Many of the methods adopted by plants to prevent undesirable insects are well known, but there are many of our native plants which deserve to be more fully studied, in order to ascertain the full relationship between the entomologist and the botanist.

OPPORTUNITIES FOR ENTOMOLOGIST AND BOTANIST.

We want to know what insects are responsible for the pollination of our native plants, and what are the food-plants of their larvæ. I feel that in this particular subject much good work might be done by the co-operation of entomologist and botanist. We may see other parts of the subject from different standpoints, but it is good for us to occasionally meet on the same ground, to compare notes, with the hope that our observations may be mutually beneficial.

Mr. T. Wilson: In regard to the relation of the animal to the vegetable kingdom, in one of Darwin's writings we find that he claims that the success of the clover-crop depends on the number of cats in the district. He deduces that crops most abundant in seed occurred near villages, and that the crops were lightest some distance away. He found that the cats killed the mice, the mice destroyed the bumble-bees' nests, and as the bees were necessary to fertilize the clover, consequently the crop depends on the number of cats. Mr. Davidson also mentioned the relation of insects to plants. I remember some experiments that were carried on in regard to insectivorous plants. They took the Venus fly-trap in order to prove its carnivorous habits. Seedlings were raised, some under bell glasses, some open, and some were fed beef and scraps. The result of the experiment proved that the carnivorous diet was merely an acquired habit.

Mr. Brittain: The disease known as fire-blight is well known to be carried by insects. Bees are perhaps the greatest factor. I have found centres of blight-infestation in very isolated spots well away from other districts already infested to a marked degree. Birds will also carry the disease, for we find the blight occurring at points geographically isolated. The green aphis also spreads the disease on trees from fruit-spurs to the twigs. The apple-leaf hopper (*Empoasca mali*) is another medium of spread. Many wound-parasites, such as flies, etc., also help to spread the disease.

The Chairman (Mr. Day): Any further remarks? Before closing, I would like to say that on Vancouver Island we find many caterpillars affected with fungous diseases. The same also with ground-insects. I will now call on Professor Wilson, who has come to us to-day from the Corvallis Agricultural College in Oregon. I take great pleasure in welcoming him here to-day and introducing him to the members present.

COMBINATION SPRAYS AND RECENT INSECTICIDE INVESTIGATIONS.

BY H. F. WILSON, ENTOMOLOGIST, OREGON AGRICULTURAL EXPERIMENT STATION, CORVALLIS, OREGON.

Mr. Chairman, Members of the British Columbia Entomological Society, and Friends,—It is indeed a pleasure for me to be able to meet with you at this time, and I wish to publicly thank Mr. Brittain, your Provincial Entomologist and Plant Pathologist, who so kindly extended to me the invitation to attend this meeting. Mr. Brittain also kindly suggested my subject for me, and he tells me that it is one in which you are intensely interested.

COMBINATION SPRAYS AND RECENT INSECTICIDE INVESTIGATIONS.

I deem it advisable to explain in general and in detail the factors which have led to the study of this subject.

(1.) I consider this to be the most important problem before the farmers and fruit-growers of to-day.

(2.) For some one or more reasons not clear to us, our knowledge of sprays and their effects is very unsatisfactory.

(3.) While our commercial insecticides are more or less stable, under certain ideal conditions the results obtained from their use are too variable for us to make definite and well-defined recommendations.

(4.) The economy of spraying and the numerous new sprays on the market at the present time demand an entirely new investigation of the subject.

OUTLINE OF EXPERIMENTS.

With these facts in view the following series of experiments have been outlined:—

(1.) Knowing that certain sprays are effective when used alone, to determine what ones may be successfully combined without lessening insecticide values.

(2.) Having effected the combination of certain sprays, to determine, if possible, the factors that govern successful application with a minimum of injury to fruit and foliage and at the same time give a maximum of protection.

COMBINATION SPRAYS.

During the last few years the economy of proper plant-protection has become a problem of great importance to the farmer and fruit-grower. We have well-known insecticides and fungicides which are quite effective in the control of different pests, but in order to be effective they must be applied at the proper time. Every pest has a distinct life-history method of development and manner of attacking its host or hosts. These factors in most cases determine the method of treatment and time of application.

