

MR. McCAMPBELL: When you advise the farmers to spray, how far apart would the sprays be?

PRESIDENT E. D. BALL: A week or ten days apart.

MR. C. P. GILLETTE: Are the eggs laid wholly on the veins?

PRESIDENT E. D. BALL: On the midribs and the stalks of the leaves. As soon as they have destroyed the leaves they will feed on the stems and destroy them also. But they feed on the leaves apparently up to the time that the leaves die.

MR. H. A. GOSSARD: We had in Ohio the maple injured similarly to tipburn and from the association of this species, we attributed it to that.

PRESIDENT E. D. BALL: This is the leafhopper that injures the growing shoots of nursery stock and young apple trees and burns them; it is the leafhopper that injures the growing tips of raspberry canes; it is not the leafhopper that injures the leaves of apple trees; it is almost never found on a slow-growing apple tree. On box-elder, it is only found on the water shoots or the fast-growing tips.

MR. P. J. PARROTT: In Geneva we have a great deal of trouble on the nursery maples.

MR. J. T. HEADLEE: Can the speaker give us some idea of how much an infestation is necessary to bring about the results on potatoes that he describes?

PRESIDENT E. D. BALL: One leafhopper will destroy a leaf.

PRESIDENT E. D. BALL: The next paper on the program will be by Mr. O'Kane on "Limitations in Insect Suppression."

## LIMITATIONS IN INSECT SUPPRESSION

By W. C. O'KANE

At the outset there should be some further definition of the subject of this paper. What I have in mind is a brief discussion of some of the difficulties and problems that arise when the entomologist faces the task of organizing a campaign against a new and serious insect outbreak. Necessarily these difficulties and problems will vary widely with the insect, the part of the country invaded, the host plant and other factors, including the entomologist himself. Therefore that which follows can be only the view of one entomologist, based on an experience necessarily limited and on contact with only relatively few serious insects. That which constitutes a difficulty in New England may turn out differently elsewhere, with another type of citizen to deal with and with another man to do the dealing.

However, no matter where the work or who the worker, there is at

least one limitation that is certain to make itself felt at the beginning of the campaign. That factor is the lack of accurate scientific knowledge of the pest that is causing the outbreak: its life-history, the intricacies of its habits, its preferences as to food plants, and, in turn, the life-history and habits of its insect enemies.

Seldom, I think, shall we find available complete knowledge as to the majority of these vitally important points. If the pest has been introduced from another country we shall certainly have to work out a detailed study of it in this country, not only because recorded information about it in its native habitat will likely be scanty, but because its behavior and its reaction to natural enemies may be a new story here. Clearly, this knowledge must be had before a well-grounded campaign of control can be undertaken.

The agencies that may undertake such a study are available in various quarters,—in our state experiment stations, the state colleges, the state divisions of insect suppression, where such exist, and the Bureau of Entomology of the United States Department of Agriculture. Whatever of these agencies charge themselves with the study, there should be correlation between their work and the efforts of those who have the campaign of control laid on them. Men who are at work on the control side of the problem, if they are scientifically trained, will discover new details that need elucidation and will help to interpret scientific facts as they come to light. Men in investigational work, if in touch with those charged with control, will help preserve an atmosphere of inquiry. Certainly, each will do the better work under the influence of close relationship.

Control measures themselves may, of course, be vested in various individuals or institutions. The entire undertaking may be laid on the Federal Bureau of Entomology. It may devolve solely on the state official in whose jurisdiction the outbreak has begun. We have had examples of both plans.

If the insect is one of great importance, especially if it is an introduced pest that has gained a foothold in only a limited locality but promises to spread to many other states or throughout the country, then it would seem clear that the larger part of a campaign of control should be undertaken by the Federal Bureau of Entomology. A lesser part may be undertaken by such states as are at the moment concerned.

