Question: Do you do any thinning?
Senator Dunlap: The only thinning I have ever done is in picking the large apples, letting the small ones stay on and mature. The Maiden's Blush and summer apples, and sometimes the Jonathan and Grimes Golden, I handle in that way, leaving those on the trees that are green and small, leaving them to be picked after we have gone over the orchard. We go back and pick these by themselves, and in the case of the Jonathan this year you could not tell the difference between those that were picked the second time and those that were picked the first, they had grown and were as red in color as the first picking. I think that pays with me. I have not had enough experience with thinning to know. I think it would pay, but it is certainly a lot of work.

CONTROL OF THE CODLING MOTH

Prof. H. F. Wilson, College of Agriculture.

Relation of Habits to Methods of Control.—In the life of every insect there are certain periods when practical control measures can be applied with greater success than others. In the case of the codling moth, this period is between the hatching of the egg and the entrance of the larva into the fruit. Regardless of whether the eggs are deposited on the leaves or fruit, about sixty to seventy per cent of the larvae of the first generation enter the fruit at the calyx end, the others entering from the side. In either case the first tissue gnawed from the leaves or skin of the apple seems to be taken into the body, and if coated with poison will cause the death of the insect before serious injury can be done.

A number of writers claim that the larvae hatched out on the leaves will take their first meal there and do not reach the fruit at all. Upon these facts and suppositions are based our present recommendations for the control of the codling moth. The first recommendation given is that the calyx cup must be filled with poison at the proper time. The second is that the fruit and foliage must be kept coated with poison throughout the periods of emergence of the larvae.

The Efficiency of Spraying.—There is a great abundance of evidence to show that spraying for the codling moth can be made from 90 to 99 per cent efficient by every grower, depending upon factors discussed later. Just how many applications of spray are necessary to bring this about will undoubtedly depend upon local conditions. All Entomologists do not seem to agree upon this subject, although the general recommendations throughout the United States indicate that at least two applications are necessary and that three or four are more dependable.

A summary of the experiments along this line would indicate that under rather ideal conditions as high as 99 per cent clean fruit can be secured from the calyx spray alone. Two applications under less ideal conditions are indicated as giving the same results. Three applications properly applied will, except under the most adverse conditions, give equally good results and more than four are entirely unnecessary.
These figures are taken as the maximum of what has been done, and
do not show the minimum range of as low as 84 per cent clean fruit in the
same experiments. We should also remember that the above figures
were taken from experiments that should produce the highest degree of
efficiency, having been carried on by trained Entomologists. (In actual
orchard practice, we should probably count on a reduction of these re-
results from ten to twenty per cent).

Therefore, in summing up the problem as a whole from the stand-
point of the commercial orchardist and his difficulties, I am compelled
to believe that the calyx spray alone will not prove practically efficient
in every day orchard practice. Further, that nearly all comparative
experiments indicate that three applications properly timed give the
best general results, and that except in sections where excessive rains
may wash off the poison, more applications are unnecessary and not eco-
nomical.

The Time of Application.—There may be some disagreement as to
the time when the second, third or fourth application should be made, but
certainly we must all agree that the first spray should be applied after
the petals drop and before the calyx lobes close. Regardless of the time of
appearance of the first larvae, the calyx lobes close within a week or ten
days after the falling of the petals, and if the poison is not placed in the
calyx cup, the most vital point of attack is left unprotected.

By a second spray we do not mean a second calyx spray, but the ap-
lication to be made at the time when the eggs are hatching and the first
brood of larvae are entering the fruit. In Wisconsin this will be from
ten days to two weeks after the calyx application.

In order to tell the length of period in any one section careful obser-
vations would have to be made for each. Every orchardist, if he has the
patience to study a little and make observations, will be able to do this for
himself.

The third application is usually given to catch the larvae of the second
brood and should be made upon the same basis as the second, namely,
the hatching of the young larvae. The life period from the young larvae
of the first brood to those of the second, occupies about five weeks, so
that generally the third application should be made five weeks after the
second. Where a fourth is deemed advisable for late “worms” and bud
moth larvae, spray three weeks after the third.

Methods of Application.—The terms used in methods of application
designate driving sprays and mist sprays. A driving spray is one in
which the spray is forced through a coarse nozzle in a heavy stream,
so as to completely drench the trees or foliage. A mist spray is one in
which the spray is forced through a fine nozzle in the form of mist and it
is desired to thoroughly coat all parts with a fine film without causing the
spray to form into drops and run off.

While there have been a few experiments to show the different results
liable to follow, I cannot recall any definite data having been obtained.
In different sections of Oregon both methods are used for all sprays and
equally good results are obtained in both cases. I am of the opinion
that there is little reason why results should not be satisfactory in each
case if the calyx cup is filled. But from the standpoint of economy, the
mist spray is the more desirable, since only half as much spray will be used in this as in the drenching spray. In either case, satisfactory results can only be obtained by steady and strong pressure. A little experimental work by the orchardist himself will most likely determine the proper method to be used in his case.

