitoes of the following spring."

The report ends with fan mail from a grateful citizenry at the end of two years trial. The town was evidently satisfied with the results for they have carried on mosquito control operations every year since — for fifty years. The moral is that no mosquito man ever works himself out of a job no matter how good he is nor how long he works.

The Staten Island campaign was in charge of Dr. A. H. Doty, the health officer of the Port of New York, who was engaged in extensive salt marsh mosquito control activities. Noting that malaria occurred in the center of the island, he made a survey of the mosquitoes present and discovered that they were predominately *Anopheles.* Apparently in the fall of 1901, although possibly not until the summer of 1902, he directed a group of his workers to carry on a house to house campaign for the control of *Anopheles* and succeeded in reducing the transmission appreciably in this small endemic area. The claim that Dr. W. N. Berkeley carried on the first anti-mosquito malaria campaign is somewhat clouded by the fact that he never named his area of operation (suburban New York town.) He visited the area in 1900 when several cases of malaria were discovered around an unnamed pond. He recommended catching all the adult mosquitoes in the houses, complete screening and drainage of the pond! Malaria disappeared. In the next few years campaigns to abate malaria through mosquito control were started from Talladega, Alabama and Atlanta and Savannah, Georgia, as far north as Old Orchard Beach, Maine, and as far west as St. Louis in 1903. Our Penryn campaign can therefore claim to be the first campaign of its sort west of the Rocky Mountains.

Professor Herms, however, was a busy consultant and missionary for the next few years. In 1913 a bill for the control of disease vector mosquitoes, known as the Guill bill, was introduced into the Legislature, and passed both houses, but was vetoed by the Governor.

The Univeristy had little to do with the legislation leading up to the passage of the Mosquito Abatement Districts Act in 1915, immediately after which both Marin, and the Three Cities Mosquito Abatement District on the San Francisco peninsula, were organized. But Professor Herms was soon in the thick of the fray in aiding the various localities in their plans for the formation of districts.

In 1916 Professor Herms and the writer were commissioned under the former's leadership to carry on a mosquito survey of California which was started that sum-

mer and completed some summers later. Thousands of miles of highway and byways were covered in collecting trips until the entire state had been covered in exceedingly complete fashion. Every mosquito taken was preserved, and the results have been of inestimable value for students over the years who have gone back to this original survey for records of individual species.

Rice was first introduced in California commercially in 1914, and by 1916 many persons had grave doubts as to the effect of the industry on the mosquito population and the endemicity of malaria. The writer made several studies on this problem later, cooperating with a field party from the United States Public Health Service under the direction of Dr. J. C. Geiger in the heart of the rice section, centering south of Chico.

In 1917 at Professor Herms' suggestion, the writer worked on the effect of petroleum oils on mosquito larvae and proved for the first time in this country, and concurrently with an Indian worker, that petroleum oil has a definite toxicity depending on its viscosity and chemical constituency in its anti-mosquito effects rather than the suffocating propensity of a surface film.

In 1917, Professor Herms played a leading role in the planning of anti-malarial mosquito control work in the Sanitary Corps of the Army. The writer was associated with him in the Sanitary Corps at the Port of Embarkation, Newport News, Virginia, in a project to carry on extra-cantonment control of *Anopheles* mosquitoes for a very considerable area of tidewater Virginia surrounding Hampton Roads. The standard methods of control were used, and a strikingly effective malaria control program resulted.

In the spring of 1919, a proposal was made to the State Board of Health that a demonstration control campaign for malaria might be inaugurated in the town of Anderson in Southern Shasta county. Governor Stevens made available a grant of $10,000 remaining in his War Emergency budget, and the writer, together with an engineer, a physician, and a microscopist, undertook a shot-gun program of malaria control in this area. The area controlled was one mile from the center of the town in each direction. The principal means of control was permanent drainage, but some oiling was done, and *Gambusia* minnows were introduced. A screening program for the homes was inaugurated, and free diagnosis and treatment at cost were made available to all residents of the community and the surrounding country. A blood smear index and a history index made in the spring of 1919 indicated a 25.2 percent positive blood smears and 72.2 percent positive history (84.6% in chilren under 10 years of age) over a period of the preceeding six months. The histories and smears were taken on street corners, and no attempt was made to seek out possible malaria carriers. In December of the same year, following the control measures, a definite search for possible carriers with positive bloods failed to indicate a single carrier. A similar survey in June of 1920 in which emphasis was placed upon getting history and specimens from persons who the local doctors thought might be carriers also failed to reveal a single positive case. The expenditures and the methods used hardly seemed sufficient to have produced these exceptional results. They emphasized, however, the great effectiveness of relatively simple procedures for the control of malaria under most California conditions.

Professor Herms was finishing his mosquito survey in California when it was interrupted by the war, and the following two summers a laboratory was set up at the Stanford Ranch at Vina in the heart of the Sacramento Valley for the study of ecological problems relating to California mosquitoes. Many students were associated with these studies as they had been with the mosquito surveys of the state that preceded them, thus indoctrinating a fresh group of youngsters each year in the mosquito studies of California. Numerous papers were published by Professor Herms and others on the ecological phases as well as on the egg laying habits and egg characteristics during these years. In 1926 the writer's "Mosquitoes of California" appeared which summarized the information on mosquito taxonomy and ecology as it was known at that time.

In 1931, Meyer, Howatt, and Haring demonstrated the virus of western equine encephalitis in horses' brains in California. This touched off a new line of endeavor, and Herms, Wheeler and Herms in 1934 published negative results on their ability to transmit the virus by means of the salt marsh form of *Aedes dorsalis*. Shortly thereafter, but not published for several years, this group carried on experiments with the fresh water form of *Aedes dorsalis* and were able to transmit the infection through their bites. This was subsequent to the publication by Kelser that the infection could be transmitted by means of the yellow fever mosquito.

One of those unfortunate tragedies occurred in this period. Reeves, who had carefully worked out the hatching requirements of *Aedes varipalpus* as a subject for his doctoral thesis, found that the details of his work had been published by others. This forced him into a new field of endeavor which, fortunately for all concerned, was that of the transmission of the viruses of the encephalitides by mosquitoes. From then on, there followed a very productive period of one discovery after another, by the Hooper Foundation group of the University, concerning the transmission of these viruses by various mosquitoes and the role played by birds as inapparent hosts to the infection. The work has gone on continuously and effectively until at the present time we have the most complete picture of the epidemiology of the arthropod borne encephalitides for any one area in the world. However, there are many loopholes in our information, and the Hooper group is forging ahead on such problems as the winter carry-over, the biting habits of the principal carriers, together with epidemiological studies of bird infections in nature. In addition, the group is vitally interested in the matter of field control. Although many individual species of mosquitoes have been shown to be possible carriers, *Culex tarsalis* is apparently by far the most important carrier in nature in California. The problem now is to determine whether eradication measures against *tarsalis* will actually control the spread of the disease. Many problems are involved, and it may be some time before the actual answer can be given. The group is speedily forging ahead toward a solution.

At the outbreak of the war, the terrain over which most of the war was to be fought indicated that one of the most

important diseases to which our troops would be subjected was malaria. The demand for entomologists, and particularly those who had had some training in the medical phases, was urgent. A statement was made rather authoritatively in Washington during the war, although I have never seen the figures to verify it, that more graduates and staff of the University of California were engaged in mosquito control work with the armed services than any other institution in the country. The statement may be true, but if so, we were strongly pressed by both Cornell and Minnesota. Whether we surpass in number or not is a difficult question to answer, but we certainly presented an extremely impressive picture of activity along the lines of mosquito control.

Professor Herms once more returned to the Service and was in charge of the training of medical officers in the field of Environmental Sanitation at Carlisle barracks in Pennsylvania. Freeborn went into the Public Health Service and was Director of Operations for Malaria Control in War Areas; Usinger in the Public Health Service, and Bailey in the Navy had the credit for being the directors of the first two epidemics of dengue that were ever controlled before the population ran out of non-immunes, Bailey functioning at Guam, and Usinger at Honolulu. Douglas was awarded special citations from both the Army and Navy for work in New Guinea and Guadalcanal, and in addition, entirely without any previous planning on his part, a Purple Heart. The Bohart brothers were largely responsible for the training of Seebees in field malariology and later went to the Pacific Area where they did a great deal to straighten out the taxonomy of the various mosquito species in the invaded territory. Furman, Peters, Perry, and Howell all did outstanding work in the South Pacific. Perry was the Area Entomologist for the Navy. Tommy Aitken, after a tour of duty in Central America, went to North Africa, atached as entomologist to the specialist on malaria control on General Eisenhower's staff. He later went on to make a distinguished record in the control of malaria in Sardinia, and stayed after the war to be the entomologist for the party that is now attempting to eradicate the disease as well as the mosquito carriers from the island. Pedro Galindo was called home to Panama for malaria control and is now in charge of the yellow fever-malaria eradication program of the government of Panama. These are only a few of the students and staff members who were engaged in entomological work with the armed services, but they give an indication of the type of activity that these people were able to carry on because of their background, training, or profession.

Since the war we have added several men to the staff in Entomology who had distinguished records in malaria control during the war. Middlekauff was, after a tour of duty as entomologist for Fourth Service Command, transferred to Panama where he headed the entomological section for the Army School of Malariology. Pritchard was the leading entomologist in the Pacific Health Service force that had the difficult problem of controlling malaria in extra-cantonment areas in Puerto Rico during the war. John Belkin, after a period of indoctrination with TVA, entered into war work and also made a distinguished record.

So much for the war record. Since the war, the Hooper Foundation group has pushed ahead strongly with their study of the encephalitides with most of the entomological work being done by Reeves and Brookman. Mention has been made previously of their plans for the present and future. At Davis, Dick Bohart has carried on his larval toxicity studies in addition to keeping his finger on the taxonomic problems relating to the group. At the present time he and Freeborn have in the press "Mosquitoes of California" with new keys, short ecological narratives, and a basic list of distribution data made up of verified records.

At U. C. L. A. in Los Angeles, John Belkin has just published a revised chaetotaxy for Culicid larvae that promises to be used widely. In addition, he has "adopted" the *pseudopunctipennis* complex, and we are all looking forward to the time when he will tell us where we stand on this confusing mixture of contradictory evidence.

No one knows exactly how many families of insects there are, but 1500 is probably a very conservative number. When you consider all these families to which the University entomologists *might* devote their attention and find that fifteen of them have made significant contributions to our knowledge of a single family—the Culicidae, there is little ground to believe that the University is not vitally and aggressively interested in mosquitoes.

It is fitting that at this point I should make quite plain the policy governing research in the University and in the College of Agriculture. Our research projects, in the main, relate either directly or indirectly to problems of some econimic importance. However, it is our firm belief that the best aproach to any involved problem is at the grassroots of basic research. Answers obtained at that level become enduring cornerstones of our permanent fund of information.

From time to time it is necessary for us to undertake a problem in what I have termed "operational" research, such as screening of insecticides, the determination of dosages, and similar problems. These are very necessary in order to answer the immediate questions of the field men, but they add little to our basic information and become worthless when, for instance, a formulation is changed, or the material is supplanted by a new product. In the case just mentioned, we would much prefer to be working on the mode of action of the active ingredient of the insecticide, its effect on the insect's physiology and its ultimate destination or destruction in the insect's body. The answers to these questions take the problem of improving insecticides out of the trial and error category. However, if staff members who are capable of doing this type of investigation are forced into operational work by pressure from the field, real progress is bound to be slowed up.

One other bit of information should be added to this sumary which relates to the modifier "continuing" in the title. Anyone who has ever worked once with mosquitoes may be diverted temporarily, but sooner or later their fascination draws him back into the field, and we welcome him as the "prodigal son."

Mr. E. A. Smith: I see no point in letting Bill sit down since he has to jump back up again. Now, he can present his own talk on Encephalitis Vector studies in California.

(Note: At Professor Reeves' request his talk was not recorded, as much of the material was in tentative form only and not ready for present publication)

Mr. E. A. Smith: The next speaker is John M. Henderson, Sanitary Engineer Consultant, CDC, Atlanta, Georgia.

IRRIGATION AND MOSQUITO PROBLEMS

JOHN M. HENDERSON, *Sanitary Engineer Director (R)*
Consultant, Communicable Disease Center, Public Health Service, Federal Security Agency, Atlanta, Georgia

Some people, after 30-day tours, have written books on the socio-economic problems of nations and how to solve them. Having been in California an entire week, by this precedent I should consider myself qualified to discuss authoritatively the mosquito problems of your state. However, I am also reminded of the learned scientist who was asked to suggest solutions to a few of the many problems of India and who replied, "I don't know India well enough; I've only lived there 20 years." Prudence, accordingly, suggests a subject with which you are less familiar, even though I may know little more than you about it. For this reason I ill deal mainly with the problems of mosquitoes and encephalitis in the other irrigated states.

Most sources report that irrigation in this country is practiced in 17 states lying west of the Louisiana-Minnesota tier. Roughly, there are 23 million acres of irrigated land in these states, of which 6 million are in California. The irrigation of 13 million acres of new land was under way or proposed by the U. S. Bureau of Reclamation in 1948. (1) None of these figures include Arkansas or Louisiana which have a million acres of rice land under existing irrigation. This adds up to some 37 million acres, exclusive of nearly 8 million acres of supplemental water developments in irrigated areas of western states on the Bureau of Reclamation program. (1) Moreover, supplemental irrigation is practiced in all or nearly all of the humid states comprising the remainder of the nation, but in summation it may be said that irrigation is of chief importance in 19 states.

The most acute mosquito nuisances arising from irrigation probably occur in California, Utah, and Arkansas, and it is significant that these are the only states in the so-called irrigated area where mosquito abatement districts either have been extensively developed or, as with Arkansas, are being actively promoted. The remaining states might be classed as virgin territory, except for a limited but important area of Oregon.

In none of this large area can malaria presently be considered a problem. The viral encephalitides appear to be an extensive but not a fully evident public health problem except in times of epidemic outbreak, when they become obviously important.

Since knowledge of the incidence and location of the infection in man during endemic years is very incomplete east of the Sierras and there is uncertainty as to the principal vector(s) in some localities, it is apparent that mosquito abatement programs based on recurrent control measures are hardly warranted in non-epidemic periods on the primary grounds of encephalitis control.

Why, then, should anyone concern himself with mosquito control in this area?

The first phase of my answer relates to nuisance mosquitoes *per se*.

Apart from disease transmission, it is no secret that mosquitoes can and do seriously interfere with human comfort and that many municipalities, some states, and the Federal government for a number of years have felt justified in spending public funds in substantial amounts for nuisance mosquito control. As for other countries, even the Malaria Institute of India has found it necessary to employ labor forces for nuisance mosquito control around Delhi, in spite of a hundred million cases of malaria in that country. In October 1950 the Surgeon General of the Public Health Service in a general letter to state and territorial health officers stated, "It is our conviction that pest mosquitoes should receive more attention from health authorities than they in the past. Public health has become something more than the absence of disease. Physical efficiency and comfort, on which mental equanimity depends to a substantial degree, may be seriously disturbed by the continued annoyance of pestiferous mosquitoes which may or may not have disease-transmitting potentialities."

The second phase of my answer is concerned with the irrigation aspects of man-made mosquito breeding places. Mosquito production in natural breeding places occurs in the general area. But it is recognized the world over that untidy irrigation and mosquito production are hand maidens, and this area is no exception. Observations by the Office of the Midwestern Communicable Disease Center Services (2) and others in field study areas reveal many man-made water-holding conditions, resulting from lack of conservation irrigation practices, which are responsible for high populations of *Culex tarsalis, Aedes dorsalis, Aedes vexans,* and *Aedes nigromaculis,* and lesser numbers of other species.

In one irrigated area over 6,800 mosquitoes were collected overnight in one trap. In another area, the average collection of females per trap-night for the 4 month season was 474 (all species) and for an 8-week period exceeded 300 *C. tarsalis*. The peak trap-night collection of *C. tarsalis* females was 1,590. Although mosquito collections in these areas are not measured by the gallon, as in California, it canot be considered that such conditions are conducive to either comfort or freedom from disease hazard.

Most irrigation projects have an estimated life of one to three centuries. Man-made mosquito breeding is built into such projects both in their physical construction and in improper irrigation practices, the latter generally being more important at the present time. It has been the experience of public health workers throughout the world that the ingrained customs of a people are more difficult to change than the physical environment. I was impressed by a statement made to me recently by an authority on the subject that the areas of this country in which the conservation irrigation program has had the hardest sledding are those where irrigation has the longest history, and faulty practices in consequence are most firmly intrenched by time and tradition.

SUGGESTED PROGRAM

I believe there is urgent need and ample justification at present for the state health departments of all irrigated states except California to initiate a long-term program of preventing man-made mosquito breeding. As for Cali-

fornia, this program requires wider acceptance and development, rather than initiation.

The program against man-made mosquito breeding should assume two forms: regulatory and educational, with the educational phase primary. Health departments and abatement districts should focus attention on, and support the activities of, The U. S. Department of Agriculture and state extension services in conservation irrigation. The prevention of man-made mosquito breeding should be presented as an added reason for waste water control, not as a separate issue. Although county agents under the extension service will be found actively engaged in rendering direct service to irrigators on conservation in some localities and states, the main effort is under the aegis of the Soil Conservation Service. Even one mosquito-prevention representative in each state, applying leverage principles by guiding, educating and serving the large number of agricultural and soil conservation agents who are rendering direct service to irrigators, should make appreciable progress in time.

In addition to a knowledge of mosquito biology and the sanitary sciences, the mosquito-prevention representative should also have good basic training in irrigation engineering or science, preferably in the soil and water or downstream irrigation phases. This is because the basic solution lies in avoiding waste water in all stages of the irrigation system, and training in the basic technology of the method of solution leads to the rendering of a more effective service to local, district and state irrigation interests.

The management of the local irrigation district and the county road department rank high in importance along with the irrigator. About 20% of the present irrigated acreage has been developed by the Bureau of Recalamation, the remainder being local developments. Although the present trend in some regions is toward the construction of systems by federal agencies, even here most or all of the distribution systems after construction are managed by local districts. Without minimizing the importance of the Bureau of Reclamation, the main effort above the level of the irrigator should be expended on the irrigation district, and mosquito prevention should be added to the economic arguments now being advanced for waste water control by conservation irrigation interests. Here again the main approach should be educational, but orderly planning suggests that plans and specifications for all new irrigation schemes upstream from the individual holding be scrutinized in the interest of mosquito prevention. This is possible only by the enactment of appropriate regulations by state health departments and/or water control commissions.

The program proposed is not spectacular and is unduly modest in proportion to the problem, since the minimum area under irrigation in any of the Pacific and Mountain States in 1945 was over a half million acres (Census of Agriculture 1945). In the Plains area, irrigated areas were comparatively small in 1945 with the exception of Texas, which had 1-1/3 million irrigated acres, but proposed and current "new land" developments in 1948 (1) varied from a quarter of a million acres in Kansas and Oklahoma to nearly 900,000 acres in Texas and over a million acres in North Dakota, South Dakota, and Nebraska. In view of the magnitude of the problem, rapid progress cannot be expected. Like the soil Conservation program, progress should be measured not from day to day, but over a period of years, and program planning should be long-term.

Conservation Irrigation

"Conservation irrigation is simply using irrigated soils and irrigation water in a way that will insure high production without the waste of either water or soil." (3) In most irrigated areas of this country, soil erosion may be considered a usual consequence of water waste, but the economic advantages of waste water control assume many other forms. The extensiveness of water loss in irrigation is indicated by Israelsen: (4) "Because of the many sources of loss of irrigation water between the time and place it is diverted from rivers, and the time and place where it is stored in the root-zone soil as water readily available to plants, the irrigation efficiency on most proects is low, probably less than 33 percent." According to the U. S. Department of Agriculture: "In the West considerably more land with soils suitable for irrigation is available for development than there is water with which to irrigate it." (1) Avoidance of water waste in consequence increases the potential acreage of irrigable land or saves water for other beneficial purposes, including stream sanitation, navigation, municipal water supply and recreational uses. Other economic benefits derived from saving irrigation water include: reduced size and cost of distribution system components, increased crop yields due to improved soil aeration and reduced leaching of soluble plant nutrients, lower payments for water, reduced cost of road maintenance, lowered pumping costs, reduction or elimination of saline and "alkali" soils, and less need for land drainage and road drainage structures.

Generally, the direct economic benefits of conservation irrigation measures materially exceed the cost. Under proper technical guidance, resultant freedom from nuisance mosquitoes and encephalitis hazard are dividends obtained at negligible cost to society.

Irrigation in California

Approaching it from another direction, let us now consider California, which leads the nation in acreage under irrigation. Not all mosquito production in California is caused by irrigation and not all of the 18 million acres (5) under organized mosquito control are in irrigated areas, but it is generally accepted that a majority of the mosquito production in the state is due to irrigation. In the three abatement districts in the Central Valley which I visited, it was reported that mosquito production arising from irrigation varied from 90 to 99% of the total mosquito problem. The intensity of this production in one area is illustrated by the peak collection of over 300,000 specimens in three trap-nights. Lack of conservation irrigation is responsible for the great bulk of the mosquito output from these irrigated areas as a whole, although some breeding does occur in minor irrigation structures, such as idle outlet boxes and standpipes, which would not be benefited by conventional conservation irrigation activities. Expenditures for mosquito control in California amount to about 2 million dollars annually; principally for the recurrent application of larvicides. Yet there is probably not a single abatement district in a principal irrigated area in which freedom from mosquito nuisance is being consistently realized

on a districtwide basis. As for disease, the California State Health Department reports there were 347 human cases of encephalitis in 1950, (6) and it has been estimated that adequate state-wide control of nuisance mosquitoes plus the vector mosquito *C. tarsalis,* might cost up to 10 million dollars annually, using present methods of control.

It is thus apparent that the price of avoidable water waste in irrigation systems in terms of the cost of killing mosquitoes comes to no mean figure and that mosquito-killing measures are neither economical nor fully effective where irrigation is as widely practiced, and conservation irrigation has been as inadequately adopted by irrigators and irrigation districts, as in California. The irrigation of nearly 2 million acres of new land in California was underway or proposed in 1948 by the Bureau of Reclamation, with supplemental water to be supplied for "firming-up" another 2½ million acres. (1) Unless conservation irrigation and eliminative work keep pace, figuratively speaking you may have to turn from the gallon to the cubic foot as a unit of measure in mosquito collections.

Mosquito-killing measures are obviously unavoidable in areas where quick relief is desired to overcome the liabilities created by 75 years of improper irrigation development, and it is not my intention to suggest their abandonment. Yet I share with many of you the feeling that you "have the bull by the tail" and that more effort should be placed on reducing existing mosquito breeding places and avoiding new man-made breeding sites, and proportionately less on mosquito-killing.

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Mr. E. A. Smith: I think we can take time to have some general discussion on this. Mr. Henderson wants to ask you questions and I was going to ask you to ask him questions.

Mr. Henderson: Just to start things off suppose I tell you about some of the situations that I've run into that I've had an oportunity to examine in slightly more detail than during this rather rapid California trip. I have looked at irrigation in Nebraska and South Dakota on some six or seven projects, and you may be interested because of the contrast with California irrigation practices. There, they have a very deep permeable top soil on the average. There are some exceptions to that, but the depth of permeable soil in one area that I went to was eighty feet. When I asked about the rates of application of irrigation water they got out the records and showed them to me, so this is not guess work on their part; they ran around fifteen inches a year, three applications of five inches each. That does not mean that you could get away with fifteen inches in many parts of California or even anywhere in California. It just shows how lucky they are in terms of rainfall; I remember the range was in the order of fifteen or twenty inches per year and a more favorable seasonal rainfall. In those areas, I found that most of the mosquito breeding problems came from a combination of situations. First of all, there was the case of the cooperative county road department. The farmer had a field right next to the county road; he irrigated by the furrow method, and he asked the county road department to widen out the roadside ditch and make a nice big sump out of it, so that he could run all his furrows directly into the roadside ditch. There being no effective drainage of those ditches, the condition was one of filling this reservoir full of water and allowing it to evaporate in due time, which gave an excellent opportunity to *Culex tarsalis* in particular. Generalizing for the plains areas that I visited, I suggest that the nuisances did not arise from over application of water in terms of a number of inches or feet per year applied to the land, but what little they do apply is applied at a too high a rate in the furrows, with the result that there is some spillage over into these sump areas.

In another area there, I found that with moderate irrigation there was still a very extensive broad area of seepage in one river valley that was due to a deep percolation from both preciptation and irrigation in combination. In Utah, which Dr. Rees is so thoroughly familiar with, the problem seems to be sheer lack of drainage as the number one problem. In other words, in the one project that I'm familiar with, there are some forty thousand acres of seeped lands. I'm not at all sure that too much water was put on this land. It may have been, but it is apparent that at the present time drainage is the primary corrective solution to the seeped land areas that exist there, and I think this is probably the case in the Salt Lake City area.

The first place I stopped at in California was Chet Robinson's district, and I asked him how much water they applied to clover, and he said seven to nine feet per year. Is Mr. Robinson here?

Mr. E. C. Robinson: That's correct.

Mr. Henderson: Now that is such a high figure that it looks to me as though in that part of the state at least,

your primary problem probably is sheer over-application of water. I don't know whether I'm right or not, but it's water wastage rather than what we might term untidy irrigation practices. You're just putting too much water on the land. I'm not speaking as an irrigation authority; I'm just in the embryo stages of learning something about irrigation. So, we have these classifications, I mean, we have putting too much water on in total amount; lack of leveling as another factor; lack of drainage is another factor, and we have the bad roadside ditch situation as still another. I'm trying to get an appraisal of these classifications of your problems.

Mr. E. A. Smith: I will call on some of the individual managers, to answer your implied questions.

Mr. G. E. Washburn: I'm a neighbor of Chet Robinson and although in his irrigation district from seven to nine feet is applied for clover, the same in the past has been applied in our irrigation district. However, two years ago our irrigation district took upon itself the authority to limit the irrigation to four acre feet, and it has been found that in the past two years the clover has not suffered. In fact there's only been about six percent, I believe, of the total irrigation area in our district that has had over the four acre foot figure. There's a penalty above four acre feet in our district. It has, of course, materially helped our problems. Before then it was the same as Chet's, just too much water.

Dr. W. D. Murray: About the same situation occurs in Tulare County. One interesting thing we all have is the farmer who has too much to do. He lines up a lot of work, he sets his pump going and comes back an hour or so too late, and we have water coming out by hundreds of gallons per minute; you get too much water too soon.

Mr. E. A. Smith: That's just carelessness or laziness.

Mr. Rolland Henderson: While all of the things Mr. Henderson has mentioned are important I think the careless aspect is the crux of the problem. The farmer either has too much to do or hires incompetent help in his irrigation.

Mr. A. F. Geib: There is a wide range in total water usage depending upon several factors; the crop, and the demand of that crop for water; the soil characteristics; and temperature and relative humidity. In any event, conservation of water is important in our area, and conservation of water use is a valuable help to the entire mosquito control program.

(The meeting then adjourned, and a box lunch was served on the lawn of the Faculty Club. The meeting re-convened in the Faculty Club at 1:15 p.m.)