In former years the number of standard sprays for insect pests or fungous diseases was very limited, and combination or mixed sprays were practically unknown. With the development of the fruit-growing industry the number of important pests increased, and at the same time more elaborate methods of control became necessary.

The time of application of a spray for a fungous disease often coincides with the time of application for some one or more important insect pests. This has led to many experiments in the combining of insecticides and fungicides to determine the practicability of applying two or more sprays at the same time, instead of making separate applications of each. Considerable success has resulted from these experiments, and the combining of a fungicide and an insecticide or two insecticides is now a common orchard practice of considerable value to the fruit-grower.

However, many complications have arisen in the work, and while many general conclusions have been upheld, combination sprays are very unstable and many details are yet to be worked out. The greatest difficulty arises from the fact that arsenic is the base of nearly all poison insecticides. Free arsenic will cause great injury to foliage, and in order to use it some insoluble compound is necessary. In the form of lead-arsenate, when properly prepared, arsenical sprays can be applied with a reasonable degree of safety, but in combination with other compounds the nature of the original arsenical may be easily changed and free arsenic liberated. A very important factor is also found in that lime-sulphur and Bordeaux mixture, the two most important fungicides, are liable to cause spray injury when used alone, and arsenates or arsenites are very apt to accentuate this danger. Climatic conditions are also supposed to enter more or less into the serious injury that sometimes happens from the use of these sprays.

Some experimenters have claimed that in the combining of lime-sulphur and arsenates of lead certain chemical reactions take place which impair the efficiency of both. As there seemed to be no published data on experiments which might throw light on this subject, the Departments of Plant Pathology and Entomology of the Oregon Agricultural College undertook in 1912 to make a series of experiments which would at least show some indication as to the relative combative effects of combinations of lime-sulphur and acid arsenate of lead, lime-sulphur and neutral arsenate of lead, and lime-sulphur and arsenite of zinc. These experiments were to be continued through three seasons in order to get checks on all data.

Several factors entered to interfere with the first season's work, so that the results were very unsatisfactory and detailed data is not worth mentioning. In going over the notes at the end of the season, however, several interesting facts were noted and are here summarized.

(1.) Lime-sulphur 29.5° Be. (1-30) + acid arsenate of lead 2 lb. to 50 gallons did not cause any more spray injury to foliage and fruit than did the lime-sulphur and neutral (spray injury was quite bad on Newtowns and Ben Davis). Injured fruit was worst on south side of tree and in direct rays of sun.

(2.) Lime-sulphur 29.5° Be. (1-30) + arsenite of zinc 1 lb. to 50 gallons (two different brands) did not cause but very little injury to foliage, and except in the case of Ben Davis did not cause any more injury to the fruit than was found on unsprayed trees. (Ben Davis suffered badly.) The injured fruit on these trees was worse on south side of tree.

(3.) Injured apples similar to those on the sprayed trees could occasionally be found on unsprayed trees in the check plot, but the difference in percentage was so great that we must conclude that the injury on the sprayed trees had in some way been caused by the spray.

In 1912, in connection with the above experiments, a series of experiments were started upon the decomposition of combined sprays when allowed to stand. The materials in each case were kept in corked bottles and examined from time to time during the following year. Apparently no further change occurred and each combination retained its characteristic odour. An examination on June 1st, 1913, gave the same conditions and tests for the insecticidal values and showed them to be apparently as efficient as freshly prepared materials.

Observations for the present season's work show some startling results, and on account of this a number of them were immediately checked. The same results were obtained in both cases.

The arsenates of lead used in these experiments were specially prepared by the Station Chemist, and were, according to methods of determination that will be published in the near future, theoretically pure.

The lime-sulphur was known as the Dependable Brand, made at Salem, Ore., and when analysed was found to be satisfactory in every particular. The arsenite of zinc used was manufactured by the California Spray Co., at Watsonville, California.

To determine the effect upon apple-foliage of the above chemicals alone and in combination, a series of experiments were conducted as follows: A block of twenty Newtown apple-trees was taken and each tree was used for one spray.

