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Experiment Station.



Bulletin No. 18. March, 1892.



ENTOMOLOGY.

F. L. WASHBURN, Entomologist.

Insects Injurious to Young Fruit Trees.  
Codling Moth. Kerosene Emulsion.  
Wire Worms. Flea Beetles.

The Bulletins of this Station are sent free of cost to all residents of Oregon who request them.



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## Insects Injurious to Young Fruit Trees.

As a consequence of the very general fruit tree planting at present in vogue in many parts of Oregon, numerous inquiries relative to insect pests found upon young trees have been received at the Experiment Station. Very many of these questions could be answered by reference to Bulletin No. 5. Unfortunately the edition of that is completely exhausted and in the present Bulletin there are descriptions and figures of a number of species which were discussed in the former publication. They are repeated here in order that the many who did not get No. 5, may acquaint themselves with the pests described therein.

It must, by no means, be inferred from the heading, that the following list does not affect mature trees also. This title is employed simply to emphasize the necessity of diligence on the part of the fruit grower at a time when the trees are least able to resist insect attack. For reasons of economy

we will be as brief as possible in the treatment of the subject. Figures 1, 2, 4, 8, 9, 11, 12, were produced from cuts courteously loaned by the California State Board of Horticulture

Wherever straight lines occur in the figures they indicate the natural size of the insect by the side of which they are placed.

### San Jose Scale.

Female scale round, flattened, gray, with center yellowish, about one tenth in. in diameter. Scale of male smaller, darker and slightly elongated. The eggs hatch about

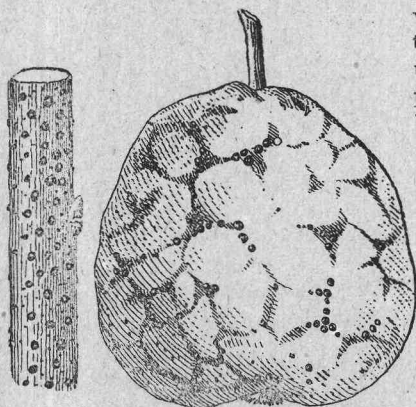


FIG. 1

Pear and twig infested with San Jose Scale. The time the cherries are turning red and the young insects migrate over the tree, soon becoming fixed and secreting scale. This scale is becoming

alarmingly abundant in Oregon. It has been found on other than fruit trees, and is undoubtedly carried, in larval stage, from orchard to orchard and tree to tree by winds, by birds, by bees and other insects.

Branches badly affected with this scale look reddish, and leaf and fruit, if scale is found thereon, show small red rings on their surface about the insects. This is a peculiarity characteristic of this scale. The sapwood of badly infested trees is found to share this red color.

#### REMEDIES.

Inasmuch as the young hatch at different times and the scale can be found in all stages during the summer, remedies applied during the warm weather are not satisfactory, and the fruit growers strongest hold is the winter wash of lime, sulphur, and salt.

*Recipe for Winter Wash.*—*a.* Boil 10 lbs of lime and 20 lbs of sulphur in 20 gals of water until all the sulphur is dissolved.

*b.* Mix 15 lbs of lime and 15 lbs of salt and add enough water to make 60 gals.

Add *a* to *b*. Mix well and strain through burlap. Spray affected trees with the solution, warming it to about blood heat.

A nozzle with a large orifice would have to be used, otherwise it will clog the aperture.

*Recipe for Summer Wash.*—*a.* 10 lbs Whale oil soap, 20 gals. of water.

*b.* 1 lb Am. concentrated lye 2 lbs sulphur 1 gal of water.

When *a* is heated enough to become thoroughly liquid and *b* has been boiled until it is thoroughly mixed and dark brown, add *b* to *a* then heat for half an hour, add 30 gals of water, and use at a temperature of about 110° Fahr.

Through May, June and July is the best time to use this spray.

It is also effectual in lessening the injury caused by the apple scab, (*Fusicladium dendriticum*) and is sure death, when used thoroughly, against the branch form of Woolly Aphis; Green Aphis succumbs to it at once, and when sufficiently diluted we have used it successfully against the Cabbage Louse on Cabbage, Cauliflower, Kale and Brussels sprouts, without injury to leaves. A number of insect enemies prey upon the San Jose Scale.

Should young trees be received affected with this or any other scale, they should be disinfected before planting.

Dipping them in a solution of 1 lb. Am. concentrated lye to every 2 gals. of water is recommended. It would seem that a moment's immersion in the wash recommended for summer use against this scale (120° Fahr.) would accomplish the desired object. We have never had an opportunity to test this; as a matter of fact the sale of such trees is against the law and is punishable by a heavy fine.

#### Oyster Shell Scale.

In shape the female of this scale resembles a mussel shell, is grayish brown, about  $\frac{1}{8}$  of an inch long. The scale of the male is straight and much smaller than the female. The eggs hatch into tender yellow lice about the time the trees are blooming, and before.