Mr. E. A. Smith: I want to make one comment about the last part of this morning's program. In planning this Conference, the Program Committee presented a program that was too long for us to cover in the time we had, so the Executive Committee had to do some wholesale slicing, and I was disappointed when they sliced out a panel discussion on water management. I'm happy now, as we had our panel discussion on water management this morning after all. I introduce now the newly elected Vice-President of the California Mosquito Control Association and turn over this afternoon's session to Rolland Henderson. (Applause.)

Mr. Rolland Henderson: When they offered me the job of Vice-President, they said there wouldn't be very much work to do and you didn't have to be very smart, so it sounded like a good job for me, and so far it's held true to form. Particularly, this afternoon the job cut out for me is extremely easy. All I have to do is introduce one person, and from there on the program runs by itself. I present G. Edward Washburn, Chairman of the Operational Investigations Committee of the California Mosquito Control Association.

OPERATIONAL INVESTIGATIONS DEALING WITH MOSQUITOES IN CALIFORNIA (1)

By G. EDWIN WASHBURN[2], R. F. PETERS[3], AND D. C. THURMAN, JR.[4]

1. Contribution of the Bureau of Vector Control, California State Department of Public Health; California Mosquito Control Association; and Communicable Disease Center, Public Health Service, Federal Security Agency, Atlanta, Ga.
2. Chairman, Operational Investigations Committee, California Mosquito Control Association; and Manager, Turlock Mosquito Abatement District, Turlock, California.
3. Senior Vector Control Specialist, Bureau of Vector Control, California State Department of Public Health. Berkeley, California.
4. Senior Assistant Sanitarian, Public Health Service,

INTRODUCTION

The Bureau of Vector Control and the mosquito abatement districts represented in the California Mosquito Control Association have for several years recognized the need for biological investigations of California mosquitoes aimed toward evaluating the efficiency of present control methods and developing effective new control methods. About two million dollars each year is expended for mosquito control in this State; thus, control measure refinements may result in extensive savings. The principal mosquito control problems of the State are related to irrigation. Problems of secondary importance are related to natural waters including salt marshes, rivers, lakes, and flood areas. Associated with irrigation mosquito problems, two principal agricultural practices contribute to the main sources of mosquitoes in California's great Central Valley: (1) the irrigation of permanent pasture and (2) the flooding of rice fields.

In view of this urgency, and since investigations of the biology of mosquitoes in rice fields and in irrigated pastures would develop information which could be related to most of the mosquito problems in other argricultural situations, these two problems were selected for initial consideration. A third problem of basic importance is that associated with the development of efficient toxicants, the study of toxicant failures, and the precision application of presently recognized toxicants.

While these problems have been recogniged for a number of years, the first broad-scale coordinated attack on the problems was developed on a cooperative basis be-

tween the Bureau of Vector Control and the California Mosquito Control Association. This was conceived at the 1950 California Mosquito Control Association Annual Conference by a resolution, and through the appointment of a committee designated as the Operational Investigations Committee. The California Mosquito Control Association has, through this Committee, taken positive action in developing and promoting an effective program of biological investigations of mosquitoes in California. Through cooperative agreements between the Bureau of Vector Control and several of the mosquito abatement districts, $25,000 was set aside to conduct these investigations in subvented mosquito abatement districts.

The Operational Investigations Committee[5] in April of 1950, after making an intensive study of the problem, forwarded to the Bureau of Vector Control its recommendations for the investigational program for Fiscal Year 1951, including nominations of essential local cooperating agencies. Following approval by the Executive Committee of the California Mosquito Control Association and the Bureau of Vector Control, three units were established:

1. One unit was established with the Turlock Mosquito Abatement District at Turlock, California, as the administrative entity cooperating with this project.
2. A second unit was established with the Sutter-Yuba Mosquito Abatement District at Yuba City, California.
3. A third unit was established with the Kern Mosquito Abatement District at Bakersfield, California.
   (Locations of all three activities are shown on map. Figure 1)

5. Membership of Operational Investigations Committee: G. Edwin Washburn, Turlock Mosquito Abatement District, Chairman; Gordon Smith, Kern Mosquito Abatement District; John Shanafelt, Orange County Mosquito Abatement District; Don Murray, Delta Mosquito Abatement District; E. C. Robinson, East Side Mosquito Abatement District; D. C. Thurman, Public Health Service, Bureau of Vector Control; Herbert Herms, Sutter-Yuba Mosquito Abatement District; Ted Aarons, Alameda County Mosquito Abatement District.

Coordination of all of the activities of the investigations of mosquito biology as related to the use of toxicants, has been a responsibility of the Biological Section of the Bureau of Vector Control. Personnel have been assigned to each project from this Section. Vehicles assigned and maintained by the Bureau have facilitated the conduct of these programs. The Bureau of Vector Control has further sponsored these investigations programs, by supplying many of the basic materials used.

All mosquito abatement districts interested in the results of this work have cooperated by furnishing manpower and equipment whenever it was possible for them to do so.

Considerable progress has been made during the brief period of the existence of these three investigational units. The toxicant investigations project has been somewhat delayed, however, due to personnel problems and other reasons.

In discussing the results of these investigations, only the results of the first two will be given; while for toxicant investigations, the plans for the next season will be given.

The Program

Investigations of the Biology of Irrigated Pasture Mosquitoes (Conducted at Turlock)

This project has been a cooperative study between the U. S. Public Health Service, the Bureau of Vector Control, and the Turlock Mosquito Abatement District as sponsored by the California Mosquito Control Association.

During the 1950 mosquito season, investigations have been divided into several phases. They have included:

1. A study of the cycles of mosquitoes during the successive irrigations in a permanent irrigated pasture (designated as the Study Pasture, see Figure 2).
2. The study of the feeding habits and activities of adult mosquitoes in a single pasture, and the relationship that these activities may have in the transmission of disease.
3. Flight range and dispersal studies of *Aedes* mosquitoes from irrigated pastures.

In order to facilitate these studies, a field station was established at Turlock, and equipped with materials and personnel. The study area selected was an irrigated pasture located about 8 miles west of Turlock. Temperature and humidity records were kept, using a recording hygrothermograph. In the course of each of the 18 irrigations in this pasture, a mosquito cycle was begun and completed. During each of these mosquito cycles, records were kept of the hatching and distribution of mosquitoes over the pasture, of the emergence patterns of adults, and of adult density indices.

To accomplish the second phase of the study, females of the species *Aedes nigromaculis* (Ludlow) were taken from the pasture and records made as to whether or not they had fed or were gravid. The engorged females were dissected, and blood from their stomach was smeared on filter paper. These blood specimens were then stored, and will be tested at a later date to determine which animal hosts provided the blood meal. Diurnal and nocturnal activities of adult mosquitoes were observed, and light trap collections were made both within the pasture and near by.

Two methods were used in the study of flight range. The first called for tagging the mosquitoes with rhodamine B fluorescent dye, and the second, with a radioisotope P-32. The rhodamine was applied to the mosquitoes in their natural habitat, using an aqueous solution of about one pound to five gallons of water, applied with an insecticide fog generator but omitting the use of heat mechanism. The radiophosphorus was placed in two large galvanized iron tanks holding about 80 gallons of water in which the mosquito larvae were concentrated. Fourth stage *A. nigromaculis* were introduced into the tanks and there ingested the isotope. On emergence they contained enough radiophosphorus for easy detection with a Geiger Counter (Tracerlab Su-3A Laboratory Monitor, see Figure 2).

Investigations of Biology of Rice Field Mosquitoes (Headquartered at Yuba City)

This project has been a cooperative project of the Bureau of Vector Control, and the Sutter-Yuba Mosquito Abatement District, sponsored by the California Mosquito Control Association.

The objective of this study was to increase the knowledge concerning the natural history of rice field mosquitoes, in view of the need for improving control measures. For the spring of 1950 the principal activities included:

1. A study within a 25-square-mile area, where intensive springtime larvicidal measures had been applied to all infested aquatic sources. The purpose was to determine whether or not this spring control would significantly decrease the numbers of *Anopheles* and *Culex* mosquitoes which occur in the rice fields after they are flooded in May (see Figure 3).
2. Studies were conducted to determine the relative mosquito productivity of various aquatic sources, using dipping records as a means of comparison.
3. Inspections of adult resting stations were used to study fluctuations in adult propulations.

The study area of 25 square miles is located in southern Sutter County and includes 2,320 acres of rice and 1,960 acres of irrigated pasture. The remaining 11,720 acres are largely fallow ground of wheat and barley fields which are not subject to irrigation. Extensive larviciding was done during the months of March and April in an attempt to control all sources of mosquitoes in this 25-square-mile area. A central, mile-square section was used for intensive observations in the hope that records in this section would indicate the degree of mosquito reduction obtained and would not be influenced too greatly by those areas outside the 25-square-mile, intensively controlled area. Following the flooding of the rice fields in April and May, dipping records were kept on the occurence of mosquito larvae. Adult resting station and light trap collections were made to determine adult density indices.

To discover additional facts concerning the biology of the principal rice field mosquitoes, *Anopheles freeborni* Aitken and *Culex tarsalis* Coquillett, living specimens were collected and observed under laboratory conditions. The numbers of eggs laid by females of both species were recorded for these conditions. Dissections for ovarian and fat body development of female *Anopheles* in relation to seasonal changes are also under way. Field observations were made of the length of time required for adults to emerge after flooding certain rice field sections. Dipping records indicate that samples taken in one part of the rice field may not represent conditions over the remainder of the field. Therefore, it is exceedingly difficult to establish reliable indices to larval mosquito densities in rice fields.

In the resting station counts for the 1950 season, it was found that the *A. freeborni* females reached a peak on September 8, 1950.

Observations have been made concerning the swarming and mating habits of *A. freeborni*. It is hoped that this study will demonstrate differences in seasonal activities of both *A. freeborni* and *C. tarsalis*.

Presentation of Results

It has been the opinion of the Bureau of Vector Control and the Operational Investigations Committee that three phases exist in the conduct of these studies: first, a study of the natural history of mosquitoes and the effect of toxicants on mosquitoes; second, the organization of results of these studies for presentation in the form of reports to mosquito abatement districts and to the Bureau of Vector Control; and third, interpretation of the information given in these studies so that it can be used effectively in guiding control operations.

From the inception of these projects, every attempt has been made to keep both investigators and mosquito abatement district personnel abreast of all development related to the organization and operation of the projects, as well as cognizant of the results of the investigations. Thus, knowledge gained can be utilized in the control program of the districts at the earliest possible moment. This has necessitated frequent meetings of the Operational Investigations Committee in which the progress of the studies has been discussed in detail. Coordination of all effort through the Biological Section of the Bureau of Vector Control has worked effectively in directing the purpose of the investigation program. At Regional meetings of the Mosquito Control Forums in the San Joaquin Valley, the Sacramento Valley, the San Francisco Bay Region, and in southern California, mosquito control workers have been apprised of the results of each project. Thus, it is the intention of the California Mosquito Control Association and the Bureau of Vector Control to make the most of every dollar spent in this work through rapid integration of investigative results and operational programs.

Planning for the Future

In planning future mosquito investigations, there are four phases under consideration for the 1951 mosquito season. Those will include:

1. Continuation of flight dispersal studies of irrigated pasture mosquitoes.
2. Investigations directed toward learning more about the eggs of *Aedes, Culex,* and *Anopheles* and the potentialities of methods for destroying mosquito eggs.
3. A continuation of the biological studies of rice field mosquitoes.
4. Expansion and intensification of the study of toxicants for mosquito control.

The first three programs will proceed along much the same lines as during the 1950 season. It is anticipated, however, that in a study of toxicants, we may be able to increase our activities in several ways. The first way is through cooperation with the Corvallis, Oregon, U. S. Department of Agriculture Laboratory. Further, it is hoped that a completed analysis can be made of the resistance to toxicants displayed by California mosquitoes. This project may also undertake to establish the relationships between temperature variations and the action of toxicants on mosquitoes. The toxicant investigations project will employ a professional person to direct a study of the development of new toxicants for mosquito control through field tests of those materials which show promise as a result of laboratory studies. Plans are being made to ex-

pand this portion of the program with the assignment of additional personnel through the Bureau of Vector Control, and through wider participation by the mosquito abatement districts in the Central Valley. Thus, in 1951, there is to be an all-out attack on the problem of selecting the right toxicants for mosquito control in California.

Discussion

The approach, both administrative and technical, being used in the study of the biology of mosquitoes important to control programs in California has been presented. It is too early in our work to be able to give much in the way of conclusive data. It is not expected that all of the biological principles learned through this program will have immediate application. All persons engaged in long range mosquito control activities have come to realize that biological investigations have their place in the mosquito control program, and it is with a progressive outlook toward the future of mosquito control in California that these cooperative studies have been established. The results of these studies are not for the benefit of a single district but will have application in the programs of all the districts of this State, and may well provide basic scientific facts useful in the mosquito abatement programs throughout the Country and elsewhere in the world.

Conclusions

Investigations have been initiated aimed at evaluating present mosquito control methods and developing new methods. This will take the form of a large-scale, all-out attack via the biological approach, the results of which are expected to increase efficiency in California mosquito control procedures.

OPERATIONAL INVESTIGATIONS HEADQUARTERS 1950

1. Sutter-Yuba M. A. D. — Rice Field Mosquito Ivestigations.

2. Turlock M. A. D. — Central Valley Mosquito Ecology Investigations (Aedes).

3. Kern M. A. D. — Toxicological and Insecticide Resistance Investigations.

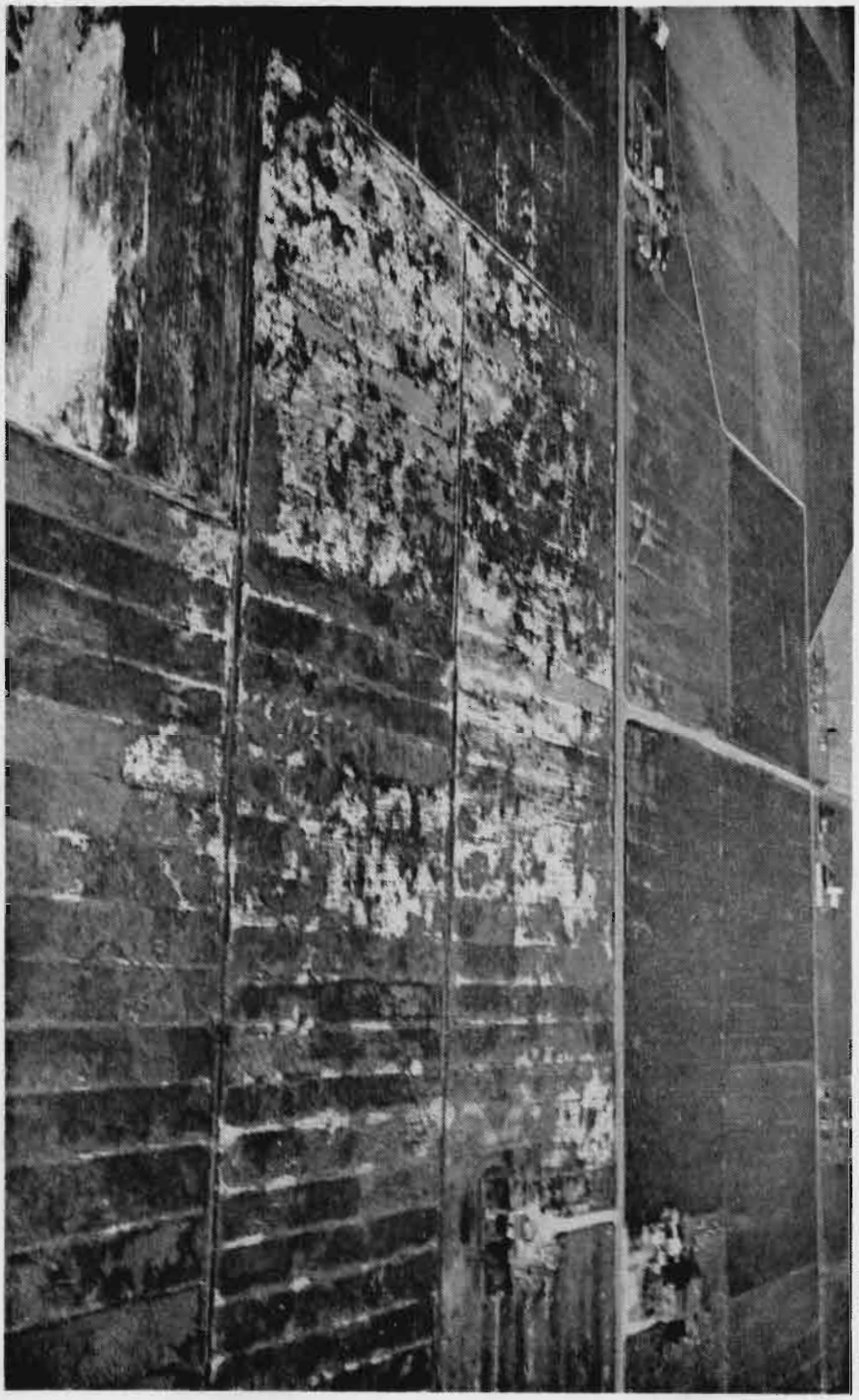

Figure 3. Aerial view of the Study Pasture at Turlock

Figure 2. Tracerlab SU-3A Laboratory Monitor used in detecting "tagged" mosquitoes.

WEEKLY DISSECTION RECORDS OF *ANOPHELES FREEBORNI* FEMALES

Work Week	Packed with Fat		Little Fat		No Fat		Noticeable Ovarian * Development		Total ex-Examined	Blood in Ventriculus		% With Blood
	#	%	#	%	#	%	#	%		Red	Dark	
10/23-27/50	60	78	13	17	4	5			77	1 4	3	10
10/30-11/3/50	82	81	12	12	6	6	1	1	101		3	3
11/6-10/50	82	82	18	18					100	16	18	34
11/13-17/50	77	74	27	26					104	8	20	27
11/20-24/50	72	72	16	16	7	7	5	5	100	20	5	25
11/27-12/1/50	65	65	23	23			12**	12	100	2	30	32
12/4-8/50	62	56	29	26	1	0.9	18	16	110	12	49	14
12/11-15/50	130	63	24	12	1	0.5	51	25	206	10	40	29
12/18-22/50	79	52	29	19			44	29	152	7	8	31
12/25-29/50	66	53	47	37			13	10	126	1	3	7
TOTALS	775	66	239	20	20	1.7	138	11.7	1172	77	179	22

* Gravid female records not included in "Fat" columns.

** The summary of gravid females begins with data gathered on Nov. 27, 1950, as incomplete records precede this date.

Figure 4

PHYSIOLOGICAL CONDITIONS OF 906 DISSECTIONS OF *ANOPHELES FREEBORNI* FEMALES*

	Packed with Fat				Little Fat				No Fat				
Gut	Egg Development				Egg Development				Egg Development				
Contents	None	½—	½+	1	None	½—	½+	1	None	½—	½+	1	Totals
	514	1	2	1	120	6		23	5			5	67.7
Empty	56.8%		.22		13.26%	.66%		2.5	.55%			.55	74.8%
	518 - 57.2%				149 - 16.4%				10 - 1.17%				
Red	23	3			30	10	1		4				71
Blood	2.54%	.33%			3.3%	1.1%			.44%				7.7%
	26 - 2.87%				41 - 4.51				4 - .44%				
Dark	31	19	2		40	40	12	9	1		1	3	158
Blood	3.4%	2.1%	.22%		4.4%	4.4%	1.3%	1.0				.3	17.4%
	52 - 5.74%				101 - 11.13%				5 - .55%				
	568	23	4	1	190	56	13	32	10		1	1	
Totals	596 - 66%				291 - 32%				19 - 2.0%				906

* Data from collections made from Nov. 27 thru Dec. 29,1950

Figure 5

Mr. Washburn: The next paper in this presentation will be presented by Dick Sperbeck, on "Studies of Rice Field Mosquitoes."

Mr. Sperbeck: This paper has been compiled by Ernie Meyers of the Bureau of Vector Control, Herbert Herms, our own Entomologist of the Sutter-Yuba Mosquito Abatement District, and from the notes of Bob Holdenried, who was Entomologist in charge of the project. Unfortunately, we lost Bob the first of the year to the Public Health Service, and he has been replaced by Jack Stuntz.

STUDIES OF RICE FIELD MOSQUITOES

By THOMAS M. SPERBECK, *Manager*

Sutter-Yuba Mosquito Abatement District

From material compiled by

ERNEST G. MEYERS, *Bureau of Vector Control*
and
ROBERT HOLDENRIED, *Sutter-Yuba Mosquito Abatement District*

ADMINISTRATION OF PROJECT

The rice field project was started to fill a definite need for more detailed information on the life history and ecology of rice field mosquitoes.

Through the study, sponsored by the California Mosquito Control Association and administered through the Sutter-Yuba Mosquito Abatement District, the rice growing districts of the state hope to be able to apply the results to their control program. Some parts of the project may have immediate application while the remainder may require long range study before reaching practical conclusions. The Bureau of Vector Control is cooperating by furnishing men and equipment. Ernest Meyers, who has been here since the start of the project, is directing much of the field work and has been assisted by Eugene Sherman, Grafton Campbell and Coleman Snyder, all of the Bureau of Vector Control.

The district has employed an entomologist for the project—Dr. Robert Holdenried, now with the United States Public Health Service, served until the first of the year, and has been replaced by Jack Stuntz. A field operator William Mack is also employed by the district. The district is also furnishing technical assistance through its entomologist Herbert Herms. With funds allocated to the project, the district furnishes supplies and equipment.

The department of biology at Chico State has assigned graduate students to work on particular phases of the project. We hope to delegate other research studies to interested and qualified institutions.

STATEMENT OF PROBLEM

Rice was first planted in California on a commercial scale in 1912 at Biggs, Butte County. Since this initial planting of 1400 acres there has been a yearly increase of at least 100 percent with this last year's planting of rice estimated at 300,000 acres or over 460 square miles. From 80 to 90 percent of this acreage is in the Sacramento Valley, of which Butte, Colusa, Glenn, Sacramento, Sutter, Yolo and Yuba counties form the center of California's "rice bowl". In all but Colusa and Glenn counties active mosquito abatement districts are to be found.

The two major species of mosquitoes that have taken advantage of rice cultivation are *Anopheles freeborni* Aitken and *Culex tarsalis* Coquillett. The first species is regarded as the major vector of malaria in the United States west of the continental divide, and the latter species is accepted to be the predominant mosquito vector of the arthropod-borne virus encephalitides in California.

The control of mosquitoes in the rice growin areas is a tedious and expensive job. The mosquito control agencies receiving subvention in the Sacramento Valley spent an estimated $279,000 for the fiscal year of 1949-1950, a substantial part of which was spent on the control of rice field mosquitoes.

OBJECTS OF STUDY

1. Comments have been made that airplane spraying and/or aerosoling of rice fields is too expensive when this operation must be done three or four times during the rice growing season. Are there methods that could be employed in place of this airplane work? This question might be aanswered by another: Is it feasible to control rice field mosquitoes in relatively small and localizd bodies of water before the rice fields are flooded rather than after flooding?

2. The second object of study, that of a 3-5 year program of investigation of the year-round life history and range of aquatic and adult habitats of rice field mosquitoes, may also be answered by a series of questions that need investigation:

1. What is the range of aquatic habitats utilized by the various rice field mosquitoes when (a) water is least abundant, i. e., in the winter and spring, and (b) after the rice fields are flooded? In other words, where should the control emphasis be placed at these times of the year?

2. What is the comparative abundance of larvae between rice fields proper and in water incidental to rice culture?

3. What are the mosquito population changes in certain specific areas in both controlled and uncontrolled areas, from season to season and from year to year?

4. What is the flight range of migrant mosquitoes in fall, winter, and spring?

5. How important is this movement from uncontrolled into controlled areas? Can control work be done at any particular time of the year—either larviciding or adulticiding—that will prevent this apparent migration or infiltration? If so, will it be necessary to go outside the district and how for out of district?

DESCRIPTION OF SUTTER COUNTY STUDY AREA

The 25 square miles in southern Sutter County, California, under study included 2,320 acres of rice and 1,960 acres of irrigated pastures in 1950. The remaining 11,720 acres were comprised largely of fallow ground, and wheat and barley fields which had remained unirrigated. Other

crops grown in the area but irrigated infrequently were milo maize, sudan grass and a small acreage of walnuts. Roads, ditches, homesites and railroad property account for a large acreage. There were approximately 62 miles of drainage and/or irrigation ditches which carried water during much of the growing season. In addition to the above, there were three square miles containing 950 acres of rice, 20 of irrigated pasture and 9½ miles of ditch, which served as a check area.

Rice Culture in the Study Area

Each farmer in the study area seems to have his own method for growing rice. Some don't work the ground until spring, and let the stubble stand over winter, while others disc it under as soon as harvesting is over, and even raise their checks for the next season. After discing, if and whenever it is done, some farmers may go over the area with a harrow or a heavily weighted board to break the larger clods left after discing.

With one or two exceptions flooding of fields occurred this past year during the last week in April and the first week in May. Seed rice, when it is to be sowed by plane, is first soaked until the kernel is swollen and the germ is about ready to break through the seed coat. The rice is then loaded into the plane-hopper and when sowed the seed will sink through the water to the ground below. A drill is also used to sow rice, but in this case each rice grain is implanted into the dry soil at a regulated distance and the water is then turned into the field.

Irrigation is another variable factor which assumes greater significance as the mosquito season progresses.

Soil conditions influence the amount of water used, but even where soils are similar the individual grower's methods and inclination may vary. Water was shut off in some fields in the area and the ground was dry for over three weeks, in others water is never shut off until shortly before harvesting.

The irrigation water is obtained largely from wells. Some rice fields utilize Feather River water which is pumped from two Reclamation Districts' cross canal. One or two fields are supplied by drainage water from other rice fields and pastures.

Soils

According to Holmes and co-workers (1915) there are seven soil types in the study area. Of these seven, there are three types that comprise about 13,000 acres of the total 16,000 acres. Stockton Clay Adobe occupies roughly about one-half of the 25 square miles. Sacramento Clays occupy the western one-fifth and Madera Clay Loams occupy part of the north-eastern one-fifth of the area. The other four soil types are listed as San Joaquin Loams, Madera Loams, Laguna Loams and Clay Loams, and Columbia Silt Loams. Except for the Columbia Silt Loams, which occur in the north-west corner, the others are to be found along the eastern edge of the area.

Observations

EGGS

Individual females of *A. freeborni* and *C. tarsalis* were introduced into vials. A total of 1,398 eggs were laid by nine *A. freeborni* females or an average of 155 per individual. The actual number of eggs deposited were 97, 100, 118, 126, 134, 150, 202, 223 and 248. The last number was laid in two batches by the same female. After the first batch of 130 eggs was laid the female was removed to another vial where 118 eggs were laid. Both of these batches were laid between 8 P.M. and 8 A.M. and on following nights.

A total of 464 were counted in four rafts laid by four individual *C. tarsalis* females, this was an average of 116 eggs per raft. The individual raft counts were 75, 116, 120 and 153.