In 1913, under press of other work, the Department of Plant Pathology discontinued their part of the work, and so the investigations this year have not included the study of fungicidal values.

The Experiments were as follows:—

*Experiments on the Decomposition of Combined Sprays when allowed to stand. * Sprays combined as follows on May 29th, 1912. Lime-sulphur used in these Experiments tested 28.75 Be.*

(1.) Lime-sulphur .... 17.5 cc. Black Leaf 40, 1-1,000..482.5 cc. Arsenate of lead, non-acid (C.S. Co.)...... 2.4 gms. C.S. Co. — California Chemical Spray Co., Watsonville, Cal.	May 29th. Combined the above materials on morning of this date. At 3 p.m. residue settled in bottom, changed from white to a grey. The odour of the Black Leaf 40 and the lime-sulphur are readily distinguished. The solution retained its amber colour and resembled lime-sulphur diluted to the same

* Materials combined at the rate of: Lime-sulphur 1 to 30; arsenicals at 2 lb. to 50 gallons for neutral and 1 lb. to 50 gallons for the arsenate of lead acid and the arsenite of zinc.

strength, except that it appears slightly muddy or cloudy. The arsenate of lead settles faster than the residue from the Black Leaf 40, and the latter settles on top of the first in a flocculent blackish mass.

June 1st. Liquid colour of dilute lime-sulphur. A considerable amount of free sulphur thrown down. A strong smell of both Black Leaf 40 and lime-sulphur still present.

(2.) Lime-sulphur .... 17.5 cc. H_2O ....482.5 cc. Arsenate of lead, non-acid (C.S. Co.)...... 2.4 gms.	May 29th. Combined the above materials to get data on reaction and to find unsatisfactory results if any be present. This solution appears identical to that of Ex. (1), except muddy colour. June 1st. Solution colour of dilute lime-sulphur. A small amount of free sulphur thrown down.
(3.) Lime-sulphur .... 17.5 cc. H_2O ....482.5 cc. Arsenate of lead, acid (C.S. Co.) .... 2.4 gms.	May 29th. Combined the above materials to get data on reactions; also to note any visible effect of decomposition of the materials. The arsenate of lead a white paste changed to a black-grey colour and more residue is apparent than in the case of the neutral arsenate. The liquid or solution remains cloudy and muddy after several hours' standing. A decided difference between the colour of the residue in this solution and that of Exs. (1) and (2) is apparent. The residue is blacker in this solution. June 1st. Liquid colour of dilute lime-sulphur in addition to a large amount of black precipitate. A small amount of free sulphur is present.
(4.) Lime-sulphur .... 17.5 cc. Black Leaf 40, 1-1,000..482.5 cc. Arsenate of lead, acid (C.S. Co.) .... 2.4 gms.	May 29th. Combined the materials in this experiment to find the resultant reactions and to get data on the effect of the different materials. Everything is similar to Ex. (3), except that the residue from the Black Leaf 40, which was not placed in Ex. (3), is slowly settling on the arsenate of lead, which has already settled to the bottom. When Black Leaf 40 and lime-sulphur are combined, a fine precipitate slowly settles out. The nature of this is unknown to us at the present time. June 1st. Liquid colour of dilute lime-sulphur. A considerable amount of a yellowish-black precipitate has been thrown down in addition to the dark-grey arsenate of lead residue. This mixture seems to be a combination of free sulphur and the lime-sulphur+nicotine-sulphate residue.
(5.) Lime-sulphur .... 17.5 cc. H_2O ....482.0 cc. Arsenate of lead, acid (Vreelands) .... 1.2 gms.	May 29th. Combined the above materials to get data on effects and also to note any apparent decomposition. After settling for several hours the solution differed very little from a similar dilute solution of straight lime-sulphur and water, except that there was a slight cloudiness. The residue was a very black-grey with minute particles of sulphur scattered through it. June 1st. Liquid colour of dilute lime-sulphur. A very small amount of free sulphur has been thrown down on top of the black residue.
(6.) Lime-sulphur .... 17.5 cc. Black Leaf 40, 1-1,000..482.5 cc. Arsenate of lead, acid (Vreelands) .... 1.2 gms.	May 29th. Combined above materials to get data on effect of combination and to note any decomposition of materials which might take place. There is a difference of colour in the

solution of this experiment, due to the suspended particles of residue formed by the Black Leaf 40 and lime-sulphur. Some of this residue has already settled, but apparently not all. The arsenate of lead, which is a dirty black, settled first and the other settled on top of it.

