Insect Pests of Nursery and Ornamental Trees and Shrubs in Oregon

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Agricultural Experiment Station
Oregon State College
Corvallis

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FOREWORD

Few persons not engaged in the nursery business realize the number, variety and seriousness of the insects that attack the nursery trees, shrubs and planting stock, or the care and skill necessary to protect them from the ravages of the insect pests.

This bulletin entitled "Insect Pests of Nursery and Ornamental Trees and Shrubs in Oregon" is intended as a nurseryman's handbook of insects affecting his plantings. An attempt has been made to present the essential facts that will assist the nurseryman to recognize his insect enemies and to apply intelligently control measures that will protect his plantings from insect attack and damage.

We still need more knowledge about certain nursery insects and how to deal with them. This is especially true in the use of new insecticides. Insect control practices are passing through revolutionary changes due to the advent of many new and powerful insecticides and methods of application. Admittedly the use of these new materials is still in the experimental stage and cannot be included in this publication. Research on the use of these new materials and methods of application will be carried on and the results released as fast as time and personnel available will permit.

Dean and Director

Cover—

The work of the Holly Bud Moth seriously damages the appearance of this valuable shrub.
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Insect Pests of
Nursery and Ornamental Trees
and Shrubs in Oregon

By Joe Schuh
Former Assistant Entomologist
and Don C. Mote
Head of Entomology
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At the request of Oregon nurserymen, the State Legislature in 1937 appropriated funds to advance the study of insect pests on nursery stock. In the years since a great many problems have been solved, but methods have yet to be discovered to combat many injurious pests.

As much as it is possible to report of the available information on insect pest control at this time is gathered into this bulletin. The contents will necessarily be incomplete, but it is hoped this bulletin will be of real value in reducing the damage of these enemies.

Only pests injuring trees and shrubs are included. Pests of seeds, cones, and fruits are purposely omitted. Insect pests of greenhouses, perennials, bulbs, and herbaceous plants are omitted also. Each of these plant groups supports an insect population peculiar to itself. The discussion of certain other pests is included because of their regulatory and quarantine importance.

Nurserymen interested in cane fruit and strawberry insect pests and diseases are advised to consult Oregon Experiment Station Bulletins 418, Diseases of Strawberry, and 419, Diseases of Cane Fruits. Only the most important facts of interest to the nurseryman or home owner are included here. The hosts listed under the various pests include only those known to occur or are grown in Oregon as nursery and ornamental plants. (There are many other plants on which these pests occur in other parts of the world.) Wherever possible, the use of abstruse technical language has been avoided. In certain cases the use of scientific names is necessary because of the lack of common names. Asterisks (*) in the text indicate that the common name is the one officially recognized by the American Association of Economic Entomologists.
European earwig*

The obnoxious earwig is found throughout the state. It will apparently feed on almost anything of vegetable or animal origin. This pest is principally a nuisance in houses, but often does serious damage to flowers, seedlings, and to the leaves of plants. It feeds mostly at night and hides under the bark of trees or in other suitable dark places in the daytime.

The earwig spends the winter in the adult and egg stages. Eggs are laid in groups in small cavities in the ground and cared for, more or less, by the female. These eggs hatch in April and May, and the spring earwigs begin their depredations with their parents.

The recommended control is a poison bait made up of:

- Bran ........................................... 12 pounds
- Sodium fluosilicate ............................. 1 pound
- Fish oil ......................................... 1 quart

This bait should be scattered evenly about the premises. Particular attention should be paid to hedges, fence rows, trees, and other spots where earwig hiding places may be found.

STONE FLIES
Tacnioperx pacifica Banks

During March and April the leaves of many plants like raspberries, plums, and others having comparatively thin leaves, may become skeletonized by stone fly adults. They eat the tissue between the veins and make the leaves look like lace. While not serious, their damage is quite noticeable at times.

The adults are light brownish black in color. They are about ½ inch long and have wings with many small veins. The immature forms live in streams. Control measures are seldom necessary, but lead arsenate spray will control them if the need arises.

ORTHOPTERA

Snowy tree cricket*
Oecanthus niveus (Deg.)

This cricket is widely distributed in Oregon and sometimes can be found on ornamental and nursery plants. It is seldom abundant enough in nurseries to warrant control measures.

Hosts: Bramble fruits of all kinds; sometimes orchard trees such as prune and apple.
DESCRIPTION: Adult snowy tree crickets are rather fragile, greenish white and about ½ inch in length. The immature stages resemble the adults but they do not have the 4 white transparent wings. The eggs are yellowish white, kidney-shaped, and they are inserted in the pith of the host.

LIFE HISTORY AND INJURY: The winter is spent in the egg state in the pith of canes and twigs. Parts of the plant where the eggs are inserted are weakened by the egg punctures and break easily. The eggs hatch in late May and June, and the nymphs feed on foliage and fruit. Where they are abundant, the fruit injury may be serious. Holes these crickets eat in the sides of fruit may make it unsalable. The crickets mature in August, then they deposit the overwintering eggs.

CONTROL: Cutting out and destroying plant parts containing eggs in early spring will help in controlling them. Lead arsenate sprays will control the nymphs and adults if they become abundant.

Grasshoppers

Although grasshoppers are not common in nurseries or on ornamental plants, they have been known to damage young orchards severely by chewing off the leaves. When, for some reason, their native food is lacking or when serious outbreaks occur, almost any
agricultural crop may suffer. The most effective means of control is with poison baits scattered on egg beds before the insects become adults, or wherever the hoppers are present. The most common forms in eastern Oregon are *Camnula pellucida* Scudder and *Melanoplus atlantis* Riley, while the most common western Oregon form is *Melanoplus femur-rubrum* Harr. The following bait applied evenly at the rate of about 10 pounds per acre is suggested as a control:

- Mill-run bran .................................................. 25 pounds
- Sawdust (about 3 times the volume of bran) ........... 3 bushels
- Liquid sodium arsenite (32 per cent arsenious oxide) ........................................... 10-12 gallons

The bran and sawdust should first be thoroughly mixed, and the arsenic solution then gradually mixed in. The finished bait should be moist but not wet enough to be sloppy when compressed in the hand. Proper precautions should be taken to prevent poisoning of livestock.

**THRIPS**  
*Thysanoptera*

Thrips are a very important group of insects. Although small in size, they do great damage because they are so abundant. Both the young and adults feed by rasping the leaf surfaces and sucking up the exuding juices. The injury consists of distortion of plant parts in many instances, especially where the thrips feed in the buds. Infestation of flower buds often results in malformed and spotted flowers. If feeding is done on the surface of the leaf, a silverying appearance results with a concomitant dirty appearance due to excreta and cast skins. Quite often a blackish fungus growth develops on the excreta which makes the host even more unsightly. Several species are known to transmit virus diseases. Some species are predatory and feed on other small insects and mites.

**DESCRIPTION**: Most of these thrips are between 1/16 and 1/40 of an inch in length. The color varies from light yellow to nearly black, although some species may be marked with various color patterns. The 4 wings are long and narrow and have a fringe of hair on their borders, giving them the appearance of small feathers. Most of the economically important species lay their eggs in the plant tissues and transform in the soil.

**CONTROL**: The standard recommendation for control on growing plants is the use of a spray consisting of 2 pounds of tartar emetic, 4 pounds of granulated or brown sugar, and 100 gallons of water. DDT dusts and sprays appear to be very effective against
some species but no definite recommendations can be made at the present time for the group as a whole.

**Pear thrips***

*Taeniothrips inconsequens* (Uzel)

This species is one of the most important pests of certain orchard and ornamental trees. It is widespread, but unless one is familiar with its injury, it may go unnoticed until it is too late to prevent damage.

**Hosts:** In nurseries and ornamentals, it is most common on flowering plums, crab apples, and cherries while in orchards it does its most serious injury to prunes and sometimes pears and cherries.

**Description:** The adults are yellowish brown to blackish in color and the nymphs are straw yellow. The eggs are very small and are inserted into the developing flower and leaf stems.

**Life History and Injury:** The winter is spent in the soil in small earthen cells. Early in the spring, usually about the first of March, the adults begin to emerge. They enter the developing buds and feed thereon, often injuring them so severely that they fail to open. The blossoms which open may appear brown and the leaves are often malformed and perforated with small holes.

The nymphs feed on the under sides of the leaves, causing scari-fication and silvering. When full grown the nymphs drop to the ground and enter the soil where they remain until the following spring.

**Thrips control on prunes**

Pear thrips, serious pests of prunes in Oregon for 25 years, can be controlled by spraying at the correct time and with the proper materials. This conclusion is based on results obtained from 19 years of experimental spraying for adult thrips control.

**Materials recommended:** The materials given below are those found to be most effective in the control of pear thrips on prunes:

1. 20 per cent DDT in oil emulsion, 1 pint, or 5 per cent DDT in oil emulsion, 2 quarts, in water to make 100 gallons of spray.

2. Nicotine sulphate 40 per cent, 1 pint, and a medium oil emulsion having the following specifications: Viscosity 70-75 seconds Saybolt; unsulphonated residue test of at least 85 per cent diluted to give 2 per cent actual oil; and water to make 100 gallons of spray.

3. Nicotine sulphate 40 per cent, 1 pint; lime sulphur, 3 gallons, and water to make 100 gallons.
Figure 3. Pear thrips injury to *Prunus bliriana*. Note the holes in the leaves which are caused by thrips feeding in the developing buds.
WHEN TO APPLY SPRAY: The sprays may be timed according to the bud development as follows:

1. First application when 30 per cent to 40 per cent of the blossom buds show green at the tips.
2. Second application when all of the blossom buds show green at the tips.
3. Third application when the stems lengthen and the blossom buds show white at the tips.

NUMBER OF APPLICATIONS: In cases of severe infestation, at least two spray applications are necessary for effective thrips control. To determine whether two or more sprays are to be applied, an examination of the buds for the thrips is necessary. At the time the second application is to be made, the orchardist should pick at random at least 300 buds from several trees, putting them in a test tube or enclosed jar. The buds are then examined for thrips by picking them to pieces with needles, and the thrips counted. If there are 90 or more thrips per 100 buds, a second spray application is necessary. The same procedure is followed in determining whether a third application is necessary.

The schedule given above cannot always be followed precisely on account of rains, winds, or other conditions that occur at the time outlined. It may be necessary, therefore, to spray lightly before or after the time given in the schedule to take advantage of more favorable spraying conditions. DDT can be used in less favorable weather than nicotine sulphate combinations. The proposed schedule, however, should be followed as closely as possible until more experimental work can be undertaken with DDT.

THOROUGH SPRAYING NECESSARY: Thrips are likely to be anywhere on the trees. The spray should reach every part of the tree. The spray materials are contact sprays and must contact the insects to kill them. The spray equipment should be capable of maintaining from 300 to 350 pounds pressure during the spraying operations. A coarse driving spray will force the spray into the buds better than a fine spray.

SPRAYING THE SOIL UNDER PRUNE TREES: Two years of experimental spraying of the soil surface under prune trees indicates that the thrips population can be reduced by spraying the soil with DDT. The spray should be applied to the ground from the tree trunk to the drip of the tree or as far as the outer limbs extend.

PREPAREDNESS ESSENTIAL: Spray materials should be on hand before the buds begin swelling in the spring. Sprayers should be overhauled and put in good condition several weeks before the spray
season begins. Success in thrips control may depend on a very few days when spraying is possible. A delay for any reason may mean failure to control this pest.

**CAUTION:** Certain precautions must be taken in spraying to avoid unnecessary injury to the trees. Oil should not be used if lime sulphur is to follow later as a fungicide for the control of brown rot. If oil has been used in the early sprays, use bordeaux instead of lime sulphur. Do not combine DDT with a fungicide.

**Flower thrips**
*Frankliniella occidentalis* (Perg.)
*Frankliniella moultoni* Hood
*Frankliniella minuta* Moulton
*Thrips tabaci* Lind., Onion thrips*

Flower thrips, these four species in particular, are very abundant throughout most of Oregon. They occur on a large variety of plants and do considerable damage by blighting flowers and scarifying and otherwise distorting leaves.

**Hosts:** Found on almost all plants.

**Description:** The adults are yellowish brown to straw-colored except *F. moultoni*, which is sometimes nearly black. For further description, see the general discussion for thrips on page 12.

**Life history and injury:** In general, these four species of thrips have similar biologies and habits. The winter is spent largely in the adult stage in protected places such as in debris, under bark, etc. In storage houses or greenhouses they may reproduce all winter. The eggs are laid in the tissue of the plants, and the nymphs and adults feed in flowers, buds, on leaves and similar protected places. When full grown the nymphs drop to the ground to transform in cracks and crevices. There are generally several generations of them a year.

The greatest injury in the nurseries is done by feeding in the buds and thus causing distortion of the leaves and growing tips; in severe cases, the buds may be killed outright. The leaves and flowers developing from these injured buds are often malformed and perforated with holes. All four species are probably responsible for the spread of the spotted wilt virus disease.

There seem to be seasonal migrations at various times of the year due to the destruction or drying up of host plants. For instance, when hay is cut the adjacent plants may suffer a severe influx of thrips. During the summer when the native vegetation begins to dry up, the adjacent crops and gardens may suddenly be deluged with these small pests.
CONTROL: Spraying with tartar emetic and spraying and dusting with DDT have given good results in most cases. Rotenone and pyrethrum dusts and sprays have given variable results and are therefore not recommended.

Other thrips occurring in Oregon

The following species are more or less general feeders and may at times be found on nursery and ornamental plants:

*Haplothrips leucanthemi* (Schrank)

*Hercothrips fasciatus* (Perg.). The Bean Thrips.*

*Heliothrips haemorrhoidalis* (Bouché). Greenhouse Thrips.*

This species is common in greenhouses on camellia, azalea, rhododendron, Bouvardia. It seems never to survive the winter out of doors.

*Microcephalothrips abdominalis* (Crawf.) is often found in greenhouses.

*Thrips madroni* Moulton occurs on madrone, elderberry, azalea, rhododendron, and many other plants.