Egg rafts of *C. tarsalis* were brought into the laboratory for experiments to determine the effect of various periods of drying upon the viability of eggs. Three days has been the longest period of time that eggs hatched after they were placed upon damp cotton and then floated on water. Other batches of eggs have apparently been dried too rapidly, and as a consequence the eggs have collapsed. About eight egg rafts were placed upon damp cotton in separate vials on July 27, 1950. On the 27th of each of the following months water was introduced into one of the vials—no hatch has yet occurred. Before each of the floodings the egg rafts were inspected with the aid of a low power binocular and all rafts appeared normal with no collapse nor mold in evidence. On February 27, 1951, the last two egg rafts were flooded with a similar lack of success.

As a possible check or control an egg raft (whether *Culiseta* sp. or *Culex* sp. is as yet undetermined) was brought into the laboratory, on February 23, 1951, and introduced to tap water as were all of the other eggs rafts. The following morning the eggs had hatched. In other words similar handling techniques were followed in all cases, the only difference being the length of time that the eggs were left on damp cotton.

From the few experiments so far tried it appears that eggs of *Culex tarsalis* will not hatch after three days of slow drying.

HATCH OF EGGS

One raft contained 78 eggs from which 77 larvae emerged. It may have been that all 78 hatched and one got lost. Of the total of 130 *A. freeborni* eggs laid by one female in one night, 102 larvae were counted in the same tap water upon which the eggs were deposited. This is a hatching of 78.4% of the eggs laid.

LARVAE

It is only in the rice fields that data about larval abundance can be accumulated and used. In other types of water within our study area, control measures are applied when dipping reveals the need.

The only larviciding in rice fields themselves has been directed at *Aedes* mosquitoes that develop at the first flooding of the fields in the spring. DDT wettable powder is added to each plane load of rice seed.

Before the rice fields are flooded, *Anopheles* larvae have been taken from pools and puddles, usually clear water with some grass growing. There also seems to be some algae always present in these puddles. Extensive dipping has been done this year and to date larvae have been taken only from water as above described.

Anopheles larvae were found in some rice fields while water was still being introduced from one rice check to another in the original flooding. The fields were being flooded during the last week in April and the first week of May. Culicine larvae gradually increased to a peak on June 26, 1950, when an average 9.5 larvae per station was taken for 29 stations and total of 193 dips. This is about 1.5 larvae per dip. On August 21, 1950, or about two months after the culicine peak, the *Anopheles* were at their height, an average of 3.2 larvae per station being taken for 27 stations and a total of 250 dips. This is about 0.3 larvae per dip.

The above data are interesting but inconclusive. Currently, there is no way to arrive at a true index to the larval population of a rice check (or any other type of larval or adult habitat.) What may be dipped in one section of a check may not be found at the opposite end of the same check or even within ten feet of the first dipping area.

Because of the unequal distribution of larvae within a check, one rice field in the center sections of the 25 mile area was used for special study. Not only has extensive larval dipping been carried on here, but also observations of adults in their natural resting places. In this field the culicine larvae were at their first peak of abundance five weeks after the field was originally flooded. The anopheline larvae reached their first peak one week later. This was during the week of June 19th. Both groups gradually declined until the field was dried between July 3 and 15. The first week after reflooding both groups reached their highest number of the year. The next peak was eight weeks (the week of Sept. 9) after this reflooding for the *Anopheles* and ten week (week of Sept. 23) for the *Culex*. Thereafter there was a steady decline in numbers of both genera.

The drying of the field undoubtedly affected the total numbers of larvae and also the time when they reached a peak.

ADULTS

Day-time resting stations.

Based on the known fact that females of *A. freeborni* live through the winter, we are interested in finding in what type of general habitat the overwintering forms were to be found in the greatest numbers. Three different types of areas were picked for study: (a) urban, (b) suburban and (c) rural or (in this case) rice field.

Not only do we hope to find out in what type of habitat the anophelines are most numerous, but also we want to find out something about their spring "dispersal flight"; their density fluctuations within and between stations from week to week; their year-round density fluctuations; and, the first and last appearance of males in the stations.

The city of Colusa has been designated as the urban area, the area surrounding Colusa the suburban, and the three different rice field areas (Colusa, Williams and Maxwell) were chosen for study. Different types of resting stations were picked in each area and in each station a series of 18 inch squares were drawn in chalk. In each station five of the 18-inch squares with the largest number of mosquitoes in them were surveyed and the numbers recorded.

According to our observations there has been a definite change in areas preferred as resting places for *A. freeborni* females from winter to those used in spring and sumer. From the last week of September until the middle of March the greatest numbers of females are to be found in the Colusa Suburban area. Between these times (mid March through most of Sept.) adults are most numerous in the rice growing or rural area. For some reason as yet undetected the Maxwell rice fields show the highest numbers of the three rice field areas.

Another rather unexpected finding was that there were a greater average number of mosquitoes per station during the first three weeks of September than at any other time of the year. During the week of September 8, 1950, the average number of *A. freeborni* females per station count was 130, while the average count per rice field station was 187. The highest count in any station was one in the Colusa suburban area on January 29, 1951; the number was 702 for the five units.

There seems to be a close correlation between the density fluctuations for the winters of 1949-50 and 1950-51. While the average per station was higher this year, the general trend of all stations is quite similar. During 1950 the lowest population of *A. freeborni* females was during the first two weeks in April when less than one per counting station was to be found. This decline began on February 2nd and dropped steadily until the 7th of April.

When the averages are graphed there are six major peaks and two minor peaks noted. It might be that the major peaks represent generations, as it is in the rice field area stations where the greatest averages are encountered. The first peak occurred on April 24th which is before the rice fields are flooded. The following dates are peaks that occurred after flooding: May 25, June 23, July 14, August 11, and September 8.

From November 29, 1949, until April 14, 1950, when males were taken in all of the five areas, male *A. freeborni* were never very plentiful in any of the stations. The last male noted in 1949 was on December 27, in a station in the city of Colusa. There is a record of one on January 23, 1950 from the same station, but whether this is to be considered a recently emerged specimen or a "hold-over" is conjecture. This record is just about four weeks after the December 27th record and about four weeks before March 3rd when two males were recorded for a station in the Maxwell rice-field area. This is probably the first hatching of adults from pupae for the season. After April 14, males were more or less expected, but there was an unexpected high peak of 298 males that occurred on September 15, in one of the Maxwell rice field areas. For that particular date there was an average of 74.1 *A. freeborni* males per counting station. As was to be expected the rice field areas produced the greatest numbers of males in the resting or counting stations. The greatest number of males counted in rice areas occured in Maxwell followed by Colusa and Williams in that order. For 1950, the last male recorded was on November 24. This year no males have been seen up to the present time (March 6th, 1951).

Observations have been made on types of natural (as distinct from man-made shelters) resting places that mosquitoes may be found in. Collections have been made in the following types of locations:

1. Among dried and matted tules and cattails.
2. About bases of green and upright tules and cattails.
3. Under loose bark of eucalyptus tree (one observation)
4. Among dead leaves still attached to a broken branch lying against a tree stump.
5. Underside of fallen tree trunk near roots.
6. Among rice straw dumped by harvester.
7. Rice stubble.
8. Uncut rice.
9. Among water grass (*Echinochloa crusgalli* Beauv.)
10. Squirrel burrows.
11. Cracks in ground.

Before the rice was harvested many *A. freeborni* and *C. tarsalis* as well as an occasional *C. erythrothorax* Dyar and *Anopheles franciscanus* McCracken were to be found about the stems of the growing rice just above the water level. When the water was drained the mosquitoes were to be found on or near the damp ground as well as on stems of water grass. Apparently the areas used must have moisture as very few, if any, adults are to be found on the dried part of the stem. Of 1,324 adults collected from these natural resting places in August, 21% were *Anopheles freeborni* and 79% were *Culex tarsalis*. In September, 53% were *A. freeborni;* only 377 mosquitoes were taken and the sample was considered inadequate. In the latter part of September and the first part of October, nearly all were *Culex tarsalis* and the majority of them were males. From the middle of December to the present time (March 6th) only a few *Culiseta inornata* (Williston) adults are to be found among the rice stubble and other types of grasses.

In at least 170 ground squirrel burrows examined a total of 53 mosquitoes were observed. Those that were taken were about equally distributed between *A. freeborni* and *C. tarsalis*. Many specimens escaped capture and these are recorded as only mosquitoes. In some squirrel holes the edge of the entrance was partially overgrown with a *Lipia* and mosquitoes were noted to be on this plant rather than on the sides of the burrow entrance. It is still hard to tell how much of a factor squirrel burrows and cracks in the soil are since the observer's range of vision is restricted to about six inches.

SWARMING:

The swarming of *A. freeborni* begins, as a rule, about two minutes after the sun sinks behind the Coast Range, though, we have a record or two of swarms forming when the later afternoon sun was obscured by dense clouds. Swarms have been observed for 45 minutes before they more or less dissolved. It seems that as few as three males could be considered a swarm.

The following observation was made by Holdenried on the formation of a swarm: At 5:49, three males were seen over the levee. At 5:50, the three males were joined by seven others. In the next minute 20 more males joined the swarm. These all flew from different directions and did not rise up from the vegetation directly below the swarm. At this time many other males were flying about singly and were in no swarms. At 6 P.M., eleven minutes after the first observation, this swarm contained an estimated 100 males.

Some point of orientation seems to be necessary for location of the swarm. Groups of male *A. freeborni* have been noted along rice field levees where the grass is higher than in the surrounding area; they have been noticed over patches of tall tules; they have been noticed over the crown of an isolated small tree. The only observation of a swarm that was much over 10 feet from the ground was of one located near an electrical transformer about 20 feet from the ground. Besides these various types of stationery objects swarms have been noticed following a walking person without breaking formation. Though the swarms seems to have definite invisible limits, the individual males circulate within these boundaries using a definite pattern. They gradually work their way from one side of the swarm to the other and from the top to the bottom. They do not seem to hover in any part of the swarm but continue circulating through it. When a female entered the swarm a very noticeable reaction followed. Instead of the leisurely swarm pattern, there would suddently seem to be a "free-for-all' until a male and the female joined, after which the rest of the swarm would resume the "waiting swarm pattern". The copulating pair would float down from the swarm and usually break apart when close to the ground. In the early part of the evenings of October the females would enter the swarm about 10 to 12 per minute. There were times when only one female was noticed to fly into a swarm within a 34 minute period. November 1st was the last date of this year that a swarm was noticed.

Dissections of female Anopheles freeborni:

This phase was begun the fourth week in October, 1950, at which time we hoped to be able to get a correlation of the numbers of *A. freeborni* with fat bodies, to temperatures. Even with a total of 1,172 dissections by the end of 1950, averaging about 100 per week for the 11 week period, we have been unable to get any apparent correlation. During the work week of November to 10 the high percentage of female *freeborni* with abdomens packed with fat was 82%. The lowest percentage was 52% during the work week of December 18 to 22. The overall percentage of the 1,172 females dissected was 69% with fat packed abdomens, 28.6% with little fat, and 2.4% with no fat. (See Chart 1)

In the mosquitoes with little fat, the fat bodies were found at the upper end of the gut and in some cases it was restricted to the rectal end of the gut. In cases where the abdomen was packed with fat the crop and the stomach were sheathed with grape-like clusters of fat. The color of the fat may vary from one female to another. The fat bodies may be milky, a clear amber, or a rusty yellow, or in most cases a clear crystaline.

In connection with this phase of the study an examination of the amount of ovarian development was made beginning November 29th, 1950. Not only was the amount of development of the ovaries recorded but also the gut contents. From November 27 until the end of the year there were dissections of 906 *Anopheles freeborni* females.

(See Chart 2).

CONTROL

Only DDT in various forms has been used on this project. Wettable powder at 0.2 of a pound per acre is dumped into the plane hopper at the time the seed rice is loaded. Concentrate was used for larviciding with approximately 0.6 of a pound applied per acre of water. All of the water in the 25 square miles was larvicided once before water was turned into the rice fields. This first "wholesale larviciding" was done without benefit of inspection. The second larviciding of the area was also completed before the rice fields were flooded, but only areas where larvae were located were sprayed. After the introduction of water and the planting of rice in the area, larviciding was done only when necessary in waters incidental to rice culture (seepage, drainage ditches, irrigation ditches, etc.). Aerosol was used during the summer time when complaints came into the office from our area. All shelters, including barns, culverts, outhouses, bridges, etc., were aerosoled during the winter to control and cut-down the potential spring egg layers.

Mr. Washburn: Not only is this investigation work doing a great deal in the line of investigations on control, but there is a great deal being done on the basic biology and habits of these particular mosquitoes.

Another project that has been in operation this past season was the study of an entirely different type of mosquito. The districts around San Francisco Bay have a terrific problem of control with *Aedes squamiger*. They instituted investigations last year on the flight range of this particular mosquito, as a cooperative project among the several districts, and Ted Aarons, who is Assistant Manager and Entomologist of the Alameda County Mosquito Abatement District will give you a report on that work.

Mr. Aarons: I shall describe another of the cooperative projects that was accomplished this last year by joint operations of the nine mosquito abatement districts in the San Francisco Bay area, with the assistance of the Bureau of Vector Control.

STUDIES OF THE FLIGHT RANGE OF AEDES SQUAMIGER (Coquillet)

by

THEODORE AARONS[1], JOHN R. WALKER[2], HAROLD F. GRAY[3], AND EMBREE G. MEZGER[4].

INTRODUCTION

Observations of the flight habits of the salt marsh species *Aedes squamiger* Coquillet in the San Francisco Bay region have led to the belief that the dispersal range of this mosquito probably exceeds that of all other California species. During the spring of 1950 a cooperative project, supported by the nine mosquito abatement districts * in the San Francisco Bay region and the Bureau of Vector Control, State of California, Department of Public Health, was undertaken for the purpose of increasing the understanding of the flight range and dispersion pattern of *A. squamiger*.

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Napa County Mosquito Abatement District
Pulgas Mosquito Abatement District
Solano County Mosquito Abatement District
Sonoma Mosquito Abatement District
Three Cities Mosquito Abatement District

Since *A. squamiger* and *Aedes dorsalis* (Meigen) typically coinhabit the salt marshes along the coast of Northern California both species were considered in this study, but attention was focused on *A. squamiger*.

These species have received the attention of workers for almost fifty years, and were the first mosquito species to become the object of organized control campaigns in California. There is reason to believe that these mosquitoes, at certain times of the year, made life virtually unbearable for the early Indians. In the course of an exploration in 1772, Father Crespi recorded in his Journal that his party was sorely afflicted by vast swarms of vicious mosquitoes while traversing the east side of San Francisco Bay in April of that year.

Records of the earliest mosquito abatement efforts in this State, which occurred in 1903 near San Rafael, Marin County gave evidence that control workers had already gained something of an appreciation of the flight range of salt marsh mosquitoes, for it was against their aquatic sources that abatement measures were directed almost exclusively. H. J. Quale (1906) working in the vicinity of Burlingame, San Mateo County, in 1904, determined, as a result of an entomological survey undertaken

to guide future control activities, that 95% of the mosquitoes causing severe annoyance in residential areas were of salt marsh origin.

An early report by H. E. Woodworth concerning the development of mosquito control in the San Mateo region through 1915, includes a statement by the project Superintendent, L. D. Whitney, to the effect that the salt marshes as far north as South San Francisco had to be included in a program designed to bring relief to the San Mateo area. Professor C. W. Woodworth, acting as advisor to this program experienced, in one instance, " . . . hordes of mosquitoes which migrated into town in a dark cloud for three days". The Peninsula Hotel had to be closed; livery stables would not allow their horses to go to the station; and out-of-door workers were obliged to wear nets, tie ropes or strings around their ankles and wrists and wear gloves—and even then were bitten.

In describing early control problems E. Stuart and N. M. Stover (1926) stated that the two salt marsh species have a considerable range of flight and have been found 15 miles inland from any possible larval source. R. W. Doane (1920) studying mosquitoes in the Palo Alto area surmised that 80% to 90% of the mosquitoes that occurred throughout the community and adjacent rural areas were of salt marsh origin, and that these were often the predominating species ten miles or more from the nearest marshes.

By 1930 the concept of *A. squamiger* dispersing long distances had become rather firmly established. H. J. Lowe (1932) observed that *A. squamiger* mirgrated freely from its larval source, and he expressed the belief that its flight range was considerably longer than that of its companion species *A. dorsalis.*

At the Second Conference of the California Mosquito Control Association held in Berkeley in 1931, N. M. Stover reported observations of two flights of *A. squamiger.* One was from Joyce Island through Martinez, Walnut Creek and Danville to a point south of Dublin, a distance of more than forty miles, and the second, from the Petaluma Creek marshes past San Quentin, Angel Island and Alcatraz Island into Golden Gate Park in San Francisco, a distance of some thirty-five miles.

D. B. Krimgold and H. P. Herms (1934) stated that salt marshes in the Petaluma Creek Basin, principally in the vicinity of Black Point, Tubbs Island and Novato constituted the major source of mosquitoes which migrated well down the Marin peninsula. These mosquitoes, emerging early in March, 1934, caused considerable annoyance in Mill Valley by the middle of the month. A smaller segment of this migration was believed to have crossed the short water gap between McNear's Point in Marin County and Point San Pablo in Contra Costa County about March 15. Part of this flight appeared to go through El Cerrito and the eastern corner of Albany, and through the hill district of Berkeley as far south as Temescal canyon. Another portion of this flight was believed to have taken an easterly course over the Contra Costa hills. The main flight southerly through Marin County was an especially severe infestation. Following the course reportedly taken in previous years, a portion of this flight apparently crossed the Bay via Angel Island, passed through San Francisco (being most noticeable on North Beach and the Marina) and continued down the peninsula into San Mateo County, following a course along the eastern side of the Coast Range mountains.

Evidence of migrations of salt marsh mosquitoes into Alameda County from the Petaluma Creek Basin would normally have been rendered invalid in view of the tremendous output of the Sobrante, Giant and Richmond marshes in western Contra Costa County. Work on these marshes in 1934, which was carried out under the technical direction of the Alameda County Mosquito Abatement District, had resulted in effective control of all important salt marsh mosquito sources in western Contra Costa County. Constant surveillance in January, February and March of that year, supplemented by larvicide treatment of residual water not completely removed by drainage, ensured that there was no significant mosquito output from marshes south of Pinole, and, on the basis of intensive inspection, no emergence of salt marsh mosquitoes was detected in northern Alameda County that spring. This was the first year that it was felt that there was substantial evidence supporting the hypothesis that mosquitoes from the Petaluma Creek marshes migrated into Contra Costa and Alameda Counties.

The annual spring migration of *A. squamiger* was carefully observed and reported by H. F. Gray (1936), who again stressed the importance of mosquito sources in the Petaluma Creek Basin in relation to the rest of the Bay area. R. P. Dow, (1947) analyzing two seasons of mosquito investigation in the San Pablo Bay region, pointed out that through the operation of light traps he gained a strong indication that the spring flight of *A. squamiger* from the Petaluma Cree Basin moves in a southerly direction and that only a small part of this flight moves easterly toward Mare Island.

Marking Site

For this study a 15 acre salt marsh located on the east side of the Petaluma Creek Basin 5 miles southeast of Petaluma and 1 mile west of the Lakeville Junction, was selected as the marking site. This narrow strip of marsh is generally flat and almost completely covered with a dense growth of pickleweed (*Salicornia ambigua*). The site included three types of larval sources: ditches, water soaked cracked marsh land and semi-open marsh. The two tide gates, located at the terminus of the marsh to allow for drainage, were kept closed during most of the study. The marsh was flooded with fresh water drainage from nearby hills and adjacent fields as well as from direct rain. The water depth varied from 2 to 8 inches during the period of observation.

A composite larval count of the marking site was obtained utilizing a modification of a technic reported by A. D. Hess (1941). A net 4 inches in diameter was used to make three foot sweeps through the water surface. Each thus covered an area equal to one square foot. Numerous sweeps were made in each of the three types of larval sources before average counts were obtained. The average number of larvae per sweep, or 1 square foot, in this manner calculated to be 37.62 during the period of maximum density. At this point the total number of larvae on the 15 acre marsh was thus calculated to be 24,581,000.

Equipment and Techniques

Drawing upon the experience of Reeves, Brookman and Hammon (1948), rhodamine B was selected as a marking material. In this case, however, aqueous solutions containing one pound of rhodamine B powder to five gallons of water were dispersed on emerging adult mosquitoes. The dye was applied with the aid of two power sprayers: (1) an Essick 65 gallon unit operating at 70 pound pressure, mounted on an Army Weasel (type M-29c 3/4 ton, amphibious), and (2) a compression sprayer operating at 150 pounds pressure and mounted on a jeep. The weasel was used on the more rugged terrain including the cracked ground and flooded areas, while the jeep was limited to the higher more even portions of the marking site. Nozzles producing a mist spray (T¼ 650067 Spraying Systems Co.) were used.

Marking Application

The first application of dye was made over the entire site between 7:30 and 9:30 A.M. on March 15, 1950. Both the weasel and the jeep were used in this application. The disturbance of the vehicles traversing the marsh caused mosquitoes to fly up out of the protecting vegetation, thereby exposing them to the rhodamine B mist. Following the dye application, nets were used to take representative random samples at the marking site. Following the first dye application, 75.55% of the specimens recovered were marked. An hour after the first net samples were taken on the site, samples were recovered in the same manner on a grain field 100 yards to windward. 25% of the adults recovered on this adjacent area were marked. A 2 to 4 m.p.h., northwest wind prevailed during this period.

Collections made on the site following the first dye application revealed *A. dorsalis* to be nearly four times as numerous as *A. squamiger,* with males predominating. The sex rato of the former was 4:1 while that of the latter was 1:1. At this same time, collections made on the adjacent windward grain field also showed the two species to be present in the same relative proportions as on the marsh, however, the sex ratio of *A. dorsalis* there was 1:2 and *A. squamiger* 1:1. The adult population at this time was still moderately light and attempts at biting were negligible.

The second dye application was undertaken on March 20, 1950 using the same equipment materials. The operation started at 7:00 A.M., and was completed at 9:30 A.M. A 5 m.p.h., northwest wind prevailed. Aerial net samples taken at random on the site following the application indicated that 69% of the mosquitoes were marked. In this short interval *A. squamiger* had now become twice as numerous as *A. dorsalis.* The sex ratio of the former as now 3:2 while that of the latter was 1:6.

The third dye application was made on the morning of March 28, 1950, using the jeep alone. The percentage of mosquitoes marked on this occasion was not determined. Of the specimens taken at this time 2.26% were *A. dorsalis* (females) and 97.74% were *A. squamiger.* The sex ratio of the latter was 1:7.

The fourth marking application was made on April 4, 1950. Both vehicles were used. Following this application 44% of the specimens taken by net were marked.

The fifth dye application was made on April 14, 1950, using the jeep alone. The percentage of specimens marked was undetermined.

The sixth and last application was made on April 20, 1950, using both vehicles. The percentage of specimens marked was undetermined; however, the marking site was thoroughly covered during these last two applications.

Recovery Phase

In the recovery phase of the project a total of 56 New Jersey light traps were employed, supplemented by hand collections using nets, choroform tubes and aspirators.

The dispersion paths of *A. squamiger* generally followed the protective chaparral, particularly along the ravines and water courses. Within the range of approximately one mile from the point of marking both sexes of this species were found on protected portions of buildings. The majority of specimens taken in hand collections at distances beyond this one mile range had found protective shelter among the available foliage. If the wind was light female specimens readily found the collector.

The recovery of adult specimens commenced on March 15 and was continued through June. As anticipated, light traps were relatively ineffective as a collecting device. Particularly was this true for *A. squamiger,* which had previously been observed to display rather feeble phototropic responses. A few of the more productive traps attracted as many as 30 specimens in a single night while others attracted much smaller numbers, even in areas where adults were known to be relatively numerous. Hand collections returned much the largest number of specimens.

An estimated 2,000,000 mosquitoes were marked on the site, of which approximately three-fourths were *A. squamiger* and one-fourth *A. dorsalis.* A total of 7,582 *A. squamiger* specimens were recovered from the following Bay areas: Marin County 2,311; Sonoma County 2,165; Napa County 302; Solano County 1,098; Contra Costa County 197; Alameda County 553; Santa Clara County 271; San Mateo County 685; San Francisco County none. A slightly greater number of *A. dorsalis* were recovered in the traps during the same period. A total number of 8,586 *A. dorsalis* were examined from the following areas: Marin County 2,766; Sonoma County 2,295; Napa County 558; Solano 1,442; Contra Costa County 67; Alameda County 728; Santa Clara County 331; San Mateo County 399; San Francisco County none.

All specimens were examined for the presence of rhodamine B particles under a low power dissecting microscope. An H4 Mercury Lamp (Keese Engineering Co., Shannon No. 92-LS) producing ultra violet light with an average wave length 3,400 Angstrum units and a range of 3,100 to 4,00 Angstrum units was used. Rhodamine B particles adhering to marked specimens were visible as bright red spots under this ultra violet light.

LIST OF MARKED AEDES SQUAMIGER SPECIMENS RECOVERED

1 female	3/8 mile SSE of marking site	Light Trap 3/30/50
2 females	1 mile E of marking site	Hand Collection 3/22/50
3 females	1 mile E of marking site	Hand Collection 4/6/50
1 male	1 mile E of marking site	Hand Collection 3/29/50
3 females	1 mile E of marking site	Hand Collection 3/29/50
4 males	1 mile E of marking site	Hand Collection 4/5/50
9 females	1 mile E of marking site	Hand Collection 4/5/50
1 female	1¼ mile E of marking site	Hand Collection 3/22/50
1 female	1-1/8 mile NE of marking site	Light Trap 4/5/50
2 females	1½ miles SE of marking site	Light Trap 3/22/50
2 females	1½ miles SE of marking site	Light Trap 4/5/50
1 female	2 miles N of marking site	Light Trap 4/5/50
2 females	7¼ miles SE of marking (Black Pt.) Marin County	Hand Collection 4/18/50
1 female	19 miles S of marking site (Corte Madera) Marin County	Light Trap 4/27/50
1 female	24 miles SE of marking site (Tilden Park) Contra Costa Co.	Hand Collection 4/20/50
1 female	38 miles S of marking site (Calif. Country Club) San Mateo Co.	Light Trap 4/27/50
1 female	38 miles S of marking site San Mateo Co.	Light Trap 4/27/50

LIST OF MARKED SPECIMENS RECOVERED AT MARKING SITE

Specimens	Date of Recovery	Time Interval Since Last Marking Application
1ST DYE APPLICATION—MARCH 15		
2 male *A. dorsalis*	March 17, 1950	3-1/2 days
4 male *A. squamiger*	March 18, 1950	3 days
2 female *A. squamiger*	March 18, 1950	3 days
1 male *A. dorsalis*	March 19, 1950	4-1/2 days
2ND DYE APPLICATION—MARCH 20		
1 male *A. squamiger*	March 22, 1950	2 days
2 female *A. squamiger*	March 22, 1950	2 days
3RD DYE APPLICATION—MARCH 28		
1 female *A. squamiger*	April 16, 1950	2 days

The numerous records of adults of both species collected at the marking site 24 hours after the dye application are not listed.

CONCLUSION

In interpreting the results of this study several factors warrant special consideration.