June 1st. Liquid colour of dilute lime-sulphur. A considerable amount of free sulphur has been liberated, and there is also present a considerable amount of black flocculent residue from the lime-sulphur + Black Leaf 40 mixture which has settled on the black-lead deposit. Between these residues there is a thin line of some thin crystalline substance which Professor Tartar suggests may be arsenate of lime.

(7.) Lime-sulphur .... 17.5 cc.
H_2O .... 482.0 cc.
Zinc-arsenite (Sherwin Williams) .... 0.6 gms.

May 29th. Combined above materials to get data on results and to note any decompositions of materials. Colour of solution quite similar to that of lime-sulphur of an equal strength with straight water. Slightly cloudy or muddy. The residue was a light grey, being quite a little lighter than that of the neutral arsenate of lead.

June 1st. Solution colour of dilute lime-sulphur. A very small amount of free sulphur shows on top of the residue (only a trace).

(8.) Black Leaf 40, 1-1,000..500.0 cc.
Zinc-arsenite (Sherwin Williams) .... 0.6 gms.

May 29th. Combined the above materials to get data on results and to note any decomposition of materials used. The colour of the arsenite of zinc was covered with a pink colouring substance. After standing several hours there seemed to be decomposition of either the Black Leaf 40 or the zinc-arsenite. The latter lost most of its pink colour and appeared dirty white. This zinc-arsenite is more finely divided than that of the California Spray Co.

June 1st. Liquid almost white with a slight tinge of black. No change. Apparently no decomposition.

(9.) Lime-sulphur .... 17.5 cc.
Black Leaf 40, 1-1,000..482.5 cc.
Zinc-arsenite (Sherwin Williams) .... 0.6 gms.

May 29th. Combined the above materials to get data on combinations and to note any decomposition of materials which might take place. The solution was black, but appeared no different from the solution of lime-sulphur and Black Leaf 40. The zinc-arsenite had of course settled and, being more or less mixed with the residue formed by the Black Leaf 40, appeared slightly different from the zinc-arsenite lime-sulphur combination. The zinc-arsenite does not seem to be affected by either the lime-sulphur or Black Leaf 40 to any great extent.

June 1st. Solution colour of dilute lime-sulphur. Arsenite of zinc a grey colour, showing dark grey at upper surface when solution and residue of Black Leaf 40 come in contact. Black Leaf residue black and flocculent. A small amount of free sulphur present.

(10.) Lime-sulphur .... 17.5 cc.
Black Leaf 40, 1-1,000..482.5 cc.

May 29th. The above materials were combined to get data on the result and to note any decomposition which might take place. When first combined the liquid turns a very dark green, and one can hardly see the reason. A close examination will show that there are present such finely divided particles of some green material as to fill the liquid and give the dark appearance. Later these form into larger flocculent masses and settle to the bottom. The liquid is then a dark green. The colour is given by many particles of suspended unknown material.

June 1st. Many very minute crystals of sulphur have collected on the side of the bottle. The black precipitate from the Black Leaf 40 still present and settled.

(11.) Lime-sulphur .... 17.5 cc.
Soap-water at the rate of 1 lb. soap to 100 gallons of water ....482.5 cc.

May 29th. Combined these materials to get data on results and to note any decomposition that might take place. The resultant solution was similar to that of dilute lime-sulphur of an equal strength. However, the soap immediately coagulated and formed a flocculent mass which settled to the bottom of the flask. This shows that soap-water and lime-sulphur cannot be combined for spraying purposes.

June 1st. Same as above.

Applications made June 16th, 1913.