Figure 4. Greenhouse thrips injury to camellia leaf.  Figure 5. Egg punctures of rose leafhoppers in rose stem.
Harvest flies or cicadas are not often seen in nurseries, but injury from them is quite common. The adults have four clear wings with a spread of 1½ to 2 inches. They usually may be found resting on twigs about ½ inch in diameter; and on warm sunny days throughout the spring and summer they may be heard making their shrill incessant song. The injury consists in making splintered egg punctures in small twigs and limbs. These punctures weaken the wood and cause the limbs to break easily. The immature stages live on the roots but cause no particular harm in Oregon. Control measures are not necessary as they are seldom abundant. There are a number of species found in Oregon.

Spittle bugs are very common pests of many plants in Oregon; in fact there are few plants on which it is not found in the Willamette Valley. Its attacks are most severe on perennial plants. Occasionally it injures annuals, shrubs, and other woody plants.

The strawberry spittle bug is a very common pest of many plants in Oregon; in fact there are few plants on which it is not found in the Willamette Valley. Its attacks are most severe on perennial plants. Occasionally it injures annuals, shrubs, and other woody plants.

The rhubarb spittle bug is not as common but often is abundant on some plants.

Both species overwinter in the egg stage. The eggs are laid mostly on the stems of plants and hatch during April and early May. The yellowish nymphs of the strawberry and the red nymphs of the rhubarb spittle bug are surrounded by a frothy saliva-like substance. They injure the plants by sucking out the plant juices. Injury consists of dwarfing and distortion of plant parts and on crops like strawberry the yield may be considerably reduced. Where these bugs are abundant they may be objectionable because of the abundance of spittle masses; this is particularly true in perennial flower gardens, hay crops, pastures, and similar locations where the vegetation is not changed yearly by cultural practices.

Control consists in the application of insecticidal dusts when the spittle masses begin to show in any numbers. Hydrated lime dusted on the plants has given fair results. The standard control is a dust containing ½ per cent rotenone. Dusts should be applied at the rate of 40 to 60 pounds per acre.
Other spittle bugs

Several species of spittle bugs belonging to the genus *Clastoptera* occur in eastern Oregon. One of these, *Clastoptera obtusa* (Say) infests junipers. An undetermined species of spittle bug is very common on lodgepole pine on the Oregon coast.

**TREEHOPPERS**

*Membracidae*

The insects of the treehopper family cause most of their damage, like the cicadas, by weakening twigs and limbs with their egg punctures. The egg punctures appear as slits in the bark and have small splinters protruding from them. Both the adults and nymphs suck the juices from limbs and twigs but cause very little damage in this way.

The adults are very strange looking creatures. They generally have one or more projections near the head or sides of the head which make them look humpbacked.

Control is seldom needed. Clean cultivation and cutting out and destroying the egg-infested twigs help to keep them down.

The following species occur in Oregon and occur on fruit, ornamental, and nursery trees:

Buffalo treehopper,* *Ceresa bubalis* (Fab.), is a species that overwinters in the egg stage. It deposits eggs in many broadleaf trees. The nymphs and adults feed on many herbs, shrubs, and trees. The adults of this species are grass green and are a little less than ½ inch in length.

Basal treehopper, *Ceresa basalis* Walk, is common in the Willamette Valley.

Green clover hopper, *Stictocephala inermis* (F.), is also common in the Willamette Valley and is often found in nurseries.

Oak treehopper, *Platycoctis vittata quadrivittata* (Say), is common on oak. It is a beautiful little insect with 4 red stripes on its back.

**LEAFHOPPERS**

*Cicadellidae*

The hieroglyphic sharpshooter

*Cicadella hieroglyphica* (Say)

The hieroglyphic sharpshooter leafhopper is about ¼ inch in length and is one of the largest species in Oregon. It may be predominantly green, blue, or brown, and may be variously marked. It
is at times extremely abundant on willows, poplars, and alders. Often it makes a nuisance of itself by getting into houses in the fall. Nicotine sprays or dusts are recommended for its control.

**Rose leafhopper***

*Typhlocyba rosae* (L.)

The rose leafhopper is one of the most common rose insects occurring in Oregon. It is widely distributed and often causes serious injury.

**Hosts:** Apple, cane fruits, cherry, currant, dogwood, elm, grape, hawthorn, maple, oak, pear, plum, rose, strawberry, and other rosaceous plants are hosts.

**Description:** The adult hoppers are yellowish white in color and are about \( \frac{1}{4} \) inch in length. The nymphs are similar in appearance to the adults but are smaller and without wings. The eggs are laid under the bark of twigs and leaf veins and appear like small blisters.

**Life History and Injury:** The winter is passed in the egg stage. The eggs hatch in the spring, and the nymphs change to adults in the latter part of May and in June. The eggs laid by the June adults produce young that mature in early fall. These fall adults lay the overwintering eggs. Injury consists in a mottling and yellowing of the upper sides of the leaves. Young leaves become curled as they grow older. The egg punctures cause pimplelike swellings on the twigs and, where they are abundant, may result in a weakened and sickly condition of the host.

**Control:** Nicotine sprays and dusts applied to the under sides of the leaves, while the hoppers are still in the immature stages, have given the best control. Cutting out and destroying the tips of plants which harbor the eggs during the winter will greatly reduce their numbers.

**White apple leafhopper***

*Typhlocyba pomaria* McAtee

The white apple leafhopper resembles the rose leafhopper to a great extent except that it is usually greener in color. It often causes quite serious injury to apple. Its life history, habits, and injury are nearly identical with the rose leafhopper, and similar control measures are recommended.
JUMPING PLANT LICE

Psyllidae

Many species of these miniature insects, jumping plant lice, occur on ornamental and nursery plants. They are about the same size as aphids and hold their wings over the body in a rooflike manner. They suck the juices out of plants much as aphids do and often secrete honeydew. Many are covered with a white woolly wax-like secretion. Some species are gall formers, only one of which is known in Oregon. The nymphs are for the most part very flat, oval in shape, and have very large wing pads for their size.

Nicotine sprays applied when the bugs are in the nymphal stage generally give adequate control.

Pear psylla*

Psylla pyricola Förster

The pear jumping plant louse is a very serious pest of pears in some of the eastern states and has only recently been found in certain sections of northeastern Oregon. Its occurrence on nursery stock may become a serious problem.

Hosts: Pear and quince are hosts of this species.

Description: The adults are only about 1/10 inch in length; they are reddish brown and fold their wings in a rooflike fashion over the abdomen. The eggs are whitish yellow and are deposited around the buds and in the bark crevices of the fruit spurs early in the spring. Later, eggs may be placed on the under sides of the leaves along the midrib. The young nymphs are soft, yellow in color, and generally covered with honeydew. The older nymphs are darker in color and have a comparatively hard shell.

Life History and Injury: Hibernation takes place in the adult stage under the bark of trees and other protected places about the orchard. The adults begin emerging early in March and soon start to lay eggs. There may be a number of broods a year, depending on the locality. Injury consists in dwarfing and browning of the leaves. The production of honeydew by the young insect induces the growth of a black fungus that gives a very unsightly appearance to the tree and often makes the fruit unsalable. In cases of severe infestation, premature defoliation may result, and the fruit may be badly deformed.

Control: Dormant oil sprays applied in early spring just before the eggs are laid have given excellent control in the East. Later applications of nicotine sulphate sprays give good control for the nymphs. The nicotine spray is generally used with 25 or 30 pounds of hydrated lime per 100 gallons of water.
Figure 6. Leaf cupping on boxwood caused by the boxwood psyllid.
Boxwood psylla*

*Psylla buxi* (L.)

The boxwood psylla is apparently a recent introduction into Oregon, but it has already widely spread throughout the Willamette Valley. The cupped leaf injury that it causes is not serious but detracts from the beauty of the host.

**Host:** Boxwood is the host.

**Description:** The adults are grayish green in color and are about \( \frac{1}{4} \) inch long. The nymphs are squat, flat, little creatures and are covered with a white cottony excretion.

**Life History and Injury:** The winter is undoubtedly spent in the adult stage as examination of infested plants has revealed the presence of no other form of this pest. The nymphs appear in the cupped terminal leaves from March to June. There appears to be but one generation a year. Injury consists in a cupping of the terminal leaves. The buds in these cupped leaves invariably appear to be dead.

**Control:** Nicotine sulphate sprays, applied when the young are present in the tips, have given satisfactory control.

Knotweed psylla

*Aphalara calilae* (L.)

The nymphs of the knotweed psylla are covered with a white cottony wax. They have been found on pine, gooseberry, and several other plants. They overwinter in the adult stage.

Other psyllids

A list of the other known psyllids that occur on ornamental and nursery plants in Oregon is as follows:

- On *Ceanothis* spp.
  - *Psylla ribesiæ* (Crawf.)
  - *Arytaina fuscipennis* Crawf.
  - *Arytaina robusta* Crawf.
  - *Euphalerus vermiculosus* Crawf.
  - *Euphalerus rugipes* Crawf.

- On *Alnus* spp.
  - *Psylla alni gossypina* Crawf.
  - *Psylla floccosa* Patch
  - *Psylla galeariformis* Patch

- On *Purshia tridentata*
  - *Psylla hirsula* (Tuthill)

- On *Ribes* spp.
  - *Psylla ribesiæ* (Crawf.)

- On *Prunus* spp.
  - *Psylla trimaculata* astigmata Crawf.
On *Amelanchier* sp.
- *Triosa sulcata* Crawf.

On *Arctostaphylos* spp.
- *Euphyllura arctostaphyli* Schwarz

On *Arbutus menziesii*
- *Euphyllura arbuti* Schwarz

On Hackberry (leaf galls).
- *Pachypsylla celtidis—vesicula* Crawf.

On *Salix* spp.
- *Psylla alba* Crawf. (Det. tentative)
- *Psylla americana* Crawf. (also reported on pine)
- *Psylla latiforceps* (Tuthill) (host not certain)
- *Psylla minor* Crawf.
- *Triosa incerta* Tuthill
- *Triosa mauro Förster*
- *Triosa minuta* Crawf.
- *Triosa pulla* Tuthill (undoubtedly on *Salix.*)

**PHYLLOXERIDAE**

**Cooley’s gall louse**

*Adelges cooleyi* (Gillette)

The small aphid-like Cooley’s gall louse is the most troublesome pest found on spruce in Oregon nurseries and ornamentals. It is widespread and causes the well-known galls on the tips of spruce.

**Hosts:** Colorado blue spruce, Engelmann spruce, and Sitka spruce are the primary hosts. Douglas-fir is a secondary host.

**Description:** These gall lice look very much like aphids in a superficial way. They are a chocolate brown color. The free living forms are covered with a white woolly exudate, and the forms in the galls are covered with a whitish powder.

**Life History and Injury:** The main injury caused by these lice is the 1- to 2-inch-long galls formed on the tips of spruce. On Douglas-fir they are often conspicuous because of the white cottony covering on the backs of the lice. These lice feed on the under sides of the needles and sometimes cause a yellowing and premature drop of the needles.

The life history, in short, is as follows: The winter is spent on the needles of Douglas-fir. In the spring about the latter part of April, the wingless females lay eggs. Part of the lice from these eggs will develop wings and migrate to spruce. The other part will be wingless and remain on the fir, producing eggs that develop into the overwintering forms again. The winged forms lay eggs at the base of the needles of the new growth of the spruce. These hatch and produce spruce galls. In July these forms in the galls grow wings and migrate back to the fir where they lay eggs that produce overwintering females.
CONTROL: Sprays consisting of nicotine sulphate and soap, of 3 per cent light medium summer oil with nicotine, or of 3 per cent oil alone applied at the time the lice appear on the needles of either the spruce or fir will give good results. After the galls are formed on the spruce there is no recourse but to cut off and destroy the galls.

**Fir Bark Louse**

*Adelges piceae* (Ratz.)

The fir bark louse is responsible for quite serious injury to true firs in the Willamette Valley. Where it becomes abundant, it often devitalizes the trees and even kills them.

**Hosts**: *Abies grandis, A. nobilis,* and other *Abies* spp.
Description, Life History and Injury: The appearance of this insect is very similar to the other Adelges. Very little is known of the life history in Oregon. The injury consists of feeding on the terminal twigs causing a swelling to form around the bud. The small twigs thus become deformed. The insects are usually covered with a white cottony covering, and a black fungus growth often develops where they are present.

Control: A 3 per cent medium summer oil spray applied in early spring is the suggested control measure.

Other Adelges pests

Adelges nüsslini (Ratz.) has been taken in Oregon on the needles of Abies grandis where it caused a distortion and also a smutting of the needles due to fungus growth on the honeydew produced by the lice. Elsewhere, it has been taken on Abies pectinata, Abies nobilis, Abies nordmanniana, Picea orientalis.

The appearance of this species is similar to Cooley's gall louse. From reports elsewhere it infests Abies spp. as secondary hosts and the spruce as a primary host. In Europe it forms a rounded gall on the tips of spruce.

Adelges tsugae Annand is a species that occurs as white cottony tufts on the needles and bark of western hemlock (Tsuga heterophylla) in Oregon. Very little is known of its life history.

Adelges oregonensis Annand has been taken on the needles and twigs at the base of the needles of Larix occidentalis and Larix europaea in Oregon. Nothing is known of its life history.

Adelges diversus Annand has been taken on the cones of Larix europaea in Oregon. Nothing is known about its life history except that the eggs are laid in July.

Woolly pine louse

Pineus pinifolii Fitch

The aphid-like woolly pine louse is widespread in Oregon. Its main damage is to young pine where it causes the needles to drop, and on spruce where it forms terminal galls.

Hosts: In Oregon it has been taken from galls on Engelmann and Sitka spruce. Elsewhere, it is reported from Picea mariana, Pinus strobus, Pinus monticola, and Colorado blue spruce.

Description, Life History, and Injury: The secondary host of this very small species is pine. Here it feeds on the needles and bark, making a whitish appearance. On spruce it forms terminal
cones-shaped galls from $\frac{3}{4}$ to 1$\frac{1}{2}$ inches long. Very little is known of the life history except that these lice migrate back and forth between pine and spruce.

**Control:** See suggestions under “Cooley’s gall louse” on page 25.

**Other Pineus pests**

*Pineus boycei* Annand is a species that is reported in Oregon as making terminal galls on Engelmann spruce from which the winged forms emerge in July. Nothing more is known about this species.

*Pineus similis* (Gillette) forms terminal galls on Engelmann spruce in Oregon and has been reported elsewhere on Colorado blue spruce, Norway spruce, Canada spruce, red spruce, and black spruce. Nothing is known of its life history.