The inability to capture large numbers of adult specimens of *A. squamiger* and *A. dorsalis* beyond a one mile radius from the marking site was perhaps the most crucial, and can be explained at least in part. The season chosen for this study was probably the most successful one in the history of salt marsh mosquito control in the San Francisco Bay region. Not only was this the case within organized abatement districts, but was also true for the areas of Western Contra Costa County and the Petaluma Creek Basin. Of particular signifiance was the extensive helicopter larviciding conducted throughout the marsh areas of southern Sonoma County, exclusive of the study plot and the adjacent buffer area of approximately one mile.

The techniques, equipment and manpower employed in the recoverey phase of the study were inadequate considering the magnitude of the undertaking. The New Jersey light trap was of very limited value as used. Carbon doxide or some other chemical attractant used in conjunction with the trap could conceivably have increased its effeciency.

The prolonged period of emergence which made necessary the six dye applications greatly limited the interpretation that could be given to factors associated with the element of time. In normal years the emergence period of *A. squamiger* has been usually less than two weeks.

While no unusual qualification appears to be required with regard to the recovery of marked specimens of *A. squamiger* up to 7¼ miles (Map 1) the single recovery at 19 miles on the Marin peninsula, the 24 mile recovery in Contra Costa County and the two 38 mile recoveries in San Mateo County (Map 2) should be viewed with due skepticism. Our limited knowledge of possibilities for the occurrence of fluorescent materials in nature, and the rather wide-spread commerical application of these types of dyes, such as their use on signboards, must be considered along with the possibility, however remote, that the marked specimens could have been transported by automobiles, as well as the possibility, though unaccounted for, that specimens could have become contaminated in the conduct of the study.

In this last regard, the dye as prepared was observed to dry rapidly, both on specimens as well as on other surfaces, and when dried was strongly adherent.

While this investigation has broadened our understanding of the flight habits of this salt marsh species, until further studies can be undertaken, perhaps using radioactive materials as markers, and employing greatly improved recovery techniques, the maximum range of flight of these species remains a subject for conjecture and future confirmation.

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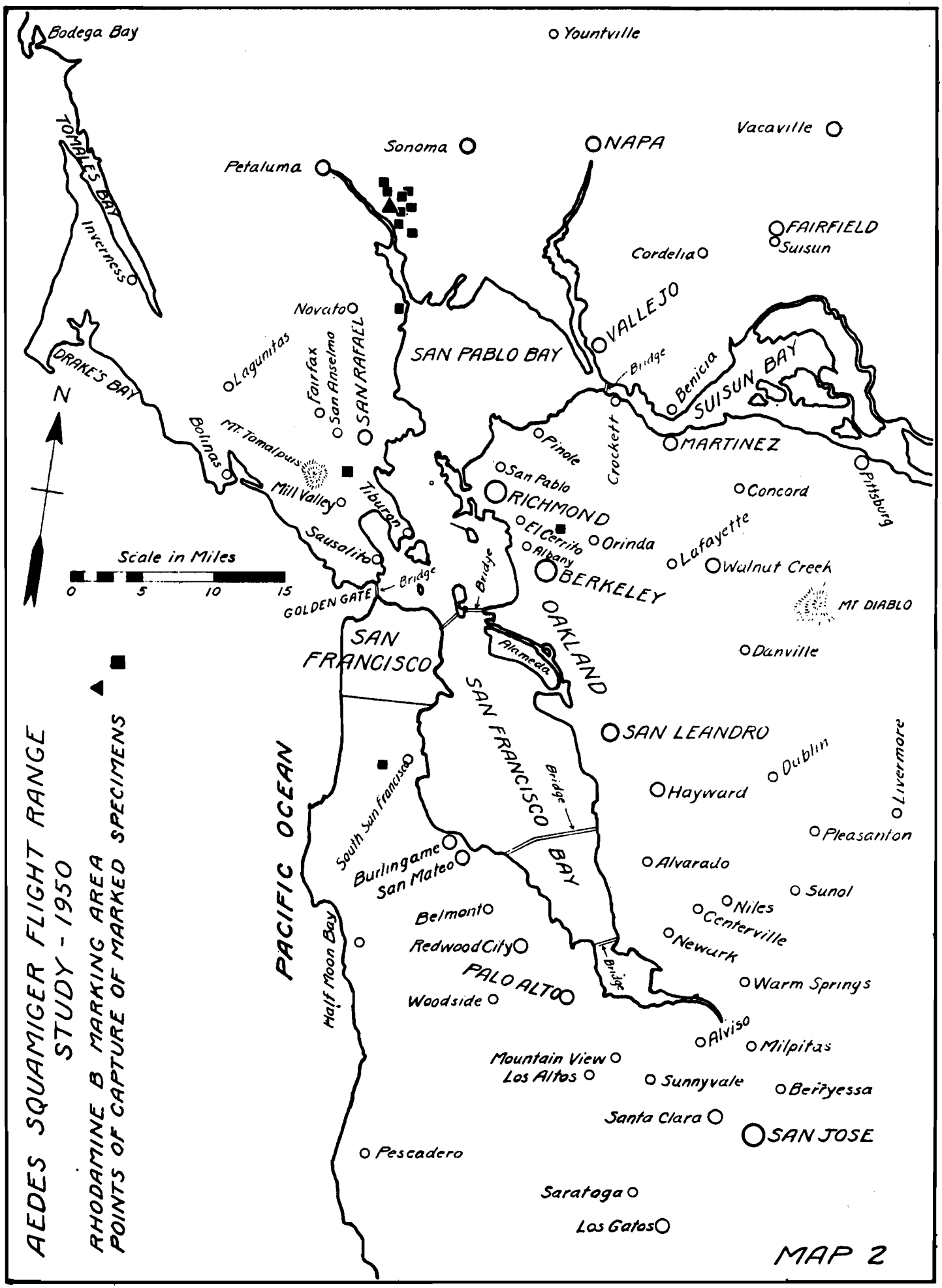
AEDES SQUAMIGER FLIGHT RANGE
STUDY - 1950
MARKING SITE AND VICINITY
SHOWING RECOVERIES OF MARKED
SPECIMENS
RELEASE POINT
RECOVERY POINT
N
PETALUMA
Lakeville
Approximate Direction
of Prevailing Wind
Shellville
SONOMA COUNTY
Sears Point
Tubbs Island
Petaluma Creek
Novato
Black Point
Ignacio
MARIN COUNTY
SAN PABLO BAY
St. Vincent School
Forbes
MAP 1


AEDES SQUAMIGER FLIGHT RANGE STUDY - 1950
RHODAMINE B MARKING AREA
POINTS OF CAPTURE OF MARKED SPECIMENS
Scale in Miles
0 5 10 15
N
Bodega Bay
Tomales Bay
Inverness
Drake's Bay
Bolinas
Mt. Tamalpais
Mill Valley
Sausalito
Golden Gate Bridge
San Francisco
Pacific Ocean
South San Francisco
Burlingame
San Mateo
Belmont
Redwood City
Palo Alto
Woodside
Half Moon Bay
Pescadero
Saratoga
Los Gatos
San Francisco Bay
Bridge
Alameda
Oakland
Berkeley
Albany
El Cerrito
Richmond
San Pablo
Pinole
Crockett
Bridge
Martinez
Benicia
Suisun Bay
Pittsburg
Concord
Lafayette
Walnut Creek
Mt Diablo
Danville
San Leandro
Hayward
Dublin
Livermore
Pleasanton
Alvarado
Sunol
Niles
Centerville
Newark
Warm Springs
Alviso
Milpitas
Mountain View
Los Altos
Sunnyvale
Berryessa
Santa Clara
San Jose
San Pablo Bay
Vallejo
Napa
Vacaville
Fairfield
Suisun
Cordelia
Yountville
Sonoma
Petaluma
Novato
San Rafael
Fairfax
San Anselmo
Lagunitas
Tiburon
MAP 2

Mr. Washburn: Another study that has been carried on this past season, though not under the sponsorship of the Association, but necessarily important to us, has been the work carried on through the University of California at Los Angeles, by Dr. John N. Belkin, Assistant Professor Entomology, on Field Observations on the Behavior of the Adults of Anopheles franciscanus in Southern California.

(Editor's Note: This paper was published in "Mosquito News" for April, 1951. The following is a brief summary of the paper.)

(*Summary*)

PRELIMINARY FIELD OBSERVATIONS ON THE BEHAVIOR OF THE ADULTS OF *ANOPHELES FRANCISCANUS* McCRACKEN IN SOUTHERN CALIFORNIA

by

JOHN N. BELKIN

Observations were made from July 20 to August 16, 1950 on the behavior of males and females of *A. franciscanus* McCracken 1904 in the vicinity of a six acre articifial lake in the City of Los Angeles, producing an estimated 500,000 adults per day. Various types of shaded situations near the lake provided diurnal resting places for large numbers of males and a smaller number of non-gravid and unblooded females, while very small numbers of blooded females were found resting in farm buildings within a half mile radius. The activities of the adults proved to be entirely crepuscular and were confined to the period when light intensity was below 50 Weston units. Both males and females are moderately attracted to artificial lights. There is indirect evidence that adult behavior is markedly influenced by environmental conditions and particularly by strong moonlight. Swarms numbering as many as 5,000 males were observed regularly in the evening when the light intensity fell below 20 Weston units and lasted for 25 minutes. Rather abundant mating was observed at the peak of swarming. Females started feeding on observers shortly before swarm formation and were particularly active in the vicinity of swarms. The limited comparative landing and biting tests indicate that *A. franciscanus* is moderately anthropophilic, feeding in preference on only the larger mammals (horse, cow, sheep), and in fewer numbers on smaller animals (duck, turkey, rabbit, guinea pig). The number biting and landing were extremely small in comparison with the enormous populations produced in the lake. Despite the difference in anthropophilism the forms investigated proved morphologically indistinguishable in all stages from *A. franciscanus* from Central and Northern California. Further investigations on this species are indicated in view of its anthropophilism and its great abundance in populated areas in Southern California.

Mr. Washburn: The next paper, on the "Ecology of Irrigated Pastures Mosquitoes", was to have been submitted by Deed C. Thurman for the group which carried on the studies. However, Mr. Thurman is in Washington, D. C., enroute to Thailand for duty. The paper will be presented by Dick Husbands, but I will first introduce Miss Bettina Rosay, Entomologist, who did identifications. Dr. J. R. Arnold, of the College of the Pacific, also was associated with the project, and was assisted by his students, Merritt Quessenberry and David Reed.

REVIEW OF THE 1950 STUDIES OF MOSQUITOES IN IRRIGATED PASTURES

by

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(4) Assistant Entomologist, Central Valley Mosquito Ecology Study, California Mosquito Control Association.
(5) Associate Professor of Zoology, College of the Pacific.

Ecological investigations are a recognized step forward in the progressive evolution of organized mosquito control. In recognition of this fact California mosquito abatement agencies established a special investigational group to study the mosquitoes of irrigated pastures. Established in July 1949 this group laid the ground work that established the method of approach to the 1950 season.

Problems that were considered of primary importance were: species present in typical irrigated pasture habitats, relative species abundance, the number of irrigation cycles per season and their influence on mosquito populations, mosquito growth cycles, and the influence of temperature on such mosquitoes. Investigations were built around these primary aims and to include such secondary studies as would find time during the course of the work.

Methods:

As a part of the study for the 1950 season a canal irrigated pasture of approximately 90 acres was selected in Stanislaus County in T5S, R9E, S9. Working in cooperation with the Turlock Mosquito Abatement District a Field Station was established in Turlock to facilitate operations. District control procedures were modified to offer the greatest assistance to the program and the special study pasture was freed from all control during the first thirteen irrigation cycles. This pasture was selected as a fertile source of investigation since it contained ladino clover, pasture grasses and weeds. At least one-sixth of this pasture was in very poor condition and almost barren from any growth. Underlying hardpan prevented good drainage and standing water was present in many of the checks from one irrigation to the next. For purposes of the study, the pasture was mapped and divided into three general areas, each area formed from a natural boundry or irrigation ditch. Fifty acres of this pasture was utilized for the special study and the central of of the three general areas was selected for the

most intensive study. Strip checks running east and west were numbered and mapped for the convenience of observations. Irrigation in the pasture followed the same pattern for each cycle. The farmer began irrigation from the east ditch, then from the center ditch and finally from the west ditch. No attempt was made to influence irrigation methods. The amount of water placed in each check varied from one cycle to the next. Usually 12 to 18 hours were required to irrigate the entire pasture but the center portion of the pasture was completely irrigated in 6 hours.

Twenty-four to thirty-six hours after each irrigation, water area maps were prepared to coincide with the development of second stage larvae of *Aedes nigromaculis* (Ludlow). Daily observation stations were selected in checks in places where water would be found for the longest period of time. Records were made of water depth, water temperature. Collections of larvae were made daily at each station and preserved for future identification. Since egg hatch for *A. nigromaculis* was found to occur within a few minutes after irrigation the mosquito cycle was computed on the basis of time of irrigation to the emergence of the first adults.

Adult population fluctuations of *A. nigromaculis* were measured during the day by daily cloth flag counts and by night with a New Jersey type light trap. A special rotary net type of trap was utilized to sample for normal flight activities and an animal bait type of trap was used both with live animals and with carbon dioxide to provide additional information on species not normally attracted to other traps.

A standard field weather station was located in the center of the pasture which contained a hygrothermograph. Wind direction and velocity were measured twice a day. A further station was constructed in the most isolated portion of the field for the rearing of adults from special tanks for the proposed flight range study. Large screen cages were also utilized to study adult activities and potential egg sources and hatches.

Results:

Canal and ditch delivered water produced eighteen irrigation cycles during the season (See Table I). A group of correlated facts resulted form the measurement of various factors that influenced the formation of broods of mosquitoes from these irrigation cycles. For example; temperature measurements showed that *A. nigromaculis* larval development was speeded up by increasing temperatures. Early March temperatures with a mean of 54°F produced a long larval growth cycle of at least 16 days. On the other hand, hourly July mean temperatures of 86°F shortened this growth to 4.75 days. The average temperature for the 18 irrigation cycles was 70°F. At least one half of the 18 cycle periods was 70°F or warmer. During the two hottest months of the season, July, and August, the mean temperatures for each cycle ranged from 70°F to 86°F and produced a pre-adult growth period that varied from 4.75 days to 6.75 days. Earlier months, March to late June, show an average temperature of 64°F and an average pre-adult growth period of 8 to 8.5 days.

Adult population measurements made from light traps and cloth flag counts show that very great increases occur during the months of July, August and September. This coincides with the recognized increased severity of the problem of control during these warmer months. Embryological investigations show that the egg of *A. nigromaculis* can be hatched in four days under room temperatures. Under field conditions this could be shorter. Collection of gravid and fed females indicate that eggs could be deposited in great numbers within 3 days after emergence of a new brood of mosquitoes. With the 4 days of egg conditioning and the 3 days necessary for the female to reach near maximum egg production it can be seen that great numbers of eggs could possibly be made available for hatch within 7 days after emergence of the adult mosquito. During the warm period of July and August the short pre-adult growth period with an average of 6.5 days, indicated that an egg to egg cycle could take place in 13 days. During the cooler months of March to mid-June, (average temperature 64°F) the extended pre-adult period of 8 days or longer would take at least 15 days to produce the egg to egg cycle.

Irrigation cycles in the study pasture occurred every 11 to 13 days with a majority of the irrigations in the 13-day period. Previous mentioned results show that egg to egg cycles can be broken down into two main groups; the 13-day cycle during the warmer months and the 15-day cycle during the cooler months. With this in mind it can be seen that the 15-day period would not coincide with the irrigation cycle. On the other hand the shorter 13 day-period is perfectly adjusted to the irrigation cycle and can produce a hatch with every irrigation. This speeding up of the number of generations of *A. nigromaculis* during the July and August period will be carried over into the September period but with an expected moderate decrease in the size of the populations produced by each irrigation. This is indicated in daily catches from light traps during this period. The duration of the period between irrigations, and the rate of development of broods of *A. nigromaculis* is thus closely related. (See Table I).

Aedes nigromaculis larvae constitute 98.4 perecnt of the *Aedes* present and 86.9 percent of the total mosquitoes collected. *Culex tarsalis* (Coquillett) larvae was 90.5 percent of the *Culex* present and 10.2 percent of the totals. *Culiseta inornata* (Williston), the only *Culiseta* found, was 0.3 percent of the total and this is based upon the fact that it was only found in the first 6 cycles.

The rate of larval develpoment is closely related to temperature. Since the most economical period of control of *A. nigromaculis* is the second and third stage larvae and because fourth stage larvae and pupae are increasingly more difficult to kill, the length of each stadia has a direct relationship to the correct timing of the application of insecticides and the length of time available to the operator for such control. At the beginning of the season the operator has available an extended period of time to find the second and third stages. For example: the longest period of larval-pupal development was 16 days, each stadium requiring the following time: first, 3 days; second, 2 days; third, 2 days; fourth, 6 days; pupae, 3 days. The short cycle in July of 4.75 days resulted in the following stadium periods: first, 24 hours; second, 12 hours (which occurred at night); third, 24 hours (with some fourths developing during the last 12 hours); fourth, 36 hours, pupae 24 hours. A majority of the larvae change from one stage to the other in mass but there is some degree of overlapping of stadia. (See Figure I). The increased rate of development during the

months of July, August, and September shortens the period of second and third stage larvae control availability to approximately 36 hours, 12 hours of that time may occur at night. This shortens the economical control period to 24 hours as compared to 96 hours for the cooler period.

Careful mapping of a single check during the tenth irrigation cycle showed the relationship between the volume of water and *A. nigromaculis* development. The check area was computed to be 36,225 square feet. At the time of irrigation 96.9 percent of this area was flooded with 53,325 gallons of water. Adults emerged in 6 days following irrigation and larval development proceeded as follows: irrigation occurred on July 11 with the development of first stage larvae reaching its climax within that period; July 12, second stage larvae were found in 43,897 gallons of water covering 26,505 square feet; July 13, third stage larvae were present in 33,870 gallons of water covering 25,209 square feet; July 14, fourth stage larvae were recovered from 28,410 gallons of water covering 21,645 square feet. The accurate measurement of larval distribution was not possible at the time but careful general observations indicated that the first stage larvae were more evenly distributed over the area than succeeding stages. Clumping together of later stages and the unequal distribution of these clumps made sampling for population size a questionable procedure during the second, third, and fourth larval periods.

Adult activity records were obtained from cloth flag counts and light traps. Peaks of adult densities occurred during the months of July, August and September. (See Figure 2).

Flight dispersal studies of *A. nigromaculis* were conducted using two methods of following such activities. Rhodamine B marked and radiophosphorus tagged adults were used on separate occasions to follow the pattern of dispersal from an uncontrolled pasture through an area of intensive larval and adult control. Recoveries of adults were accomplished by hand collecting and light traps. Seventy different light trap stations were located over a 100 square mile area surrounding the point of release. Marked mosquitoes were released from the study pasture and followed by daily collections. Rhodamine B marking was obtained by spraying emerging adults with an aqueous solution of the dye. Radiophosphorus tagged specimens were obtained by rearing larvae in tanks containing 0.1 microcuries of Phosphorus 32 per milliliter of solution. Black light examination of all recovered specimens revealed the dye marked adults and a Geiger counter quickly located any radiophosphorus tagged individiuals. Recoveries of adults indicated that under conditions of an extensive available food supply (the released area was surrounded by many pastures containing cattle) and resting places the pattern of dispersal was possibly influenced by the direction of the prevailing winds. The greatest distance of dispersal was down wind, a distance of 1-7/8 miles. Recoveries upwind were made at a distance of 1-1/2 miles. Approximately 400,000 *A. nigromaculis* adults were tagged with radiophosphorus and of these 250 specimens were recovered in light traps and 226 by hand collections. Rhodamine B marked speciments indicated the same general pattern of movement.

Discussion of Results:

The interrelationship of ecological factors offers a rich source of material for future application to control practices. *Aedes* population fluctuations can be followed during a complete season by light traps and cloth flag counts if measurements are taken at regular intervals and under the same conditions. Larval records are indicative of species composition and the rate of development. Larval temperature relationships are important from an operational standpoint and indicate that a general speeding up of control activities is necessary as temperatures increase. Two factors are important to control programs in areas where such factors can be applied. One is the date of irrigation and the other is the mean temperature during the period of larval development. Irrigation cycles and cycles of mosquitoes are closely related. The shortening of the egg to egg cycle of *A. nigromaculis* during the warmer summer months increases the number of generations of mosquitoes produced during these months. In addition to this increase in the number of generations there is a general speeding up of the rate of larval growth and the consequent shortening of the time during which second and thind stage larvae are available for control by materials, such as DDT, that possess a selective toxic action. The months of July, August and September have been shown to produce the greatest numbers of mosquitoes in the Stanislaus area. The pattern of dispersal of *A. nigromaculis* under conditions of the experiment possibly was influenced by the direction of the prevailing wind and limited to short distances by availablity of food and egg sites.

Conclusions:

The 1950 studies of mosquitoes in irrigated pastures have provided the groundwork for future progress. Many encological factors have been measured; some are in need of refinement and of added weight before they can be considered as conclusive. More information is needed on the conditioning and the development of the egg in the field as well as embryological work that will correlate this with egg conditioning and development in the adult.

Literature

Aitken, Thomas H. G. 1940. Notes on *Aedes nigromaculis* (Ludlow), *A. increpitus* Dyar, and *Culex territans* Walker in California (*Diptera, Culicidae*). Proc. Ent. Soc. Wash. 42:142-147. Bates, M. (1949). The natural history of mosquitoes. New York; The MacMillan Co.

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TABLE I. Irrigation dates (hatching date for Aedes eggs), dates adults first emerged, length of growth cycle in days and the mean of the maximum, minimum and mean temperatures for the period.

Cycle	Adults Emerged	Date Irrigated Date	No. days	Mean of Air Temp. in °F		
				Max.	Min.	Mean
1	March 16 (6 a.m.)	April 1 (a.m.)	16.0	67	41	54
2	April 6	April 20	14.0	70	44	57
3	April 20	April 29	9.0	78	43	61
4	May 3 (2 a.m.)	May 13 (a.m.)	10.0	76	44	61
5	May 13 (8 p.m.)	May 22 (a.m.)	8.5	84	48	66
6	May 25 (4 p.m.)	June 1 (a.m.)	6.5	93	56	75
7	June 5 (10 p.m.)	June 14 (8 a.m.)	8.5	78	49	64
8	June 17 (6 p.m.)	June 24 (a.m.)	6.5	87	53	70
9	June 29 (6-12 a.m.)	July 4 (a.m.)	4.7	107	64	86
10	July 11 (5-12 a.m.)	July 17 (a.m.)	6.0	96	60	78
11	July 23 (a.m.)	July 29 (p.m.)	6.5	91	55	73
12	August 3 (a.m.)	August 10 (noon)	6.7	87	53	70
13	August 15 (noon)	August 21 (a.m.)	5.7	100	58	79
14	August 26 (a.m.)	Sept. 1 (a.m.)	6.0	97	60	79
15	Sept. 6	Sept. 13	7.5	82	53	67
16	Sept. 18	Sept. 24	6.5		47	70
17	Sept. 29	October 6	8.0	81	47	64
18	October 9	October 20	11.0	84	50	66

TABLE II. Record of the amount of water covering a single check (check #9) Special Study Pasture, Stanislaus County, California, 1950.

Date	Days After Irrigation	Area Covered By Water (Sq. Ft.)	Percent of Area Covered By Water	Volume of Water (In Gallons)	Aedes Record
July 11	0	35,110	96.9	53,325	Hatch
12	1	26,515	73.2	43,897	
13	2	25,209	69.6	33,870	
14	3	21,645	59.8	28,410	
15	4	18,101	50.0	21,502	
16	5	no record	no record	no record	
17	6	10,368	28.6	9,720	Emerged
18	7	5,184	14.3	4,665	Emerged
19	8	3,564	9.8	2,452	Complete
20	9	1,782	4.9	1,110	
21	10	972	2.7	397	

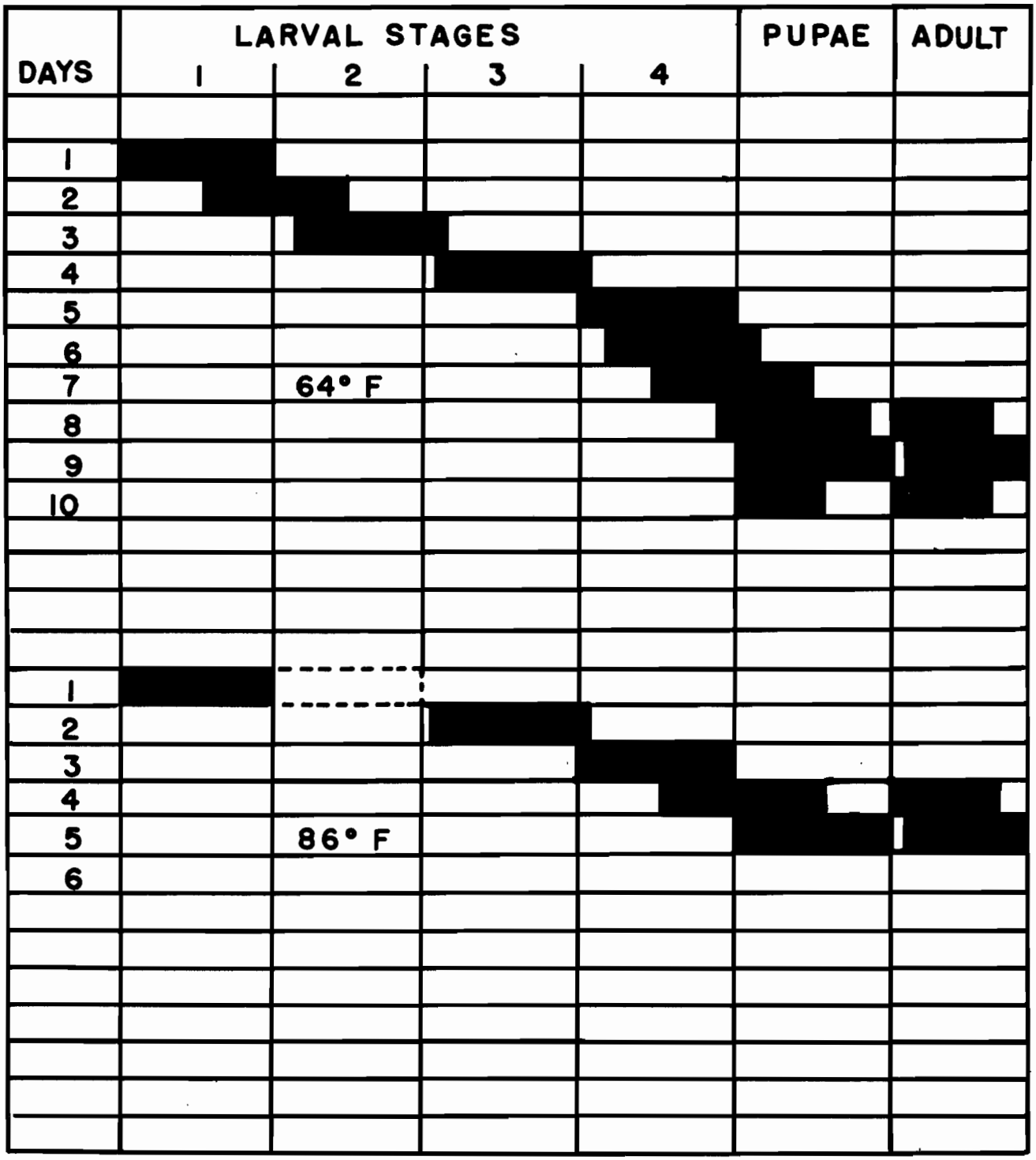

Figure 1. A comparison between the rates of development of stages of *A. nigromaculis* as influenced by the mean temperature of the air. Irrigation proceeded the first larval stage by 12 hours or less.