## REMEDIES.

Scrape mature trees well in winter to get rid of old scaly bark. Examine young trees before planting and clean if infested. In summer, use

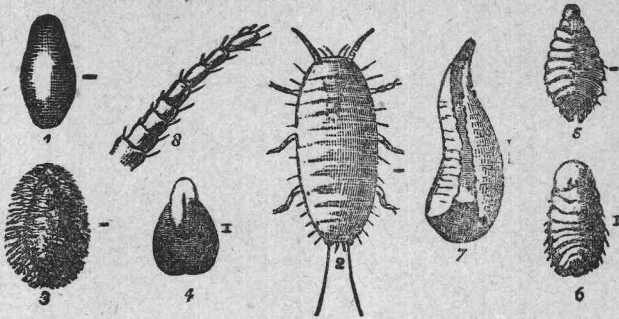


FIG. 2.

OYSTER SHELL SCALE.—1, Egg. 2, Young Insect. 3, Young, with secretion forming scale. 4, A form of the scale before it reaches maturity. 5 and 6, Appearance of Insect after moulting. 7, Mature scale. The lines indicate the natural size of insect.

wash recommended above for San Jose Scale, when lice are hatching, or kerosene emulsion. After scraping trees apply the wash recommended below for apple tree borers.

## Woolly Aphis.

Found in woolly clusters on our apple trees. Everywhere too common. A root form infests the tree below the ground and there is thought to be a

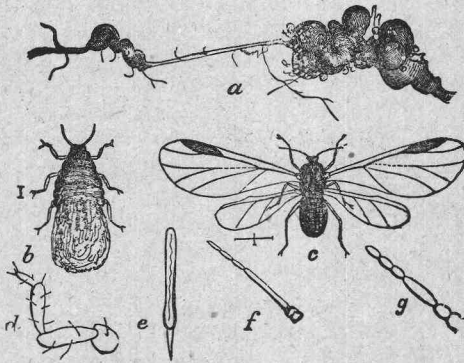


FIG. 3.

WOOLLY APHIS.—a, galls on root. b, larva. c, winged female. d, leg. e, beak. f, antennae of female. g, antennae of larva.

migration from root to branch. This insect ruptures the bark of the branches and causes gnarled condition of the roots, sapping the tree's vitality and affecting its bearing qualities.

## REMEDIES.

Old and valueless trees which are badly infested should be destroyed by burning root and branch. If the colonies on branch are few, a feather dipped in pure kerosene and applied to each colony will kill them. Or if

very few they can be crushed with the hand. In summer they can be killed by spraying forcibly and frequently with the summer wash recommended for San Jose Scale, applied warm.

Trees treated with this wash last summer (see report of work with the Codling Moth) were practically exempt from the branch form of Woolly Aphis as long as spraying continued, though they had been badly affected in previous years.

The following Rosin Solution will kill them. It is also good for other Aphidæ, when used at one half the strength here indicated.

**Rosin Solution.**—Dissolve one pound of Am. concentrated lye in two quarts of water, add 4lbs of rosin, heat until dissolved and then add 2½ gals. of water.

Use as spray when warm (100° F.), diluting it by adding 1 gallon of water to every quart of the solution. To kill their winter eggs and eggs of any of the Plant Lice (little, oval, shining black bodies found in clusters about bud axils) use 1 pound Am. concentrated lye to every 2½ gallons of water. Never use this wash on any tree after the buds begin to swell.

For root form, lay bare the roots, pour some soft soap, slightly thinned, over them, and cover them with soil other than what was taken out. Or, heap unleached ashes and lime about base of tree. Gas lime spread about the tree (about two shovelfuls) so as not to be in contact with the bark, is said to be excellent. The use of bisulphide of carbon may prove efficient in connection with this form of pest.

This Aphis, as well as others of the same family, are preyed upon by parasites and many beneficial insects such as "Lady Bugs," Laced-winged Flies, Syrphus Flies, etc.

### Western Peach-Tree Borer.

*Sannania Pacifica.*—Riley.

A steel-blue, wasp-like looking, clear-winged moth which flies in the day time. It lays its eggs on the plum, cherry and peach tree (or peach stock, whatever the tree may be) at or near the collar and the larva, hatching, bores downward in the sapwood and bark.

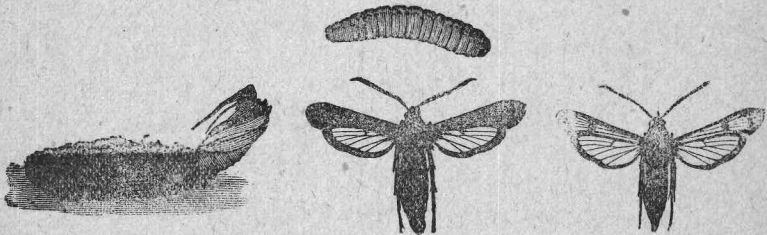


FIG. 4.  
Western Peach Borer. Larva, and Male and Female Moths. Also Moth emerging from Cocoon.