*Pineus coloradensis* (Gillette) forms dirty waxy mats on the needles of pines. In Oregon it has been taken on *Pinus contorta*, *Pinus strobus*, *Pinus nigra*, *Pinus Austriaca*, *Pinus monticola*. Elsewhere it has been taken on *Pinus ponderosa*, *Pinus edulis*, *Pinus lambertiana*, *Pinus monophylla*, and *Pinus sylvestris*. Hibernation occurs on the needles.

*Pineus engelmanni* Annand has been collected only on the needles of Engelmann spruce in Oregon.

**Grape phylloxera**

*Phylloxera vitifoliae* (Fitch)

The root-feeding aphid-like grape phylloxera has often been intercepted on grape stock shipped into Oregon. As Oregon is not a large grape producing state, it is of no real economic importance here.

**Host:** American grapes.

**Description:** These pests are yellowish aphid-like insects that feed on the roots and form nodule-like galls.

**Life History and Injury:** The phylloxera overwinters in the roots. In the spring the young wandering forms migrate from vine to vine spreading the infestation. There are a number of generations yearly. Injury consists in a slow death of the vine due to the destruction of feeder roots. It also attacks the leaves in some instances, depending on the locality.

**Control:** Quarantine regulations and the growing of grapes on resistant rootstocks are the best means of preventing infestations.
PLANT LICE

*Aphididae*

Plant lice are familiar to anyone who is interested in the growing of plants. There are a great many species that are superficially alike. Most species have a definite host or group of hosts, and others have a very wide host range. In general, the injury is similar for all species, and the life histories follow a more or less definite pattern. For that reason a brief résumé is given of the family biology rather than a discussion of each species in detail.

These pests are soft-bodied, sucking insects averaging about 1/8 to 3/16 of an inch in length. They vary greatly in color and may be white, yellow, green, blue, red, brown, black, and various shades and combinations of these colors. Some have whitish to bluish powdery body coverings and others are coated with cottony white exudates.

The large majority live on the leaves, twigs, and bark; some feed on roots; and some form galls or other deformities.

The main direct injury these pests cause is devitalization of the plant and deformation of the leaves. Some species cause the bark to crack and become rough and thus allow a chance for the entrance of fungi, bacteria, insects, and other injurious plant pests. Many

![Figure 9. Aphid injury to green ash.](image-url)
species are directly involved in the transmission of virus diseases and in this way cause untold damage. Most species secrete a substance known as honeydew and in this way make the plants and the ground below unsightly. Black fungus growths often grow on this honeydew which further detracts from the beauty of the plant.

In general, the biology is as follows: The winter is spent in the egg stage. The kidney-shaped eggs are shiny black and are laid on the under sides of leaves, on twigs and branches, and in the axils of buds. In the spring, these eggs hatch and develop into stem-mothers, which produce living young parthenogenetically. There are several generations of these wingless aphids during spring and early summer. Part of these spring aphids then produce wings and migrate to other hosts where a number of generations are produced. In late summer and fall winged forms are again produced which migrate back to the overwintering host. The progeny of these fall migrants produce female and male aphids that mate and lay the overwintering eggs. These egg-laying forms may be winged or wingless. All aphids produce living young without fertilization, and the male is necessary only for fertilization of the egg stage.

Most aphids have what is known as a primary host. This host is generally a shrub or tree and serves as a place for the early spring and late fall generations to develop. The secondary hosts are often herbaceous and offer suitable food for the summer generations.

The standard control measures are nicotine dusts or sprays.

Following is a list of aphids which have been found on ornamental and nursery plants with brief notes on injury:

- *Amphicercidus pulexulens* (Gill.) On *Symphoricarpus racemosus*.
- *Amphorophora bartholomei* Essig. On under sides of leaves of *Lonicera involucrata*.
- *Amphorophora nervata* (Gillette). On leaves and new tips of *Arctostaphylos patula*, *A. columbiana*, *Arbutus menziesii*.
- *Amphorophora rubicola* (Oest.). On new tips and under sides of leaves of *Rubus parviflorus*.
- *Anoecia corni* (Fab.) *Cornus occidentalis*. In curled leaves.
- *Aphis abietinus* (Walk.) Sitka spruce, Engelmann spruce. Occurs on needles and at times is very destructive.
- *Aphis bakeri* Cowen. Apple, crab apple, hawthorn, pear, quince.
- *Aphis cardui* L. *Prunus demissa*. On leaves.
Aphis hederae (Kalt.) Hedera helix. On stems and leaves.
Aphis helichrysi Kalt. Prune.
Aphis medicaginis Koch. On stems and leaves of Laburnum sp.
Aphis neilliæ Oest. Ninebark. On leaves and stems.
Aphis persicæ-niger Smith. Peach, apricot, plum. On leaves and twigs.
Aphis rosca (Baker). Apple.
Aphis rumicis L. Snowball, fig. Curled leaves.
Aphis saliceti Kalt. Willow. On leaves and twigs.
Aphis sambucifoliiæ Fitch. Elderberry. On young stems and tips.
Brevicoryne cyphoricarpi (Thos.) Snowberry. On curled leaves and flower stems.
Calaphis annulata (Koch). Betula fontinalis. Rolled leaves.
Callipterus juglandis (Frisch). Walnut. On midrib on upper leaf surface.
Capiophorus fragaefolii (Ckll.). Strawberry, rose, raspberry. Under sides of leaves.
Capiophorus ribis (L.). Currant, gooseberry. Causes red blister-like formations on upper sides of leaves.
Capiophorus tetrarhodus (Walk.). Sweetbriar rose.
Chaitophorus acers (L.) Alnus sp., Acer sp.
Chaitophorus populifoliiæ (Oest.) Poplar. On leaves and twigs.
Chronaphis juglandicola (Kalt.). English walnut. Under sides of leaves.
Cinara coloradensis (Gillette). Chamberlin (unpublished notes) reports this on spruce in nurseries.
Cinara curvispes (Patch). Abies sp. Feeds on roots and twigs. Has also been found on Cedrus atlantica.
Cinara sibiricae (G. & P.) Juniperus fastigiata. On twigs.
Cinara taxifoliiæ (Sw.). Chamberlin (unpublished notes) reports this species on Douglas-fir.
Cleavigerus bicolor (L.) Willow. On tender stems and young leaves.
Cleavigerus populifoliiæ (Fitch). Poplar and willow. On young stems.
Cleavigerus saliceti (L.) Willow. On bark.
Cleavigerus smithiae (Monell). Willow. On young twigs.
Drepanaphis acerifoliiæ (Thos.). Silver maple. On leaves.
Eriosoma americana (Riley). Elm. In curled leaves.
Eriosoma langera (Hausm.). Apple, elm, crab apple. On bark of limbs and roots and in curled leaves.
Euceraphis betulac (Koch). Birch. On leaves.
Hyalopterus pruni (Geoff.). Prune. In curled leaves.
Kakimia cynosbati (Oest.). Ribes sp. On young stems and deformed leaves.
Figure 10. Aphid galls on elm leaves. (*Eriosoma* sp.)

*Lachnus laricipiniae* Wilson. Western larch.
*Macrosiphum euphorbiae* (Thos.). Strawberry, mountain-ash, rose. Tender tips and leaves.
*Macrosiphum laevigatae* Essig. Strawberry.
*Macrosiphum pelargonii* (Kalt.). Pear. On leaves.
*Macrosiphum pisi* (Kalt.). Scotch broom, black locust. On leaves and tender tips.
*Macrosiphum rosae* (L.). Rose. Tender tips and young leaves.


*Myzocallis annulatus* (Hart.). Oak. Under sides of leaves.


*Myzocallis coryli* (Goeze). Filbert, hazelnut. Under sides of leaves.


*Myzocallis tiliae* (L.) *Tiia americana*. Under sides of leaves.

*Myzus eresi* Fab. Cherry. In curled leaves.

*Myzus convolvuli* (Kalt.). Strawberry, elderberry, magnolia, holly. New tips and leaves.

*Myzus persicae* (Sulz.). Prune, peach, cherry, chokecherry, apricot, camellia. On leaves.


*Oecithoidella flavia* (Dvds.). Alder. Under sides of leaves.

*Periphyis populi-caulis* Fitch. Poplar. Forms twisted galls on petioles at the base of the leaf blade.

*Periphyis populi-monitis* Riley. Poplar, willow. Forms galls on under side of leaf blade.

*Periphyis populi-transversus* Riley. Poplar. Forms a transverse-mouthed gall on leaf petioles.


*Periphyllus californiensis* (Shinji). Broadleaf, Norway and vine maples. Under sides of leaves.
Figure 13. Aphids on stems of English ivy. *(Aphis hederae).*

Figure 14. Aphids on rose tip. *(Macrocephum rosae).*

*Periphyllus lyropiclus* (Kessler). Alder, various maples. Under sides of leaves.
*Periphyllus populicola* (Thos.). Aspen. On tender stems and petioles.
*Prociphilus humelae* Schrank. Red and white ash. In pseudogalls on leaves.
*Prociphilus fraxinifolii* (Riley). Oregon ash. Curled leaves.
*Pterochlorus rosae* (Cholod.). Rose. On stems.
*Pterochlorus salignus* (Gmelin). Willow. On bark in large colonies.
*Schizoneura rileyi* Thos. Cork Elm. On bark and in rolled leaves.
*Tamalia covenii* (Ckll.). *Arctostaphylos* spp. In reddish leaf galls.
*Vacuna californica* Davidson. Garry Oak. Under sides of leaves.
SCALE INSECTS

*Coccoidea*

Among the insects of the large *Coccoidea* group are some of the most important economic pests. The large majority are generally not recognized as insects by the novice. They assume many shapes and forms and in many cases are so well hidden or so inconspicuous on their hosts that they go unnoticed.

All species obtain their nourishment by sucking the sap out of plants. Most species secrete honeydew on which a black fungus growth often develops. The presence of scales may often be detected by the presence of ants which seek the honeydew. Some of the most important economic forms have the body of the insect covered with a shell or scale while others do not have a covering. Some secrete a white cottony material that often completely hides the body.

The large majority reproduce by the production of eggs that hatch and produce active crawlers. These crawlers, after finding a suitable feeding place on the plant, settle down and lose their legs and remain there for the rest of their lives. The adult females may be called a feeding sack possessing a beak for sucking plant sap. They serve only as a means for perpetuating the species. The adult males possess wings in most cases and are thus able to fly about to fertilize the females.

**Means of Dispersion:** A knowledge of the ways in which scale insects spread often aids in the prevention of infestations on different plants and the dissemination of these pests to new localities. In the crawler stage, they may be carried from plant to plant by birds, insects, and other animals. Wind may spread these crawlers at times and may also blow about leaves infested with scales ready to produce young. Transportation of plants or plant parts is probably the most important means of spreading scales.

**Control:** Scales have many natural enemies, the most important of which are small parasitic wasps and predators such as ladybird beetles and lace-wing insects. Natural weather conditions in northern climates prevent the continued existence of many species introduced from the warmer regions. Quarantine inspection aids greatly in preventing the introduction of scales into new territories.

Dormant sprays of oil or lime sulphur are applicable to the control of many species. During the growing season, oil sprays alone or in combination with nicotine or rotenone will control many species. Dipping cuttings or small plants before placing them in
their permanent location is often an easy way of treating large numbers of plants and will save the more costly field control. Methyl bromide or cyanide fumigation is applicable for scale control in many instances. It could be used to advantage in more cases than at present.

**Margarodidae**

**Alder scale***

*Xyllococcus betulae* Perg.

Alder scale has been reported in Oregon on alder. It is apparently of no economic importance. The body of the scale is oval, dark brown, and is covered with slender white waxy threads. It is found under the bark in protected places.

**Ortheziidae**

**Western orthezia***

*Orthezia occidentalis* Douglas

The western orthezia insect has been reported as having been shipped from Oregon to California on the roots of apple nursery stock. Nothing more is known about it. It is a soft-bodied scale covered with waxy white filaments. The eggs are laid in a long white egg sac.

**Kermidae**

**European elm scale***

*Gossyparia spuria* (Mod.)

European elm scale has been discovered in several localities in Oregon. Where it becomes abundant, it can be a very serious pest both to nursery and ornamental elm.

**Description:** This scale is very conspicuous because of the white cottony fringe around the edge of the body. It is oval in shape, dark reddish to brown in color, and 3 to 4 mm. (about 15/100 inch) in diameter. The eggs are oblong, pale yellow, and hatch soon after being laid.

**Life History and Injury:** This scale passes the winter in a partially grown condition. In the spring the scales take up their permanent location on the bark of the limbs and trunks. The young either settle on the bark of the tree or on the under sides of the leaves in the summer. In the late fall, the young migrate to suitable protected places on the bark.

If infestations are severe, trees may be killed outright. Usually only a devitalization of the tree results. On ornamental trees, the
black fungus growth on the honeydew secreted by the scales gives
the trees an unsightly appearance and often sidewalks and ground
under the trees are covered with the sticky honeydew.

**CONTROL:** Dormant oil sprays have given the best control.
Summer oils at a low concentration (1 to 1.4 per cent) applied after
all eggs have hatched have also given satisfactory control.

*Eriococcus gillettei* Tinsley species is reported as fairly common
on western juniper in eastern Oregon (Chamberlin, unpublished
notes). The bodies of these scales are enclosed in a white felt-
lke sac.

**MEALYBUGS**

*Pseudococcidae*

Several species of this family of scales occur in greenhouses in
Oregon, but there are no known species that survive throughout the
year under outdoor conditions. They may survive and multiply
there during the summer, however. These scales do not possess a
scale covering but most species are covered with a white mealy
covering. They usually have two or more long white filaments pro-
jecting from their posterior end. They attack a large variety of
plants.

Control of these pests is rather difficult. Repeated applications
of any control measure are usually necessary. Spraying with oil
emulsions, nicotine, and fumigation with cyanide have been the most
generally accepted remedies.

**Ground mealybug***

*Rhizoecus terrestris* (Newst.)

The soft-bodied ground mealybug scale is covered with thin
white powder. This pest has been taken on the roots of Kentia palm
in greenhouses of Oregon. It has not been discovered living out-
of-doors.

**COCIDAE**

**Soft (brown) scale***

*Coccus hesperidum* L.