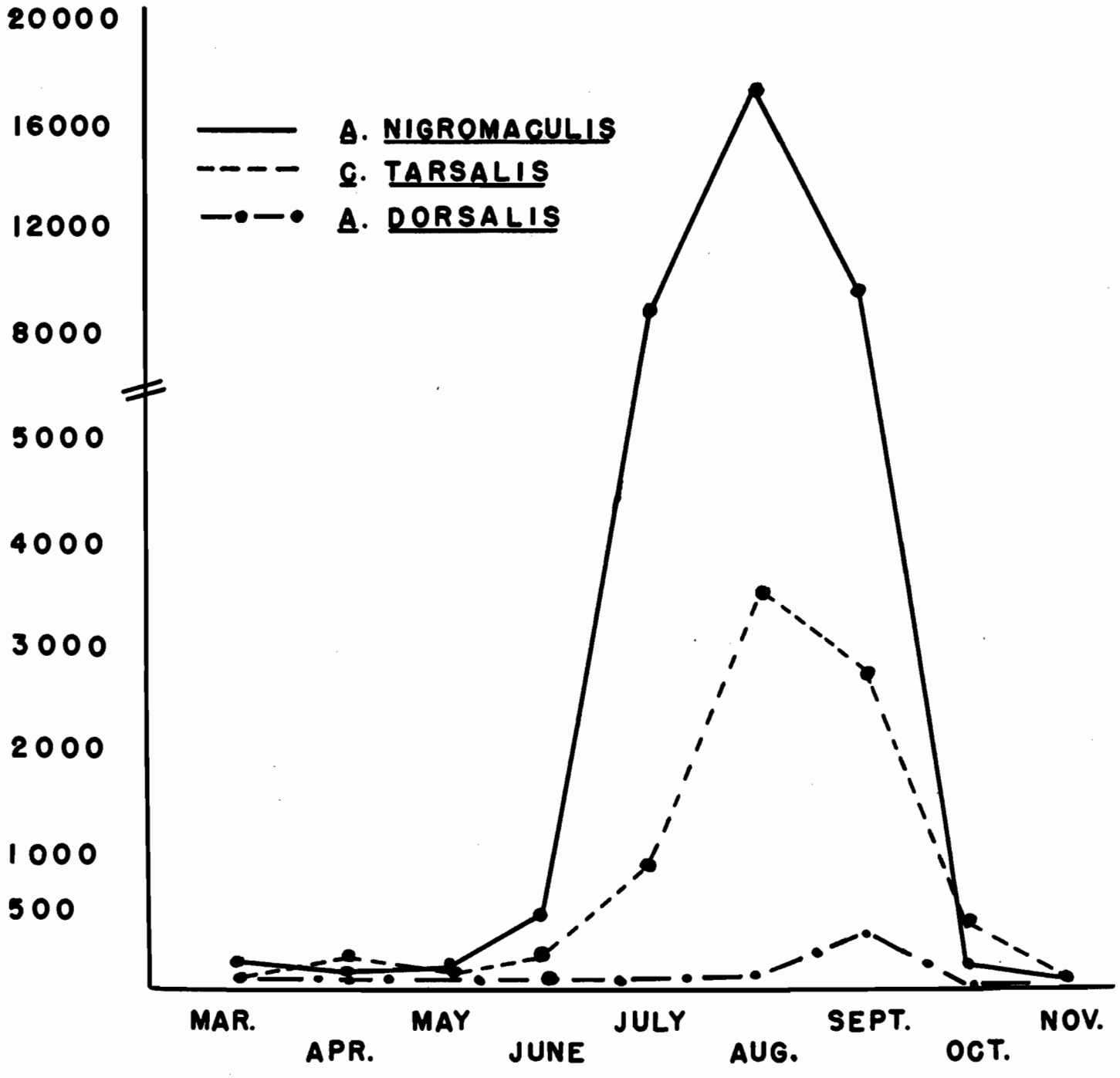

Figure 2. Seasonal Light Trap Collections.
A comparison of the adult mosquitoes taken from a single light trap located in the special study pasture during the 1950 season.

Mr. Washburn: Thank you, Dick, and Dr. Arnold for this presentation. One of the features of the Operational Investigations Committee has been its frequent meetings with these various projects throughout the state. Not only did this Committee want to know what was going on and how it was progressing, but we also wanted this information to be available to the individual control agencies in case some of the findings could be used in control procedures. The basic idea of these investigation projects is to facilitate control operations in our state.

Our last paper before we go on the tour of the Experiment Station is the control of weeds in and along water ways, by E. A. Dudley, Deputy Agricultural Commissioner of Orange County.

CONTROL OF WEEDS WHICH INTERFERE WITH THE APPLICATION OF INSECTICIDES FOR MOSQUITO CONTROL

by

E. A. DUDLEY, DEPUTY AGRICULTURAL COMMISSIONER,
Orange County, California

Aquatic weeds have been recognized as a factor hindering the application of insecticides for controlling mosquitoes for many years. The lack of suitable chemicals to control these weeds has limited the work. Since 1945 a number of chemicals have been introduced partially overcoming problems of the past. We probably should discuss the type of weeds which enter into this problem before any discussion of the chemical control is taken up.

The first type is *submerged aquatics*. These weeds are attached to the bottom of the ditch and actually grow beneath the surface of the water. They give protection to mosquito larva from their natural enemies such as fish and insects. A few of these weeds are Sago pond weed (also called horsetail moss); Horned pond weed; Horned wart; Water milfoil.

The second type is *immersed aquatics*. This weed roots below the surface but rises above the water. This particular type of weed hinders the flow of water and greatly encourages mosquito propagation. A few of these are Tule; Cattail; Burreed; Rush; Burhead; Water plantain.

The third type is *surface aquatics*. Some of these float freely on the surface while others attach themselves to the bottom and sides of the ditch and float only in fixed areas. A few of these are Yellow water weed; Water hyacinth; Water lettuce; Broad-leaved pond weed; Penny wart. A sub-section of this particular type of plant includes such perennial grasses as Bermuda grass; Water grass; Johnson grass and some annual such as Crabgrass and Ditch grass. These are not strictly aquatic weeds, but they do interfere with the flow of water.

Prior to the introduction of some of the new chemicals, the mechanical methods of control were about the only satisfactory methods available. Dredging was a method used for many years in cleaning out irrigation and drainage ditches, etc., using a drag line dredge equipped with buckets. The first six or eight inches or more of the ditch were recoved along with numerous weeds growing therein. This is a very expensive method and has cost up to $1,000 to $1,500 per mile. It should be understood that the accumulation of weed growth in the ditches also causes rapid filling of the ditch with silt coming off fields irrigation into the ditch or actually carried with the water from the source. The disposition of the material taken from the ditch has been a serious problem, many times necessitating hauling it away and dumping it in some area not fit for agricultural use.

Hand cleaning has been another method used extensively. Long hooked knives are used to cut off the tules and other growth on the bottom of the ditch. The material is then taken out by means of mechanical forks or similar equipment. This is also a very expensive method.

One of the least expensive operations is the simple drying up of the ditch for at least six weeks to two months during the dry season of the year. This method can be used in limited areas.

A method of eradication used in years previous to 1945 and still being used in some areas is the burning method which is done by a flame-throwing type of equipment, where intense heat is generated by applying pressure to Diesel oil or some other type of oil, and following down through the ditch with an extended arm operated mechanically or by hand. The Imperial Valley Irrigation District has carried on this type of work for many years and has spent tremendous amounts of money in keeping their ditches clean of weed growth. This gives only temporary relief and necessitates burning at least one a year and sometimes oftener.

Chaining is another method used. which consists of dragging a heavy linked chain along the bottom of the ditch with a tractor on either bank. The heavy chain cuts off and looses growth and sometimes it is necessary to go in both directions in the ditch to clear it. It is also necessary to collect the loosened weed growth at some central point further down the canal or ditch and have it taken out by mechanical fork or by hand. This operation is limited unless the bank is accessible on either side to tractors.

We have several other methods which have been used in some areas where it is possible to dry up the ditch temporarily, then turn sheep or other animals into the area. Where this method is used the soil must be fairly firm or the animals will cause considerable damage by breaking down the dikes. Discing has been used, too, where the water is removed and the bottom of the ditch is wide enough for equipment to be operated.

Chemical Methods

Sodium arsenite has been used for many years for the control of weeds although we do not recommend its use because of danger of poisoning livestock feeding in the area where the material has been applied. If used as a sterilant and applied at the time when no growth is present it can then be safely used.

Sodium chlorate is another chemical that has been used for many years. It is quite expensive and should be used only in areas where the minimum rainfall is 10 to 12 inches or more per season. This chemical is used in soil sterilization and is particularly effective on perennial weeds such

as Bermuda grass, Johnson grass, broad-leaved perennials which sometimes grow along ditch banks; Russian knapweed and Hoary cress.

A more or less new material now on the market is a combination of sodium chlorate and borax. There are several manufacurers and the range is between 25% sodium chlorate and approximately 72% boron to a maximum of 42% sodium chlorate and 58% boron. These materials can be used for the same purpose as sodium chlorate but the fire hazard is cut to a minimum so far as vegetation, the operator and equipment are concerned. Care should be taken in applying this to irrigation ditches which are being used at the time to irrigate crops, as most crops are susceptible to boron poisoning if the water should contain more than 3 to 4 parts per million.

This material is highly inflammable when it is applied to organic material. Precaution should be taken to remove all surface growth prior to the application. Particular attention should be paid to the persons applying the material. All clothing should be washed out thoroughly each day to remove the sodium chlorate; rubber boots should be worn and the equipment used for applying the material should be thoroughly washed outside and inside with water. If possible a detergent should be added to increase the wetting of the surface, assisting to remove the chemical. Sodium chlorate should not be used in flooded areas unless the water is first removed, the application made, and then a small amount of water added to the ditch so that the material does not travel too fast in the soil.

TCA is a new chemical which has been in use in California for three or four year. It is a relatively expensive chemical used only for the control of deep-rooted grassy perennials such as Johnson grass, Bermuda grass and Quack grass. Probably the most satisfactory place for this chemical would be where Johnson grass and Bermuda grass are growing along the water line. Applications in the fall at the rate of 125 lbs. per acre and another application in February or March on the basis of 50 lbs. per acre are most satisfactory. This chemical requires some rainfall to carry it into the root system of the plant.

Contact sprays have been used for many years in controlling weeds in ditches and along ditch banks. These consist mainly of hydro-carbons such as Diesel oil, fuel oil, waste oils, etc. In the last few years there has been considerable change in Diesel oil, the aromatics having been removed. Therefore, Diesel oils are not as toxic as before the war. Weed oils now consist mainly of the aromatics which are taken out of the oils in the process of refining. These oils are very toxic to weed growth and there are many of them on the market.

We also have several other materials which are added to fuel oil and Diesel oil to increase their toxicity, mainly pentachloro-phenol and di-nitrol materials. These oils are used mainly for killing grasses and the top growth of tules and other aquatic weeds. They do not give permanent control of perennial weeds and are only satisfactory as far as temporary relief is concerned. If mosquito fish are present in the ditches, streams and ponds being treated with these materials, it will be necessary to replant because all of these materials are very toxic to fish. In Orange County where approximately 10 miles of drainage ditch has been sprayed consistently for a number of years. it is necessary to replant these ditches with mosquito fish after an application of aromatic oil.

For permanent control of willows, tules, cattails, water hyacinth, water primrose, penny wart and sedges, 2,4-D has proven very satisfactory. 2,4-D is a relatively inexpensive material. There is no hazard of poisoning livestock or pets and no danger from the standpoint of persons handling the chemical, but it is a very dangerous chemical to crops growing within the immediate area.

Practically all crops are more or less sensitive to 2,4-D. Some of them are more so than others, particularly cotton, sweet potatoes, tomatoes, blackeye beans, grapes and many other vegetable crops. Under Section 1066.7 of the Agricultural Code and the California Administrative Code, persons using over 1 lb. of 2,4-D, 2,4,5-T or similar materials in the regulated area and 5 lbs. in the unregulated area of the state must obtain from the Agricultural Committioner of the county a permit for the application of this material.

The ester of 2,4-D is a very volatile material and is capable of causing damage for some distance from the point of application. Drifting of the material at the time of application has caused serious damage in many areas. 2,4-D should not be used in irrigation ditches if at the time of application crops are being irrigated. This is particularly true of cotton, tomatoes, peppers, and other susceptible plants. Recently several chemical companies have developed non-volatile esters which have greatly reduced the possibility of damage. I would suggest that anyone contemplating use of this material first consult the Agricultural Commissioner to determine whether it might be a dangerous operation to use this chemical.

Since 1945 we have carried on test plots of 2,4-D for the control of tules, cattails, sedges and willows. We have determined from our test plots that the iso-proply ester of 2,4-D used at the rate of 1½ gals. per acre-mile* of ditch with 2% Diesel oil or light medium spray oil will give at least 65% control the first year, an dat the end of the second year with the same dosage used, probably 5% of the growth will still be present. After this period of time cheap maintenance can be obtained by spraying the few remaining infestations and any new infestations which may appear from time to time. This material should be used only where no susceptible crops are growing within two to three miles of the area treated.

Satisfactory control of tules, willows, cattails and sedges may be obtained by using the amine salt of 2,4-D plus a detergent on the basis of 1½ gals. per acre-mile. The amine salt will not give as good control as the iso-propyl ester, but we have found we are able to obtain 50% kill the first year and 60% of the remaining the second year, with a fairly good cleanup the third season.

During 1950 we have tried combinations of 2,4-D and TCA at the rate of 4 lbs. of 2,4-D** sodium salt and 12 lbs. of TCA per 100 gals., drenching plants thoroughly from both sides of the ditch, using from 300 to 400 gals. per acre-mile. We have also tried the same combination with sodium salt of 2,4-D and ammate used on the basis of 4 lbs. of 2,4-D and 8 lbs. ammate per 100 gals. of water,

* Acre-mile is a ditch one mile long and eight feet wide

** Lbs. indicate actual 2,4-D acid

thoroughly drenching the plants from both sides of the ditch.

Where heavy growth of willows and cottonwoods have been treated with 2,4-D, the most satisfactory method is that of spraying the trunk with the iso-propyl ester of 2,4-D and Diesel oil on the basis of ½ lb. to 1 lb. of 2,4-D in 10 gals. Diesel oil. Four to five feet of the trunk from the ground upwards is all that is necessary to cover. Where cottonwoods have taken on a heavy corky bark, slashing the trunk for 18 to 20 inches with a heavy knife and spraying with a combination of sodium salt of 2,4-D and water at the rate of lbs. to 3 lbs. per gal. has given satisfactory control.

There are two seasons of the year when plant growth of tules and willows is most satisfactory for treatment. When the plants have grown 18 to 20 inches above the water; or at the time when seed heads appear. The intermediate period has not proved to be very satisfactory, at least in Orange County. Spring or fall treatment for willows and cottonwoods seems to be the most satisfactory time.

The following results were obtained on test plots located along 17th Street from Cliff Drive northward in Costa Mesa. Applications were made on August 10, 1950.

Plot B and Plot C consisted of an area of approximately 30,000 sq. ft. and was treated with 14 lbs. of sodium salt containing .816 lbs. of actual 2,4-D acid and 20 lbs. of ammate in 300 gals. of water. The area was infested with a heavy growth of cattails, sweet anise, wild celery, cockle burr, sunflower, milkweed and several annual weeds. There were also two clumps of willows in the treated area. The southerly clump was treated for 4 ft. to 6 ft. above the ground on the trunks only. The northerly one was treated with an over all drench spray. At the present time there are few green leaves showing. Re-growth of the other vegetation is very slight.

On the same day we also treated three plots at the Naval Ammunition Depot. The first plot contained 10,000 sq. ft. Material used was 1 qt. of amine salt of 2,4-D containing 1 lb. of actual acid per qt. and 2.2 lbs. of aluminum sulfate in 225 gals. of water. Both sides of the ditch were sprayed and at the present time very little growth can be found. The vegetation in this area was cattails and sedges.

The second plot consisted of 6,000 sq. ft. One gallon of iso-propyl ester of 2,4-D containing 3.4 lbs. of actual acid and 5 gals. of aromatic weed oil in 100 gals. of water was the material used. At the present time there is very little re-growth of any vegetation in this area. Vegetation treated consisted of cattails, sedges and few miscellaneous plants such as willows, mulefat, etc.

Plot #3 consisted of 10,000 sq. ft. One gallone of amine salt containing 4 lbs. of actual 2,4-D acid in 50 gals. of water was used. This plot was not acidified as was the case of Plot #1 and ¼ of the actual volume of water was used. At the present time there are indications of re-growth in this area. Further observations will have to be made on this plot, as we do not believe the coverage was as satisfactory as in Plot #1.

The following plots were treated in September, 1946 as follows:

Plot #1—ammonium salt of 2,4-D, 8.3 lbs. actual acid, 1 lb. of actual per 100 gals. water plus Intramine-WK speader using 300 gals. per acre. This same plot was re-treated in May, 1947 with 3.5 lbs. of ammonium salt of 2,4-D plus 1 qt. of di-nitro and 6 ozs. of Intramine-WK in 100 gals. of water. On April 12, 1948 the same material and volume of water was used.

Plot #2 was treated on September 11, 1946 with 6 qts. of Stantox 40 containing .66 lbs. per qt. of tri-ethyl-amine salt of 2,4-D plus 2 qts. of di-nitro and 12 ozs. of Intramine-WK. The results of this treatment were fair. On May 7, 1947 amine salt was used on this plot at the rate of 3 qts. of 2,4-D containing 1 lb. of actual acid per qt. Stantox of the same percent of acid used the previous year was no longer being manufactured. From our observations of the previous year, the application of di-nitro caused too rapid killing of gegetation so this material was not used in this application, but 12 ozs, of Intramine-WK was used as a wetting agent. Very good results were obtained and a repeated application of the same dosage was made on April 12, 1948. Since that date no treatment has been made in the area except spraying with an aromatic oil.

Plot #3 was sprayed with the methyl ester of 2,4-D at the rate of 2 lbs. actual acid per 100 gals. of water in September, 1946. From our observations the methyl ester gave the best control on the first application. In 1947 the use of the methyl ester was discontinued as it was not being manufactured. The iso-propyl ester of 2,4-D was used on the basis of 2.5 lbs. actual 2,4-D plus 5 gals. Diesel oil. At the beginning of the growing season in 1948 very little re-growth appeared and this area again was treated on April 12, 1948 with the same dosage. No further treatment with 2,4-D has been made and annual applications of an aromatic oil have been used to control annual weeds.

Plot #4 was treated on May 7, 1947 using 2 qts. of Esteron 44 containing 2 lbs. of actual 2,4-D acid plus 5 gals. of naphthanate bottoms and 12 ozs. of Intramine-WK spreader. The results of this treatment were not too satisfactory as the naphthanate bottoms caused too rapid killing of the plants. In 1948 the area was divided into three plots an dtreated as follows:

Plot #1 at the rate of 3.4 lbs. or 1 gal. of Esteron 44 plus 2 gals. of Diesel oil in 100 gals. of water.

Plot #2 was treated with 4 lbs. sodium salt of 2,4-D containing 80.3% actual acid per pound plus 20 lbs. of the sodium salt of tri-chloro-acetic acid 50% or ½ lb. actual TCA per pound in 100 gals. of water.

Plot #3 was treated with 25 lbs. of sodium salt of TCA 50% material or ½ lb. of actual TCA per pound. The results of this treatment are shown in the slides.

These are merly suggestions for your information to try in your particular area. We have found that variations in climate conditions, particularly temperature and humidity, cause considerable variation in the results where treatment with 2,4-D is used. It will be necessary for you to find the best combination of these materials for your own use.

We will now take up recommendations for the control of vegetation which is considered *submerged aquatics*, such as algae and related growth. For many years copper sulfate was used to control this type of vegetation. In the last several years a material called Benechlor, which is a chlorinated

benzene plus an emulsifying agent has been used. There are two of these materials, Benechlor and Benechlor 3-C.

This material is injected into the ditch at the point where the water is moving slowly. It is a very stable emulsion and will move up to three miles and give satisfactory control on this type of weed .Exposure should be for a period of one hour if the concentration is 300 ppm or more; 40 minutes for a concentration of 600 ppm; and 2 hours at a concentration of 150 ppm. This is by weight, and Benechlor weighs approximately 11 lbs. per gal. and water 8.3 lbs.

On the basis of 300 ppm. this dosage is approximately 6 gals. of chemical per hour applied in a stream of 1 cu. ft. of water per second. If the operator knows the cross-section of the ditch and the speed at which the water moves, he can calculate the rate of application required to get the necessary ppm.

Another material which has given satisfactory control of this type of weed is solvent naphtha. This material is made from either coal tar or petroleum oils and is similar to Benechlor. It must be used with a stable emulsifier and at the rate of 185 ppm. on a volume basis for one hour. This is approximately 5 gals. of chemical per cu. ft, per second flow applied for a one-hour period. Climate conditions and other circumstances may require higher dosages and more resistant plants such as sago palm weed and others may require as much as 1400 ppm. For further information refer to California Agricultural Extension Bulletin Circular 158, "Control of Aquatic and Ditch Bank Weeds."

References used in this paper are:

California Agricultural Extension Service Bulletin, Circular 163, "California Rice Production"

California Agricultural Extension Service Bulletin, Circular 133, "2,4-D as a Weed Killer"

Report of the 2nd Annual Conference, April 1950

Mr. Washburn: I now turn the meeting back to your Vice-President.

Mr. Henderson: Thank you very much, Ed. Before we adjourn, I wsh to express our appreciation to the staff of the Citrus Experiment Station for their courtesies in furnishing the facilities for todays meeting, including the lunch, and for arranging the tour of the laboratories at the Station which will begin immediately upon adjournment.

(The meeting then adjourned and the members were taken on a conducted tour of the laboratories of the Citrus Eperiment Station)

The final session of the Conference convened at 9:15 A.M., in the Music Room in the Mission Inn, Riverside, with President E. A. Smith presiding.

Mr. E. A. Smith: The first talk on the program this morning is on the subject of radioactive isotopes in studies of mosquitoes and flies. It will be given by A. W. Lindquist, Entomologist in Charge, United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, Corvallis, Oregon.

Mr. Lindquist: Mr. Chairman, members and friends of the California Mosquito Control Associaton, these radioactive substances are not going to be used at the present time to control mosquitoes and flies, that is, you will not be able to get them and go out and wipe out your insect populations, even if they can do similar things with the atomic bomb. They are mainly a useful tool in biological and physiological studies.

RADIOACTIVE ISOTOPES IN STUDIES OF MOSQUITOES AND FLIES

by

ARTHUR W. LINDQUIST
U. S. D. A., Agr. Res. Adm., Bureau of Entomology and Plant Quarantine

Experiments conducted at the Corvallis, Oregon, laboratory of the Bureau of Entomology and Plant Quarantine during the past year have been concerned with the handling and uses of radioactive isotopes in the study of the habits and control of insects. This field is comparatively new, and much information is needed on the advantages and limitations of radioactive isotopes in experimental work. Jenkins and Hassett (1950) have reviewed the literature and suggested numerous ways in which these isotopes can be applied to entomological studies.

One of these uses is to tag insects in flight-habit studies. Insects that have been made radioactive can be identified later by mean of a Geiger counter. In the past, colored dyes, stains, and powders have been used for this purpose, but the isotope tagging appears to have advantages in many cases. Perhaps one of the most useful isotopes for tagging insects is P^{32}. This material has a half-life of 14.2 days, which limits its usefulness in studies requiring longer than 30 to 60 days.

Early studies in Corvallis were concerned with how to get the P^{32} into an insect. Mosquito larvae (*Aedes sticticus*, *A. vexans*, *A. nigromaculis*, and *Culex* spp.) were reared in aqueous solutions of radioactive phosphoric acid containing from 0.00005 to 0.1 microcuries of P^{32} per milliliter. Most third and fourth-instar larvae reared in solutions containing 0.001 to 0.1 microcuries of P^{32} per milliliter gave readily detectable amounts of radioactivity in the adults that emerged several days later. Mosquito pupae required higher concentrations to become radioactive.

Tests showed that adult mosquitoes could also be made radioactive by allowing them to feed on aqueous solutions containing P^{32} to which had been added about 10 percent sugar or by having them take blood from a rat that had been injected with a solution containing the isotope (Yates, Gjullin, and Lindquist, 1951). For tagging large numbers of mosquitoes it appears that rearing the larvae in solutions containing P^{32} is the most feasible.

Studies with flies show that they can be made radioactive by rearing them in various media containing P^{32} or by allowing the flies to feed on a 10 percent sugar solution containg this isotope. (Hoffman, Lindquist, and Butts 1951). With house flies and blow flies it appears that feeding them the isotope is the easiest and most economical. Preliminary tests have shown that house flies can be made radioactive by spraying them, in a small closed container, with a solution containing P^{32}. Sprays containing 1.0 microcuries per milliliter did not produce radioactivity that could be detected with a laboratory monitor supplied with a thin-walled Geiger-Muller tube, but when 2 percent of a wetting agent, Wetsit or Tween 20, was added to the spray, detectable radioactivity (125 to 400 cpm per fly) was found for 10 to

14 days thereafter. Spraying radioactive solutions except under rigidly controlled conditions is hazardous.

An experiment was conducted near Corvallis in which several thousand house flies, blue bottle flies, and black blow flies were allowed to feed on a solution containing P^{32} and released. Screen-wire traps baited with decomposing liver encircled the area. From 3.6 to 14 percent of the tagged flies released were trapped over a 3-week period. House flies were recovered 12 miles from the point of release. Further studies of this nature will no doubt give valuable information on the flight habits and abundance of flies in a given area.

Absorption of radioactive DDT by insects has also been investigated at Corvallis. Topical application of small measured dosages of the DDT was made on house flies, followed in 24 hours by a rinse in acetone to remove exterior DDT. The flies were then macerated, the DDT or metabolites extracted with acetone, and counts made of the radioactivity. Only about 2 to 2.5 micrograms of 15 microgram dosages were actually absorbed in 24 hours. When *Aedes* mosquito larvae were subjected to acetone solutions containing radioactive DDT, only about 0.0038 microgram was absorbed per larva. This infinitesimal amount caused death of abount 50 percent of the larvae.

It is hoped that the information obtained on the absorption and degradation of DDT and other insecticides will aid in explaining how DDT kills and perhaps how resistance develops in insects. With such knowledge it may be possible to find chemicals that will overcome or block the insect's ability to metabolize DDT and other insecticides.

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Mr. E. A. Smith: Thank you Mr. Lindquist. We come next to a Symposium on the use of insecticides in mosquito control. It will be moderated by Art Geib.