The full grown worm is about 1 inch long, yellowish white with a red dish, brown head and strong brown jaws. The presence of the pest is indicated by exuding gum often mixed with sawdust-like castings.

It behooves all owners of peach or prune trees to be alive to the destruction which this pest can cause.

#### REMEDIES.

Examine collar and larger roots for borer twice a year, early in February and again in October. At these times dig the soil away and make a careful search, as the larvæ are often found way down among the larger roots. Remove borers, when found, with knife.

Wash trunk early in May and again six weeks later with the following:

Add 1 gal. of hot soft water to 1 gal. of common soft soap and stir in 1

pint of crude carbolic acid. When well mixed add ten gallons of soft water and enough lime to make the mixture a thin white wash.

Some entomologists recommend the addition of a little glue to this mixture to make it more durable.

At the Station we have wrapped (July 14, 1891), 7 trees with newspaper, several thicknesses, allowing it to project a few inches below the surface and to extend up to lower branches. Removed Oct. 8 and trees found exempt from borers. This paper should be applied earlier in the season. We have also painted the trunks and collars of a number of trees with the rosin wash, full strength, recommended under Woolly Aphis, with good results.

### Flat Headed Apple Tree Borer.

A dark-brownish active beetle  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch long, under side with a coppery lustre. Its larva, a yellow grub about 1 inch long with a very large

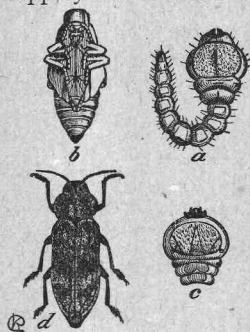


FIG. 5.

FLAT-HEADED APPLE-TREE BORER.—a. Larva. b. Pupa. c. Head of larva. d. Beetle.

flattened head, attacks not only the base of the apple tree, but is found more or less over the trunk and is not confined to the apple but attacks pear and plum and occasionally the peach. Discolored bark which has a dried appearance almost always indicates the presence of the borer; often, too, the sap oozes out where the pest is at work, and the sawdust-like castings are seen either on trunk or at base of tree. The eggs are laid by the beetle in cracks and crevices of the bark and the young larva bores into the sap wood. Later it works in the more solid wood. It undergoes its transformations just beneath the bark.

#### REMEDIES.

Use the same precautions and remedies suggested for peach tree borer. Young trees newly transplanted and weak trees are more subject to attack, and it is a noticeable fact that the southwest side of the tree where the bark may have been injured by the hot sun, is preferably the place of attack.

Woodpeckers pick these borers from their hiding places and three or four parasitical insects are known to attack them.

### Green Aphis, Peach Aphis, Plum Aphis.

The Green Aphis (*A. mali*) is found on the apple. The Peach Aphis (*Myzus persicae*) are black, brownish, or yellowish  $\frac{1}{8}$  inch long. The Plum Aphis is green with blackish markings on abdomen. The name in each case indicates the food plant of the insect.

#### REMEDIES.

If but few colonies are observed in an orchard, perhaps crushing by hand is the most practical remedy. Spraying with kerosene emulsion No. 1 (see beyond under *Kerosene Emulsion*) in the proportion of 1 part emulsion to 25 parts of water will kill any of these without injury to the foliage. There is the greatest necessity for early treatment, before the lice get well started, and when their numbers are comparatively few. Spraying with strong soap suds or soap suds and tobacco is another summer treatment recommended. A forcible spray

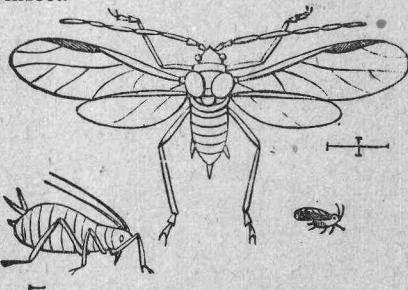


FIG. 6.

GREEN APHIS.—Winged and wingless forms.



should be directed against the under side of the leaves and every part where the insect may be concealed, should be reached by the spray. We have found that the Climax Nozzle, manufactured by the Nixon Nozzle and Machine Co., Dayton, Ohio, does good work against these and all other Aphids, inasmuch as it delivers the spray with great force. To destroy winter eggs, see remedy under Woolly Aphid.

### Pear and Cherry Tree Slug.

A dark green slimy worm about  $\frac{2}{3}$  inch long found feeding on the leaves of pear, cherry and other trees. It eats the upper side of leaf, causing it



SAW-FLY producing Pear and Cherry Tree Slug.



FIG. 7.  
CHERRY LEAF, showing Slug at work. a, Larva, natural size.

to wither and fall to the ground. This larva undergoes its transformations in the ground, changing to a four-winged fly which lays its eggs on the leaves.