The soft (brown) scale is one of the most common scales to be
found in Oregon. Its host range covers many of the broadleaf ever-
green trees and shrubs.

**Hosts:** Holly and camellia appear to be the most common hosts.
but it has also been found on apple, apricot, *Araucaria*, ash, boxelder,
*Clematis*, fig, gardenia, grape, hawthorn, hibiscus, English ivy, jas-
mine, California laurel, locust, madrone, magnolia, manzanita, maple, mulberry, peach, pear, plum, poinsettia, poplar, rose, strawberry tree, willow, rhododendron, azalea, and boxwood.

**Description:** This insect has no scale covering. It is light to dark brown, oval-shaped, and much flattened. It is 3 to 4 mm. in length (about 15/100 inch) when full grown.

**Life History and Injury:** This scale produces living young and seems to reproduce at all times of the year except during the winter. There apparently are no males. It produces large quantities of honeydew that is often covered with black fungus growth. Several species of small wasps help to keep it in check.

**Control:** A 3 per cent light-medium summer oil emulsion gives satisfactory control when thoroughly applied. Several applications may be necessary to effect complete control.

**Cottony maple scale***

*Pulvinaria vitis* (L).

A conspicuously large scale, the cottony maple scale is common throughout Oregon on many broadleaf plants, but it seems never to be of much economic importance.

**Hosts:** The most important hosts are various maples, but it also occurs on grape, blackberry, pear, alder, apple, beech, boxwood, buckeye, currant, elm, euonymus, gooseberry, hawthorn, honeysuckle, lilac, linden, locust, mountain-ash, mulberry, oak, peach, plum, poplar, quince, rose, spiraea, sumach, sycamore, viburnum, willow, and Virginia creeper.

**Description:** The body of this scale is oval and very much flattened. It looks much like the soft brown scale until the egg sac begins to form. The cottony egg sac of this species is pure white and is about 2 or 3 times the length of the body of the scale. The over-all length of the scale and egg sac is about 1/3 of an inch. The immature forms are flattened, brown to yellowish green in color and are oval in outline.

**Life History and Injury:** This scale overwinters on the bark of its host in a partially grown condition. Development is completed during late spring. The white cottony egg sacs are said to contain as high as 3,000 eggs. These eggs hatch during June and July, but not many of the scales reach maturity because of their many insect enemies. The young scales migrate to the leaves and may usually be found on the under side along the midrib. In the fall, before the leaves drop, the scales migrate back to the bark to overwinter. There is one generation a year.
Control: Dormant oil sprays give excellent control, while lime sulphur sprays are less effective. Nicotine soap sprays applied while the scales are on the leaves also give good control.

Other species

Pulvinaria floccifera Westwood, and Pulvinaria camelicola Sign., are two scales of this family that have not been found in Oregon, but it is suspected that both are present. *P. floccifera* infests holly, camellia, and similar plants. *P. camelicola* has been tentatively determined to infest camellia in Oregon. Both species have large white egg sacs in which the eggs are deposited. The young look very much like the soft brown scale.

Summer oil sprays applied at the time when these scales are immature should give satisfactory control.

European fruit lecanium*

*Lecanium corni* Bouché

The European fruit lecanium, often called the brown apricot scale, is especially common on fruit trees. It is widely spread and at times becomes very serious where no regular spraying schedule is followed.

Hosts: Apple, apricot, peach, plum, pear, ash, alder, boxelder, cherry, quince, locust, elm, poplar, willow, basswood, beech, blackberry, chestnut, currant, gooseberry, grape, hawthorn, hazelnut, magnolia, and rose are host plants.

Description: This scale is brownish in color with a few black markings, hemispherical in shape, and is often covered with a white powdery secretion. It is 3 to 5 mm. in diameter. The eggs are pearly white in color.

Life History and Injury: The insect passes the winter in a half-grown condition on the smaller limbs and twigs of its hosts. The eggs are laid in the spring, and the young settle on the twigs and under sides of the leaves. In the fall the scales move from the leaves back to the limbs. Many die on the leaves when they drop early in the fall. There is but one generation a year. At times it becomes very abundant and has caused serious damage, especially to prune orchards.

Control: Dormant oil sprays (4 per cent) have given the best control. Dormant lime sulphur (12 gallons per 100) sprays also give good results but are somewhat inferior to the oil sprays.
Other species

*Lecaniun fletcheri* (Ckll.) scale is found commonly on arborvitae in the Willamette Valley, but has never been found to be very abundant or to cause any particular injury. It is very similar in appearance to *Lecaniun corni* and probably has the same habits and life history. A light medium summer oil spray applied during early April has given good control.

A large hemispherical brown *Lecaniun* scale about 5/16 inch in diameter is found often in nurseries on cherry, maple, mountain ash, horse chestnut, birch, and crab apple. The scales are generally found on 1- to 2-inch limbs and trunks near the axils (angles between limbs and stems, or trunks) of limbs. The scales overwinter as small brownish red scales near bud scars and develop into the large hemispherical form by May and June when they are filled with many hundreds of pinkish eggs covered with a whitish cottony material. The young scales migrate to the under sides of the leaves and small twigs for the rest of the summer and in the fall move back to the limbs and trunks to hibernate. These scales may be controlled with a dormant lime sulphur or oil emulsion spray.

*Physokermes concolor* Coleman species is rare on *Abies concolor* and *A. grandis* in Oregon according to Chamberlin (unpublished notes). This is a large globular brownish species occurring on twigs.

*Physokermes taxifoliae* Coleman is only tentatively determined as a species that is quite common on the twigs of Douglas-fir. It is hemispherical in shape and tannish brown in color.

Figure 15. *Lecaniun sp.* on Norway maple.

Figure 16. Rose scale on Himalaya blackberry.
Holly scale  
*Dynaspidiotes (Aspidiotus) britannicus* (Newstead)

Holly scale is apparently present throughout the state and has been known here since 1898.

**Hosts:** Holly and boxwood seem to be the favored hosts. It has also been found on Oregon grape, English laurel, privet, butchers-broom, *Hedera, Rhamnus*, and *Viburnum*.

**Description:** The scale covering is light brown to tan in color, oval in outline, and about 2 mm. (about 8/100 inch) in diameter. The scale insect itself is lemon yellow in color. The eggs are also lemon yellow.

**Life History and Injury:** This scale overwinters in a partially grown condition. Feeding begins during the latter part of March or early April. Mating takes place during May as a rule and the eggs are laid during June and July. There is but one generation annually. Injury consists of plant devitalization, yellow spotting of leaves and smutting of leaves due to fungus growth on the secreted honeydew. As a rule the scales seem to congregate on the lower leaves inside the tree. Two small wasps often heavily parasitize this scale.

**Control:** Excellent control has been obtained with a 3 per cent light-medium summer oil emulsion applied during the last week in March and the first week in April. At this time the scales seem to be particularly susceptible to this spray. Applications later in the spring or summer are not recommended as they have consistently given less satisfactory results than the early spring sprays.
Oleander scale*  
*Aspidiotus hederae* (Vallot)  
The scale covering of the oleander species is whitish gray and circular in outline. The scale occurs on the bark and leaves of its hosts. It has an extremely wide distribution but appears not to be very common in Oregon. No records of its occurring under outdoor conditions are at hand, although it is not uncommon in greenhouses. It occurs on almost any imaginable broadleaf plant and even on a few conifers.

Putnam scale*  
*Aspidiotus (Aspidiotus) ancyclus* (Putnam)  
Putnam scale is reported from Oregon on the needles of hemlock (Chamberlin, unpublished notes). The scale covering is blackish brown in color. Essig (1934) reports this species on apple, peach, pear, plum, apricot, ash, beech, boxelder, cherry, currant, cranberry, elm, linden, maple, oak, poplar, and quince. Numerous other broadleaf hosts are reported by Ferris (1938).

Greedy scale*  
*Hemiberlesia rapax* (Const.) (Syn. *Aspidiotus camelliae* Sign.)  
Greedy scale has a wide distribution but is not as common as the San José or Oyster Shell. In Oregon it occurs more commonly in greenhouses, but it is known to occur out of doors. It has not been found to be of any great importance in Oregon to date.

**Host:** This scale is a general feeder and has been found on the following hosts: apple, boxwood, scotch broom, *Ceanothus, Camellia*, cherry, cotoneaster, holly, English ivy, English laurel, *Euonymus*, fig, fuchsia, Spanish broom, grape, heath, Japanese quince, locust, magnolia, manzanita, mistletoe, nightshade, Oregon grape, poplar, pear, *Pyracantha*, quince, red bud, sage, rose, *Sedum*, strawberry tree, *Strelitzia*, English walnut, and willow.

**Description:** This scale is light gray in color, about 1.2 mm. (about 5/100 inch) in diameter, more or less circular in outline but generally somewhat lopsided, and with the cast skins near one edge. The body of the female scale is bright yellow in color.

**Life history and injury:** Little is known of the life history of this scale under outdoor conditions. Under greenhouse conditions, continuous generations of scales are produced. As a rule, it is found on the bark of its host, but it is not uncommon to find it on the leaves and fruit. Injury consists in general devitalization of the plant and an unsightly appearance when the scale occurs on the leaves.
Control: Oil sprays give the most satisfactory control. The type of oil to be used will depend on the condition of the host, species of host, condition of the scale, and the time of year.

Hemiberlesia (Aspidiotus) degenerata (Leon.) scale has been taken on camellia under outdoor conditions at Santa Clara, Oregon. Examination of the specimens at hand (March 6) showed no evidence of males so it appears that this scale may overwinter in a nearly fullgrown condition.

The scale covering is more or less circular, ashy gray to brownish in color, and about 1.5 mm. (about 6/100 inch) in diameter. The body of the scale itself is lemon yellow.

**Black pine leaf scale**
*Nucluspis (Aspidiotus) californica* (Coleman)

According to Chamberlin (unpublished notes), the black pine leaf scale is quite common all over Oregon. These scales occur on the needles of hemlock, Douglas-fir, various species of pine, and probably on true firs. The scale covering is almost circular and nearly black in color. The body of the female is yellow to brown. The winter is spent in a partially grown condition. It often occurs in considerable numbers. A light-medium summer oil spray applied in early spring is suggested as a control measure.

**European fruit scale**
*Quadraspidiotus (Aspidiotus) ostreaeformis* (Curt.)

Very little is known about this scale in Oregon. It has been collected on cottonwood in Oregon and reported from apple, plum, and pear elsewhere.

**Walnut scale**
*Quadraspidiotus (Aspidiotus) jugland-regiae* (Comstock)

Walnut scale has been found in several localities in Oregon but has not become a serious pest.

Hosts: English walnut, pear, locust, cherry, poplar, apple, apricot, ash, boxelder, currant, elm, grape, linden, maple, peach, plum, rose, and willow are hosts of this scale.

Description: The scale covering is flat, pale gray to yellowish, nearly circular, and about 2 mm. (about 8/100 inch) in diameter. The exuvia is generally slightly off center. The body of the scale itself is pale yellow with irregular orange spots.

Life History and Injury: Little is known about the life history in Oregon. The injury to the host seems to be localized on certain branches and seldom becomes serious over the entire plant.
INSECT PESTS OF TREES AND SHRUBS IN OREGON

CONTROL: Dormant oil or lime-sulphur sprays, depending on the host, have been suggested for control.

San José scale*

*Quadraspidiotus (Aspidiotus) perniciosus* (Comstock)

The San José scale is undoubtedly one of the most important and most widely distributed in Oregon. It attacks a large variety of hosts and often develops into enormous numbers before its presence is noted because of its small size and inconspicuous appearance. Its main damage is done to fruit trees and ornamentals.


Description: The scale covering of this pest is ashy gray in color, almost circular in outline with the exuvia nearly central in location. The scale insect is about 2 mm. in diameter. The female scale is lemon yellow. The eggs are white.

Life history and injury: This scale passes the winter in a half-grown condition on the bark of limbs and trunks of deciduous

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Figure 19. San José scale injury to English laurel hedge.

Figure 20. San José scale on English laurel leaf.
trees and often on the leaves of evergreen hosts. Development of
the scale is completed during May and June. There may be one or
more generations a year, depending on weather conditions and locality.
The large majority of the scales settle on the limbs and trunks
although it is quite common to find large numbers on the leaves and
fruit. If abundant, entire plants may be killed; if localized, individu-

CONTROL: Dormant sprays of oil or lime sulphur give excellent
control of these pests. On English laurel, excellent control has been
obtained with a 3 per cent light-medium summer oil applied in May.
Light summer oils (1 per cent) applied when the scales are crawling
(June to August) have given fairly satisfactory results.

Other species
Aspidaspis arctostaphyli (Ckl. & Rob.) species is reported
from Oregon by Ferris (1938). It occurs on the leaves and twigs
of California laurel, madrone, and various species of manzanita.
The scale covering of this species is nearly circular in outline and
brownish in color.

Aspidaspis oxyccocus (Woglum) species is reported from Ore-
gen by Ferris (1938) on cranberry. The scales occur on the leaves
and fruits. The scale covering is gray in color and nearly circular
in shape.

Rose scale*
Aulacaspis rosae (Bouché)

Rose scale is widely distributed on many of the plants of the
rose and caneberry group. Where normal pruning and good care
of the infested plants are exercised, this scale is seldom a serious
problem.

Hosts: Roses and caneberrys of nearly all varieties are hosts.

Description: The scale covering of this species is nearly cir-
cular, pure white or light gray, and about 1 millimeter in diameter.
The body of the insect is orange to dark red. The eggs are pinkish
red.

Life history and injury: This scale overwinters in the egg
stage. The young hatch during the spring and distribute themselves
over the plants. There is but one generation a year. Infested plants
generally show less vigor than clean plants. Where infestations be-
come severe, the scale often completely encrusts the canes of the host
and at times will kill the host.

Control: Dormant oil or lime sulphur sprays give satisfactory
control. Normal pruning generally keeps this pest in check.
Figure 21. Juniper scale.
Juniper scale*
*Carulaspis visci* (Schrank) (Syn. *Diaspis carueli* Targ.)

Juniper scale is the most widely spread and the most important scale affecting conifers in Oregon. It has a wide variety of hosts and is important because it is so easily transferred and perpetuated by various means of propagation.

