Close attention must be given to mixing. Water *never* should be added after the oil has been poured into the solution of soap and lye. Dissolve the soap in 8 to 10 gallons of boiling water and place in barrel or tank; add the rest of the water to make up 43 gallons. If using tank, start the agitator, add the lye, follow up with the oil, pouring the same slowly into the thoroughly stirred suds.

(Note.—This will not make a stock solution, which can be safely kept any time, so should be sprayed as made.)

Whenever a better oil or distillate is obtainable, I would not advise the use of the above crude oil, since often it contains so much foreign matter that it forms a poor emulsion and makes spraying more dangerous through non-uniformity of mixture. This crude emulsion should never be used except where it is possible to apply at least 200 lb. pressure with a good angle nozzle which throws a finely divided spray.

The chief advantage of the crude-oil emulsion is its apparent cheapness, but in reality the cost is about the same where a good stove distillate testing 29° Baume can be procured. Laid down in the Okanagan last year the costs were about as follows (to make up 200-gallon tank), F.O.B. Vernon: Slop distillate (crude oil), 19° Baume, 10 to 12 cents per gallon; fuel distillate (little better than stove), 35° Baume, 18 cents per gallon.

To make up 200-gallon tank requires: Crude oil, 24 gallons at 10 cents, $2.40; fuel distillate, 16 gallons at 18 cents, $2.88; kerosene, 12 gallons at 28 cents, $3.36; lime-sulphur, 20 gallons at 13 cents, $2.60.

(Note.—Kerosene used by ordinary formula would take approximately 12 gallons to make 200 of the dilute emulsion. Lime-sulphur for comparison only.)

In making the stove-distillate emulsions the same ingredients should be used, but both the amount of soap and the quantity of oil should be reduced. The following is satisfactory: Whale-oil, 4 lb.; lye, 1 lb.; distillate, 4 gallons; water, 45 gallons; total, 50 gallons. In the use of distillate, as in crude oil, do not add water after the oil has been poured in. In other respects follow the same rules.

There are several other interesting new sprays, such as the soda nitrate, used to stimulate growth and early development of fruit-buds, and powdered arsenates of lead to replace the ordinary paste. As a fungicide, atomic sulphur has proven very effective, and combines readily with both oil emulsions, soap solutions, Black Leaf 40, and arsenates of lead, therefore being more adapted to combination spraying than its predecessor, Bordeaux mixture.

Any of the above-mentioned spray materials could be studied separately, but time will not allow it here. Neither have I taken up the insects and diseases combated by the sprays mentioned, since they are known through study of more common sprays, which are all applied at the time most suited to kill or control the insect or disease in question.

THE TARNISHED PLANT-BUG (LYGUS PRATENSIS LINN.).

By R. C. Treherne, Field Officer, Dominion Division of Entomology, Agassiz, B.C.

In consideration of the comparative prevalence of fire-blight (*Bacillus amylovorous*) in various parts of the Okanagan District, I have thought it advisable to draw your attention to the fact that the disease is capable of being spread by means of several and sundry insects of the orchard. Mr. L. L. Palmer, Horticulturist, Coldstream Estate, at the meeting of this Society last July in Vernon, made mention of the fact that the several species of aphides are chief among the economic pests of the Okanagan. This is an important point, for it is clearly proven that aphides, and in particular the green apple-aphis (*A. pomi*), are capable of spreading the disease.

Naturally, then, the disease of fire-blight varies in extent in accordance with the prevalence of aphides, and the obvious control of the blight is accomplished, in

due proportion, to the control of the aphides. I cannot do better than draw your attention to the very excellent article written by Mr. Palmer and published in Bulletin No. 3, N.S., British Columbia Entomological Society, on "Some Problems of Aphis-control in the Okanagan."

Obviously, all insects that feed, more or less, on portions of plant-tissues or on plant-exudations affected by fire-blight are capable of transmitting the disease to healthy plants. Such insects, as numerous flies, wasps, bees, ants, bugs, borers, all effect their quota in transmitting the disease. Pruning alone may be practised with any degree of success against such visitants, which in very many cases are known to be a benefit to a tree rather than otherwise. The veterinary slogan "Remove the cause" may well apply.

There is one insect, the name of which heads this article, the tarnished plant-bug, which requires some attention. Mr. W. H. Brittain, who during the past summer held the position among you as Provincial Entomologist and Plant Pathologist, records this insect among his papers (printed in Bulletin 4, British Columbia Entomological Society) as noted "attacking a wide range of crops" in the Okanagan. "Probably," he states, "the most damage was done to nursery stock. Leaves that are attacked when young become wrinkled and curled. Sometimes small areas of the leaves become brown and die, subsequently dropping out and producing a 'shot-hole' effect. Blossom-buds attacked on fruit-trees are retarded in development, if not killed. Leaf-buds, when pierced at the base, frequently die and drop off."

In the same issue of our Proceedings (Bulletin No. 4) I have recorded this insect as being prevalent in the Lower Fraser Valley, and especially noted as a serious pest in greenhouses. Its presence is also noted in the orchards of the Lower Fraser Valley, although during the past two years I have not observed it as being especially destructive to fruit or blossom buds or to the leaves.