Two arguments may be offered against this theory. A state remote from the outbreak may urge that it should not be called on to help finance control of a pest that is two or three thousand miles away and may never reach its borders at all. It may argue further, that the area which has been so unfortunate as to acquire the pest is not entitled

to bequeath the penalty for that misfortune to other states, any more than it would assume the right to ask other states to help bear its burden of fire losses. As a matter of fact, however, in the case of any really threatening insect that has been introduced into the United States at some point and has actually become established, the pest is a matter of concern for other states, usually for all of them. It has made its start at one particular point, not through the carelessness of the state, as a rule, but by chance; and, in any event, the personal views of individuals as to responsibility will have no effect on the dispersion of the pest into new territory.

The state in which an outbreak has begun may fairly assume an obligation to assist in control measures. In the first place, it has the problem within its midst. The thing is there. It is doing damage. It is a fact on hand. Aside from this, the state may be of real assistance to the federal authorities. For example, a federal quarantine can concern itself only with shipments interstate. Movement of the pest or its host from the infested area to other areas not invaded and within the same state is not subject to control by the federal regulations. Such movement may be controlled by state authority.

It would seem, therefore, that a campaign for control of an insect outbreak may profitably be laid upon both the Federal Bureau and the states immediately concerned; and this applies as well to the necessary study of the insect and its enemies.

The nature of the outbreak itself will determine what degree of control may properly be undertaken. But that degree should be thoughtfully and carefully weighed early in the campaign. It is one thing to retard the spread of a new insect pest; it is another thing to control it; it is still a different thing to suppress it; and it is again otherwise to exterminate it. Very rarely, indeed, may we rightly set about our campaign with the promise of extermination, either implied to ourselves in the arrangement of our campaign, or expressed to the public in any announcements or, especially, in requests for funds. Once in a great while an outbreak arises where actual extermination or eradication is reasonably within hope. For example, I feel that we have such a situation at this moment in the European corn borer, although the possibility of actual extermination is problematical and will cease to be a possibility in another year or two. The work in progress against the gipsy moth is, to my mind, partly a matter of retarding spread, partly a campaign for control through the introduction of parasites, but only remotely a possibility of suppression and the latter only if it should happen that the introduced parasites prove extraordinarily efficient. It is not now a campaign of extermination, though once, years ago, it had that possibility in it.

It is not proper to speak of extermination or to hold it out as an inducement in asking for public funds, unless actual extermination is reasonably in sight. This may be a limitation, for the public likes to think of eradication rather than control, and quite likely will be quite unable to see why actual eradication is not entirely feasible. But if eradication or suppression is promised without sufficient foundation, a mistaken idea is built up which, eventually, will have to be corrected.

It is equally unfortunate to think of eradication in drawing up one's own plans if such an outcome is improbable. Those measures that would be justifiable if eradication is actually to be sought may become a sheer waste of money if a less degree of control is all that can possibly be expected. I must confess to a feeling that sometimes, as entomologists, we have entered on a campaign drawn up on the basis of eradication and involving heavy expenditures, whereas the best promise of ultimate solution lay in accepting the new pest as a permanent resident of our fauna, and determining that it should occupy as low a natural level as possible, in part through systematic introduction of its natural enemies. It must be acknowledged, of course, that it may be possible to get public money for suppression by mechanical means, where such funds would be more difficult or impossible if they are to be spent for travel abroad and for the study of the natural enemies of the pest. Sometime soon I hope that there may be arrangements concluded by which, as I think already proposed by Doctor Howard, we may enjoy the permanent services of experts, whose task it will be to study and to send to us the parasitic enemies of various serious pests that we already have or may acquire.

Granted, however, that direct means of suppression such as spraying, must be undertaken on a large scale, in the course of a campaign to control an insect outbreak, will it be desirable to get this work done by placing the burden of responsibility on the private property owner or should it be undertaken by men employed by the state or federal authorities?

If the insect is really a very serious one and if the aim of the campaign is to exterminate it or to stop spread, then I feel that dependence on the owner of private property will be wholly inadequate. There are various reasons for this. Eradication must be absolutely thorough. It does not mean to do a job that is 60 per cent complete or 80 per cent complete. It means to approach closely 100 per cent. Even suppression in the stricter sense means thorough work, properly performed at the proper time, and systematically carried through wherever the pest exists.