**Hosts:** Most or all varieties of *Juniperus, Chamaecyparis,* and *Thuja* are hosts. It has been observed also on *Libocedrus decurrens, Cupressus* spp., and occasionally on pine.

**Description:** The scale covering of this pest is circular, snowy white, with the exuviae central and yellow; it is 1 to 1.5 millimeters in diameter. The female scale itself is yellow during the summer and fall and dark brown in early spring. The eggs and young are pinkish to yellow in color.

**Life History and Injury:** This scale overwinters as nearly full-grown, fertilized females. The eggs are laid during late May and throughout June. There is but one generation a year. The scales may be found on the younger twigs, needles, and cones of infested plants. When infestations are severe the plants have the appearance of extreme drought. Due to the secretion of honeydew by the scales, the plants often take on a blackish, smutty appearance caused by a fungus growth on the honeydew.

**Control:** A 3 per cent light-medium summer oil applied during the last week in March or the first week in April has given satisfactory control. Applications of oil earlier may result in oil injury because of cold weather, and oil applications during the summer months may result in severe burning.

In propagating coniferous plants or importing these plants it is always a good practice to dip or spray the plants or plant parts with a 3 per cent summer oil emulsion.

*Chionaspis longiloba* Cooley, whitish oblong scale, has been found abundantly on some plants of cascara in Multnomah County. The determination is tentative.

Florida red scale*
*Chrysomphalus (aonidum) (L.)* *ficus* Ashmead

Florida red scale has often been imported into Oregon, especially on broadleaved evergreens which it attacks. It appears not to be able to pass the winter out of doors, but thrives in the greenhouse.

**Hosts:** In Oregon it has been taken only on camellia and boxwood, although it no doubt would attack many other plants commonly grown in greenhouses.
DESCRIPTION: The scale covering seems to be formed of a number of concentric rings. It is dark brown to reddish brown and is nearly circular.

Nothing is known of its life history in Oregon.

CONTROL: Light-medium summer oil sprays are suggested for its control. Methyl bromide fumigation (2 pounds, 3 hours at 70°F) has given good control.

Oystershell scale*

*Lepidosaphes ulmi (L.)*

Oystershell scale is distributed widely over the United States and occurs on many broadleaf plants. It is seldom a pest in nurseries except where infested plants or infested plant parts are imported; however, at times it becomes serious on ornamental plants.

HOSTS: Following are some of the nursery and ornamental hosts occurring in Oregon, on which this scale has been found: apple, alder, andromeda, aspen, crab apple, apricot, ash, barberry, basswood, beech, birch, black walnut, boxwood, boxelder, camellia, cherry, chestnut, cotoneaster, cranberry, currant, dogwood, elm, fig, filbert, gooseberry, grape, hawthorn, heather, holly, honeysuckle, horse chestnut, lilac, locust, maple, mountain-ash, oak, peach, pear, plum, poplar, quince, rock-rose, rose, Scotch broom, spiraea, sycamore, tamarix, tree of heaven, tulip tree, magnolia, viburnum, Virginia creeper, English walnut, and willow.

DESCRIPTION: The common name of this insect is very well chosen as the shells of this scale look very much like a miniature oyster. The scale cover is about $\frac{1}{2}$ inch long and is ashy gray to blackish. The body of the female is yellowish white. The eggs are pearly white to yellowish and often number 100 or more to the scale.

LIFE HISTORY AND INJURY: The scales overwinter in the egg stage on the twigs and branches of the host. The eggs hatch under western Oregon conditions during May. There is one generation a year.

Injury consists in devitalizing the plant by sucking out the plant juices. In cases of severe infestation, plants are often killed outright. This scale occurs almost entirely on the bark of twigs and limbs.

CONTROL: Dormant sprays are not very satisfactory in the control of this pest; however, dormant sprays of lime sulphur or oil will give fair control if applied from year to year. The oil sprays have given the most satisfactory results. To prevent infestations, obtain clean planting stock and other plant materials.
Figure 22. Florida red scale on boxwood.

Figure 23. Pine needle scale on Douglas fir needle.

Figure 24. Parlatoria camelliae on camellia.

Figure 25. Camellia scale on camellia leaf.
Camellia scale*
*Lepidosaphes camelliae* Hoke

Camellia scale looks very much like the common oystershell scale except for the tannish brown scale covering. It is often intercepted in Oregon on camellias shipped in from the southern states. It has never been found to reproduce under outdoor conditions in Oregon, but does so in greenhouses. Summer oil sprays or methyl bromide fumigation (2 pounds, 3 hours at 70° F.) have given good control.

Other species

Chamberlin (unpublished notes) reports *Stramenaspis* (Lepidosaphes) *kelloggi* (Coleman) as being found on *Abies grandis* in the Willamette Valley. Ferris (1937) also reports it from Douglas-fir, "big cone fir," *Pinus radiata*, and various species of *Abies*. These scales occur on the needles.

*Parlatoria canelliae* Comst. is the most common scale insect to be found on camellia in Oregon. It is able to survive out of doors but does especially well in greenhouses.

Hosts: The most common host is camellia. It has also been reported on the following genera of plants known to be grown in Oregon. *Acer, Euonymus, Jasminum, Vitis* and *Azalea*.

Description: The scale covering of this pest is ashy gray to brownish, is oval in outline, and 1.5 to 2 millimeters long. The insect is deep rose purple in color. The eggs are purple to lavender.

Life history and injury: Little is known about the outdoor life history of this pest. One lot of specimens examined (March 6) indicates that the scales may overwinter either as full-grown scales ready to mate in the spring or in the egg stage. In the greenhouse all stages of the insect may be found at any time. Injury consists of plant devitalization, and spotting and smutting of the leaves.

Control: Light-medium summer oil emulsions (3 per cent) have given excellent results. Several applications may be necessary to obtain complete control. Methyl bromide used at the rate of 2 pounds per 1,000 cubic feet and 3 hours exposure at 70° F. has given complete control. Caution—some camellia varieties are very susceptible to methyl bromide injury so care should be exercised in its use.

Pine needle scale*

*Phenacaspis (Chionaspis) pinifoliae* (Fitch)

The pine needle scale pest is one of the most widely spread scale insects on various species of pine. It seems not to be of any great
economic importance although it does at times injure small trees and cause them to look yellow and unsightly.

**Hosts:** *Pinus* spp., *Picea* spp., Douglas-fir, *Abies* spp., and incense cedar are hosts.

**Description:** The scale covering is snowy white with the exuvia (scale covering, including cast off shells) light yellow and located at the narrow end of the scale. The covering is long and narrow and is larger on one end than on the other. The body of the female is purplish red as are the eggs.

**Life History and Injury:** This scale overwinters in the egg stage. The eggs hatch late in the spring. Injury consists of yellowing and devitalization of the plant. Very often the growth of a blackish fungus that develops on the honeydew secreted by the scales adds to the unsightliness of the host.

**Control:** Dormant oil sprays in early spring or summer oil sprays during June have given good control.

**White Flies**

*Aleyrodidae*

White flies are small sucking insects averaging about 1/12 of an inch in length. The adults are miniature white four-winged insects and the immature forms are flat, oval whitish objects which appear to be glued to the lower leaf surface of the host. The eggs are pearly white as a rule, and are generally laid singly on a chalky white spot on the lower leaf surface. As a whole, most species have two or more generations a year.

The injury caused by white flies is more or less similar to that of plant lice and scales in that they secrete honeydew and cause a devitalization of the plants by sucking out the plant juices.

Control of these pests is generally not too easy. Repeated applications of nicotine sprays applied at regular intervals will generally give fair control. In greenhouses, cyanide fumigation has given the best results.

Very few species of white flies are reported from Oregon. This is probably due to the lack of species of economic importance; it is known, however, that there are many species present. The following are definitely known to occur in this state:

*Aluroplatus myricae* (Quaint. & Baker) occurs on holly in southern Oregon.

**Greenhouse whitefly**, *Trialeurodes vaporariorum* (Westw.), is a very common pest in greenhouses. It attacks a large variety of greenhouse plants and is especially troublesome to fuchsia. In the summer months it will multiply under outdoor conditions.
BOXELDER BUG*

*Corizidae*

*Leptocoris trivittatus* (Say)

The boxelder bug is very common at times on boxelder and maples. It feeds mostly on the fruits of the maple but often changes over to such fruits as apple, pear, plum, etc., where it causes deformities. The greatest concern that this bug causes is the adult's habit of getting into dwellings and other shelter for the purpose of hibernating in the fall. This often creates a great nuisance.

**Control:** The adults may be killed by spraying directly with kerosene or a strong oil emulsion.

**Description:** The adults are grayish black, about \( \frac{1}{2} \) inch long, and have conspicuous red lines on the back. The young bugs are bright red at first and become black, striped with red as they grow older.

LACEBUGS OR TINGIDS*

*Tingidae*

The economically important lacebug species occurring in Oregon all have more or less the same appearance. All do similar injury to their host plants, although the life history varies.

The adults are oblong to oval. The wings are lace-like in appearance and have many small circular to rectangular cells. The general color of the wings are whitish with different patterns of darker brownish to blackish markings. The immature stages greatly resemble the adults.

These bugs obtain their nourishment by sucking the juices out of the leaves of the plants. The lower leaf surface is, as a rule, covered with cast skins and black smears of excrement which give the leaves a very dirty appearance. The upper surface of the infested leaves is usually yellowish or light green in color and appear to be stippled with small white dots.

The eggs of most species are laid in either side of the leaf midrib on the under sides of the leaves.

Satisfactory control may usually be obtained by spraying with nicotine sulphate, when the immature bugs are in evidence.

**Rhododendron lacebug**

*Stephanitis rhododendri* Horv.

The rhododendron lacebug infestations are spotty in western Oregon. On the plants where it is abundant, it causes serious yellowing and discoloration of the leaves.

**Host:** Rhododendron is the principal host.
DESCRIPTION: It looks very much like other species of lacebugs.

LIFE HISTORY AND INJURY: The winter is spent in the egg stage. The eggs are laid in the midrib on the under side of the leaves. The eggs appear as small black spots and are never laid entirely to the tip or to the middle of the leaf. The eggs hatch during the latter part of May and early June, and most of the nymphs have reached the adult stage by July. There appears to be but one generation in Oregon. Injury consists of a yellowing and profuse stippling on the upper leaf surface and a dirty appearance on the lower leaf surface. This appearance is caused by black excrement and cast skins.

CONTROL: Nicotine sulphate sprays, applied while the bugs are in the nymphal stages, give good control.

**Western willow tingid**

*Corythucha salicata* Gibson

Western willow tingid occurs quite commonly throughout the Willamette Valley and at times seriously injures apples.

HOSTS: Willow, apple, *Prunus emarginata*, *Osmaronia cerasicformis*, *Ceanothus sanguineus*, and *Eriodycton californicum* are hosts.

DESCRIPTION: This species has the characteristics and appearance of the other lacebugs of economic consideration.

LIFE HISTORY AND INJURY: The winter is spent in the adult stage under the moss of trees and similar places where suitable shelter is available. The adults deposit their eggs in the midrib on the under sides of the leaves throughout the spring and early summer. Nymphs begin to appear in May, and all stages can be found throughout most of the summer. Hibernation begins in early September. In cases of severe infestation, trees may lose most of their leaves, although most of the injury is less severe. There appears to be but one generation.

CONTROL: Nicotine sulphate sprays, applied at the time the immature bugs are in evidence, give good control.

**Other lacebugs**

*Corythucha obliqua* Osb. & Drake is abundant on various species of *Ceanothus* in western Oregon.

*Corythucha juglandis* (Fitch) has been reported from walnut, butternut, and linden.

*Corythucha padi* Drake is common on choke cherry and wild cherry in western Oregon.
PLANT BUGS OR LEAF BUGS*

*Miridae

Most members of the mirid family of bugs feed on herbaceous plants and shrubs but some are predaceous. A few are common on trees. They feed by sucking the sap and often cause considerable damage by causing tender tips to wilt and seed to be infertile. When the bugs are abundant, the plants become covered with black excrement and fungous growths.

DESCRIPTION AND LIFE HISTORY: The eggs of most species are laid in plant tissues. Overwintering is generally in the adult form. Most species have more than one generation a year. They are generally gray, green, brown, or black in color and are $\frac{1}{4}$ inch or less in length. All have a small triangular spot on the middle of the back.

CONTROL: DDT dusts promise to be the best insecticide for their control.

Some of the more common species occurring on ornamental and nursery trees are as follows:

*Irbisia solani* Heid is black in color and has been found on rose, peach, and plum.
Lygus shulli Knight, Lygus elisus Van D., and Deraeocoris brevis var. piceatus Knight, are three of the most common species in Oregon. They are often very abundant and destructive to cultivated and native Scotch broom. They cause a very noticeable yellowing of the plant and premature leaf drop. They also cause the branches and leaves to become black with excrement and fungous growths.

Neoborus amoenus scutellaris (Rt.) is often abundant on Oregon ash. It is a beautiful black and yellow species.

SWALLOWTAIL BUTTERFLIES

Papilionidae

The swallowtail butterflies in the adult stage are familiar to all. They are the beautiful large butterflies with yellow wings marked with black. None of these are serious pests, but they do occur on ornamental and nursery plants quite often. Most of the larvae are large, hairless caterpillars, yellow in color with black spots or stripes and with retractile horns behind the head. All overwinter in the pupal stage in a hanging position. The eggs are laid singly on the host.

Species and occurrence: The western swallowtail (P. rutulus Bdv.) feeds on alder, apple, cherry, plum, Rubus spp., sycamore, and willow.

The Daunus (Papilio daunus Bdv.) occurs on ash, choke cherry, plum, and on many other plants of the rose family.

The Eurymedon (P. eurymedon Bdv.) feeds on cascara and Ceanothus.

SULPHURS AND WHITES*

Pieridae

Pine butterfly*

Neophasia menapia (Feld. & Feld.)

The pine butterfly is principally a pest of the forest, but occasionally it is serious on ornamental trees.

Hosts: Its preferred hosts appear to be yellow pine and Douglas-fir, but it includes lodgepole pine and western white pine.

Description: The butterflies are pure white with a large black band near the tip of the forewing. They look very much like the common cabbage butterfly. The caterpillars are one inch in length, dark green, and have four white stripes on the body.