Ex. No.
(1.) Arsenate of lead (acid) ......8 lb. to 100 gallons water.
(2.) Arsenate of lead (acid) ......4 lb. to 100 gallons water.
(3.) Arsenate of lead (acid) ......2 lb. to 100 gallons water.
(4.) Arsenatė of lead (non-acid) ..8 lb. to 100 gallons water.
(5.) Arsenate of lead (non-acid) ..4 lb. to 100 gallons water.
(6.) Arsenate of lead (non-acid) ..2 lb. to 100 gallons water.
(7.) Arsenite of zinc ....8 lb. to 100 gallons water.
(8.) Arsenite of zinc ....4 lb. to 100 gallons water.
(9.) Arsenite of zinc ....2 lb. to 100 gallons water.
(10.) Arsenate of lead (acid) ......8 lb. to 100 gallons lime-sulphur 1-30.
(11.) Arsenate of lead (acid) ......4 lb. to 100 gallons lime-sulphur 1-30.
(12.) Arsenate of lead (acid) ......2 lb. to 100 gallons lime-sulphur 1-30.
(13.) Arsenate of lead (non-acid) ..8 lb. to 100 gallons lime-sulphur 1-30.
(14.) Arsenate of lead (non-acid) ..4 lb. to 100 gallons lime-sulphur 1-30.
(15.) Arsenate of lead (non-acid) ..2 lb. to 100 gallons lime-sulphur 1-30.
(16.) Arsenite of zinc ....8 lb. to 100 gallons lime-sulphur 1-30.
(17.) Arsenite of zinc ....4 lb. to 100 gallons lime-sulphur 1-30.
(18.) Arsenite of zinc ....2 lb. to 100 gallons lime-sulphur 1-30.
(19.) Water without chemicals.
(20.) Lime-sulphur 30.5° Be. 1-30.

These trees had not been previously sprayed, and the leaves were more or less affected with scab. The orchard had only been cultivated once, and therefore was in prime shape to give results in an experiment of this kind.

The two days following the application were more or less cloudy, and the week following varied from rain to sunshine, mostly rain.

Summary of Results.

Lime-sulphur + arsenite of zinc, lime-sulphur + arsenate of lead (acid), and lime-sulphur + arsenate of lead (non-acid) in all strengths caused serious burning. If anything, the non-acid injury was slightly the worst.

Lime-sulphur caused considerable injury, but not one-half as much as in the combination sprays.

Arsenite of zinc alone and in all strengths caused some injury. The injury was different, however, from that of the combination and lime-sulphur sprayed trees.

With the combination sprays the entire leaf was destroyed, or else the injury covered a distinct portion, all parts of which were discoloured. Scab-spots on the leaves appeared black, ordinary leaf-tissue brown.

With the arsenite of zinc only the scab-spots were injured. In a few cases entire leaves were blackened or browned. The majority of the injured leaves were spotted with injury. Each one of these spots was determined to be the seat of germination of a scab-spore. The leaf-tissue between and surrounding these spots did not appear to be injured.

Arsenate of lead (acid) and arsenate of lead (non-acid) did not cause injury in any case.

The tree sprayed with water did not show injury. The injury did not begin to show up badly for about five days, when suddenly, overnight, it appeared at its worst.

As soon as the injury on trees sprayed with arsenate of lead (non-acid) + lime-sulphur 1-30 became apparent, checks were made on different trees of the same block. The check sprays were the same as on the trees 10, 12, 13, 15, 16, 18. The utmost care was used in these applications, and as the same injury occurred a second time, we must conclude that, even with the purest of chemicals, lime-sulphur + arsenate of lead is not a stable spray under North-west conditions.

The controlling factors are yet to be determined. Two other experiments for the control of the codling-moth have not yet been finished. But in one of these lime-sulphur + arsenates of lead, acid and non-acid, and arsenite of zinc did not cause more than slight injury at the first application. The second application on June 30th caused serious injury. Therefore we may say that the above combination sprays are safe for the calyx spray, but are unsafe at the time of the second codling-moth spray.*

RECENT INSECTICIDE INVESTIGATIONS.