#### REMEDY.

Spray affected trees when foliage is full, with 1 pound good Paris green to every 250 gallons of water used. Five pounds of soap added to that quantity of liquid will help it to spread evenly over the leaves. Thoroughly mix these and keep them well stirred when using. This mixture cannot be used when the bloom is on, nor can it be used on cherry trees when the fruit is just starting.

Hellebore 1 oz. to 2 gals. of water is claimed to be an effective remedy, applied the same way.

### Peach Moth.

Several terminal twigs of peach trees have been sent to the Station containing the pinkish larvae of the Peach Moth or Twig Borer, about  $\frac{1}{2}$  in. long. They affect the fruit of the peach and plum as well as the twigs.

This insect is not likely to become a serious pest. The only sure remedy is to remove infested twigs and burn them.

Probably the summer wash recommended for the San Jose Scale would prove beneficial if a remedy were necessary.

In the east this insect feeds on strawberry roots.

#### WHITE-MARKED TUSSOCK MOTH.

Female moth wingless about  $\frac{1}{2}$  in. long brownish; male gray strikingly marked with darker colors and with white:

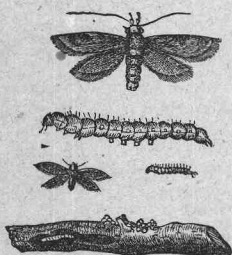


FIG. 8.  
PEACH MOTH AND LARVA, Enlarged and natural size, and twig showing work of insect.

Caterpillar light yellow 1 in. or more long, head and two protuberances



toward posterior end of body, red. Four tufts on back yellowish white. One black plume extends from posterior end of body, two from the anterior

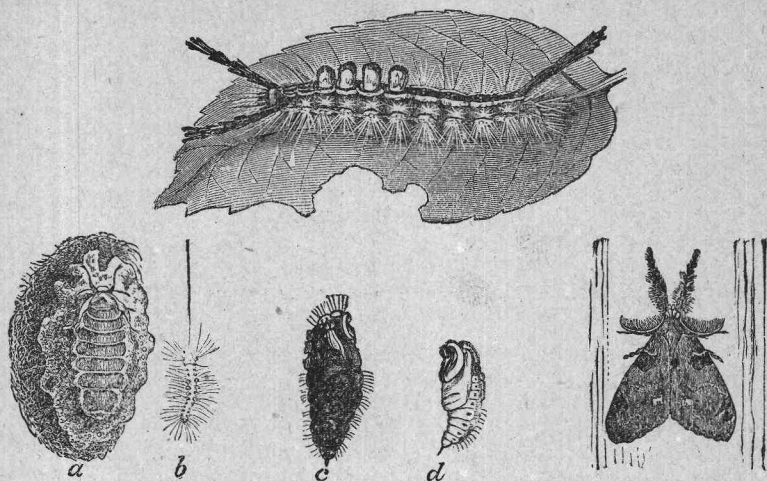


FIG. 9.

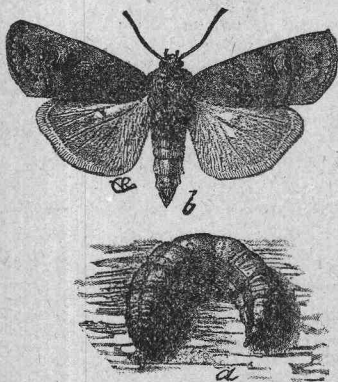
WHITE-MARKED TUSSOCK MOTH, CATERPILLAR ON APPLE LEAF.—*b*. a young caterpillar  
*c*. Crystals of female. *d*. that of male. *a*. The wingless female shown on empty cocoon.  
The male moth is also figured.

end. Fine yellowish hairs on side of body. Egg masses found on a cocoon beneath a leaf fastened to branch of tree.

The larva being a leaf eater would naturally succumb to arsenical sprays used against the Codling Moth. It is by no means a serious pest.

### Cut Worms.

The various colored larvæ of several night-flying Moths. Unfavorably known as "cut worms" on account of their habit of cutting through the roots of many garden vegetables just below the ground, or through the stalk just above the ground. Some species also injure young fruit trees by climbing up the trunks and feeding on the tender buds and leaves.

FIG. 10.  
CUT-WORM AND MOTH.

### REMEDIES.

Inasmuch as they lie concealed during the day in the immediate neighborhood of the plant attacked the previous night, when a young tree is observed to be newly injured, the orchardist should look for the depredator in the earth a few inches from the tree and one or two inches below the surface. Pieces of tin or zinc fastened round the tree in the form of an inverted funnel keeps them from ascending. Shaking the trees late at night and so jarring them onto a sheet below is one good means of collecting them. Numerous holes, about one inch in diameter and a few inches deep, punched in ground about trees will serve as traps into which some will fall and be unable to extricate themselves. Sprinkling the

leaves and buds with Paris Green solution (1 lb to 300 gals. of water) will kill them. Dipping bunches of freshly cut clover in the solution of Paris Green and scattering same about trees will poison many. In preparing these baits the solution might with profit be made stronger than the proportion given. After eating of this clover the worms burrow beneath the ground an inch or two and there die; one must not expect to find them on the surface.