Life history and injury: The winter is passed in the egg stage. The eggs are bright green, about twice as long as wide, and
laid in rows on the needles. The eggs hatch in June and the larvae are full grown about the first of August. The moths emerge in August and September to lay their eggs. Injury consists in defoliation which at times is very severe.

CONTROL: On ornamental trees, a lead arsenate spray is suggested as a control.

BRUSH-FOOTED BUTTERFLIES

*Nymphalidae*

The Hop butterfly, *Polygonia satyrus* Edw., is a reddish-brown, angular-winged butterfly that feeds on several plants including currants and rhododendrons. The larvae are black with a coarse spine covering.

The California tortoise shell, *Nymphalis californica* Edw., butterfly larvae feed on *Ceanothus*, manzanita, and fruit trees and also many other non-ornamental plants.

Mourning-cloak butterfly,* *Nymphalis antiopa* (L.), is beautiful with purplish blue wings tipped with golden yellow bands. It feeds on elm, poplar, and willow. The caterpillars are black, very
spiny, and have a red spot on top of each body segment. The larvae of this butterfly are often very abundant on individual plants, often causing complete defoliation.

**Painted lady** or thistle butterfly, *Vanessa cardui* (L.), is a spiny black caterpillar with pale yellow stripes down each side. It feeds almost entirely on thistles and other herbaceous plants. It is gregarious and often literally eats itself out of house and home. If this occurs, it will readily attack other plants such as peaches and prunes and may cause serious defoliation.

**Lorquin’s admiral**, *Basilarchia lorquini* Bdv., is a hump-backed, brownish caterpillar that is often found singly on apple, cherry, plum, poplar, crab apple, and willow trees.

**SPHINX, HAWK, OR HUMMINGBIRD MOTHS**  
*Spingidae*

The larvae of the large moths in the sphingid family are commonly known as hornworms. They are so called because of a large backward projecting spine that is usually present on the back near the posterior end of the abdomen. The pupae are brown and most of them have the tongue enclosed in a case resembling the handle of a pitcher. The larvae of some species may be as long as 4 inches although the majority are about 2 inches long. They vary in color, but most species are green and blend well with the leaves of their hosts. The moths are variously colored and generally have a sharp pointed abdomen and an extremely long tongue. The wingspread varies from 2 to 4 inches for most of the common species.

The larvae are ravenous feeders, and the various species feed on a large variety of plants. Pupation takes place in the soil.

The larvae are not uncommon on nursery and ornamental plants. Since these worms are generally not very abundant and are mostly very large, hand picking will usually suffice as a control.

Following is a list of some of the more common species found in Oregon:

- **Tobacco hornworm**, *Phlegethontius sexta* (Johan.), feeds on solanaceous plants and has been taken on cherry.
- **Tomato hornworm**, *Phlegethontius quinquemaculata* (Haw.), generally feeds on various kinds of solanaceous plants but has also been taken on poplar.
- **Elegant sphinx**, *Sphinx perelegans* Hy. Edw., larvae feed on apple, plum, and manzanita.
- **Wild cherry sphinx**, *Sphinx drupiferarum* A. & S., larvae feed on cherry and plum.
Eyed hawk moth, *Smerinthus cerisyi* (Kirby), larvae are common on willow.

Vancouver sphinx, *Smerinthus cerisyi ophthalmicus* Bdv., feeds on snowberry.

Poplar hawk moth, *Pachysphinx modesta* (Harris), larvae are common on willow and poplar.

Achemon sphinx*, *Pholus achemon* (Drury), larvae feed on Virginia creeper and grape.

White-lined sphinx*, *Celerio lineata* (F.), larvae are quite common on nursery and ornamental plants. It feeds on many herbaceous plants as well as apple, azalea, elm, gooseberry, grape, pear, plum, willow, and other woody plants.

**GIANT SILK MOTHS**

*Saturniidae*

**Ceanothus silk moth**

*Platysamia caryahus* (Bdv.)

The large caterpillar of the ceanothus silk moth is not uncommon on ornamental plants but has never been of economic importance.

**Hosts:** Apple, birch, *Ceanothus*, manzanita, willow, and probably many other broadleaf plants are hosts.

**Description:** The moths have a wing spread of 4 to 5 inches. The wings of the moths are hairy and reddish brown with lighter colored bands on the tips and several white spots in each wing. The larvae, when full grown, are about 3 inches long and pale green in color. The back is pale blue with golden spots and blue spots on the sides. The large hairy cocoons are attached to the limbs of the host.

**Life History and Injury:** These moths hibernate in their cocoons on the limbs of their hosts. There is one generation.

**Control:** As these moths never cause any serious defoliation, no particular control is needed. Collection of the overwintering cocoon is suggested.

**Polyphemus moth**

*Teia polyphemus* (Cramer)

The polyphemus moth's large conspicuous caterpillar is occasionally found on nursery and ornamental plants. It is very beautiful, both in the moth and larval stages. It is seldom of economic importance.
Hosts: Alder, apple, birch, cherry, elm, filbert, hazel, linden, madrone, maple, oak, peach, plum, poplar, quince, and willow are hosts.

Description: The moths have a wing spread of 4 to 5 inches. The wings are pale brown to reddish in color with a large pale spot margined with black on each wing. The larvae are about 3 inches long when full grown, pale green in color, and have a light yellow oblique line on the side of each abdominal segment. The larvae also have numerous orange and reddish spots on the sides. The cocoons are oval in shape, about 1½ inches long, and are generally covered with several leaves as an outside covering with the silken hairy cocoon enclosed. The brown biscuit-shaped eggs are laid on the leaves.

Life History and Injury: Hibernation takes place in the cocoons attached to the limb of the host. The moths emerge in the spring, and the larvae complete development in the fall. Defoliation by this insect is not serious as they seldom occur in large numbers.

Control: Hand picking of the cocoons in the winter is the best means of control.

Pandora moth*

Coloradia pandora Blake

The large Pandora moth is a serious pest of yellow and Jeffrey pine. It is common in central and southern Oregon and often causes widespread defoliation.

Hosts: Yellow and Jeffrey pine, and sometimes lodgepole pine are hosts.

Description: The moth has a wing spread of over 3 inches. The forewings are brownish gray with a single black spot in each. The hind wings are pinkish with black margins. The larvae are about 2 inches long when full grown, green to greenish brown in color, and have only a few stout spines on the back of each segment. The eggs are biscuit-shaped, shining pale green in color, and are laid in clusters on the bark and branches.

Life History and Injury: Two years are required to complete the life cycle of this insect. The first winter of any one brood is spent as larvae about 1 inch long hibernating on the trees at the base of the needles. The larvae become full grown the following June and drop to the ground where they burrow into the soil to pupate. They remain in the soil until the following June or July when they emerge as moths and lay eggs which generally hatch during August.

Control: Lead arsenate sprays or dusts, when the larvae are in evidence, is the suggested control.
Brown day moth

*Pseudohazis egleinerina* (Bdv.)

The larvae of the brown day moth feed largely on wild plants but occasionally attack ornamentals. It is seldom of importance.

**Hosts:** Blackberry, cascara, *Ceanothus*, cherry, grape, manzanita, plum, rose, and willow are hosts.

**Description:** The wing expanse of this moth is about 3 inches. The ground color is salmon with black stripes and spots. The larvae are about 2 inches long, dark brown to black with red spots on the back, and are covered with branched black and yellow spines. The orange eggs are laid in large masses around small twigs.

**Life History and Injury:** The winter is passed in the egg stage. The larvae feed throughout the summer, and the moths emerge in the fall to lay eggs. This species is a defoliator of little importance.

**Control:** Where necessary, lead arsenate sprays are suggested as a control.

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**Tiger Moths**

*Arctiidae*

Silver-spotted halisidota

*Halisidota argentata* Pack.

The caterpillar of the silver-spotted halisidota is one of the common coniferous-feeding pests. Caterpillars of this group are generally known as woolly bears.

**Hosts:** Douglas-fir, pine, spruce, and true firs.

**Description:** The moths have a wing spread of about 2 inches. The forewings are reddish brown with numerous silver white spots. The caterpillars are densely clothed with long brownish to black hairs which gives them their name of “woolly bears.” The eggs are pea green and are deposited in clusters on the twigs and needles.

**Life History and Injury:** The larvae hibernate in dense clusters on the twigs of their hosts. The mature larvae pupate in June and the moths emerge in July and August. The silken cocoons are interwoven with the larval hair and are attached to the needles and branches. Injury consists of defoliation which at times is quite serious.

**Control:** Lead arsenate spray when the larvae are in evidence is the suggested control.
Spotted tussock moth*
*Halisidota maculata* (Harr.)

The spotted tussock moth is very similar in appearance to the silver-spotted *Halisidota* both in the adult and larval stages. It has a wide distribution and defoliates a large variety of broadleaf trees among which are the following: alder, maple, oak, poplar, willow, poison oak, hazel, plum, elm, beech, and locust.

Yellow woolly bear*
*Diocrisia virginica* (Fabr.)

The yellow woolly bear is found occasionally in nurseries but attacks a large variety of vegetable and other crops. The nursery plants it is known to attack are blackberry, cherry, currant, gooseberry, grape and raspberry. The wings of the moths are pure white with a black spot in each forewing. The wingspread is about 1½ inches. The abdomen is orange with black spots. The caterpillars are about 1½ inches long and are covered with long yellowish hair. The cocoons in which they overwinter are interwoven with body hair. There are two broods of caterpillars a year, one in July and August, and one in September and October.

This species is a defoliator and may be controlled with lead arsenate.

The banded woolly bear*, *Isia isabella* (A. & S.), is found occasionally in nurseries. It is, more or less, a general feeder, largely on herbaceous plants. The wings of the moths are orange yellow with a few dark spots. The caterpillars are very hairy and brown in color, usually banded with black. Winter is passed in the larval stage.

Salt-marsh caterpillar*
*Estigmene acrea* (Drury)

Similar in habits to the banded woolly bear, the salt-marsh caterpillar is a general feeder being seen often on broadleaf nursery plants. The caterpillars are very hairy, mostly black with some reddish hair.

Fall webworm*
*Hyphantria cunea* (Drury)

Fall webworm is a widespread species of moth that feeds on a large variety of broadleaf hosts. It seldom becomes a serious problem but at times becomes abundant on individual plants.

Hosts: Alder, apple, cherry, peach, madrone, poplar, willow, black and English walnut, pear, birch, plum, hazel, hawthorn, lilac,
service berry, maple, English laurel, elderberry, oak and a large number of other broadleaf plants are hosts.

**DESCRIPTION:** The moth has a wing expanse of 2 inches or over and is almost pure white with a few black spots on the wings. The larvae are about 1 inch long when full grown, pale yellow to brown, and covered with long whitish hairs that arise from black and orange tubercles. The eggs are globular in shape, white to golden yellow in color, and are laid in large masses on the under sides of the leaves.

**LIFE HISTORY AND INJURY:** This moth overwinters in the pupal stage in brown cocoons on the bark of the host or in the trash beneath. The moths emerge during June and July to lay their eggs. The larvae spin large, loosely-woven silken nests on the tips of the branches wherein they feed. They enlarge this nest to include more leaves when the food runs out. These nests are conspicuous during August and September. Development is completed during September and October.

**CONTROL:** Burning out or cutting out the nests is one means of control. Lead arsenate spray is also effective.

**CUTWORMS**

*Noctuidae*

There are a number of cutworms which occur in Oregon, the most important of which are the variegated, olive green, greasy, yellow-striped army worm and the alfalfa looper. The latter species is often a pest in greenhouses, while the others are pests of many and varied crops.

**LIFE HISTORY:** In general the life history is as follows: The winter is spent in the soil as partially grown larvae and pupae. The larvae begin feeding in April and May and change to pupae in the soil. The adults emerge from April to June and deposit eggs on the soil or on such objects as fence posts, buildings, trees, etc. The eggs are laid singly or in groups depending on the species. These spring-laid eggs produce larvae that mature in July and August. The moths from these larvae produce eggs that develop into the overwintering forms. The adults of cutworms are the large gray moths commonly known as “millers.”

**INJURY:** Most of the cutworms feed at night, then drop to the ground and hide in the soil and under debris during the day. Some species known as “climbing cutworms” may remain on the plants at all times.
The main injury caused by cutworms is defoliation, but at times they do damage by cutting off plants at the ground level and chewing into and destroying low-growing fruits. When cutworms occur in large numbers, they may destroy crops in a very short time. Careful watch must be kept for developing infestations.

**CONTROL:** The usual control measure is a poison bran bait applied at the rate of 12 to 15 pounds per acre. The following formula is the one that is generally recommended:

- Wheat bran ................................................................. 25 pounds
- Sodium fluosilicate, Paris green or white arsenic ................ 1 pound
- Molasses (1 quart), syrup (1 pint), or brown sugar ............... 1 pound
- Water (enough to make the bait moist and crumbly.)

### THE PROMINENTS

**Notodontidae**

**Yellow-necked caterpillar**
*Datana ministra* (Drury)

Yellow-necked caterpillars have a black body covered with long, whitish hair and have four yellow stripes on each side of the body. They have occasionally been found in nurseries but have been of no importance. The larvae are gregarious like the red-humped caterpillar and feed on practically the same hosts as that species.

**Red-humped caterpillar**
*Schizura concina* (A. & S.)

While not uncommon in Oregon, the red-humped caterpillar has never become particularly important. It infests all of the common orchard trees as well as birch, hawthorn, huckleberry, poplar, rose, willow, and walnut. The caterpillars are gregarious and defoliate localized spots on the host plants. The caterpillars get their name from the large red hump on the top of the abdomen. Control may be obtained with a lead arsenate spray.

### TUSSOCK MOTHS

**Liparidae**

**Rusty tussock moth**
*Notolophus antiqua badia* Hy. Edw.

The rusty tussock moth occurs quite abundantly in Oregon but seldom in large numbers except on individual plants.

**Hosts:** Its wide host range includes apple, mountain ash, apricot, alder, aspen, beech, birch, blueberry, heather, hornbeam, pear, plum, raspberry, rose, hazelnut, oak, willow, quince, hawthorn, poplar, pine, larch, and spruce.
DESCRIPTION: The female moths are wingless, ash gray in color, and about \( \frac{1}{2} \) inch long; the males are winged with an expanse of about 1\( \frac{3}{4} \) inches. The wings are rusty brown with two dark transverse bands and a white spot on each wing. The caterpillars are about \( \frac{3}{4} \) of an inch long when full grown and are covered with many black, white, and orange hairs. There are 4 white brushes on the top of the body and five tufts of bluish black hair on the sides (2 near the head, 2 at the back of the thorax, and 1 on the tail end). The eggs are laid on the cocoons of the females and are grouped in a one-layered mass of 200 to 300; they are about 1 millimeter in diameter and are dirty gray in color.