SYMPOSIUM ON THE CHEMISTRY, TOXICOLOGY, USAGE COST, AVAILABILITY AND REGULATION OF INSECTICIDES USED IN MOSQUITO CONTROL

Moderator: ARTHUR F. GEIB

Panel Members

A. W. LINDQUIST, T. M. SPERBECK, T. G. RALEY, W. D. MURRAY, GORDON SMITH, E. A. SMITH, C. M. GJULLIN, R. F. PORTMAN, H. H. STAGE, RALPH MARCH, ROBERT L. METCALF, H. ROBERTS, E. WAMPLER, LEO GARDNER, ED. COE, G. H. WELDON, A. B. LEMMON

Mr. A. F. Geib: Thank you, Ed. This Symposium will be conducted by considering each toxicant as a unit. First, Dr. Metcalf will present the chemistry of the toxicant; then its usage and potential in mosquito control will be presented; third, its toxicological characteristics will be given; and fourth, its production, cost and availability will be discussed. Mr. Lemmon of the State Bureau of Chemistry will discuss the regulatory aspects of each material.

(Mr. Geib then introduced each member of the panel, as follows:)

A. W. Lindquist, Bureau of Entomology and Plant Quarantine at the Corvallis, Oregon, laboratory; T. M. Sperbeck, Manager, Sutter-Yuba Mosquito Abatement District; T. G. Raley, Manager, Consolidated Mosquito Abatement District; W. D. Murray, Manager, Delta Mosquito Abatement District; Gordon Smith, Entomologist, Kern Mosquito Abatement District; E. A. Smith, Manager, Merced County Mosquito Abatement District; C. M. Gjullin, Bureau of Entomology and Plant Quarantine at Corvallis; R. F. Portman, Manager, Butte County Mosquito Abatement District. This group will report on the usage and potential in mosquito control of the toxicants: the toxicological aspects will be covered by Harry H. Stage, Bureau of Entomology and Plant Quarantine, Washington, D. C., and Dr. Ralph March, University of California Citrus Experiment Station at Riverside: the industrial report will be made by Mr. Roberts of Dupont Chemical Company; Mr. Wampler of Rohm & Haas Company; Mr. Leo Gardner, California Spray Chemical Company; Mr. Coe, Julius Hyman Company; Mr. Burnside, Hercules Powder Company, and Mr. George Weldon, Velsicol Corporation.

We will first discuss DDT completely in all aspects, then we'll go on to the next material. I would like Dr. Metcalf to introduce DDT.

Dr. Metcalf: We're all familiar with DDT, and I don't think there is any necessity of going into details as to its chemical and physical characteristics before this group.

Mr. Lindquist: DDT is considered the oldest of the chlorinated hydrocarbon insecticides and has had wide use over the world in control of various insect pests particularly mosquitoes. The use of DDT as a residual treatment of buildings for control of *Anopheline* mosquitoes is widespread. Control of this vector has reduced the incidence of malaria to such an extent that DDT has been named one of the modern miracles.

In this country DDT is used primarily as a larvicide in the control of mosquitoes. It is most commonly used in an oil or as an emulsion, although wettable powders are occasionally applied. Dosages range from 0.1 pound to 0.5 pounds per acre for ordinary larviciding operations. In pre-hatching treatments dosages range from 0.5 to 4 pounds per acre.

DDT is frequently used as aerosols or mist sprays for control of adult mosquitoes. The method has also been used for larviciding in some places.

From all that we hear here in California DDT may be losing ground because of insect resistance to this insecticide. It may be that several years from now we'll speak of DDT in California as that good old insecticide that we used many years ago.

Mr. Stage: I have arranged on the blackboard the acute toxicity and chronic toxicity of these materials. It gives the acute toxicity of the materials based on external applications to baby calves. We start first with methoxychlor; the maximum percentages are given, which in the case of methoxychlor, DDT and TDE are eight percent. Methoxychlor is less toxic than DDT, which is less toxic than toxaphene and chlordan. These are less toxic than heptachlor, and heptachlor is less toxic than aldrin and lindane. Chronic toxicity does not follow that order. Aldrin is perhaps the most toxic chronically and methoxychlor the least toxic on a chronic

basis. This information was obtained only last Friday from Dr. R. D. Radeleff, a veterinarian stationed at our Kerville, Texas, laboratory. I'm only reporting his results.

DDT is a relatively safe insecticide. Single applications of eight percent can be tolerated by all live stock As many as ten applications of two percent DDT at two week intervals failed to produce clinical symptomns. Cattle have also tolerated thirty applications of 0.5 percent DDT at two week intervals. Cows that had been fed for one hundred and sixty days on hay sprayed with 8.7 and 6.7 parts per million DDT showed no ill effects. Cattle, horses, sheep, goats, and hogs have all tolerated as many as eight treatments with 1.5 percent DDT applied at four day intervals. From the foregoing, it is seen that DDT is a material of very low toxicity to live stock. It is safely used on dogs, but it must be used with caution on cats. They can be poisoned by relatively small amounts. Of course, when barns are treated extensively with DDT, it may get into the milk of dairy cattle in those barns. DDT has been shown to be stored in the fat of cattle sprayed with the material, or of cattle fed with contaminated feed. In preliminary experiments. Hereford cows with suckling calves were sprayed five times with 0.5 percent DDT at four week intervals. One half the calves were sprayed at the same time, while others received no treatment. Two weeks after the fifth treatment, they found the cows contained an average of fifteen parts per million DDT. The calves not sprayed, but suckling these sprayed cows, averaged twenty-five parts per million. Calves which were sprayed and suckled sprayed cows averaged twice as much.

Mr. Roberts: I believe our Moderator wanted me to talk regarding the supply outlook on DDT and what has caused its shortage. Its greatest shortage was caused last year by the tremendous demand for it in cotton areas of the United States, and industry not being prepared for the tertific demand. At the end of the season practically no supplies were carried over, and with the war effort and stockpiling of crude materials by the government, it was impossible for most suppliers to operate during the winter months as they did in previous years. Consequently, production fell far behind the need. With the government's desire for increased cotton acreages and the general overall increased production of agricultural products, it has fallen far short of what everybody seems to need. Consequently, in a short market, everybody wants more perhaps than they will need. The stocks of technical DDT, which this group is more interested in than the formulations, has become very tight and low. The government has stepped in and requested the industry set 25% of their production of technical DDT aside for DO orders, and that material is consequently taken out of the normal channels of trade. Prices have gone up proportionately to the increased costs of benzene, alcohol and chlorine and it is pretty hard to say exactly what the price situation is. On technical DDT, I've heard various prices quoted from as low as 43c to as high as a dollar a pound. It would normally run in the range of from fifty to sixty cents per pound, depending on the quantity and the size container. The outlook for the balance of the year looks extremely tight, and most prudent buyers, where they think they're going to need it and can secure it, are buying it even gefore they are going to need it, as they may not be able to get it at the time that they wish it as they have in the normal market.

Mr. Lemmon: The law in California requires each economic poison, that is any pest control material, to be registered before it can be offered for sale in the state. There are about nine thousand different brand named products registered for sale in the state at the present time. That includes material used for mosquito control, for household pest control, for agricultural pest control and so forth. Each year only about three-fourths of that number of products are registered when the registration expires in June 30, and then new products come in where they change the label, or change the formulation, and each is counted as a new product. The rate of perhaps ten a day for new products would be a good average. I bring this up to point out that the registration or development that comes prior to registration is a continuing operation. We often think of products as being put once on the market always remaining the same, but the life of an economic poison product is not very long. In 1949 there were eighty-two hundred products; in 1950 that increased to nine thousand and by June 30, 1951, there will be somewhere around ninety-four hundred.

Before a product can be accepted for registration, we must have inforation to establish its effectiveness, its toxicity, both acute and chronic, and any hazards that are involved in its use; we must know its composition and, of course, it is desirable to have an analytical method both as to the material itself and as to the minor amount of residues that may be involved. If it is to be used on a food product, that's more important than if it's to be used as a rodent poison, but anyway we need information with regard to analytical methods. Then, of course, its spray residues must be considered and any taste factors that may be involved if it gets on to food.

The regulatory office, the Bureau of Chemistry, Department of Agriculture, does no experimental work. Information to establish whether or not a product is eligible for registration is the responsibility of the manufacturer. That is submitted with his application for registration to substantiate that his product is ready for general sale.

Products containing DDT have been registered since about 1945, and as you know there are a great many of them on the market. In this state, we have a spray residue law, probably the only state that has a specific law with regard to spray residues. Our spray residue law sets up a tolerance of seven parts pr million for DDT. Federal tolerances for these materials have not yet been set, although hearings were held during 1950 and th matter is under consideration. We hope in due time the regulations with regard to tolerances will be set up. When the Federal tolerances are set, without doubt our California tolerances will be modified to correspond to those of the Federal government, because there must be uniformity. You cannot have a tolerance in one state different from that in another state. It has been mentioned DDT gets into the milk and fat of animals and although it is not regarded as a highly toxic material, it is a material that we do not want to get into our food products. The seven parts residue per million, from the way the testimony looks, is probably higher than will be permitted under the Federal Regulations. That brings the matter to you. You must use care in handling DDT products to see that there is no food contamination, and where it does go on fruits and vegetables either there is adequate provision to remove it or to at least see that it is below whatever legal tolerance is set, which for California, is now seven parts per million.

Mr. Geib: I beleive that covers DDT adequately, so let us go on to the next toxicant, DDD.

Mr. T. M. Sperbeck: We have used DDD for the last three years. We have bought it in both forms, the 30% formulation or emulsion, and the technical. We make our own emulsion by dissolving it is solvent and putting it through our own mixing vats. We have used up to about three tons of technical per season to be used especially on our dairies, due to the fact that information has indicated it was probably a little less toxic than DDT. I bought some this spring and the last half ton we received cost us sixty-four cents a pound. I haven't found that we can use less of it and get results comparable with DDT, and if it wasn't that technical DDT was very scarce, I doubt that I would have invested in DDD this season.

Mr. Stage: Single sprayings of cattle using 0.05% DDD spray have produced two weeks later an average of eleven parts per million in fat. That's the minimum. The maximum has been at the rate of 15.6 parts per million in fat. However, twenty-seven weeks after this spraying there was still an average of 0.5 up to 0.7 parts per million in stored fat in cows. In no case have we experienced any ill effects when these animals were sprayed with as much as an 8% spray. For example, one spraying of an 0.5% spray gave an average of eleven parts per million in the fat, and that continued for some little time. It has been estimated that a fatal dose for a man is 300 milligrams per kilogram of body weight.

Mr. Wampler: There isn't too much to say on DDD with relation to supply. I can just about repeat Mr. Roberts' words on supply. The compound goes mostly to agricultural use. As far as mosquitoes go, the supply is again going to be rather rough and if anything is available it will probably be in the technical form; the price is about as has been stated.

Mr. Lemmon: As far as DDD is concerned, we have regarded it in the same general category as DDT, even though it is indicated as perhaps somewhat less toxic. There has been no tolerance set up under our state spray residue law for DDD. We've treated it the same as if it were DDT. It happened to be that DDT was first; our lesislature put a tolerance for it in the law, and at the same time provided that the director could after hearing establish tolerance for other materials. Personally, I felt that we should wait until the outcome of the Federal Food and Drug Hearings was settled, so we would know where we were, and not have the spend the money for additional hearings which cost a lot of money. The matter is still dragging on that basis. We have had no particular problem from the residue angle and in proper usage there shouldn't be either with it or DDT.

There is a difference in wording and opeartion between the Federal Food and Drug Act and our State laws. Our State Food and Drug Act is administered by the Department of Public Health, Bureau of Food and Drugs. It follows very closely the Federal law, but we have in addition a specific law in the Agricultural Code relating to spray residues. That covers only fruits and vegetables, but in our registration of economic poisons we go a step further in covering acceptable directions or labelling. It all sounds rather confusing, but to try to straighten it out, the U. S. Food and Drug sets tolerances, or is in the process of doing so, which will cover the whole field of foods and feeds. The State Spray Residue Act applies only to fresh and dried fruits and vegetables, and would not apply to forage. The Economics Poisons Act, which applied to labelling, is intended to protect the users or purchasers of insecticides. It requires that the manufacturer give true labelling of the product. On those labels, directions for use are required, and in those directions for us it is not permitted on either DDT or DDD to recommend or suggest usages that will cause a problem of DDT or DDD in the milk or in the fat of animals.

Mr. Geib: Are there any further questions on DDD? If not, we will go on to the next compound, lindane.

Dr. Metcalf: I'd like to point out that lindane is essentially the pure gamma isomer of benzene hexachloride. Crude benzene hexachloride chemically consists of only ten to twelve percent of this gamma isomer, and other amounts of about seven different chemical compounds. Therefore it's quite important to make distinction between the use of lindane and the use of crude benzene hexachloride because these other impurities are responsible for a great many of the unpleasant odors resulting from the use of benzene hexachloride. They also contribute a great deal to the chronic toxicity of this compound.

Mr. Raley: Lindane has been a worthwhile supplement to our mosquito spray program at Consolidated. It came the closest to being the all purpose mosquitoicide of any used. Its only drawback was the rather high initial cost, but in overall field use it compared favorably with the others. From this past experience, we will use lindane in all spray work during the spring and early summer of 1951.

Minimum lethal dosage rates of lindane were never accurately determined. Controlled laboratory testing was attempted but the many difficulties experienced in handling *Aedes nigromaculis* in any form, forced us to use rough comparisons with DDT as a guide to field application. From tests in the laboratory, lindane (gamma isomer of B.H.C.) was 100% effective on pupae of *C. quinquefasciatus* and *A. dorsalis* at dosages up to 1 part in 50 million. At 1-100 million it was 70% effective.

Initial field spraying of lindane was done with 25% wettable powder. As proper formulations were developed, a 20% emulsifiable concentrate was substituted. The liquid form has been much more satisfactory than the powdered, in every respect. When used as an aqueous spray, each form was applied at an average rate of 0.06 pounds lindane per acre. This amount was effective for both larviciding and adulticiding. When fog generators were used for adulticiding the application rate averaged 0.018 pounds per acre.

Lindane was used successfully in power sprayers applying six gallons of diluted water mix per acre; in hand sprayers applying two gallons of fortified Diesel oil per acre; in the airplane applying three quarts of either a water spray or an oil spray per acre; in briquettes; in oil drips; and in fogging with ground equipment or the airplane. Properly applied lindane controlled all local species of mosquito larvae and adults. In Diesel oil it was an effective pupicide and was especially good in dairy drains and sewer effluent. It was not too effective in the syphon or for prehatching treatment.

In our experience lindane is very nice to handle and does minimize transportation problems. No special equipment is required and no unusual precautions are taken in protecting either the equipment or operator. As used there is little if any danger to animals coming in contact with either the spray or residue. No criticism was voiced by either the public or the operators.

In this area no lindane resistance in mosquitoes has been observed. As a larvicide it is not as effective at high temperatures as it is at low temperatures, but surprisingly, in thermal exhaust aerosols it is pershaps the most stable of all the chlorinated hydrocarbons. This heat stability, plus its irritating qualities to adult mosquitoes makes this an excellent material for fog machines.

Dr. March: We know very little of the toxic action of lindane except that its chief pharmacological action seems to be a stimulation of the central nervous system. Because of its similarity to meso-inositol, which is a growth vitamin, certain workers have attempted to show that its neuro-toxic action is due to an interference with metabolism of meso-inosital. Data at the present time is conflicting in this respect although it has definitely been shown that certain yeasts are growth inhibited by lindane, and that inhibition is reversed by the addition of meso-inositol. It has also been shown that the inhibition of pancreatic amylase by lindane can be prevented by the addition of meso-inositol. The effect of lindane on insects, such as mosquito larvae, has not been reversed by simultaneous applications of meso-inositol. We also know very little of the fate of lindane in the body. Certain differences between lindane and DDT as concerned with storage are worth mentioning; however, the storage of lindane in the body fat is much less than that of DDT at the same dietary level. The body storage levels for lindane are about the same as the amount fed in the diet whereas with DDT the material can be concentrated and stored in the body; for example, feeding one part per million the material is concentrated to about six to twenty-eight times. Lindane is rapidly metabolized and completely disappears from the body after it is removed from the diet. The only difference between lindane and DDT is that small amounts of lindane are found in the brain tissue while DDT is not found there.

Lindane is somewhat more toxic acutely, two to three times than DDT, based on the average oral L/D 50 dose for laboratory animals, which is 90 to 100 milligrams per kilogram for lindane as compared to 250 for DDT. It is also somewhat more toxic by skin absorption. From a single dermal dose with an oily solution, there is an L/D 50 of fifty milligrams per kilogram as compared with more than 2800 for DDT. It is also more toxic by means of multiple doses. The estimated injurious dose for man is fifteen grams or about half an ounce orally, or three grams per single dermal dose from oily solution, or one or two grams by multiple dose. Chronically, however, it has been found to be less toxic than DDT. The lowest figure in parts per million in the diet causing clinical effects or pathological effects such as on the liver, is four hundred parts per million of lindane and five parts per million of DDT. The lowest figure in diet for retarding growth or for growth effects are even higher, being sixteen hundred parts per million for lindane and a hundred parts per million for DDT.

Mr. Gardner: Lindane has great stability to heat and the material will volatilize from the solid form to the vapor and revaporize as a solid form without any change in chemical composition or any loss in toxicity. It is stable in water dilutions, it is stable in stron acids, sulphuric acid, and one point I might mention briefly relative to its comparative safety is the quantity used; for example, where one would use ten pounds DDT per a given control value, the quantity of lindane used might be a half pound or a pound, and considering this difference in quantity and interpreting this in relation to toxicity, it shows a better picture for toxicity because of the reduced quantity. Lindane also has a high volatility rate, which is quite important, and depending upon the conditions under which it is applied, the rate of loss by vaporization in the air ranges from about 2.8% per day to about 25% per day, so that the toxicity factor is also improved by its transient nature. A. J. Lehman, Chief of the Division of Pharmacology of Food and Drug Administration stated that lindane is rapidly metabolized, is not accumulated in body fat, and that if DDT has a chronic toxicity of 1, BHC has the toxicity of ½, and lindane ¼. I merely mention that as an interpretive point of toxicity. In reference to the advantages and disadvantages of lindane in relation to other materials, its higher cost is probably its greatest disadvantage. One of its advantages is ease of formulation, safety in use, and easy use in cities and populated areas and around crops and trees, because of its transient nature, lack of residue and safety to humans. In reference to the precaution that should be taken in the handling of lindane, probably the most common cause of irritation would be that from the solvents used in making the emulsifiable liquids. The pure lindane has relatively no odor, but causes a nose and throat irritation somewhat of the same type as rotenone. There have been no fatal accidents on record from lindane, and its troubles have been primarily solvent irritation. So far as I know there will be ample supplies of lindane during 1951. The situation is a little tight, but the primary shortages are not lindane but solvents, the critical solvents to make the 20% emulsifiable liquids, and also the plastic liners for containers that it takes to hold the material, so that the chemical itself will probably be available and the tightness of supply currently is on the special solvent and the plastic liners for containers. The latter may force shipment in glass.

The different types of formulations of lindane are 20% liquids containing approximately 1.66 pounds of lindane per gallon and also liquid formulations containing one pound lindane per gallon. In wettable powders, there is 20% wettable powder, and dust containing 1%, 1½%, and 2% lindane. The price of the material is roughly around $25.00 a gallon for the 20% liquid, and about $3.50 on 25% wettable powder. Lindane is distributed by many different companies. On a world-wide basis lindane is manfufactured by two different companies in Germany, by one company in England, and one company in Italy. It is used extensively in central Africa on animals and also for mosquitoes. It is also used in central Europe and in the South American countries. The volume of usage in the rest of the world is probably 25% of the volume used in the United States. The ease of compounding of lindane is one of its important features, its stability and the freedom from odor in handling. The only problem currently is that of

solvents and containers, and I believe that with as many suppliers as there are of this material, it should be available in ample quantity.

Dr. Tinkham: In the summer of 1949, working with adulticide sprays using the Hoskins and Caldwell Spray Chamber, I found lindane at less that 0.5% actually activitated the gnats. About fifteen percent of the population outlived my test experiments.

Mr. Lemmon: Lindane is one of the newer materials in usage, and we don't have all the answers as to agricultural usage. Tolerances have not as yet been set up. It's another one of those materials waiting the Food and Drug hearing, but the smaller quantity used, as pointed out by Mr. Gardner, does help as to residues that may be left when it is used on vegetables particularly. We're still somewhat concerned about the taste factor. Benzene hexachloride taste has been one of the objections to agricultural usage, and lindane seems to have considerably less obnoxious taste, but we're not convinced that in all cases it has no effect upon the taste or flavor; in fact, in some cases it has been proved that there is this difficulty from lindane.

Mr. Geib: That completes the discussion on lindane, so we will continue with the next material, toxaphene. Don Murray, Manager of Delta Mosquito Abatement District, has had experience with the use of toxaphene.

Mr. Murray: This insecticide has been used in the Delta District a year and a half now, and we expect it to be the main one during 1951. It is used exclusively as a larvicide. As a residual spray, it is practically useless, but as a larvicide for *Aedes nigromaculis* under our conditions, it has been exceedingly effective. We've had very few failures with it. Some of the failures during 1950 apparently were due to difficulties in formulation. The material was very unstable part of the time and I understand that the present products of 1951 are improved and compare with the 1949 material, which was very stable. Appparently, there is very little residual action in spraying in the field. We have found that we can spray a pool of water where *nigromaculis occurs,* kill all the *nigromaculis,* and within one week we will have *Culex tarsalis* breeding in significant numbers. There certainly is no possibility of using it as pre-hatching treatment because it disappears so quickly. We have found in spraying equipment that it does not damage the rubber gaskets as does DDT formulations. It does not hold up very well in contact with metal; it breaks down apparently in toxicity and also in formulation, so we mix up enough to last for only one or two days in our spray tanks.

So far, we have not seen any significant development of resistance to it. One of the biggest advantages of toxaphene in the lower San Joaquin Valley is that it is more effective at high temperatures; when our temperatures reach 100 and *nigromaculis* are developing within three and a half to four days, we want something that works fast, and toxaphene seems to be tops.

Dr. March: Like lindane, the chief pharmacological action of toxaphene seems to be a stimulation of the central nervous system. We actually know very little about its neurotoxic acion due to the lack of a sensitive micro-analytical method for the material. We know very little of its secretion in milk, its deposition in tissues, its metabolism and degradation, or its elimination and excretion.

Toxaphene, like lindane, is also somewhat more toxic than DDT acutely. The oral L/D 50 dose is sixty milligrams per kilogram. It is also more toxic by skin absorption from solutions, as you can see from the figures for single or multiple doses. The estimated dangerous dose for man is from two to seven grams orally, or somewhat less than a quarter of an ounce; forty-six grams for a single dermal dose, or 2.4 grams for multiple dermal doses. Like lindane, toxicity is the opposite as far as chronic toxicity is concerned, being somewhat less toxic than DDT.

Mr. Burnside: Toxaphene is used more extensively for mosquito larvae control here in California than in any other state in the country. In the south, it is my understanding that efforts are directed towards adult mosquito control, and toxaphene is not as well suited for this use as other chemicals. Concerning the availability of toxaphene, the U. S. Department of Agriculture has estimated that about forty-seven million pounds of technical toxaphene will be needed in this country this year. Hercules Powder Company will make every effort to meet this requirement, provided sufficient chlorine can be secured. Chlorine is at present in very short supply. In the western area we expect to have about twice as much technical toxaphene available this year as compared to last year. As present, toxaphene is made in this country only at Brunswick, Georgia. However, in the near future, we expect to have a plant in operation at Hattiesburg, Mississippi. We also have a plant in London, England, which supplies some of the foreign demand. Toxaphene is made in part from ingredients found in southern pine stumps.

Hercules does not formulate toxaphene into finished products. The technical material is sold to other insecticidal manufacturers who are in a better position to formulate it and get it to the ultimate consumer. The price of technical toxaphene is 23c per pound in carload lots f.o.b. Brunswick, Ga. Toxaphene is formulated into emulsions, oil solutions, wettable powders and dusts. In this area, emulsions vary in price from $3.60 to $6.40 per gallon, depending on the amount of toxaphene per gallon, and the supplier. These are consumer prices. The 40% wettable powder retails for between 28c and 30c per pound and a 10% or 20% dust sells for 12c and 20c per pound, respectively. The largest outlet for toxaphene is for control of cotton insects. However, through continuous research, the use of toxaphene has been expanded for insect control on a variety of row crops, such as lima beans, onions, sugar beets, mushrooms, ornamentals, tomatoes, alfalfa, etc.

Mr. Lemmon: Toxaphene gives us a problem as there is no adequate analytical method for the smaller amounts. One problem that has recently come to the front, that I think might be facing all of you, is that the Fish and Game Commission is very much concerned over fish poisoning. Recently there was a meeting in Marin County where it was alleged that fish were being killed by rotenone. That immediately brought up the whole problem of the use of insecticides that might be dangerous to fish, and toxaphene is one of the materials they're looking the hardest at. Where toxaphene is used, careful consideration should be given to prevention of poisioning of game fish or the Fish and Game Commission will be greatly involved.

Mr. Geib: What is the dosage rate of toxaphene lethal to fish?

Mr. Lemmon: I haven't the information with regard to its toxic limits on fish. The Fish and Game Commission is doing work on that, and I had hoped to have that information before this meeting. This whole problem has come up rather suddenly as a result of rotenone sprays being used on dairy cattle for grub control. In Marin County the claim was made that the spray was allowed to run into streams. From that, all insecticides then become subject to question by the Fish and Game Commission, with particular emphasis on toxaphene. We will get that information for Fish and Game as soon as we can, but we haven't yet gotten definite information.

Mr. Geib: I would like to ask Don Murray in what form and at what rates of application he's using toxaphene in larvicides.

Dr. Murray: We are using only 50% emulsifiable material. You can buy it at 40% or evn at 60%. We break that down to approximately 3%. With airplane applications, we apply that at about one gallon to the acre. By hand applications, the same material goes out at approximately two gallons per acre. Generally, we get 100% control unless the vegetation is rather heavy, in which case we up the rate to perhaps four gallons per acre. We do not get a very good pupal kill with toxaphene.

Mr. Geib: We will now go to the next material, aldrin. Apparently Dr. Metcalf has no comments in regard to the chemical structure of this compound. Therefore, Gordon Smith will comment on the use of aldrin as a mosquito larvicide.

Mr. Gordon Smith: Aldrin is a relatively new material and we don't have too much field experience with it.

In the laboratory screening work on fourth instar *Aedes nigromaculis* larvae, the oxicity of aldrin was aprroximately five times that of DDT. We put the material in the field on that basis, using only emulsible concentrates. The first attempts in field work were in the range of 0.05 pound to the acre applied at the rate of ten gallons per acre by spray. The results on the whole were that the above dosage resulted in few failures, even under adverse conditions. Later, we put the material on with five spray rigs operating on the routine control programs at rates from 0.075 to 0.083 pounds to the acre over a period of about a month and a half in the heavy part of the season (July - August). The material was excellent in the field. We had only one failure in airplane applications on very heavy Bermuda grass in water. The material has no apparent effects on the spray rigs. We did have some complaints from the men because of the odor, which we attribute to impurities in the aldrin itself. It is produced now as a 60% aldrin equivalent with 40% of impurities. There were some complaints of headaches. We were not sure whether that was psychologic or otherwise. The material has a very short residual life which we feel to be of value in our work, particularly where larviciding applications must be made over forage crops.