Cabbage leaves, it is claimed, laid on the ground form attractive baits under which they conceal themselves and can be killed in the morning.

Gardeners will readily see which of the above remedies are applicable in vegetable gardens.

### Divaricated Buprestis.

A rough bronze colored beetle nearly 1 in. long. The wing covers at posterior end are slightly spread apart. Frequently found sunning itself on limbs of cherry and peach. The larva or grub, which feeds on the sapwood closely resembles the flat-headed borer. Though reported as not especially troublesome, I have just taken (Mar. 9) from the collar of a peach tree, larva of this species over  $1\frac{1}{4}$  inches long and in the same tree found two or three other specimens considerably smaller. The treatment recommended for the Peach Tree Borer would be efficacious here.

### Red Spider.

(*Tetranychus telarius*.—Linn.)

Not a true spider, but a minute mite which sometimes swarms on branches of fruit trees. Their small eggs, colorless when laid soon turn reddish, making affected spots on branches, look as though covered with iron rust.

These little fellows spin delicate webs on the under side of a leaf and there feed on the leaf's juices. The leaves thus affected turn yellow. Quite recently some dried prunes were sent us covered with this pest.

### REMEDIES.

Spraying with strong soap suds will destroy them, should they become troublesome; but said spray must be directed against under side of leaves until those parts are thoroughly wet. In winter the eggs can be destroyed by a wash of 1 lb Am. concentrated lye in  $2\frac{1}{2}$  gals. of water. Kerosene emulsion is disastrous to these animals, as is also any wash containing sulphur.

This little pest is frequently very troublesome on green house plants, and is reported as injuring the hop vine.

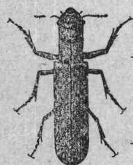
### Tent Caterpillars.

Hairy caterpillars spinning webs on forest and fruit trees. See Bulletin No. 14.

### Canker Worms.

Smooth, naked caterpillars called "measuring worms" or "loopers" from their peculiar mode of walking. They are leaf eaters and could therefore be successfully attacked with the arsenical spray.

### Branch and Twig Borer.



A small brownish beetle boring in axils of twigs on pear and other trees. See Bulletin No 14.

FIG. 11. Branch and Twig Borer.

### Unicorn Prominent.

A leaf eating caterpillar, not common enough to cause special injury and seldom noticed because of its protective coloring. Hand picking, jarring trees, and arsenical poisons could be used against it.

### Plum Tree Catocala.

A moth whose eggs produce a caterpillar  $1\frac{1}{2}$  in., whose body is thickened in middle. General color of caterpillar grayish brown with two to four small reddish tubercles on each segment. On upper part of ninth segment there is a fleshy horn; on twelfth segment a fleshy ridge tinted behind with deep reddish brown. Leaf eaters, but not common enough to cause special injury.

### Red-humped Caterpillar.

A leaf eating caterpillar a little over an inch long, emitting a strong dis-



FIG. 12.—RED-HUMPED CATERPILLAR, LARVA AND IMAGO.

agreeable odor when handled. Head red and a red hump on fourth segment. Hand picking and jarring trees, for this and the preceeding could be resorted to if necessary.

### Cicadas.

Different species of so called "Locusts" and among them the Seventeen Year Locust. The mature insect punctures the branches and in the slits so made deposits her eggs. The twigs and branches, thereby weakened, are broken by the wind. The larval and pupal stages are passed in the ground where the larvæ feed on the juices of the roots. They have not been reported to the Department as yet doing damage in Oregon.

### Scolytid Borers.

The larvæ of very small snout beetles which not only destroy vast areas of forest but frequently attack fruit trees. A number of reports have reached the Station, accompanied by specimens, which bear evidence to this latter habit. Their presence in a tree in large numbers foretells its death. They work on trunk and branch and their mines are just underneath the bark. Frequently the course of their burrow is plainly indicated on the outside of the bark by a narrow, tortuous blister, as it were.

The whitewash recommended for the apple tree borer would act as a preventive in this case. We have before us now (Feb. 23) some of these larvæ transforming into beetles, indicating the necessity for early spring treatment.

Once in the tree the surest way to combat them is to cut off the branch, or trunk, below the affected region and burn it. It is fair to conclude that where young fruit trees are planted amongst timber, they may invite attack. We would suggest to those planting fruit trees in the midst of extensive tracts of timber, as on claims, that, if the forest in the vicinity is affected the best way to prevent the spread of the pest is, as far as practicable, to cut down all the dead and dying trees in the neighborhood, strip of the bark, and use it (the bark) for fuel. The loosened bark on forest trees newly affected should, if deemed practicable, be stripped off and burnt. Thousands of these minute larvæ can be found in one stump in felled regions. If the bark from such stumps be burned, the naked stumps do not



offer so great inducements. Such radical measures as outlined above would hardly be called for unless the pest became much more destructive than it is at present.