LIFE HISTORY AND INJURY: The winter is spent in the egg stage. The egg masses generally cling to old dead leaves on the trees but are often found on the ground. The eggs hatch in April and May. Development is completed during June and July, and the moths emerge in July to lay more eggs. There is a second generation of caterpillars that feed throughout the summer; the moths of these emerge in September and lay the overwintering eggs.
Figure 32. Larva of a tussock moth. (*Notolophus antiqua badia*.)

Figure 33. Tussock moth larva on apple leaf.

Figure 34. Tussock moth. Adult female.

Figure 35. Tussock moth. Adult male.
Injury consists of defoliation and skeletonizing of the leaves.

**CONTROL:** Hand picking of the egg masses about the home is an easy means of control. In large plantings, spraying with lead arsenate has been effective.

**Douglas-fir tussock moth***

*Hemerocampa pseudotsugata* McD.

The life history, habits, and general appearance of the Douglas-fir tussock moth are similar to the rusty tussock moth except that there is just one generation. The moths emerge the latter part of August to lay the overwintering eggs.

**Host:** The preferred host of this species is the Douglas-fir. It often defoliates great numbers of these trees in certain areas in outbreak years. It will also attack other conifers when mixed with its favorite host.

**CONTROL:** Destruction of the egg masses in the winter and dusting or spraying with lead arsenate when the larvae are in evidence are suggested control measures.

**Western tussock moth***

*Hemerocampa vetusta* (Bdv.)

The western tussock moth is very similar in habits, description and method of injury to the rusty tussock moth, except that there is but one generation a year. The eggs are laid in July but do not hatch until the following spring.

**Hosts:** Apple, apricot, blackberry, cherry, hawthorn, manzanita, oak, pear, plum, poplar, raspberry, walnut, and willow are hosts.

**Satin moth***

*S1iphoia salicis* (L.)

Satin moth is a very widespread and destructive pest. Outbreaks often occur, and serious defoliation results. Its natural enemies generally keep it in check, however.

**Hosts:** Silver poplar is its preferred host. It also attacks other poplars, willows, and occasionally oaks.

**DESCRIPTION:** The adults are beautiful satiny white moths with a wingspread of $1\frac{1}{2}$ inches. The caterpillars are $1\frac{1}{2}$ to 2 inches long when full grown, black with white markings on the sides and back, and covered to some extent with spines and pale hair. The eggs are cemented together in clusters and are laid on the leaves, limbs, trunk, etc.

**LIFE HISTORY AND INJURY:** Hibernating takes place when in the form of small larvae that are hidden in silken cocoons under
loose bark and moss on the trees. The larvae complete development in June and pupate in loosely woven cocoons in rolled leaves and elsewhere about the host. Eggs are laid during July and August, and the young larvae develop to the third instar before spinning their overwintering cocoons.

**CONTROL:** As a rule a number of parasitic wasps and flies keep this pest in check. If control measures are necessary a lead arsenate spray is recommended when the larvae are present during May and June.

**TENT CATERPILLARS**

*Western tent caterpillar*

*Malaconsa pluvialis* (Dyar)

At times western tent caterpillars occur in enormous numbers on many wild and cultivated plants and completely defoliate them. This is especially true of alders and willows. Parasites generally hold them in check, but there is an outbreak of this pest every 8 to 10 years.

**Hosts:** Apple, alder, poplar, willow, quince, cherry, rose, prune, hawthorn, and currant are the most common hosts, of which alder seems to be the preferred one.
Figure 37. Variegated cutworm egg mass on twig.

Figure 38. Eggs of western tent caterpillar on willow twigs.
DESCRIPTION: The moths are rather robust and have a wing expanse of little more than an inch. They are light to deep brown in color. The larvae are somewhat hairy, dull yellowish brown, with a row of blue spots flanked by orange spots along the back. They are 1 1/2 to 2 inches long when full grown. The eggs are laid around twigs or small limbs in a froth covered mass. These egg masses consist of hundreds of eggs and surround the twigs on which they are laid.

LIFE HISTORY AND INJURY: Western tent caterpillar eggs hatch during April. The larvae build large silken nests or tents in which they are protected and from which they feed. Limbs on which these nests occur are generally completely defoliated. The larvae become full grown in May and June, and the moths emerge in June and July when they lay their overwintering egg masses.

CONTROL: Natural control by parasitic wasps and flies as well as a fungus disease help to keep the western tent caterpillar in check. Destruction of the egg masses in the winter and cutting out and burning the tents in the spring give good results around the home. In larger areas, spraying with lead arsenate gives good control.

Great Basin tent caterpillar, Malacosoma fragilis Stretch

The Great Basin tent caterpillar feeds on ash, aspen, bitterbrush, Ceanothus, cherry, gooseberry, manzanita, oak, plum, poplar, rose, and willow.

The eggs of this species are laid only part way around the twigs.

The blue-sided tent caterpillar, M. constricta Stretch, has been found especially abundant on garry oak, but it also feeds on many other broadleaf trees and shrubs.

The forest tent caterpillar*, Malacosoma disstria Hon., feeds on alder, birch, poplar, willow, apple, quince, cherry, rose, plum, box elder, choke cherry, hawthorn, peach, pear, and many other broadleaf trees and shrubs. This species does not build the large tents that the western tent caterpillar does, but usually collects in large colonies on the trunks and limbs of the hosts when not feeding.

MEASURING WORMS

Geometridae

Walnut spanworm
Coniodes plumogeraria (Hulst)

The measuring worm, walnut spanworm, has been reported in Oregon on backyard and orchard fruit trees. It apparently is of little importance in Oregon.
Hosts: Apple, plum, English walnut and live oak are hosts.

Description: The female is a gray wingless moth, and the male is winged, dirty gray in color, with a wing expanse of about 1\(\frac{1}{2}\) inches. The caterpillars are a little less than 1 inch long. They vary greatly in color but are generally gray to pinkish. The eggs are oval in shape and are laid in masses on the branches.

Life history and injury: The pupae overwinter in the soil, and the moths emerge early in the spring to lay their eggs. There is one generation.

Control: Lead arsenate spray applied in the spring is the suggested control.

The larvae of the looper, *Nepytia phantasmaria* Stkr., is reported by Chamberlin (unpublished notes) to work often in company with the hemlock looper on hemlock, spruce, and Douglas-fir.

**Hemlock looper***

*Ellopia fiscellaria var. lugubrosa* Hulst.

The hemlock looper measuring worm is largely a pest of forest trees but has occasionally been of concern on ornamental and nursery trees which it attacks. When they become abundant, large areas of forests are destroyed in the coastal area.

Hosts: Western hemlock is the preferred host and often conifers such as Sitka spruce, Douglas-fir, and western red cedar may be attacked when intermixed with hemlock. Where infestations are severe, almost any broadleaf or coniferous plant will be eaten.

Description: The moths are pale yellowish brown in color with two darker narrow angulated bands across the forewings and one band across the hind wing. The wing expanse is about 1\(\frac{1}{2}\) inches. The caterpillars are about 1\(\frac{1}{2}\) inches long when full grown, green to brown in color, and have diamond-shaped markings on the back. They travel in the characteristic measuring-worm way. The eggs are gray green or brown in color, are about the size of a pinhead, and are laid on twigs and branches.

Life history and injury: Winter is spent in the egg stage. The eggs hatch during late spring, and the larvae feed throughout the summer. The larvae transform to pupae in August and September. Eggs are laid late in September and October. The larvae defoliate large numbers of trees and have caused very serious injury in certain years.

Control: Spraying or dusting with lead arsenate gives good control.
Oak looper
_Ellopia somniaria_ (Hulst)

This pest is very similar in appearance, habits, and life history to the hemlock looper. By some authorities it is considered to be the same species. It confines its attack almost entirely to the garry oak and at times defoliates large areas.

**SNOUT MOTHS**

_Pyralidae_

Greenhouse leaf tier; celery leaf tier*
_Phlyctaenia rubigalis_ (Guen.)

Leaf tier moths are largely a pest of greenhouse plants in Oregon but have been found abundant on celery under outdoor conditions. Their attacks are largely confined to herbaceous annuals and perennials, but they have been reported on roses. The moths are reddish brown with a wingspread of about 3/4 of an inch. The larvae are yellowish green with 3 lighter stripes on the back. The larvae feed by tying the leaves of their host together.

Other Pyralid pests

_Phlyctaenia profundalis_ (Pack.) is a species of moth that has been found causing considerable injury during August to seedling white birch in seed beds in the Portland area. The pale green caterpillars feed on and roll the leaves and sometimes do serious defoliation. The moths are pale brown in color with numerous darker spots. Lead arsenate sprays have given effective control.

_Diorictria xanthoenobas_ Dyar., attacks the twigs and cones of Ponderosa and knobcone pine.

_Diorictria ponderosae_ Dyar., is a species that has been reported in northern California and probably occurs in Oregon. The larvae girdle the bole and tops of various species of pines which are 8 inches or less in diameter.

Zimmerman pine moth*
_Pinipeslis zimmermanni_ (Grote)

The gray Zimmerman pine moth with a wing expanse of about 1 1/2 inches attacks lodgepole, ponderosa, white, and other pines as well as Douglas-fir. The whitish gray larvae are about 3/4 inch long, work near the tops of their host, and mine the cambium of the main trunk where the limbs join. This injury causes the death of the tree tops and results in what is known as “spike top.”
American plum borer*

_Euzophora semifuneralis_ (Wlk.)

The larvae of the American plum borer moth work just under the bark and injure the limbs and trunks of many trees, among which are apple, apricot, mountain ash, cherry, mulberry, peach, pear, plum, and willow. They form matted silken tubes in these trunks. The moths have a wing spread of about 1 inch, the wings being characterized by two brown red bands with a broad gray band between them. The moths emerge in August.

This pest has been found commonly associated with the poplar and willow borer and seems to be of little importance in Oregon.

**LEAFROLLER MOTHS**

_Olethreutidae_

_Badebecia urticae_ Hbn.

The long slender dark-chocolate brown larvae of _Badebecia urticae_ are common in the spring in the tips of raspberry and thimbleberry in the northern Willamette Valley. The larvae invariably chew a round hole in the stem or a small portion out of the side of the tip. This injury causes the tips to turn brown and die during April and May. The larvae are extremely active and wriggle violently when disturbed. They spin but very little webbing and generally are found hiding in the dry curled leaves.

_Hedia ochroleucana_ Hbn., moth larvae are very similar in appearance, size, color, and habits to the oblique-banded leafroller. They are commonly found rolling and tying together the leaves of wild and cultivated roses and are known to occur also on apple. The adults are about the same size as the leafroller but have gray wings with broad white bands.

Several species of the genus _Rhyacionia_ work in the leaders and shoots of young pines in neighboring states. No definite Oregon records have been noted.

The pitch nodule moths of the genus _Petrova_ bore in the twigs and branches of pine, spruce, and true fir near the tips. They generally work in the nodes below the tips and cause nodular swellings. Infested tips are weakened and are easily broken off. Chamberlin (unpublished notes) lists _P. burkeana_ (Kearf.) and _P. picicolana_ (Dyar) as occurring in Oregon. The former works in spruce and the latter in true fir. Destruction of infested tips is suggested as a control.

_Barbara siskiyousana_ Kearf. Chamberlin (unpublished notes) reports mining in twigs of true fir by _Barbara siskiyousana_ Kearf.
Eye-spotted Budmoth
Spilonota ocellana (D. & S.)

Eye-spotted budmoth is one of the most common pests to be found in nurseries during the spring of the year. It is widespread and often causes considerable damage.

Hosts: The most common hosts appear to be apple, crab apple, cherry, plum; but it also attacks pear, blackberry, hawthorn, oak, peach, and mountain ash.

Description: The moth has a wing expanse of about 15 millimeters (about 6/10 inch). The wings are gray with a broad white band across them. The larvae are light brown in color with black head and anal shield and are about 12 millimeters long when full grown. The larvae are very slow in their movements as compared to the leafrollers. The eggs are disc shaped, and more or less transparent, and are laid singly or in groups on the under sides of the leaves.

Life History and Injury: The winter is spent as partially grown larvae in leathery, silken cocoons or excrement-covered tubes fastened to the bark or in the crotches of buds and twigs. The larvae leave this cocoon about the time the buds are opening in the spring. The larvae build very tough leathery silken tunnels in which they hide. They feed on developing buds, roll up leaves and devour them, and often eat out the side of small twigs, sometimes killing them. If blossoms are present, they are also often webbed together and eaten. The larvae complete development in June and July, and the moths emerge soon after. The young larvae from these moths confine their feeding largely to the under sides of the leaves and skeletonize them. About September the larvae begin spinning their hibernating cocoons. There is one generation a year.

Control: Lead arsenate spray or dust applied after the buds have opened in the spring give good results. DDT sprays and dusts have given poor results on this pest.

Other Olethreutids

Eucosma sonomana Kearf., is reported as mining the pith of the terminal twigs of Ponderosa pine and Engelmann spruce.

Eucosma bobana Kearf., mines the pith, cones, and seeds of Ponderosa, Jeffry, and knobcone pines.

Eucosma rescissoriana Heinrich mines the cones and pith of lodgepole pine.
Maple tip moth
Proteotera aesculana Riley

The small, dark, olive green maple tip moth is mottled with yellow and gray. It has a wingspread of about ½ inch. The larvae bore in the terminal and lateral tips of silver maple, red maple, and boxelder in Oregon. They are often quite abundant and do considerable injury at times by causing nursery trees to branch excessively. The larvae generally feed in the pith of the tips and sometimes mine in the leaf petioles. The larvae are present and nearly full grown in July. The moths emerge in July and August. Nothing more is known of its life history in Oregon. No control measures have been established.

Spruce budmoth
Zeiraphera raticomaria (Ratz.)