The following practice should prove satisfactory in all cases:

1. Never spray when your engine is running under 150 pounds pressure.
2. A forceful spray, whether driving or mist, is absolutely essential for thorough work and penetration to all parts of the tree.
3. A driving spray should be used for the calyx application in order to reach the inner cup.
4. A mist spray, being more economical than the driving and just as effective, should be used for later applications.

Spray Materials.—Of the various spray materials that have been used in combating the codling moth, arsenate of lead is now the standard. Paris Green, Ferrous Arsenate, Arsenite of Zinc and Calcium Arsenate are used, to some extent, but all of these materials show more or less unstable characters and serious injury may be caused by all but the Ferrous Arsenate. For these reasons the materials named are not commonly used. Competition has compelled the manufacturers to improve their spray chemicals to the highest possible point of perfection; and arsenate of lead has passed through a strenuous development from the crude homemade product to the almost perfect manufactured article of today.

This does not mean that all brands have reached perfection, nor does it mean that somewhat imperfect brands are not satisfactory in codling moth control. There are two different known arsenates of lead used in insect control and most commercial brands are a mixture of these two. These conditions no doubt will account for the variable results obtained. Just why we should have two kinds of the same material is a chemical problem which I will not attempt to explain. It is enough to say that by manipulation of the chemicals used, two stable compounds are produced with distinct amounts of arsenic in each. They are known under various names as acid and neutral or non-acid arsenates of lead, but all of these names are misleading to the fruit grower, because of the suggested presence of an acid of some kind which is not the case.

In our work at the Oregon Experiment Station we designated them as lead hydrogen arsenate and basic arsenate. The principal difference between the two is that chemically pure the lead hydrogen arsenate contains approximately 33 per cent, and the basic arsenate of lead contains approximately 25 per cent arsenic oxide, the active killing agent. In comparing the two kinds we have found that the lead hydrogen arsenate is superior in many ways to the basic form. The main point in favor of the latter is the fact that it can be added to lime-sulfur with less decomposition and supposed loss of efficiency than in the case of the other.

No one has yet demonstrated that there is a loss of efficiency in a combination of the lead hydrogen arsenate with lime sulfur, although it is well known that there is a greater apparent chemical decomposition. Experiments conducted at Corvallis during the past summer show that the Lead Hydrogen Arsenate is quicker acting than the basic and that it
is also much more finely divided than the basic form and will stand in suspension much longer. Our work also showed that in combination with lime-sulfur and in strengths containing equal percentages of arsenic oxide, the lead hydrogen arsenate was as much or more efficient than the basic. (This does not mean that the former combination is recommended for orchard practice).

Considerable experimental work yet remains to be done with both of these sprays in order to determine their limitations. But except in cases where proven otherwise, I would recommend the lead hydrogen arsenate when used without lime-sulfur.

Originally all arsenates of lead were sold in paste form, but now several manufacturers are producing and selling the lead hydrogen arsenate in powdered form as well. We have used the powdered basic form in some experiments with satisfactory results, but its great tendency to settle may make its use prohibitive in this form.

**Combination Sprays.**—In the economy of spraying, combination or mixed sprays have been evolved for the purpose of fighting insect pests and fungous diseases with a single spray. In this work arsenates of lead, Black Leaf-40 etc., seem to mix well with the fungous sprays, and these mixtures are now a part of general orchard practice. Our greatest difficulty comes from the fact that both Bordeaux mixture and lime-sulfur have a tendency to cause spray injury and in the case of lime-sulfur, when the arsenates of lead are added such injury is apparently greatly increased.

Experiments at the Oregon Experiment Station show that at the time of the first application for codling moth, the combinations are much safer than for later applications. That climatic conditions may and do enter to complicate the spray problems is quite evident. Just why spray injury is more prevalent in some seasons is a problem that still needs considerable research work, and until solved or until some fungicide is found that will control apple scab without causing spray injury, the growers must expect to suffer a loss in this manner. There is a general agitation at this time regarding sulfur as the most likely material to do this, and there are a number of sulfur compounds on the market which give promise of some merit. Just how they are going to turn out is still an open question.

**How Much Poison is Necessary.**—By this we mean, is it necessary to use one, two or more pounds of arsenate of lead per fifty gallons of water for efficient control. General recommendations vary between one and three pounds. Hardly enough comparative experiments have been tried to determine this point except within certain limits. In the Northwest, two pounds is a great plenty so far as the codling moth is concerned. A number of orchardists have continued good success with one and one-half pounds, and several of our Entomologists claim to have had excellent results with one pound.

These figures are based generally on the paste forms and if powder is used, should be reduced accordingly. The powdered forms, if chemically pure, are just twice as strong as the paste and contain 50 per cent water content. Here again is a problem for the individual. If you are using three pounds per fifty gallons of water, I believe that amount is too much. Try two to fifty on a small part of your orchard next year and
compare with the rest of the orchard. If two pounds proves successful then try one and one-half and even one pound if you think it is worth while. However, other leaf-feeding insects must be controlled as well as the codling moth and the weaker strengths may not do for these.