#### Round Headed Appletree Borer.

Use same remedies as for Flat headed borer. This species however confines its attacks to the base of the tree while the Flat headed Borer may be anywhere on the trunk and sometimes on the larger branches.

#### Pear Blight Beetle.

A very small dark brown beetle about one tenth of an inch long that works at the base of the pear bud, though occasionally found on other trees. Cut off affected twigs and burn them with beetles contained therein.

#### Purple Scale, Glover's Scale, Lemon Scale, White Scale.

One or more of these species are frequently seen on imported oranges and lemons. There is nothing in their occurrence to especially alarm the Oregon orchardist, although they are a serious menace to the orange industry.

#### Some General Suggestions.

Thorough cultivation, thereby keeping trees vigorous, is one of the best means of preventing insect attack. All old and valueless trees badly infested with any insect pest such as scale, woolly aphid, borers etc should be destroyed by burning, as they form the supply house from which more valuable trees may receive the infection.

All rubbish should be kept away from an orchard and woodpiles will fall under this heading; their presence near an orchard is undesirable. Cut out of the trees all dead and dying wood. All fallen fruit should be fed to stock or destroyed.

Scraping off the scaly bark from mature or old trees and white-washing their trunks will do much to keep away insects. Take care that your newly planted trees do not get sunburned as such weakened spots are chosen by borers for the beginning of their operations. A shake on the southwest side of each tree will prevent this.

### The Codling Moth.

A detailed report of the season's work with the Codling Moth will have to be reserved for a later bulletin. Briefly, it costs 7 cents per tree, labor and material, for each spraying, using the combined fungicide and insecticide employed the preceeding year, and 6 cents per tree if Paris Green and water alone are used. The labor, of course is the chief expense. In this experiment student labor was employed; where farm labor can be used the attendant expense would be less. We used, the past year, a Bean Spray Pump, manufactured by the Bean Spray Pump Co. Los Gatos, Cal., and for sale by Mitchell, Lewis & Staver of Portland, agents in this state. This pump worked admirably. As far as we have gone with it we regard it better than any pump we have tried. Equally good reports of its merits come to us from various fruit growers and farmers throughout the state. One of its chief recommendations is the ease with which it is worked.

We had a sheet iron tank constructed, holding 125 gallons, which hooked onto a frame which, in turn, rested on a wagon bed. Below the tank, and inside the frame was a sheet iron stove, whereby the liquid could be kept warm if necessary. This tank, when not in the field fitted into a brick furnace, affording a means of heating any desired mixture. The nozzles used were the new Vermorel Cyclones manufactured by the Field Force Pump Co. Lockport, N. Y.

All fruit growers realize the necessity of spraying. Each general farmer,



however, must decide for himself whether it be practical or not in his special case but even though he has but few trees and raises apples for his family alone, the satisfaction of having clean smooth fruit without blemish, should prompt him to the slight effort and expense necessary.

Oregon apples are bringing at wholesale in Sacramento market, at this date Feb., \$.90 to \$1.50 per box and in some fruit raising districts in Oregon, Medford for example, farmers receive from 40 cents to 50 cents for apples which are shipped to California, the commission men furnishing boxes and packing. Portland commission houses are paying 75c to \$1.50 per box, and there is a good retail trade in our smaller cities at 50c to \$1.00 per bushel. In last year's report (see tables Bulletin 10) it was demonstrated that from 70 per cent. to 90 per cent. of fruit can be saved by spraying with Paris Green. It is evident that at least four and probably more sprayings are necessary in most parts of the State where the moth is established.

## Kerosene Emulsion.

The general usefulness of this agent cannot be too strongly emphasized. It is, without doubt, one of the most powerful agents known to the agriculturist. Simple in composition, when properly made and rightly used, it is sure death to very many insects and causes no injury to foliage. It is especially good for use against the various species of plant lice. There are two or three ways of making kerosene emulsion, viz:

### NUMBER I.

*The Riley-Hubbard Emulsion.*—One half pound of hard soap dissolved in one gallon of water; while boiling hot remove from the fire and add 2 gallons of kerosene (any cheap brand) and agitate immediately by forcing through pump and back into vessel. After a few minutes of this work the emulsion should form a creamy mixture.

One part of this to 12 parts of water is recommended for the various plant lice. It would doubtless have to be made weaker for trees with very tender foliage. In every case it is well to test it on foliage to which it is to be applied, before using. With some kinds of hard soap this will not dilute readily with water unless it be heated, and if it be diluted with hard water the oil may rise to the top of the mixture. These are the only objections to this emulsion.