Mr. Stage: There is very little known about the toxicity of aldrin to cattle. Baby calves have been mildly affected by sprays containing 0.25% concentration. Hereford cattle fed 25 parts per million of aldrin in every item of their feed have shown that 39 parts per million were recovered in the fat twenty-eight days after feeding, and 78 parts per million in the fat after fifty-six days. Sheep fed the same diet showed 28 parts per million on the twently-eighth day of feeding and 78 parts per million on the fifty-sixth day of feeding.

Mr. Coe: On the availability of aldrin, the supply in 1950 was about 2,800,000 pounds. It was used rather extensively in the cotton areas, and also for grasshopper control. We feel that there will be ample supplies for all the mosquito work that might be contemplated this year. On formulations, aldrin is being put out in emulsifiable concentrate at 2 pounds per gallon; 25% wettable powder; 2.5% in dust. The emulsifiable concentrates in price will be one gallon $7.75; in five gallon containers $7.50; thirty gallon containers $7.35; fifty-five gallon containers $7.30. These will be packed in returnable drums. Dust sells at about 13c per pound. Some 25,000,000 pounds of 2½% dust were put on the southern cotton areas last year. For grasshoppers two ounces of actual chemical per acre was used very extensively as sprays, or three ounces in the dust form per acre. Using baits for grasshopper control, two ounces per hundred pounds of bran, at five to ten pounds to the acre, gave excellent control. On the soil pests, from two to five pounds of actual chemical per acre has given excellent control on wire worms, and seed corn maggots.

Mr. Lemmon: Aldrin and products containing it have been accepted for registration for cotton, grasshoppers, and other uses which are experimental. There's been no tolerance yet set up, the material being another one of those awaiting the outcome of the Food and Drug hearings. It is another of those materials that needs to be used with care.

Mr. Geib: Mr. Robinson wants to know if there's data available on the effects of temperature upon aldrin.

Mr. Coe: Our information indicates that the toxicity is about equal at various ranges of temperature. The product is very stable in either alkaline or mild acid waters, and it can be used in salt water without difficulty. The product put out last year contained 60% available aldrin and 40% impurities. Our plant is being remade for the manufacture of the pure crystalline product which can be much more easily handled, and shipped in ordinary containers. This product should be available sometime in the mid-spring. Execpt for difficulties as procurement of essential equipment, we should have the plant in operation very shortly.

Mr. Geib: We will go on to the next compound, dieldrin.

Dr. Metcalf: Dieldrin is closely related to aldrin. It merely has one oxygen atom added to the compound aldrin. The result of this change is very profound, however, and produces a compound which has extreme stability. Next to DDT it has the most residual effect of all organic insecticides.

Mr. Gordon Smith: We screened it in the laboratory and got approximately the same toxicity to mosquito larvae as aldrin, but due to the residual qualities in the material we did not put it in the field.

Mr. Raley: In 1949 we had two field units using dieldrin for larviciding. It looked exceptionally good. In fact, we thought we had found something to take the place of DDT at a fair price. We continued that work in 1950 with only one unit, not knowing too much about the material at that time. Unfortunately, in the early part of 1950, dieldrin broke down in field use. One week, it looked excellent; the next week apparently a resistance had developed and we achieved no effective control with diedrin at that time in that area.

Mr. Geib: Mr. Gjullin or Mr. Lindquist, have you anything to contribute on dieldrin in your experiences with it as a mosquito insecticide?

Mr. Gjullin: Nothing in the field.

Mr. Geib: How about the laboratory?

Mr. Gjullin: It looks very good.

Mr. Stage: The use of dieldrin on live stock has not been established, but we do have more information on it than we have on aldrin. It is very toxic to baby calves at 0.25% concentration and to cattle at 2.0%, sheep and goats at 3%, and hogs at 4%. It is not safe when it is used repeatedly. Cattle sprayed three times at two week intervals with 0.5% material showed clinical symptoms of poisoning. It is stored in the fat of cattle sprayed with it, and two sprayings of 0.25% at three week intervals produced 17 ppm in the fat three weeks after the second spraying. Young Hereford cattle fed 25 ppm dieldrin in every item of feed showed 59 ppm in the fat on the twenty-eighth day of feeding and 74.5 ppm in the fat on the fifty-sixth day of feeding. Sheep fed the same diet showed 34 ppm. It is excreted in milk, and dairy cows with 0.5% spray showed a maximum of 7 ppm in the milk on the third day after spraying.

Mr. Coe: We hope to have some limited stocks of dieldrin for experimental use about May 1. The product was manufactured on a pilot plant operation last year. Some sixty-five thousand acres were sprayed or dusted in the cotton area in the south for the control of cotton insects. We hope to have ample supplies for use on experimental work out here.

The compound is formulated in 1½ pounds of actual chemical per gallon of emulsifiable concentrate, into 25% wettable powders and 1½% and 2% dusts. On emulsifiable concentrate, to the mosquito control groups, the price in 1 pound cans will be $9.45 per gallon, in five gallon containers $9.20, thirty gallon containers $9.05, in fifty-five gallon containers $9.00. Wettable powder prices have not been established. The 1.5% dust will probably compare with 2½% aldrin dust in price. I might suggest that with Ted Raley's experience, it's just possible that there may be some fault with the particular formulation. We don't know whether it could develop a resistance in that brief time. If any product is applied at sub-lethal dosages resistance could be expected with any material. In Arkansas in the rice fields there's been some experimental use on the control of various pests and mosquitoes at 0.05 and at 0.1 pounds per acre. In cotton at fifteen-hundredths of a pound per acre dieldrin gives excellent control on quite a group of insects. On grasshoppers, one ounce per acre was effective. On soil pests, one to three pounds per acre seemed to give an excellent control for various soil pests, such as wire worm, seed corn maggots and certain other forms of life in the soil.

Mr. Lemmon: Dieldrin is not yet accepted for registration in this state for general sale, although it has been for experimental use. At the present time, as far as we're concerned, it is almost ready for acceptance for cotton. One of the things that we're still awaiting is a suitable analytical method for the small quantities in the residue range. Its residual action, as mentioned previously here, may be a particular problem as to usage on a food product. That may be somewhat offset depending upon whatever tolerance the Food and Drug Administration decides upon, and the small amounts that will be used apparently for control may reduce the residue problems, but that may be offset by the long residual life of the material. We're still waiting for the information from the manufacturer before registration can be accepted.

Mr. Geib: I would like to ask Ted Raley if he has an explanation as to what might have happened with his applications? Do you think it was a breakdown of your emulsifiable material?

Mr. Raley: We have no reason to believe that, because the same material used in other areas where it had not been used before gave the same results as the initial spray had given.

Mr. Geib: I have another question. At what rates of applications in using dieldrin did you observe residual action?

Mr. Raley: The residual was very good, in fact so good that we were a little frightened using it in pasture areas. That was why we dropped back to only one unit in the second year, until we could get more information on the application rate for dieldrin. We were at that time comparing dieldrin against lindane, applying dieldrin at the rate of 0.06 pounds per acre in an aqueous emulsion spray.

Mr. Geib: How long did you feel that you obtained residual action when you first began using it?

Mr. Raley: In suitable locations, we had no reinfestation and no appearance of larvae for three months after the first application.

Mr. Geib: Mr. Coe, what effect will salt water have upon this compound?

Mr. Coe: It should be completely stable in salt water and under alkaline conditions as well. It hasn't broken down under any alkaline condition encountered.

Mr. Geib: Then its long residual action should make it an effective material for control in salt marshes.

Mr. Coe: I think it would be very desirable on salt marshes, and we anticipate considerable use in those areas. On a pasturage area you might wish to observe some precaution in the matter of any residues on grasses.

Dr. Tinkham: When we use any chlorinated hydrocarbon in great dilution, such as 0.06 pounds per acre, we are running a chance on building up a resistant strain of mosquitoes. In any population, there are some weak members and some very resistant members, or as we say the "sur-

vival of the fittest"; according to the statisticians about 67% of a population is what might be called the normal. At each end of the population curve you have the strong members and the weak members, and when you get down to great dilutions you always run that danger that these extra-resistant members of the population may not be killed, and will survive to produce new generations of a resistant strain. This I have observed on DDT, DDD, toxaphene and other chlorinated hydrocarbons.

Mr. Geib: We can now go on to the next compound, heptachlor.

Dr. March: I think the only comment necessary is that this particular material, heptachlor, is the most toxic ingredient next to technical chlordan, which is closely related to it.

Mr. Geib: Mr. Ed Smith, Merced Mosquito Abatement District, will report on the use of heptachlor.

Mr. E. A. Smith: We obtained a sample of heptachlor late in the season and had opportunity to test it only on *Aedes nigromaculis* in pastures. On one test we obtained about 50% kill with an application rate of ,0.02 pound to the acre; on doubling that to 0.04 pound per acre, we jumped it up to about 85% kill. The only other data I have is that Gordon Smith tells me they obtained 100% kill with 0.075 pounds to the acre, and that was on both *Aedes* and *Culex* mosquitoes. If any other districts have had an opportunity to test it, I would be very much interested in hearing this results.

Mr. Gordon Smith: I might add that in our work we had very little material, and it was rather a hurried trial, but it is interesting to note that on two applicaions of polluted waters at sewer farms, where we wouldn't expect good results with toxaphene or DDT, we did get good kills with heptachlor.

Mr. Stage: Again, we have very little information on the toxicity of heptachlor to animals. We fed a calf with heptachlor 70-30 emulsion internally and on the 25 mg/kg wieght basis the calf was definitely affected, and died. Two calves were treated on a 15 mg/kg basis and were not affected. Later three calves were sprayed with 1% emulsion; of these, two died and one recovered.

Mr. Weldon: I contacted most of the mosquito abatement districts in California this year, and many times promised them heptachlor, but the material was never received. The reason was our pilot plant was shut for enlarging. We have now doubled its capacity, and we now hope to have enough heptachlor for everyone who would like to run some trials with it. Due to our inability so far to obtain certain pumps that we need, we're unable to get our commercial plant in production, and so will have to depend entirely on our pilot plant for this year. We're planning a very intensified experimental program this year, and hope that we will be able to have some more data for you a little later. Heptachlor is more volatile than chlordan. therefore we don't expect it will have as long a residual action as chlordan. In the way of stability of formulations, we have one report on one of the samples that was sent to the west by our laboratory. One of the commercial companies ran some stability tests on this formulation, and emulsifiable concentrate, and they made the statement that it is the most stable product they had seen after dilution in water.

Formulations will be in 25% wettable powders, 25% emulsifiable concentrates, 5% dust and 2½% dust. There is no price as yet, but the price will be competitive with comparable products.

Mr. Lemmon: As the previous speakers have indicated, the information has not yet been developed to the point that registration can be issued and no registration has been issued for heptachlor, or any products containing it. We'll need full data for this new material before we can issue registration. It will be up to the company to submit the information when it submits its application for registration.

Mr. Geib: Would you have any advice for mosquito abatement districts using material of this type on trial basis?

Mr. Lemmon: With any new material you should secure full information from the company, along with a sample, what precautions you should take, and you should follow these precautions because the manufacturers are in the best position to know what precaution should be taken with the material.

Mr. Geib: We purposely put heptachlor on the program, realizing that not too much is known about it. Several of the member districts are interested in it, so we thought we'd at least give them what we do know at the present time.

We'll go to the next compound, and you'll note that so far we've been in the group known as the chlorinated hydrocarbons. This next material is the first variation from that group, and we go into the phosphate group, with parathion.

Dr. March: Parathion is O.O-Diethyl-O-p-nitrophenyl thio-phosphate. It is a dark brown liquid, very slightly soluble in water and slightly soluble in kerosene, and miscible in alcohol, acetone, and xylene.

Mr. Geib: Mr. Gjullin of the Bureau of Entomology and Plant Quarantine of Corvallis will tell us something about the use of parathion for mosquito control.

Mr. Gjullin: Parathion hasn't been used for mosquito control except in an experimental way. Laboratory tests indicate that this material is considerably more toxic than DDT to several species of mosquito larvae. However, Mr. Deonier in unpublished information on small plot field tests found that parathion and DDT were about equally effective against *Anopheles* larvae. Mr. Fluno also from that laboratory found that parathion was only slightly more effective than DDT against *Aedes taeniorhyncus* larvae in small plot field tests in which the material was applied in emulsion form. In trying to estimate the potentital use of parathion in mosquiton control, the toxicity of the material to man and animals is probably the primary consideration. The American Cyanimid Company has put out a handbook on this material, in which they recommend that all persons working with it should use rubber gloves, respirators and change their clothes immediately after working with it. It also recommends that all live stock in the areas to be sprayed or dusted should be removed, and that particular care should be taken to avoid wind drift on to adjacent areas. When you consider all these limitations, it's doubt-

ful that parathion would have very much of a future as a spray or dust in mosquito control work unless it should prove to be particularly effective against some species that are resistant to other insecticides. However, Mr. Geib has suggested that it may be practical to mix this material directly with irrigation water before it flows into the pastures or fields. The method that he has in mind, I think, is one he used before, and it consists of a drum of the material with a tube leading into the water; the material is applied on a parts per million dilution basis, and by this method you have very little danger from toxicity to man or animals.

Mr. Geib: We've given considerable thought and some work to the possibility of developing a mechanical applicator which would apply given concentrations in given volumes of water, hoping that we may be in a position, if and when we encounter a high degree of resistance to chlorinated hydrocarbons, to substitute parathion.

Dr. March: We probably understand more of the toxic action of parathion than any of the other insecticides under discussion today. Investigation has shown that its principal toxic action is the inhibition of the enzyme cholinesterase. This enzyme cholinesterase is concerned with the transmission and mediation of nerve impulses across nerve synapses, and its inhibition results in the blocking of recovery of nervous tissue and in excessive spontaneous nervous activity. One of the features of parathion poisoning, which I think is worth mentioning is the slow return of cholinesterase levels to normal following inhibition. Parathion inhibits the enzyme irreversibly and recovery to normal depends upon formation of new enzyme. This is at the rate of only a few percent of normal per day; in the case of red blood cell cholinesterase it may take as long as two months to regenerate the enzyme to normal levels. We know very little of the fate of parathion in the body. We know that it is not stored as DDT is, or concentrated, but it is apparently metabolized very rapidly and is excreted as unknown metabolists in the urine.

Parathion is many times more toxic than DDT; with an oral L-D 50 of three to four mg/kg as compared with 150 for DDT. It differs from some of the other materials under discussion in that it is readily absorbed through the skin, not only from oily solutions but also from the technical material and from dusts, where most of the other materials we discussed this morning are not particularly hazardous as technical products. The estimated dangerous dose for man is relatively low compared to the other, being on the order of 12-20 mg orally or a very small fraction of a gram. By skin absorption it is 3 grams per single dose, or 300 milligrams for multiple doses. Chronically, however, parathion can be considered as much less toxic especially in the light of its very high acute toxicity.

Mr. Gardner: The status of production of parathion in the United States is. I belive, in ample supply for 1951. I assume that the major producer, American Cyanimid. supported by Monsanto and two other companies producing the material, will be capable of taking care of all the national demand for this material. Parathion is also exported from this country. The principal foreign country producer is Germany, with England having two plants in production and I believe in France they have some minor production, so that the world production of parathion is quite substantial.

In respect to formulation of parathion, the most common formulation is the 25% wettable powder, that is 25% parathion and 75% of an absorbent clay. It is also made in a 15% wettable powder, and in addition to that it is made as a 25% emulsifiable liquid. The emulsifiable liquid contains two ponuds of actual parathion per gallon. In Europe the typical formulations are different than in the United States in that in Germany and several other mid-continent countries, they use 15% liquid formulation, or 85% more generally than anything else. Wettable powders are hardly used at all. They use different types of formulations which are designed to prevent skin penetration. In France they use the liquid type but containing 15%. It's interesting to note that also in Germany that at the end of World War II parathion was the material used to control bedbugs and other household pests to clean up the country after the ravages of war, so that this highly toxic chemical was used safely in the habitations of people generally throughout the country.

The prices vary on 25% powders from $1.00 to $1.40 per pound. Those of you who are working with parathion should read the precautions carefully, contact your local doctor or emergency hospital and be sure he has emergency treatment information, and also to go over it with your men so that they know exactly what to do in case of any accident. Also, consider the storage room for this material and do not set up a room such as a galvanized shed that's tight, where there will be wettable powder and chances for the material to vaporize and get a high concentration where people are working packaging materials. If you're getting liquid material be careful of your handling of empty drums, and empty drum disposal. I'm confident that parathion is one of the most effective insecticide tools in our hands, and if a ned should develop for a highly toxic agent with a comparatively short residual life, that it has high versatility against many different insects.

Mr. Lemmon: There are a great many products containing parathion registered for sale in this state and it is rather widely used in agriculture. It is classified under the law as an injurious material, and as such can be used only under a permit from the Agricultural Commissioner of the County in which it is to be used. Perhaps, I should explain a little about injurious material regulations. In 1949, the Legislature added Section 1080 to the Agricultural Code requiring the Director of Agriculture to make an investigation with regard to injurious economic poisons and determine what precautions or what particular handling should be required in order to protect those using the materials as well as their neighbors. Hearings were held as a result of this new provision of law, rules and regulations were set up, and the hearings were rather prolonged. One session was in Sacramento, and another one in Los Angeles. As an outcome of the classification of parathion and certain other materials as injurious materials, the law required that they can be used only when a permit is secured from the Agricultural Commissioner of the County in which it is to be used. The purpose of this is to make every use of parathion a matter of record. Intent is not to prohibit or prevent the use, but to let us say encourage intelligent use where there is adequate understanding of the precautions that should be followed. It is recognized as a valuable tool but also an extremely hazardous one. It is not registered fo ruse in or around households, and permits would not be

issued for such usage. There appears to be rather a low residue problem; it seems to dissipate in the course of two to three weeks when applied according to the normal dosages necessary for agricultural pest control. Tolerance has not yet been set, although on the basis of pharmacological information that we have seen for the U. S. Food and Drug Administration, we've been operating on the basis of 2 parts per million. We've not had any seizures of produce in ou rinspection programs, because those using parathion realize they must allow between two weeks or a month between the last application and harvest. This allows the material to dissipate and leaves no residue problem at all. With proper handling there should be no spray residue present, but it may develop that a reasonable tolerance would be two parts per million, but we're still waiting the outcome of Food and Drug hearings before establishing state tolerance.

I'd like to emphasize if any of you are considering using it, even experimentally, you should see your Agricultural Commissioner, secure a permit and make it a matter of record, so that there can be no questions but what you have full protection in having complied with the law in case an accident of some type did occur.

Mr. Raley: From observations of cotton fields where parathion dusts were used, with both pre-inspection and post-inspection surveys, we observed no change in the larval mosquito population within those cotton fields. But it was a dust material used for cotton insects only.

Mr. Lemmon: Where you are making inspections when parathion is being applied by aircraft, don't get out and stay in the dust. Make your inspections several days after application, not during the application.

Mr. Geib: Any further comments? Time is getting short if we're going to cover the insecticides listed on the Symposium. I suggest that we move along as rapidly as we can. Next on the schedule is lethane. It has been used by a number of districts experimentally but not extensively according to my understanding. Mr. Portman has had considerable experience with the use of lethane.

Mr. Portman: Apparently a number of the districts have used lethane and some have used it because it was available on a "give" basis last year from surplus war material. I contacted several other districts to see what their reaction was to it and their ideas in regard to it are somewhat different from mine.

Larviciding

Sutter-Yuba Mosquito Abatement District has used lethane in conjunction with light kerosene in back pumps, and found it very effective especially on pupae. No evaluation has been made to determine whether or not the lethane was entirely responsible, or whether the light kerosene was responsible in part for the kill obtained.

The Oroville Mosquito Abatement District used surplus 10% lethane in light kerosene as a larvicide and found it very effective.

The Butte County Mosquito Abatement District has used a DDT oil larvicide containing 1% lethane for two seasons, applied at the rate of 0.01 gallon lethane per acre. This DDT-oil-lethane larvicide resulted in a rapid kill of larvae, often within 15 minutes, and a high pupae kill within a half hour, whereas the kill by the DDT water-oil emulsion without lethane gave a much slower larvae kill and an incomplete or poor kill of pupae. Lethane used in a DDT emulsible oil larvicide containing 2% lethane on a sewer ditch gave a good kill on larvae and pupae which was not obtained by other formulations not containing lethane. An oil base plane aerosol larvicide spray containing lethane was applied to rice fields in 1949. The application rate of 0.16 pounds DDT/Ac. and 0.004 gallon lethane per acre gave an excellent kill. An oil base plane larvicide spray containing lethane was applied to a rice field in 1950. The application rate was 0.22 pounds of DDT/Ac. and 0.0055 gallon lethane per acre. This gave a good kill except in dense rice where the kill of culicine larvae was not too good. The concentration of lethane was doubled to 0.011 gallon per acre and a good kill of both anapheline and culicine larvae was obtained in dense rice.

Aerosoling

Solano County Mosquito Abatement District has never had any indication of any kill using lethane as the only toxicant in aerosoling. It has an irritant effect on the adult mosquitoes. Lethane is used at the rate of 12% in an aerosol formulation containing 0.8 pounds of DDT per gallon.

The Sutter - Yuba Mosquiton Abatement District has added 1% lethane to an aerosol formulation which contains 0.66 pounds of DDT per gallon and belives it acts as an irritant in the aerosol and stirs the adult up enough to cause it to move around and get a greater exposure to the DDT. They doubt that the killing power of their aerosol formulation is improved enough by 1% lethane to justify the cost.

The Butte County Mosquito Abatement District has for two years used an aerosol formulation containing 0.8 pounds of DDT per gallon and 2% lethane. This formulation has proved to be very satisfactory. The lethane activates the adult mosquitoes and makes the aerosol more effective.

Miscellaneous

The use of a 10% lethane in light kerosene spray, containing 0.4 pounds of DDT per gallon for residual spraying showed that the lethane activated and killed the adults which were resting in the places sprayed.

We have some of this surplus 10% lethane and light kerosene and we used it in aresidual spray program this last fall. We added 0.4 pounds of DDT per gallon and we used it instead of Diesel oil like we had formerly used in our residual spray formulations. The men have constantly reported that when they use lethane it really activitates the adults and kills them and they get a good knock down.

Mr. Geib: Mr. Wampler reports that lethane has been used extensively in aerosols and is considered to be relatively non-toxic in that form. Any other comments?

Mr. Stage: I have seen the concentrated material placed on the comb of a chicken and it killed the chicken within a very short time, but I also know that the Navy has used a 10% lethane spray as a space spray for several years. However, the Army took it off its supply list. The Navy is now using, I believe, 5% lethane and 3% DDT space spray.

Mr. Wampler: There are very few comments to make on the lethanes because you are undoubtedly familiar with them. For many years it was one of the first compounds to be synthesized commercially and used in wide scale operations.

As to the supply of the materials, there should be, comparatively speaking, a fairly good supply for next year because the intermediates involved are not in tight supply like some of the intermediates for chlorinated hydrocarbons.

The lethanes have in the past been used extensively in fly sprays, and then they decreased on the advent of the chlorinated compounds; now that resistance is appearing they are again being given attention because of their apparent effect on resistant insects as a contact insecticide. There are three formulations available, lethane 384, lethane special and lethane 60 cotaining various amounts of the active ingredients in slightly difference formulations. The price of lethane 384 varies from $4.50 to $5.00 per gallon while the special and the lethane 60 are somewhat cheaper than that.

Mr. Lemmon: These sparys containing lethane products have been on the market for a good many years, and there seems to be no particular problem involved with their usage.

Mr. Geib: There are a number of individuals who are interested in chlordan and that is next on our list.

Dr. March: Technical chlordan, like toxaphene, is a mixture of various compounds colsely related, comprising from 60% to 75% pure chlordan, which contains 8 atoms of chlorine. The associated componets contain from 6 to 9 atoms of chlorine. Technical chlordan is a brown viscous liquid, very easily soluble in most organic solvents and insoluble in water.

Mr. Lindquist: As a mosquito larvacide chlordan has not enjoyed particularly wide usage. The reason for that may be that it came along shortly after DDT, and people were so enamoured with that toxicant that they didn't give too much attention to chlordan. This compound is not as effective as DDT an dseveral others as a mosquito larvicide, but tive as DDT and several others as a mosquito larvicide, but several things in its favor. It has a fumigatory action and it is well known that if it is applied in rather heavy dosages in enclosed areas, the insects are killed by fumigatory action, as well as by contact. I am not familiar with what's been done with this material in anopheline control in various parts of the world, but it should be considered because of this fumigant property. As to the potential uses of chlordan, I don't have anything to offer. If it gets down real low in price, it may have possibilities in specialized uses.

Mr. Stage: Chlordan is relatively safe insecticide to use from the standpoint of acute toxicity. Most farm animals, except young calves, can withstand 2.0% sprays and dips. Baby Jersey calves that are one or two weeks old however can easily be killed by a spray containing only one percent. Chlordan is not so safe as a chronic poison; adult cattle can withstand one or two 2% treatments at two week intervals, but are killed with three such applications. This genreally appears to be the case with all other farm animals. It's a safe insecticide to use on dogs as long as it is used at the recommended dosage. American pest control operators have used large amounts of this material in homes, but when it is so used we recommend that it be used as spot treatments. It is a particularly good insectide against ants, cockroaches and spiders.

Mr. Weldon: I have one larvicide roprt by Dr. W. V. King, Orlando, Florida; he used a one-hundredth of one percent chlordan and got a ninety percent kill within forty eight hours. That's the only report that I have on chlordan as a larvicide.

Mr. Lindquist mentioned that if the price of chlrodan got in a low enough range there might be some use for it as a mosquitocide. We realize very well that the high price of chlordan in the past has caused many of you to shy away from even its possibilities. However, by not raising our prices in the past year, we're gradually getting in line.

The availability of chlordan, however, is something else. I'm told that the demand of the Federal Government for chlordan for use in the armed forces the last half of this month and April is going to be very heavy; therefore the supply is going to be small in April and the first part of May. However, during the latter part of May and June the demand will ease off and an abundant supply will be available after that time. Chlordan is very easy to formulate. It can be formulated into almost any type of formulation you want. Probably the most available formulations are 2% and 3% in kerosene, and an eight pound or a four pound emulsifiable concentrate, also 40% or 50% wettable powders and 5% and 10% dust.

Mr. Lemmon: There have been may products registered containing chlordan. One of the interesting things we notice in our registration of economic poisons is that apparently the increase in new products somewhat follows the style of women's dresses. When a new thing comes out on the market, everybody wants to register a product containing it, then pretty soon there's a rush for another new one. We have been treating chlordan somewhat the same as DDT, although no tolerance has been set. We've been awaiting the outcome of the Food and Drug hearings. The tolerance will probably be pretty low.

Mr. Weldon: I'd like to make one statement about toxicity. At the present time we have a toxicologist as the University of Illinois, who is reviewing the toxicity of chlordan, and we hope to have some results from these tests soon.