There are many private property owners who could do their share, having the money, the time and the intelligence. But even some of

these will fail because they will delegate the work to others who will prove incompetent or because they themselves will, on account of their multiplicity of interests, fail to move at the right time.

In contrast to these favored individuals there are many others, probably a majority, who lack the means, the time or the understanding to carry out real control measures. Their intentions may be excellent but their performance will not average high.

Against this idea it may be argued that statutes can provide for compulsory suppression, requiring a property owner to take certain measures, and can make a further provision that, if he fails, the work shall be done by a public official and the cost charged against the property as a part of his taxes. This will not necessarily succeed. No statute can make a man do thorough work if he is inclined to be careless. No law can teach every individual that adherence to some seemingly unimportant detail may be the key to success in control.

Furthermore, there is a definite limitation as to the amount of cost that the statutes may charge against a property. This is true whether the law requires the owner to do certain work or whether it provides that the work shall be done by a public official and the expense charged in the taxes. In either event it is necessary to limit the charge to some percentage of the assessed valuation of the property concerned. The maximum percentage that appears allowable is one half of 1 per cent. To assess that much means, usually, to increase ordinary taxes by 25 per cent. But one half of 1 per cent for a farm assessed at \$5,000 is only \$25, and the latter sum may be only a tenth of the actual cost of the work that should be done on the property in question.

If it be argued, in turn, that the state or federal government may properly assume the remainder, the reply is that the government had better assume the whole thing and do the job, thus placing it in the hands of trained men who have that one thing on their mind and whose duty it is to perform the task completely and at the proper time.

If, however, the campaign of suppression at hand is one of more liberal interpretation, in which the aim is to mitigate the damage done, to retard spread, to establish natural enemies, in other words, to accept the pest as a new member of the fauna, but to bring it to the lowest possible level of normal abundance, then there is good reason for asking the property owner to assume from the start an individual share in the burden of control. Indeed, to do anything else is to convey to the mind of the people an impression that the state or federal government is going to assume full responsibility for the pest in question and that the private property owner need not concern himself about it, either now or in the future.

To get the individual to conduct proper control measures means to

carry through a campaign of education and stimulation. In fact, in planning any comprehensive program of insect control there is reason for adopting a definite schedule of educating the people, in order that they may give to the problem intelligent and competent support, financial and otherwise.

At the best, the results of such a program of education will fall far short of the mark that one would like to set. When it would seem that certainly every citizen in the state must have come to understand the principal facts about a disastrous insect outbreak, the entomologist certainly will discover that six out of ten of those with whom he talks have practically no real conception of the problem and probably are sadly mixed in such information as they have absorbed.

It follows that every available means must be used if a considerable percentage of the public is to be reached and to be taught the essential facts that eventually the property owner must know. The newspapers will reach some, although their message will actually get into the minds of a much smaller number than one at first anticipates. Circulars and bulletins serve their purpose, but here, again, I doubt if more than one out of five mailed out is read or absorbed by the recipient. Posters can be made to help, provided they are very brief, so that their import can be seized at a glance. Any printed matter should invariably be simple, concise, void of technical terms and well illustrated. One page is better than two if one can possibly suffice. Two pages are better than four.

The spoken word will get a message home where no circular or bulletins can find entry. People will listen to that which you say though they may lay aside that which you have had printed for them. The best combination is the spoken word, reinforced by the printed circular distributed at the same time, and exemplified by the insect itself or its work actually exhibited.

At the best, there is apt to be difficulty enough in getting adequate funds for a real campaign of eradication or of strict suppression of a threatening insect. Certainly sufficient funds constitute an absolutely vital factor if the campaign is one of this nature. If it requires \$100,000 to suppress a new insect at the beginning of its career, to spend half of that sum may be practically to throw the money away. The campaign must go the whole way. To stop short of the whole task is to build a bridge that lacks one or two spans. It may be an excellent structure to look at but it will be no good as a bridge.