In experiments at the Station we used this emulsion, but substituted whale oil soap for the hard soap recommended and diluted with hard water. On September 23d, 1891, we sprayed a row of cauliflower badly affected with cabbage louse with this emulsion slightly altered as indicated, using one part of emulsion to 25 parts of water, with the effect of killing the lice and not injuring leaves. A number of cabbage plants infested with this aphid were also sprayed with the same strength, also a branch of a Grindstone Pippin infested with Green Aphid. In each case the lice were killed and foliage not injured.

Cabbage plants, young and old, were being injured at this time by the Cabbage Moth, *Cerastoma brassicellæ*, which, however little harm it may do to mature plants, can, by attacking young plants, very seriously impair their growth.

The larva is a slender green worm about  $\frac{1}{2}$  inch long eating many ragged holes in cabbage leaves. It spins its cocoon and undergoes its transformations on the leaf. The same solution was used against this insect with perfect success. Pupæ which were drenched with the spray were killed. The spray should be directed against these pests and against aphids with great force. We find the Climax Nozzle the best suited for this purpose. Atten-

tion has already been called to the necessity of beginning treatment against all plant lice early in the season before they get well started.

In this experiment we diluted with cold hard water, and after standing some time a part of the oil rose to the top. *When this occurs it should be skimmed off, as pure coal oil is fatal to vegetation.* Soft water should always be used with this emulsion if possible.

Prof. C. V. Riley, U. S. Entomologist, recommends this emulsion for the Hop Louse, 1 part emulsion to 25 parts of water, and it has proved of great benefit in this direction.

In Bulletin No. 10, from this Station, kerosene emulsion, 1 part to 30 parts water, was recommended as a good spray for the hops, and for plum trees in the spring before the louse had migrated to the hops.

From answers to many inquiries sent to hop growers of this State, we learn that it was tried the past season in many cases, and generally with success, though several reports came in of its failure. Such failures must be ascribed to the fact that it was not, in those cases, properly made or properly used. Under the right conditions it is a perfect success.

We are prompted here to mention the fact that a prominent hop firm in Washington State is issuing a circular to the effect that an extract of quassia chips is the only remedy for this pest and denouncing kerosene emulsion as of no value against the hop louse. This is both unjust and untrue as repeated experiments have proven.

Hop growers should have ready for use in spraying their yards a Cyclone nozzle with *side* discharge piece in order to reach the under side of the lower leaves. These nozzles are for sale on this coast.

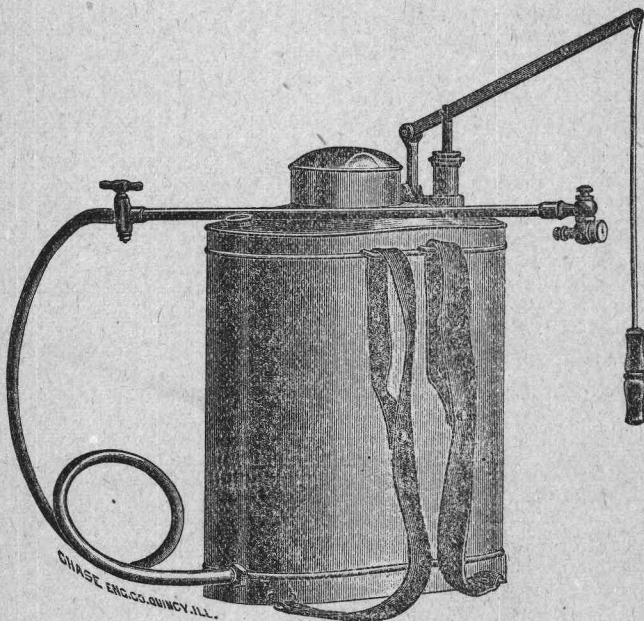


FIG. 13—EXCELSIOR KNAPSACK SPRAYER.

Knapsack sprayers which fit on one's back are handy in spraying small yards or small orchards. Fig. 13 represents one sold by Wm. Stahl of

Quincy, Ill., for \$14. Another is manufactured by the Field Force Pump Co., Lockport, N. Y., and sold at the same price.

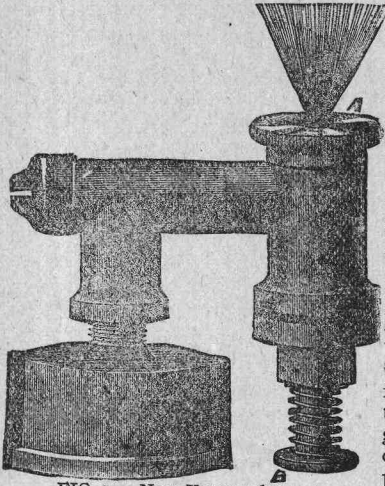


FIG. 14.—New Vermorel Nozzle.