Mr. Coe: I failed to mention the availability of aldrin and dieldrin to the various formulators. Our exclusive supply manufacturer will be Shell Chemical Corporation, and they intend in turn to sell to the various formulators such as California Spray-Chemical, Stauffer and many others.

Mr. Stage: Last week I was at the Kerville, Texas, laboratory where we are testing many of these insecticides on animals. We saw symptoms of toxicity ,but of course you and I must not make any interpretations of them. In case of suspected poisoning we should have a veterinarian examine the animal as soon as he can, to make the proper diagnosis. The veterinarians tell us these insecticides show their effect on animals in the form of various nervous disturbances. No two animals poisoned by any of these insecticides show exactly the same chain of symptoms, yet they are sufficiently alike to be fairly distinctive. An af-

fected animal generally will first become excitable, a little more alert to its surroundings; twitching of various muscles usually begins at the head, and slowly goes backward to the end of the body. The twitches may increase in intensity until they are spasms, finally convulsions, and then death. In addition, many abnormal attitudes of the body are shown; an animal will stand with the head between the forelegs and under the body, with a persistent chewing movement. If you look carefully, you will see the animal is not chewing but is continually making a chewing movement right at the ground. Occasionally, they become somewhat belligerent; it's amusing to see a calf six weeks old start fighting you. There is usually profuse salivation, rolling of the eyes, dribbling of urine and bawling or crying of the animal; the body temperature is very high up to about 114 degrees.

Mr. Geib: In closing this Symposium I wish to thank this group of experts we've had before us. They have given us valuable and recent information that we would have a very difficult time obtaining by any other method. They've traveled considerable distances, and it is indeed a rare occasion to get a group like this together. Thank you very much, gentlemen. (*Applause.*) I will turn the meeting back to President Smith.

Mr. E. A. Smith: Norm Ehmann has an announcement to make.

Mr. Ehmann: The total registered attendance was 125 at this convention and I'm glad to report we'll have over $100.00 to turn back to the Association over and beyond the $150.00 that was loaned to us to work on. (*Applause.*)

Mr. E. A. Smith: This has been rather a long session, so we're going to have a recess. We have only three more papers to go and they're very interesting ones. However, let's take about one minute to stand up and stretch before we go into the home stretch.

Will the Members of the Board of Directors of the California Mosquito Control Association please come up here to the front of the room at the close of this session for just a very few minutes.

The next paper is on the subject of the Clear Lake Gnat, to be presented by John R. Walker, Vector Control Specialist, Bureau of Vector Control, Berkeley.

AN EVALUTION OF THE 1949 CLEAR LAKE GNAT CONTROL PROJECT

by

JOHN R. WALKER

California State Department of Public Health
Bureau of Vector Control

This report is intended to be informal in nature in that a detailed account of the project will be published in the near future under the senior authorship of A. W. Lindquist, who, assisted by A. R. Roth, was responsible for the extremely thorough planning which went into the control program, and who heads a list of the many individuals who over a period of years contributed directly or indirectly to the success of this undertaking.

The Clear Lake gnat, *Chaoborus astictopus* Dyar and Shahnon, though a non-biting insect, was for many years the cause of extreme discomfort to residents and tourists along the shores of Clear Lake. Since the economy of the Lake County area is in a large part based on recreational developments, the matter was one of unusual concern. The annoyance was caused by the presence of the gnat in astronomical numbers and by its attraction to lights.

It was not possible to evaluate clearly the public health aspects of this problem in that no thorough medical investigation was included in the studies. There was, however, considerable evidence based on clinical observations of local physicians which indicated that the unusual incidence of individuals suffering from allergens could be correlated with the seasonal abundance and distribution of the gnat population. The fact that a condition of hypersensitivity to certain insect proteins is a rather common and widely recognized phenomenon has been observed by a number of investigators.

Preliminary Studies

Between 1916 and 1936 investigators from the University of California, under the direction of Professor William B. Herms, contributed much to the present knowledge of the biology of this species. In 1938 Congress appropriated funds to the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine, to make further studies on the biology and control of the gnat. Mr. A. W. Lindquist was placed in charge of these studies, and subsequently, under his technical direction, the control project was conceived, planned and executed.

Between 1938 and 1942 much basic information was obtained with regard to the gnat, as well as other aquatic fauna. All control measures showing promise were explored. These included numerous mechanical and chemical agents directed toward the various stages of the life cycle. No large scale control project was undertaken, however, and with the onset of World War II the work was discontinued.

Following the war a series of laboratory and field tests conducted by the U. S. Bureau of Entomology and Plant Quarantine clearly demonstrated the value of certain of the newly developed chlorinated hydrocarbon insecticides in controlling gnat larvae. By 1948 experimental work had progressed to the point where it appeared that a high degree of control could be obtained in Clear Lake with a TDE (1,1 bis (P-chlorophenyl)-2,2-dichloroethane) larvicidal treatment without endangering the fish. The California Division of Fish and Game studied the effect of the treatment on fish during these preliminary tests.

In 1947 a test was run in Low Blue Lake, a lake of about 75 acres located near Clear Lake. TDE was applied in the ratio of 1 part to 45,000,000 part of water. The experiment was highly successful, except that a few fish were killed. In 1948 a second test was run in Detert Reservoir. The ratio of TDE was changed to 1:75,000,000. In this test complete control of the gnat larvae was apparently achieved without apparent harmful effects on the fish.

The Control Program

In February, 1948, the Lake County Mosquito Abatement District was organized. Through this medium tax funds

were procured to provide for the control of mosquitoes as well as to undertake a full-scale gnat control project.

On June 17, 1949, Governor Warren approved Assembly Bill No. 3102, whcih amended the State Health and Safety Code and provided for the allocation of certain vector mosquito control subvention funds to agences undertaking the control of gnats which adversely affect the public health. Accordingly, the State Department of Public Health through the Bureau of Vector Control allocated $10,000 for the 1949 - 50 Fiscal Year to assist in financing the project.

Clear Lake, with its area of almost 42,000 acres and a volume of over 850,000 acre-feet of water, was treated on September 15 and 16, 1949. Six tugs, each pulling barges loaded with drums of TDE emulsion base containing 30 percent TDE, 10 percent of Triton X-100 and 60 percent of xylene were used in the project. The insecticide was applied through hoses by gravity feed. Approximately 14,000 gallons of the concentrate were used to obtain a dilution of one part of active insecticide to 70,000,000 parts of water.

In addition to Clear Lake, a total of 22 small lakes and reservoirs within 40 miles of Clear Lake were treated during September and October by Eric Winkler, the District Entomologist.

Evaluation

Extensive post-treatment surveys conducted at Clear Lake and at the surrounding smaller lakes indicate that a remarkable degree of control has been achieved.

Over the period of years between 1938 and 1949, during which time the Bureau of Entomology and Plant Quarantine conducted the preliminary investigations, great seasonal and yearly fluctuations in gnat populations were observed. Bottom samples taken with Ekman dredges showed average density variations ranging from 96 to 1004 larvae per square foot. One extensive series of tests conducted over a period of two years indicated an average total seasonal emergence in excess of 500 gnats per square foot. It was calculated by Lindquist and Deonier in 1939 that the total seasonal production on the upper arm of the lake comprising 44 square miles, on the basis of emergence in cages, was approximately 712 billion gnats, or 356 tons. One night's emergence if spread evenly for a mile back of shore would result in a concentration of some 5 gnats per square foot.

On September 12, 1949, three days prior to the application of insecticide, dredges taken to give a representative sampling of the lake bottom revealed an average density of 144.6 larvae per square foot. This figure was rather low for this time of the year. Adult density which had reached a peak during the warm days of the first week of September had dropped appreciably by September 15th.

On September 19th, three days after treatment, extensive dredging showed a density of 18 larvae per square foot, a reduction of 87.5 percent. By the end of one week the density had fallen to 5.6 per square foot, a 96.1 percent reduction. Ten days following the application a 99.83 percent reduction was observed.

As a further check for the presence of gnat larvae remaining in the lake, plankton nets were drawn through the water at night in an attempt to take free-swimming larvae which were known to migrate vertically from the mud after sunset. The past two larval specimens recovered from Clear Lake were taken in this manner on October 18, 1949, 33 days later treatment. At that time an estimated 10,000 cubic feet of water was strained. In previous years, sampling of such a magnitude would have yielded at least 50,000 larvae. Extensive seining and dredging subsequent to that October 18th survey have failed to recover any *Chaoborus* larvae in Clear Lake. In like manner, light traps operated on both sides of the lake during the 1950 season failed to take any adults of the species.

This degree of perfection has not held for certain of the smaller lakes and reservoirs which were treated. Some required second and third applications at increased concentration to obtain what appeared to be a complete kill in 1949. In the fall of 1950 eight of these smaller lakes showed evidence of reinfestation and were treated again, in some cases using still higher concentrations.

The only lake of apparent consequence in the area which has not been treated is Lake Pillsbury which is located some 29 miles north of Uupper Lake. In that this lake is stocked with trout, an extensive testing program would be required before permission to treat would be granted by the Division of Fish and Game.

Species Eradication Considerations

The Clear Lake Gnat Control project was the climax of many years of intensive study embracing all phases of the biology of *C. astictopus* as well as exhaustive investigations covering almost every conceivable mechanical, biological and chemical method of control. The method and materials finally chosen for this project, and which apparently achieved such a remarkable degree of control for this species in Clear Lake, were not notably effective against the other aquatic Diptera, all of which are widely separated bionomically from *C. astictopus*. While the densities of several species of Chironomids present were reduced at least temporarily, this group remains relatively abundant in Clear Lake. There was no evidence to indicate that the density of littoral fauna in general had been reduced significantly.

These observations considered along with difficulties encountered in controlling Chaoborids in some of the smaller lakes and ponds support the contention that there is a high degree of specificity in the methods and materials which can be used successfully in the control of a species in a given ecological situation.

The term "species eradication", though literally implying world-wide extermination of a species, has frequently been applied to the elimination of a given species in a limited, though at times relatively extensive area. When this has been accomplished, the species may reappear after interruption of the control program only if reintroduced. The probility of reinfestation should be expected to vary with the size of the area cleaned and with the degree of isolation from infested territory.

On the basis of 18 months of close observation since the treatment of Clear Lake it is apparent that complete or near complete control of *C. astictopus* has been achieved in this area. Perhaps by the end of 1951 we shall be in a position to determine whether eradication has been accomplished. Should this be borne out, an uninterrupted program of surveillance and control will be required to maintain the barrier against reinfestation.

Mr. E. A. Smith: The next speaker on the program is Mr. Leonard Miller, Chief Santitarian in the Riverside County Health Department.

THE GNAT PROBLEM OF ELSINORE

by

LEONARD MILLER

Sanitarian, Riverside County Health Department

The control of gnats at Lake Elsinore takes on an aspect peculiar to any similar project handled by one of the abatement districts.

When the problem gained the magnitude of a general nuisane, the Health Department secured a legal opinion from the County Counsel that general public funds could not be expended within a localized area to abate an insect nuisance that had no specific public health significance. In addition, a legal question was raised as to public or private ownership of the lake, and we were further hampered with a legal opinion that public funds could not be used to abate a nuisance on private property unless said nuisance could be proved to be a public nuisance.

Through several conferences, it was agreed that the Health Department could legally expend funds in research to determine if a public nuisance existed, or to compile data which would enable the local citizens to bring about proper control; thus a research project was organized. As the Health Department had no finances budgeted, we enlisted the services of Dr. Robert Metcalf and Dr. Ralph March of the U. C. Citrus Experiment Station to perform the entomological studies and to give us technical advice on the research. Our appeal to Arve Dahl secured a donation of 350 gallons of 35 percent DDT, 2 percent Triton x-100 and 63% xylene concentrate. This was surplus material owned by the State Health Department, Bureau of Vector Control.

In February, 1949, the local citizens of Lake Elsinore, by local subscription raised $250.00, and the City of Elsinore appropriated $200.00, which provided the funds to begin the research.

Information available was analyzed to determine the extent of the problem. This consisted of an analysis of the waters of Lake Elsinore made in 1940 by C. G. Gillespie, then Cheif, Bureau of Sanitary Engineering, State Department of Public Health. At that time, the lake contained approximately 2,000 acres of water with an average depth of 10 feet or, roughly, three billion gallons of water which contained:

135,000	tons of wet algae with 1/10 of algae on shoreline
55,000	tons alkali
150	tons nitrogen
5,000	tons algae sludge
3,000	tons dry suspended solids
14,000	tons sulphates (as Hydrogen sulphide—300 ppm.)
4,000	tons oxygen consumption
1,350	tons B. O. D.

In April, 1949, the research was actively launched by Doctors March and Metcalf assisted by James Hastings, R. S. of the Health Department.

Four light traps borrowed from the State Health Department, Bureau of Vector Control, were placed at locations which would give an average infestation at all points. Adults trapped averaged 20,000 per hour. At one time as many as 165,000 adult gnats weer trapped in a one-hour period.

Larvae were strained from the mud of the lake bottom and averaged 200 per square foot.

Identification disclosed *Tanypus venustue* and *Chironomus plumosus* (blood worm) with the latter predominating.

Barrel tests were conducted to determine the effects of larvicides. Many chemicals were tested with DDT and BHC showing the most promising results as follows:

DDT 1/25,000,000 parts	72% kill
DDT 1/25,000 parts	72% kill
DDT 1# wettable powder per acre	74% kill
BHC 11% 1# wettable powder per acre	94% kill

To prove the laboratory results of larvicide treatment, prison labor was secured from the County Sheriff to dyke two one-acre test plots each containing approximately an average depth of 6 inches of water, Three days after the dykes were completed, Doctors March and Metcalf and Mr. Hastings arrived to conduct field applications and found the plots entirely devoid of water due to evaporation. A portable water pump was recruited without charge from the Los Angeles Clay Products Company located nearby. A truck was borrowed from the City of Elsinore and the pump was loaded, hauled, unloaded and placed in operation. The plots were filled and maintained until confirmation was secured on the efficiency of BHC 11%.

The cost of treatment was determined as follows:

2,150 acres of lake surface	
2,150# 11% BHC @ 38c per pound	$817.00
Aeroplane dusting	250.00
Total Cost	$1,067.00

The funds could not be raised until a year later when the investation had reached proportions greater than the year previous and the gnats were three inches thick on all exposed lights after dark.

On May 22, 1950, the citizens of Elsinore purchased and had delivered to the lake 1800# 11% BHC wettable powder (the lake, due to evaporation, had produced approximately 1600 acres.)

The Health Department contacted Jack Kimball and attemped to borrow a water buffalo to apply the dust but Jack was unable to assist as his amphibious equipment was out of service. A long distance phone call to Art Geib could not get us a dust plane, so an emergancy conference was called with the Elsinore Chamber of Commerce who raised $200.00. A call to Everett Stone, M.D., County Health Officer, secured a commitment of $120.00 to be paid by the Board of Supervisors to employ an aeroplane to dust the lake in order that our research could be completed.

On May 23, 1950, the lake was treated. The first run with dry BHC was not successful as wind drifts carried the dust into the hills; the balance of 1600 pounds was emulsified with water and sprayed by plane.

Twenty-four hours after treatment it appeared to be a failure. In forty-eight hours, the dead larvae or blood worms began to wash onto shore and within a week lined the shores for 2' to a depth of 1". Subsequent tests by Doctors March and Metcalf indicated an 80% kill of larvae which was remarkable as the algae in suspension had more than doubled in the ten years, which prevented a large part of the BHC from penetrating into the mud. About three weeks after treatment, a tremendous kill of adult gnats was noted, being washed onto the banks. The citizens were happy; the Health Department was off a spot, and I'll be forever indebted to Bob Metcalf, Ralph March and the U. C. Citrus Experiment Station.

As an interesting sidelight to this problem, in August, 1948 a phenomenon occurred which unbalanced the forces of nature in the lake. Lake Elsinore had a type of algae growth which consumed oxygen during the dark and released oxygen in sunlight. A period of several overcast days allowed this algae to consume sufficient oxygen to kill the carp in the lake. At this time millions of *Gambusia* were living in the upper 2" of water. In February 1949 not a single *Gambusia* could be found or any trace of a skeleton of the *Gambusia.*

There is a natural cycle through which life passes in such a lake. This spring the lake started with plant life. Something has undoubtedly disturbed the balance of Nature recently and this explains where there has been an ascendency and unrestricted growth of a single species of *Spirulina* this spring. In the second phase of the cycle there are the Rotifers, still larger organisms of the animal kingdom, thriving and devouring the Spirulina. In the natural course of events, some still larger organisms, the Chironomids, will appear to devour the Rotifers. Ordinarily, fish feed on the Rotifers and, insofar as the food supply is converted in tonnage of fish flesh, the lake is cleared of its food supply for plants. But there are evidently no fish in Lake Elsinore. After the Chironomids consume the Rotifers and take to wing they become an insect pest in the neighborhood. To the extent that such insects leave the lake, organic food supply for future cycles in the lake is taken away. But when you start with, say, 3000 dry tons of food supply in the lake, withdrawals in the form of winged insects is not a great help.

And while all these things are going on, the dead algae plants, animals and insects left in the lake undergo decay and this in turn leads to fresh crops of green or brown algae; then the small animal life, and finally, the insects come on in their successive cycles. Some of these produce much oxygen which keeps the lake fresh. Others produce none. The result you get is the net of all of them. You can readily see that control by introducing fish is impossible and our only hope is that the lake will be dry by June, 1951.

I might just briefly add that Lake Elsinore in the early days used to be known as Lagunda Grande, or big lagoon. Pio Pico when he first came into the Valley sent his scouts out looking for water. One of his scouts returned and said he had found this beautiful Laguna Grande, and they asked how was the water: he said, "Like Hell, Senor!" As long as I have known Lake Elsinore, it's been the same proposition.

Mr. E. A. Smith: For the final paper, we have Dr. Ernest R. Tinkham, the Entomologist of the Coachella Valley Mosquito Abatement District, who will discuss the gnats of of the Coachella Valley.

Dr. Tinkham: Those of you who have ever been to our Valley will know something about the friendly nature of our inhabitants and perhaps have heard of the friendly Indio "wave". Little do those tourists and travelers, passing through our Valley, realize that with that Indio "wave" there are muttered anathemas and protestations by people plagued wih a pesky and pestiferous creature. They dive-bomb your ears, and they dive-bomb your eyes. If you mutter curses, they dive-bomb your mouth and get in your larynx and suddenly stop those things that may be muttered from your mouth. At one time they closed the schools of our Valley with "pink eye", a very serious condition. Every one of the schools in the valley even today, especially in the fall, has nurses to take care of a whole roomful of children every morning that have developed "pink eye" in the last twenty-four hours, so it is a medical as well as an economic entomological problem.

We have five species of gnats in the valley, belonging to the Genus *Hippelates;* they are *colosar, robertsoni, dorsalis, pusio* and *hermsi. Colosar* is a yellow-legged species, black body and is an annual species. Any day in the wintertime with a temperature over sixty they'll be out, hibernating when the weather is colder. *Robertsoni* is a very interesing species, a spring species; apparently it has come into the valley recently. The type locality is Idlewild, about 8,000 feet elevation, and it is probably able to survive in the Coachella Valley only as a spring species. *Dorsalis* is a gray summer species and *pusio,* closely related to *colosar,* is apparently mainly a fall species. Last of all, we have *hermsi,* named after the late Professor Herms by Sabrosky. It is a non-pest species, and is not found near human habitation. The only way one can find it is by sweeping the air of the orchards.

The most outstanding discovery in 1949, made jointly by our district and the Bureau of Vector Control with Mr. Ernest Meyers in charge, was that we discovered the gnats breed almost entirely in freshly chilled or disced soils of the mature date and citrus orchards. Contingent on that very important fact then must be the fact that to control the gnats would be a simple matter if we could get rid of that practice, shall we say vicious practice, of cultivating every two or three weeks. Everytime that a grower discs his orchard, he is bringing on a new generation of gnats. Our district program last summer was a fourfold program, and naturally the first and most important one on that program was cultural control. Since gnat control is intimately bound up with the cultural practices of the valley, it's going to be a matter of education over a period of years before we can shift the cultural practices. Everybody cultivates not because there is a valid reason, but because they're mostly wheat growers from the central states, but everybody is following Tom, Dick and Harry, and there are only a few individuals in the valley that have ever given any thought to what is the best type of cultivation. Mr. Williams' sister went over to Mesopotamia about 1935 and found that the Arabs in Irac did not cultivate and it is evident that dates have been grown for thousands of years under non-cultivation, and

that ought to be the best way to produce dates. So the Williams orchard has a beautiful Bermuda cover, and it is one of the very important orchards that has figured in our investigations. More important still is the fact that non-cultivation actually produces better crops. Here's a figure that I got from Cosgrove, one of the growers who in the winter of 1948 and 1949 went over from cultivation, in which he produced only twelve hundred boxes of grapefruit off of four acres, and in the previous year fifteen hundred. He turned over to non-cultivation in a very bad year, the year of the worst freeze since, 1937, and in 1949 produced thirty-two hundred boxes of grapefruit, and to indicate that it was not an accident in 1950 he duplicated it by producing thirty-three hundred boxes, which is over forty thousand pounds of grapefruit per acre. Likewise, date production apparently is greatly increased. Right across a narrow road leading into the Williams' house is the Wood place; no two orchards could be more identical, except for cultivation. Williams with his Bermuda cover which has not been touched with a disc or plow since 1941 outproduced his near neighbor by twenty-eight hundred pounds per acre. Pulcifer down in the oasis area has a near neighbor, Brown who uses every means of cultivation and fertilization, and produced eighty-six hundred pounds, but Pulcifer produced a phenominal almost thirteen thousand pounds per acre, and his orchard has not been touched with a disc or plow since it was put in in 1932. It's a matter then that the control of gnats would be a matter of education, but we cannot take time to wait for the pendulum to swing by education. It's going to take years, so we have to go to another type of program until we're able to supplant it with a cultural control. In the control of an insect, the best control is the natural control and this cultural control program of non-cultivation would actually save everybody money.

It would cost the taxpayers to run our district Fifty to Seventy-Five Thousand as compared to Nineteen Thousand this year, if we soil treat all the mature date and citrus orchards of the valley. The cost to the grower is the cost of tractor and disc, fuel and manpower to drive the tractor, the cost of the reduced yield and also the cost of impaired soils. The latter is a result of the vicious practice of cultivating. As soon as the soil has been disc and irrigated it starts to dry out. Our air is very, very dry, below 10% relative humidity, and as the ground starts to dry, capillary action takes place, up comes the water from the sub-soil and the water goes into the air leaving the salts behind. These salts permeate the top layers of the soil until when the orchard dries out, you can't make a heel mark into those soils, so the farmer has to get in there again and break it up and irrigate to get water penetration.

Not so with non-cultivation; you can go into these orchards that haven't been cultivated for years and find a coarse type of soil. With this coarse type of soil you have some very interesting characteristics, one of which is increased production. In your citrus orchards you have the feeder type of roots roght in the soil surface, and your disc is actually cutting away ten inches of the feeder root. In other words, the citrus trees are practically bleeding to death. In good citrus practice they say you ought to snip off the fruit rather than pull it. Well then, that is what is happening to the tree roots when the disc is cutting them away all the time. These matters then enter into an education program, informing the growers of the benefits of non-cultivation, and trying to get a few to start; in a year or two they'll convince their neighbors that they're out-producing them, and then in maybe four or five years the pendulum swings to the other side and we'll have the valley devoted to non-cultivation in the date and citrus orchards, and we will have eradicated the gnats and everybody will be happier and more wealthy.

Next we have soil chemical control, in which I have done most of my experiments during the last two years. This is more or less being abandoned; that's the way it is with investigations. This method is very costly and not a cure at all, but if you're going to control the gnats you've got to get at them where they're breeding in the soil, rather than wait for them to come out and then treating adult gnats. We could probably spend $25,000 a week with airplane control trying to combat the gnats of the valley, and yet they're just pouring out of the soil by the millions. We tried that out with the Beskil and the York-Hessian fogger, but the best type of spray equipment that we found is one that's not manufactured. It is what is called the Lasley machine from the name of an Operator at Bellflower. He has an airplane propeller powered by a separate air-cooled engine, and an engine powering the sprayline; there are nine nozzles in front of the propeller, which blows the spray mist into the orchard. By doubling that machine's capacity with twelve to eighteen nozzles in front of a four foot propeller we could produce, I think, a pretty good type of machine to control the gnats by air adulticide, but we wouldn't be getting anywhere and it would be very costly.

Of all the types of unnatural controls, the most promising appears to be soil chemical irrigation; by that I mean a chemical which is sprayed on the soil from a boom in front of the jeep and sprayed on soil which has been disced. The chemical in the soil kills the larvae upon irrigation. The three most promising chemicals in order are aldrin, BHC and DDT. We plan to use heptachlor and chlordan in some experiments this year, since we're still in the research experimental phase. Our soil chemical irrigation will be carried out mainly prior to the heavy oviposition in the soils which starts about mid-July. It takes a number of generations for the soil population to build up; when it does it really goes to town and as a result the lives of the inhabitants are made most unhappy. The treatment is going to be almost entirely in the date and citrus orchards; because of our extreme temperatures, there is little or no breeding in the vineyards or young date orchards, or other types of fields which are exposed to the sun, because that soil temperature gets up to around a 160 and 170 by ten o'clock in the morning. An estimated cost is about $7.60 per acre.

Lastly, we have carried on a trapping program. Trapping has never proved very successful in the control of any insect, but during the last ten years the district has had a trapper and they have been using a rotten meat bait. When people hear about progreess being made invariably they wind up with "Well, what are you using for bait?" We're still using that rotten meat bait and they always say "Well, I'd rather have the gnats than that bait". Last summer we discovered a new type of bait, which is very cheap, much cheaper than the cheapest meat you can buy; that was stirring a raw egg in a coffee tin three quarters full of

water; in about three days that egg is developing hydrogen sulphide with other odors, and the gnats flock to it. We had some promising resultsh in our trapping program and at last I feel that with a new trap that was developed in the fall of '49, the so-called Tinkham trap, we have, I think, at last arrived at a trap and a bait which will index the gnat populations in the orchards. One trap alone in the Pyramid Date Garden plot caught 114,000 gnats this fall from September 1 to the end of December.

Mr. E. A. Smith: Are there any announcements? If not, I'd like Jack Kimball to stand up. I want to express my admiration for the very fine way in which Jack Kimball and his Committees have handled this entire Conference. Norm Ehmann has been Local Arrangements Chairman. Tommy Mulhern has been Program Chairman. I think all three of them deserve a good round of applause for the fine work they've done, and thanks to Ed Washburn for his constant work up here with the recording machine. (*Applause.*)

I've been informed that the Southern California region of the California Mosquito Control Association has elected Norman Ehmann as Representative on the Board of Directors for the next year. I ask that Board of Directors to come up here for a short meeting, and I now declare the meeting adjourned.

THE TWENTIETH ANNUAL CONFERENCE OF THE CALIFORNIA MOSQUITO CONTROL ASSOCIATION WILL BE HELD IN FRESNO, CALIFORNIA, FEBRUARY 13, 14,-15, 1952.