In view of the undoubted presence of this insect in our orchards, I beg leave to quote Professor Stewart, of the Cornell Experiment Station. In Bulletin 329, 1913, "it is believed that the most important agent in transmitting the 'blight' parasite to healthy trees has been the tarnished plant-bug (*Lygus pratensis*)." I would suggest, therefore, that those of you who are especially interested in the control of the fire-blight organism pay attention to the presence, prevalence, and control of this bug.

The adult belongs to the Heteroptera and to the family Capsidæ, or leaf-bugs. When fully mature the adult measures about 6 mm. long, and is shield-shaped in general outline, brown in colour, and marked with black, red, and yellow. There seems considerable variation in the colouring; some are inclined to be greenish or yellowy brown. The winter is passed in the adult stage beneath rubbish in the orchard or in such places as fence corners, clumps of leaf-mould, etc. Early in the spring, and possibly to some extent in the fall previous, oviposition commences. For a long period of time the season of the year and the place of oviposition have been in doubt, owing to the difficulty of successful breeding in captivity.

Within the past few years steps have been taken to more fully determine this point in the life-history, for obviously it is most important. In the *Journal of Economic Entomology*, 1908, Professor E. P. Taylor has recorded the fact that injuries to young developing fruit, "formerly classed as that caused by the plum or apple curculio, was instead the result of egg-punctures made by the tarnished plant-bug." Professor Taylor has not observed oviposition in apples at any time except in the very early spring immediately at or just after blossoming, and then particularly on the early-blooming varieties. Peculiar "dimples" are produced in the after-fruit, which outgrows the injury caused from the spring attack.

In 1910, Professors F. H. Chittenden and H. O. Marsh, in the same Journal, stated that they found eggs laid in the following places, viz.: (1.) April 19th—deposited on kale "slightly inserted on the upper side of the leaf." (2.) May 23rd—on volunteer turnips, deposited "in the seed-stalks, stems, and leaves, scattered about singly and in irregular rows or groups, sometimes three being placed close

together." Evidently eggs are "deposited chiefly in the stems, less seldom in the midribs, and occasionally in the leaves." (3.) On mullein—"eggs being inserted in the petiole or leaf-stem and in the midrib."

From these notes it would appear that oviposition in the early spring takes place in volunteer plants, weeds, and developing fruit. Yet a further reference is found in the *Journal of Economic Entomology* for 1913 by Professor Haseman, of Missouri. He believed that the bug "does not deposit its eggs in the tissues of plants, as some maintain, not even in the soft stems of weeds." He claims that the ovipositor is not strong enough to drill into the tissues of plants. In Missouri, he claims, the bug "deposits its eggs in the fall of the year at least, only in the blossoms of flowers such as daisies, asters, and particularly 'mare's-tail' (*Erigeron canadensis*)." Professor Haseman has further determined that the life-cycle may be completed in about a month.

We may judge, therefore, that, although this insect is among the commonest in our entomological fauna, there still remains a doubt as to its oviposition period. There seems little doubt that eggs are laid, as stated and observed, in the fall and in the spring, and for the most part in weeds. While the actual points of oviposition remain in doubt, yet it would seem that weeds act as the host-plants in the fall and in the spring; consequently the net value of these records to the farmer and fruit-grower remains the same. Destroy weeds.

In the spring, in due course, the eggs hatch to nymphs or immature stages of the bug. Probably four or five moults are undergone before the mature adult is formed. The adult, of course, sucks its food, and it possesses a long beak fully one-third the length of its body, which is folded beneath it when not in use. The adults are very active, darting off immediately they are disturbed. The only hope of capturing them is in the very early morning in spring, when they are partially dormant. They may then be shaken off the plants.

As Mr. Brittain noted last year, the chief injury at present is in the effect of the attack on the terminal shoots, and especially noted in nurseries. Peaches, pears, and apples are attacked, and no doubt also a variety of other plants, by the bugs, which suck the juices from the buds, causing a cessation of growth, followed by a twiggy formation or by a complete check. It may be noticed that there is a certain difference in the growth of the various varieties of fruit-tree growing under like conditions. Pear-trees develop most rapidly in midsummer; apples a little later. Furthermore, conditions of growth vary in accordance with climatic arrangements for the year, and induced growth at periodic intervals may be forced under artificial or irrigated conditions. All such conditions have an important place in our orchards, when it is realized that a succulent condition of growth is a determining factor in reference to the spread of fire-blight in certain varieties by such insects as the tarnished plant-bug. Given a succulent growth, the presence of *L. pratensis*, and the blight organism, it will be noted that the attack will be more severe than on a growth hardening up or previous to sap activity with the same two agents present.

For control measures may be recommended the destruction of all weeds and the cleaning-up of fence corners in the orchard. The trapping by sticky shield or by beating in the early morning and the application of kerosene emulsion in dilute form to the leaves at the time when nymphs are present. Sprays of dilute nicotine extracts may also be used, applications in this form being applied about every ten days, especially under greenhouse conditions.

THE PART PLAYED BY INSECTS IN THE SPREAD OF PLANT-DISEASES.

By J. W. Eastham, Provincial Plant Pathologist, Vernon, B.C.

Plant-diseases are of two kinds. In the first place, we have the so-called physiological or non-parasitic ones, which are due to some irregularity or disturbance in the processes going on in the plant and induced by external conditions, such as deficiency or excess of certain chemical substances in the soil, too much water,