(1.) To find the value of lime-sulphur as a stomach-poison.
(2.) To find the value of arsenate of lead (acid) as a stomach-poison.
(3.) To find the value of arsenate of lead (non-acid) as a stomach-poison.
(4.) To find the value of arsenite of zinc as a stomach-poison.
(5.) To find the value of arsenate of lead (acid) + lime-sulphur as a stomach-poison.
(6.) To find the value of arsenate of lead (non-acid) + lime-sulphur as a stomach-poison.
(7.) To find the value of arsenate of lead as a stomach-poison.

The chemicals used were secured from the same source as those used in the spray-injury experiments.

Larvæ of the tent-caterpillars *Malacasoma erosa* and *Malacasoma pluvialis* were used in these experiments, and were placed on sprayed twigs in the open part of the insectary. Newspapers were placed under the twigs to catch the dead larvæ and every experiment kept separate from the rest.

Summary of Results.

In these experiments arsenite of zinc was a quicker-acting poison than arsenate of lead, acid or non-acid, and remained in suspension much better. Acid arsenate of lead was a quicker-acting poison than the non-acid and remained in suspension better.

Non-acid arsenate of lead was slow in its action, but was satisfactory in that death finally occurs.

Lime-sulphur in our experiments has not proven to be much value as a stomach-poison.

Lime-sulphur with arsenicals seems to retard to a more or less extent the action of the poison, and it is possible for larvæ to feed on foliage sprayed with weak

* Arsenite of zinc is apparently not entirely satisfactory under all conditions, and should not be used until after more experimental work has been done.

strengths of lime-sulphur + arsenate of lead, and to recover if transferred to fresh foliage within a few days.

Very young caterpillars placed on twigs freshly sprayed with lime-sulphur 1-30 died within two or three days, but, as they did not feed, death must have resulted from the gases given off.

Very young caterpillars placed on twigs that had been sprayed with lime-sulphur 1-30 and allowed to stand refused to eat, and finally died from starvation.

Half-grown larvæ placed on twigs sprayed with lime-sulphur did not feed like larvæ on unsprayed twigs, but did eat to some extent. After two weeks on lime-sulphur sprayed twigs they were transferred to fresh-sprayed leaves, and finally matured, pupated, and emerged in the adult stage.

Lime-sulphur probably acts as a repellent to biting-insects in the same way that Bordeaux does against the potato flea-beetles. Lime sprinkled or sprayed on the foliage in the same proportions as found in a certain amount of lime-sulphur had no effect.

Mr. E. W. White: I have been delighted to listen to the address of Mr. Wilson. I am sure we will all feel the benefit of his remarks. With our conditions here in British Columbia, contrary to the Oregon conditions, we probably do not under ordinary conditions need to apply more than two sprays annually—the first as the buds show green with lime-sulphur and Black Leaf 40 for aphis, and the second as the blossoms fall for scab and leaf-eating insects.

Mr. Tom Wilson: Professor Wilson claims that aphis-eggs are not killed by the use of winter applications of lime-sulphur. I may say that I believe this to be quite true; I have failed to do so myself. By the addition of caustic soda the necessary effect will be produced. For the woolly aphis I have seen the use of lead paint advocated.

Mr. Lyne: There is one item that occurs to me, and that is the burning effect of sprays. When applying the usual formulæ, if we find the foliage suffering, I find that the addition of lime will control the burning effect of lime-sulphur.

Mr. Cunningham: By adding 6 lb. of lime to lime-sulphur 1-15 no damage results on fruit or foliage. We can also apply a lime spray to control the burning effect of lime-sulphur.

Professor Wilson: All these points bear out our recommendations. We find that lime-sulphur 1-10 can be applied without any injury, but, on the other hand, sometimes an application of 1-40 will result in injury. Consequently no recommendation can be stable.

Mr. L. L. Palmer: I notice in your paper that you have been carrying on your experiments with the use of pure arsenicals. How can we as fruit-growers obtain them? What firms sell them?