And, finally, there is the limitation of human capabilities among those who are planning and directing the campaign. I believe that seldom, indeed, shall we find, in the same man, the qualities that will make him successful in conducting the scientific investigation of an



insect and will, at the same time, make him competent as the administrative head directing the staff who carry out the measures of suppression. On the other hand, as he is more typically an administrator, so his talent will less readily find expression in the details of investigation. There is need for specialists in both fields.

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PRESIDENT E. D. BALL: The paper is now before us for discussion.

MR. T. J. HEADLEE: We have heard a great deal during this meeting about the necessity of the business administrator in carrying out work for the suppression of injurious insects. While I agree heartily with the idea that a business-like administration of such a project is a necessity, I want to point out that a purely business administrator is just the man not to have in charge of such a project. He believes from his experience that the methods of procedure should be easily and definitely laid down and he will have no patience with the uncertainty which the nature of the problem creates in the mind of the entomologist. Pure business administrators for large projects of this kind, for directors of experiment stations and presidents of colleges are likely to prove a failure, because the very standardization which such a man will tend to introduce will destroy the initiative and render sterile the mind of the specialist without freest activity with which success cannot be had.

MR. McCAMPBELL: In the matter of educating the public, I wonder if you realize how far your appropriations would go if you spent them with some of the weekly and farm papers in the form of pure editorial matter. My observations in Monmouth County are that the farmers there read the two country papers religiously; they read everything, and if the experiment station in New Brunswick wishes to reach those farmers, let them get up a nice readable story which the farmers can understand, and bring it right home to them, you will reach every farmer in the country. A little bit of time spent with those editors will get you two to five times as much through the editorials. I think this would be a wonderful way to get this information to them, and I am sure it will do lots of good.

MR. H. A. GOSSARD: I wish to call attention to the fact that if we are going to call upon the infested districts to bear the full burden of suppression, that certain parts of our country will be loaded with nearly all of that expense. The great ports of entry for insect pests are in the New England and Middle States, and nearly all of our serious pests have gained entrance into the country from these points. We cannot reasonably expect that these states will pay for everything or feel that it is their duty to suppress all pests that may have entered

the country through their ports of entry. If we are going to get adequate means, the whole country must get under the burden and help, otherwise these few states will get weary of the load and leave it to those states which are most interested, but which won't realize what they must do to stay the invasion, until it is too late.

MR. C. P. GILLETTE: We speak quite often about insect extermination. I would like to have the members of this body give us a list of the insect pests we have exterminated in this country.

PRESIDENT E. D. BALL: We have exterminated the gipsy moth in half a dozen places; wherever they have tried, since they really took hold of it.

MR. J. G. SANDERS: The pink bollworm is well under way.

PRESIDENT E. D. BALL: The potato bug has been exterminated in some countries we know.

MR. W. D. PIERCE: The cattle tick has been exterminated in whole states.

PRESIDENT E. D. BALL: The scabies is practically eradicated from the western range.

The next paper is on "Control of the Chrysanthemum Gall Midge with Nicotine Sulphate—with Notes on Life-Cycle," by T. L. Guyton.

## NICOTINE SULFATE SOLUTION AS A CONTROL FOR THE CHRYSANTHEMUM GALL MIDGE, DIARTHROMYIA HYPOGAEA H. LW.

By T. L. GUYTON, Harrisburg, Pa.

A brief study of *Diarthronomyia hypogaea* was made at the Ohio Agricultural Experiment Station under the direction of Prof. H. A. Gossard. The writer is indebted to Professor Gossard and Mr. J. S. Houser for helpful suggestions in applying control measures.

*Diarthronomyia hypogaea*, a European pest for many years, was first recorded in this country in 1915 by Dr. E. P. Felt from specimens taken from greenhouses in Michigan. Professor Essig of California reported its presence in that state in 1915 and 1916. The first known outbreak in Ohio greenhouses was in February, 1918.

### LIFE-HISTORY AS NOTED IN GREENHOUSE

This study extended from the last of February to first of May, and one complete brood was observed. The length of the life-cycle is from forty to fifty days in a greenhouse where the temperature was about 70° F. The eggs are placed promiscuously about the young, growing part of the host plant, and the number deposited by each female is from 80 to 150.