Fig. 14 illustrates the new Vermorel nozzle which has given satisfaction with us during the past season. It is made by the Field Force Pump Co., and sells for \$1.75 post paid. It causes a fog-like spray similar to that obtained with the Cyclone. Its advantage, however, over other nozzles lies in the fact that anything which clogs the aperture at "A" can be instantly removed by pressing the thumb against the cleaning needle "B." Furthermore the nozzle can be unscrewed in the centre, as indicated in figure, and a slender stream thrown to the top of very high trees. We regard it as a most excellent nozzle for orchard use, barring the rather high price.

Another form of emulsion we will call

#### NUMBER 2.

*Hard Soap Kerosene Emulsion.*—Hard soap  $\frac{1}{4}$  lb dissolved by boiling in 2 quarts of water; add one pint of kerosene and agitate with force pump as before. Then add an equal amount of hard or soft water (that is,  $2\frac{1}{2}$  quarts) and it is ready for use.

An objection to this is that it becomes, with some soaps, lumpy and stringy when cold and sometimes has to be heated before it can be diluted further.

#### NUMBER 3.

*Soft Soap Kerosene Emulsion.*—Soft soap 1 quart, dissolved in 2 quarts of boiling water. Remove from fire and add 1 pint of kerosene and agitate with force pump. Then add an equal amount of hard or soft water.

The advantage of this emulsion lies in the fact that it can always be diluted with cold water either soft or hard. Prof. Cook, of Michigan, in a recent bulletin, says this sometimes injures the foliage, which fault can be remedied by using one half the quantity of soap (i. e. 1 pint). When this is done add only  $1\frac{1}{4}$  times the amount of water, not twice the amount. In this and the preceding the amount of kerosene is to the whole emulsion about as 1 : 15.

## Wire Worms.

Yellowish or reddish or brown nearly round, hard larvæ (worms) with six legs, and of various lengths, species of from  $\frac{3}{4}$  to  $1\frac{1}{2}$  in. being the more commonly found. After two, three, or more years they turn into Click beetles or snapping beetles; so called, because if placed on their backs they snap themselves up and over with a clicking noise. They are found



in low moist land, especially land that has lain in clover or grain for some time. They must not be confounded with centipedes which have legs on either side the entire length of the body, nor must they be confused with species of *Julus*, "earwigs" as they are called, comparatively harmless animals which look like round, hard, dark brown worms with very many small legs. These earwigs, when disturbed will coil themselves up and remain motionless; they crawl about at night; during the day they are found hiding in moist places under old boards or logs and frequently in the vicinity of bruised or spoiling fruit.

On May 22 last, finding that wire-worms were taking the bean plants on the experimental grounds, we cut potatoes into pieces 2 in. square, removed the eyes that they might not sprout, impaled each one on a stick, and buried them 2 in. below surface and one or two inches from bean plant, apportioning one or two pieces of potato to each hill. These pieces were examined every day or two and a large number of wire-worms were taken from them during the week the experiment lasted. This is only practical on a small scale, of course. Where large areas of wheat or a number of acres of vegetables are affected another remedy is called for.

Potash salts are rapidly coming into favor, not only as fertilizers, but also for their insecticidal qualities. We have received some Muriate of Potash and Kainit of Potash and propose trying their effect on wire-worms and cut-worms both serious pests in Oregon. We should be pleased to send small packages of the above salts to any one personally known to members of the Station force, who is willing to co-operate with us by experimenting on their own land and reporting results. Only a limited amount can be disposed of in this way. We should expect consignee to pay the small attendant express charge.

## Flea Beetles.

May 20, 1890, our radishes were badly affected with these beetles and a portion of them were liberally sprinkled with a solution made by boiling 1 lb of waste tobacco stems in 2 gallons of water. Within a week from treatment these plants showed a wonderful increase of growth, in marked contrast to those not treated. Examination of the roots of the treated and untreated plants disclosed the fact that on those not treated the six legged larvæ of flea beetles were working on surface of root, and in some instances had eaten below the surface.

In other instances, surrounded by a crust of earth, they were evidently preparing to pupate. Those treated with tobacco water were barely, if at all, affected, and later these treated plants developed fine, large, smooth roots.

The secret of success here lay largely in the fertilizing qualities of the tobacco, enabling the plant to get ahead of the ravages of the beetle; for, when the leaves are well advanced this pest forsakes them for more tender food. Then, again, the solution, absorbed by the earth around the roots, naturally made the surface of the root distasteful to the insect.

We have also treated tomato plants with Paris green and water (1 lb to 200 gals.) with no bad effect to the plant and with some good effect on the beetles, but owing to a number of objections, and the superiority of the tobacco treatment, we would not recommend this. It is claimed that kerosene emulsion is good for the flea beetle. It is well worth a trial.

The following remedies are recommended: Dusting leaves with Pyrethrum (too expensive), dusting with soot, with ashes. Dusting with ashes, we find, only affords a temporary relief. Sprinkling plants with a strong tansy tea made by boiling the leaves in a sufficient amount of water to cover them.

A number of applications of the tobacco solution may be necessary.