**Efficient Spray Machinery.**—No orchardist can hope to be lucky enough to successfully control insect pests and fungous diseases year after year if he has an inferior and inefficient spray outfit. In any enterprise success depends upon efficiency and as the efficiency is great or small, so will the enterprise be. In my opinion, after thorough application, the most necessary thing in successful spraying is pressure; not pressure that varies from 50 to 250 pounds, but pressure that stands at 150 pounds or over all the time. It is sometimes hard to keep this up on account of leaky valves, poor packing in the pump, etc., but certainly there is no economy in permitting such conditions to continue. Neither is there economy in using wornout, leaky hose or connections.

Probably the most provoking and sometimes unavoidable trouble is with the engine. Of all the tortures invented by the evil one, certainly a poorly working spray engine is the father of them all. The outfit to be used rests mostly upon the judgement of the grower. Of the various power machines manufactured, it is hard to choose the best. Any one of the standard makes should prove satisfactory.

**Unsuccessful Control of the Codling Moth** may usually be found due to one or more of the four factors which follow:

1. Lack of personal supervision of the actual spraying operations.
2. Inefficient spray outfits.
3. Careless application of spray and lack of thoroughness.
4. Lack of knowledge of the habits and life history of the insect.

**Relation of the Control of Leaf Feeding Insects to that of the Codling Moth.**—This can be summed up very briefly. There are a certain number of insects that feed on the leaves and fruit of apples and pears and the greater majority of these are killed by the poison sprays used against the codling moth. Some few have the habit of feeding in the buds or folded leaves in such a manner as to escape. These may have to be combatted in another way. Others seem to be able to withstand the strengths ordinarily used, and it may be necessary or advisable to use greater amounts.

**DISCUSSION**

Mr. Richardson: What is your statement in regard to minimum temperature?

Prof. Wilson: There is a general belief among entomologists throughout the United States that the codling moth does not lay eggs until the evening temperatures are about sixty degrees Fahrenheit or above. How well founded this belief may be, I am unable to say except that there appears to be some foundation to the belief.

Mr. M. S. Kellogg: Speaking of the arsenate of lead, we heard yesterday of the easy solubility of the powdered arsenate of lead and the danger of its being easily washed from the foliage after application. Do you con-
sider that there is any danger in that, or is this the dry powdered arsenate as successful as the paste form?

Prof. Wilson: There has been some little contention regarding that factor and I have had some argument with two or three different manufacturers over the question. Our experience has been that the paste arsenate of lead will stick better and spread better than the powdered arsenate of lead. However, it is undoubtedly true that the powdered forms will stick sufficiently well unless the rains are very heavy. This being true, there is really not much choice between the two. Laying aside the inconvenience connected with the paste, I prefer it to the powdered form. If the farmer will stop to figure, and is interested in the cost, he will find that his paste arsenate of lead is cheaper and the important thing that we are after today is, in my opinion, the economy of producing fruit. During observations made in Oregon we found that certain growers could quite often make a profit through economy in spraying where they might otherwise suffer a loss through extravagance in the use and application of material.

Mr. Brayton: In regard to the number of times of spraying, it seems to me that that largely depends on the temperature. In the southern part of Illinois in 1913, in fact 1914, they were obliged to spray as high as five to seven times, and even then they did not hold the codling moth very well. As late as October a crop of codling moth came out and nearly ruined the crop of apples which were almost ready to pick, due to a long, dry, warm season. In regard to the dry arsenate of lead, I have used it in my orchard for the last four years, and it has given me perfect satisfaction. In Northern Illinois, where I live, we consider three sprays are about sufficient to hold the codling moth.

Mr. Irving Smith: I would like to ask the Professor if there is any way in which the adult codling moth may be killed before they lay their eggs?

Prof. Wilson: Some efforts have been made to control the adult by trapping, but not with a great deal of success. Also certain numbers of the mature larva may be secured and destroyed by scraping and banding the trees, but this only tends to keep the infestation down and no one has shown that such handling or treatment would be worth the expense or trouble of this operation. In other words, it is cheaper to spray than to try and keep this insect down by scraping the trees over any large area.

Mr. Smith: Do not the older ones eat?

Prof. Wilson: Well, that is a question. I would say that in breeding cages they do feed, to a limited extent, on sweetened syrup. They are not attracted to lights as are some other insects and so far as I know, no one has attempted to destroy them by feeding them poisoned syrup or something of similar nature.

WHY IS A COMMISSION MERCHANT?

W. G. Baldwin, Duluth, Minn.

I want you to know that I feel that I am meeting with the growers of one of the greatest states in the Union, and I also want you to know that I feel that you are listening to a representative of one of the greatest