Professor Wilson: All our experiments in the past were based on commercial sprays, and we find they vary. We believed that experiments previously carried on by other experimental stations were unreliable, as they never really knew with what they were working. In our work, then, we believed it best to have a reliable basis to work on, and our chemists at the station did this for us. I may say there are two pure arsenates of lead on the market, but I am not at liberty to inform you of the names of the satisfactory firms. The great variations that have taken place in arsenical experiments in the past probably account for the variations in the results. In our work, however, we carried on duplicate experiments with the ordinary commercial sprays. There has been, I fancy, a great improvement in the arsenates of lead during the past few years.

Mr. Taylor: Sherwin Williams arsenate of lead had no effect on cherry-slugs at the rate of 1-40, but 1-20 killed the insects.

Professor Wilson: Pyrethrum at the rate of 1-50 is a most satisfactory spray for cherry-slugs.

A member: Which would you advise us to use, the powdered or paste form of arsenate of lead?

Professor Wilson: It is only a question of time that powdered arsenates will be used altogether.

The Chairman: This has been a very excellent discussion. Forasmuch as the next paper by Mr. Winslow has a bearing on the present discussion, I take pleasure in asking Mr. Winslow, Provincial Horticulturist, to present his paper.

THE ECONOMIC SIDE OF PEST-CONTROL.

BY R. M. WINSLOW, PROVINCIAL HORTICULTURIST, VICTORIA, B.C.

I propose to deal with pest-control on fruit-trees and with the economic side of that question, largely in its relation to the question of costs of production. The cost of controlling insects and diseases on fruit-trees is a part of the larger one of total cost. Our present cost of fruit-production, I am safe in saying, is out of proportion not only to the market prices being received for the product, but is further greater than the production costs of our competitors in those markets. It is true that our fruit has a certain percentage from the Customs tariff, and is, in addition, protected in some cases even more heavily than by the tariff, by more advantageous freight and express rates than our competitors enjoy. It is my own conclusion, however, that the advantage given us by lower freight rates and the Customs tariff does not nearly equal the higher cost of production. If, therefore, our competitors were receiving remunerative prices for their product, our prices, though relatively higher, would be actually less remunerative because of our much higher costs. For instance, skilled orchard labour costs us approximately 25 per cent. more than it does in Oregon and Washington. Most of the materials, such as land, nursery stock, spraying materials, tillage, tools and implements, fruit-packages, paper, nails, packing-house equipment, etc., cost us approximately 20 to 40 per cent. more than our competitors. The fruit-grower's cost of living itself is, perhaps, even higher proportionately, while money both on mortgages and on personal loans costs from 10 to 25 per cent. more. The effect of all these differences is to raise the average cost of apple-production, for instance, in bearing orchards in the interior of British Columbia to about 75 cents a box, as against 50 cents for our competitors; in many cases the difference is very much greater.

The big problem of successful fruit-culture is strictly an economic one. We must be able to sell our fruit at a return that represents at least a margin of profit to the producer, and every possible assistance should be given him to that end. Action has been taken to provide a marketing organization which, while it may not be expected to reduce the cost of marketing, is expected to enhance to some degree the selling-price of the fruit, so providing a larger net return to the grower. The cost of actual production is beginning to give many fruit-growers much concern, and many of them are working to reduce their costs as much as they justifiably can.

As Secretary of the British Columbia Fruit-growers' Association and as Provincial Horticulturist, I have had special opportunities to study the costs of fruit-production, and I am aware that much remains to be accomplished in making savings in every operation in the orchard. Our growers are just beginning to study the economics of their work. Many of them started in fruit-growing with the assumption that profits were so great as to make little economies in production unnecessary. It is an economic law that one part of any general business in the world will stand inordinately high costs, and fruit-growing in British Columbia is not likely to prove any exception. The history of fruit-growing in California and in Western Oregon, the first two fruit sections of the Pacific Coast, amply illustrates this.

Among other things, then, the cost of pest-control is a consideration. You may remember that in the literature issued by Government and by those with land for sale it has been said that pests are at a minimum in the Dry Belt, in which the greater part of our orchards are located; the absence of codling-moth, San Jose scale, and apple-scab, the three most injurious orchard pests, as cited, was undoubtedly correct, and by this intending fruit-growers were led to conclude that injuries