Spruce budmoth works in the developing buds of Sitka spruce along the Oregon coast. The moths lay their eggs on the spruce needles late in the summer. In the spring each caterpillar works into a developing bud and webs together the young needles. In cases of severe infestation most of the tips may be killed, thus causing a malformed tree.

Black-headed fireworm*.
Rhophobota naevana (Hbn.)

The black-headed fireworm is one of the most serious pests to be found on cranberries. Its appearance is almost identical with
Figure 41. Holly bud moth egg.
that of the holly bud moth but its life history seems to differ. Its main injury consists of rolling and webbing together the leaves about the fruit buds. The winter is passed in the egg stage on the leaves and in this way it is transported about on cuttings.

**Holly budmoth**

*Rhopobota naevana ilicifoliana* Kit.

The holly budmoth species occurs in the northern coastal counties of Oregon. It has never definitely been reported from any other parts of Oregon. If this species became widespread it could be a very serious holly pest.

**Host:** Holly is the host.

**Description:** The adult moths have a wing expanse of a little over ½ inch and are grayish in color, mottled with brown. The larvae are yellowish to greenish gray in color and are a little less than a half inch long when full grown. The eggs are oval, flattened discs and orange red in color surrounded by a translucent ring; they are laid singly on the under sides of the leaves.

**Life History and Injury:** The winter is spent in the egg stage. The eggs usually hatch during the latter part of April or early May, and the larvae feed in the developing buds, often completely destroying them or disfiguring the leaves in such a way as to make the tips unsalable. The tip leaves are tied together with silk, and the larvae feed within this nest. Most of the larvae become full grown in July, and the moths are present and laying eggs in July and August. Pupation takes place in the trash and litter on the ground. There is one generation a year.

**Control:** Good control has been obtained with a 3 per cent light-medium summer oil applied in early April before the eggs hatch. It is important that the spray be thoroughly applied to the under sides of the leaves in order to contact the eggs. Varying results have been obtained by spraying with lead arsenate (with or without the addition of nicotine) when the larvae are in evidence.

*Epinotia hopkinsana* Kearf., species is reported by Chamberlin (unpublished notes) as working in the cones and sometimes the twigs of the Sitka spruce.

**The cypress webber**

*Epinotia subviridis* Hein.

The larvae of the cypress webber moth are quite common on pyramidal arborvitae throughout the Willamette Valley. The larvae, which are about ½ inch long when full grown and light brown in color, web together the small branches. They are seldom abundant
enough to be of any concern. The moths emerge during July and are pale greenish in color with white markings.

Control measures for this species have not been worked out. A lead arsenate spray would probably be of value in controlling the larvae if applied during April and May.

**Oriental fruit moth***

*Grapholita molesta* (Busck)

The very destructive oriental fruit moth has recently been found in eastern Oregon. For quite a long time, its destructiveness has been evident in the eastern states, and in the last several years it has appeared in the states bordering Oregon.

**Hosts:** The following hosts are listed in the order of preference: Quince, peach, plum, cherry, apple, and pear. It also attacks closely related ornamental and nursery plants.

**Description:** The moths have a wing expanse of about 3/4 inch; the forewings are grayish brown in color with light wavy lines. The larvae are about 3/4 inch in length when full grown and are white to yellowish in color. The eggs are about the size of a pinhead and are laid singly on the leaves of the host.

**Life History and Injury:** The winter is spent in cocoons in the larval stage. These are secreted on the bark of the host or in debris on the ground. The larvae either work in the tips of plants causing their death much as the peach twig miner does or work in the fruit. There may be a number of generations a year, depending on the weather. The main concern of nurserymen, of course, is the possible presence of various stages of this pest during shipment of stock. It is probable that no real damage will be done on nursery stock except for the possible quarantine restrictions.

**Control:** No really effective control measures have been worked out for this pest. In California, the mass liberation of parasites seems to be keeping the pest under control. Lead arsenate sprays give fair control, while DDT has proved to be the most effective insecticide to date. No definite recommendations for control can be made at this time.

**Lesser apple worm***

*Grapholita pruniwora* (Walsh)

The lesser apple worm is quite common on prunes and cherries in eastern Oregon and is known also from western Oregon. It has not been found on nursery stock, but may occur there. Little is known of its control in Oregon, but DDT sprays applied when the moths emerge and another application a month later gave good results.
Laspeyresia laricana Busck is reported from Oregon by Cham-
berlin (unpublished notes) as mining in the cambium of larch and
Douglas-fir.

Codling moth*
Carpocapsa pomonella (L.)

The well-known codling moth does the largest amount of its
damage to the fruits of apple and pear trees. It is listed here be-
cause, at times, it works in the terminal twigs causing them to wither
and die. Only a small amount of feeding is done on the leaves.
Other hosts include crab apple, apricot, cherry, peach, prune, haw-
thorn, and walnut.

LEAFROLLER MOTHS

Fruit tree leafroller*
Archips argyrospila (Wlk.)

The fruit tree leafroller is only occasionally found on nursery
plants but is most often a pest in orchards where it feeds on the
fruits of apple and sometimes even causes defoliation of some con-
sequence. It is a widespread species.

Hosts: Apple, apricot, ash, blackberry, boxelder, cherry, cur-
rant, elm, gooseberry, locust, loganberry, oak, pear, plum, poplar,
quince, raspberry, rose, English walnut, and willow are hosts.

Description: The moth has a wing expanse of 20 to 25 milli-
meters (about 8/10 inch), is rusty brown in color with numerous
whitish spots sprinkled irregularly over the wings. The larvae are
green with shining brown or black head capsule and anal shield.
They are 20-25 millimeters in length (about 8/10 inch) when full
grown and wriggle very vigorously when disturbed. The eggs are
laid in imbricated irregular masses and are grayish in color.

Life history and injury: The winter is passed in the egg
stage on the limbs and trunks of the host. The eggs hatch from
March to May and the larvae become full grown in June. The eggs
are laid during June and July.

Injury consists in the larvae feeding on the developing buds,
rolling together and feeding on the leaves, and eating holes in the
side of the fruit. Severe infestations may result in serious defo-
litation.

Control: Dormant oil sprays give excellent control for the
eggs. Lead arsenate sprays applied after the larvae begin to feed
give good control.
Archips lamberdianae (Busck) is often very destructive to the buds of sugar pine. The caterpillars feed in colonies and web the terminal shoots.

**Oblique-banded leafroller***

Archips rosaceana (Harr.)

The larvae of the oblique-banded leafroller moth are one of the most general feeders to be found in nurseries. They feed on nearly all broadleaf plants. They are widely distributed.

Hosts: Some of the more common cultivated hosts are apple, cherry, filbert, maple, holly, birch, prune, pear, poplar, willow, and rose.

Description: The moths are brownish red in color with a darker oblique line across the center of each forewing. They have a wing expanse of about 1 inch. The larvae are light to darker green with a brown or black head capsule and are about 1 inch long when full grown. They are very active and wriggle violently when disturbed. The eggs are light green and are hard to detect on the upper surfaces of the leaves where they are laid; they are laid in imbricated clusters of about 50 to 300. After the eggs hatch, they are snow white and are easily detected on the leaves.

Life history and injury: The winter is spent as small larvae about ¹⁄₂ inch long in small disc-shaped silken cocoons. The cocoons
Figure 44. Upper left: unhatched eggs of the oblique-banded leaf roller. Upper right: hatched eggs. Lower left: parasitized eggs among hatched eggs. Lower right: eggs (black head of larvae showing through egg shells).
are hidden under loose bark and bud scales. Emergence takes place from early March to late April. The young larvae feed in the developing buds and later roll up the leaves. Development is completed in late May and throughout June, and the moths emerge in June and July and lay eggs. Part of the larvae from these eggs spin up in hibernating cocoons and emerge the following spring. Other larvae begin feeding and complete their development in mid-August. The moths from these summer larvae deposit eggs in late August and September, and the young larvae then spin up for the winter.

Injury consists mainly in defoliation and destruction and deformation of developing buds. In cases of severe infestation, nearly complete bud destruction and defoliation take place.

Control: Parasitic wasps and flies generally keep this insect to a low level, but control measures must often be practiced to prevent serious injury. DDT sprays and dusts have given the most satisfactory results. A 3 per cent dust or a spray of 2 pounds of 25 per cent wettable DDT to 100 gallons of water applied about May 1 should give nearly complete control. Application of DDT later in the season is not recommended. Lead arsenate sprays applied when the larvae are in evidence have given only fair control.

Orange tortrix*

*Ochrois citrana* (Fern.)

Orange tortrix is a widespread species of moth that infests a large variety of hosts. Superficially, the moths resemble those of the oblique-banded leafroller both in size and color, but the larvae are lighter green.

Hosts: Some of the commoner hosts are caneberries, apricot, rose, oak, walnut, and many other woody and herbaceous plants.

Description: The moths are pale reddish brown with darker oblique bands across each forewing. The wing expanse is $\frac{3}{4}$ to 1 inch. The larvae are yellowish to pale green and are nearly 1 inch long when full grown. The eggs are whitish to yellowish green and are laid in imbricated masses on the leaves and other smooth surfaces.

Life History and Injury: Little is known about the life history. The partially grown larvae hibernate in debris and on leaves of their hosts. They reach a good size in growth by April and early May. Fairly large larvae can again be found in July and August, leading to the conclusion that there must be at least two generations. Injury is due largely to defoliation and leaf tying.

Control: Cryolite spray generally gives good control.
Apple skin worm
*Torix franciscana* Walshm.

The apple skin worm resembles the fruit tree leafroller very much and is not uncommon in greenhouses. It attacks both herbaceous and woody plants. In Oregon it has been found doing considerable injury to gardenia and several herbaceous plants in greenhouses but has not yet been found under outdoor conditions.

**Omniverous leaf tier***
*Cnephasia longana* (Haw.)

The larvae of the omnivorous leaf tier moth is one of the most omnivorous feeders occurring in Oregon. It has been variously known as the "omnivorous leaf tier," "iris worm," "flax worm," "Cnephasia," and "strawberry fruit worm." It is widely spread throughout the Willamette Valley.

**Hosts:** The larvae generally feed on the tender tips and flowers of its hosts. The hosts are too numerous to list here but nearly all broadleaf herbs, shrubs, and trees are attacked. Tips of conifers also suffer serious damage. The most common nursery hosts are apple, cherry, plum, birch, and hawthorn.

**Description:** The adult moths have a wing expanse of about ½ inch. The females are grayish, mottled with brown spots, and the males are an even grayish yellow in color. The larvae, when full grown, are about ½ inch long and are dirty yellow in color with three darker stripes running the full length of the body. The eggs are salmon red in color and are laid in groups on the bark of trees, telephone poles, fence posts, and other more or less rough surfaces.

**Life History and Injury:** The moths emerge from late May, through June, and into July, depending on the season. The eggs are laid during July. The eggs hatch soon after they are laid, and the young larvae spin tiny silken cocoons in which they remain until the following spring. Beginning about the first of March, these small larvae spin silken threads on which they are carried by air currents to suitable hosts. At first they work as leaf miners in such broadleaf plants as clover, plantain, vetch, etc. Later they emerge from these mines and begin to roll tender plant tips together. Their tip-feeding habit in nurseries often results in malformed trees and shrubs because they cut out the leaders. Most of their injury is done during May and the first two weeks in June.

**Control:** The only insecticide tried to date which has given satisfactory control in nurseries is DDT. A 3 per cent dust applied at the time when injury first becomes evident materially reduces the damage by this pest.
Black-headed budworm*, *Peronea variana* (Fern.), is a species that commonly occurs in company with the hemlock looper. The larvae bore into and feed on the opening buds and web the new needles together to form a protective nest in which they feed. Their main host in Oregon appears to be western hemlock, but they also feed on Douglas-fir, spruce, larch, and true fir. The injury is often of a serious nature, especially on hemlock.

GELECHIID MOTHS

*Gelechiidae*

**Ponderosa pine needle miner**

*Recurvaria moreonella* Hein.

The larvae of the small ponderosa pine needle miner moth mine the needles of ponderosa pine in southern Oregon. They occasionally cause serious foliage loss.

**Needle miners in lodgepole pine**

*Recurvaria* spp.

There is at least one or more species of these small needle miners that attack and mine the needles of lodgepole pine in central Oregon. They cause a yellowing and premature needle drop. They are very small and can only be found on close examination.
The cotoneaster webworm is now widely distributed in western Oregon. It becomes very abundant on certain varieties in a short time after it is introduced and greatly detracts from the beauty of its hosts by the unsightly webbing and destruction of the foliage.

**Hosts:** The most common host is *Cotoneaster horizontalis*, but it also occurs on *C. microphylla*, *C. franchetii*, *C. simonsi* and undoubtedly on other species of *Cotoneaster*. One case is known where this species was feeding on plum adjacent to heavily infested *C. horizontalis*.

**Description:** The moths are dark brownish black in color and have a wingspread of about \( \frac{1}{4} \) inch. The larvae are chocolate brown, a little over \( \frac{1}{2} \) inch long when full grown and are very active when disturbed. The eggs are yellow to reddish in color and are laid singly or in small groups on the leaves, stems, or other plant parts.

**Life History and Injury:** The winter is spent as a small third-stage larva in tough grayish white silken cocoons placed in the axils of the twigs or on the bark of larger twigs under debris consist-
ing of dead leaves, etc. About mid-March the larvae begin to feed by skeletonizing the developing leaves. They build silken tubes from which they feed and in which they hide when disturbed. These silken tubes are often so abundant on badly infested plants that they nearly cover up the foliage and branches. The larvae complete their development during late May and June, and the moths emerge to lay eggs in June and July. The larvae from these eggs develop to the third stage during August and then spin their silken hibernation cocoons.

**CONTROL:** Lime sulphur, 6 to 8 gallons per 100 gallons of water, applied during the dormant period has given excellent control. Pyrocide “20” or similar pyrethrum containing extracts used at the rate of 1 quart per 100 gallons of water is the best known control that can be applied when the larvae are active. Lead arsenate and nicotine sulphate sprays have also given satisfactory results. DDT is a promising material for control.

*Gelechia periculella* Busck. moth larvae are reported as mining in the twigs of Douglas-fir by Chamberlin (unpublished notes).

**Peach twig borer**

*Anarsia lineatella* Zell.

The peach twig borer moth occurs throughout Oregon and is a menace because it infests the tips of twigs and kills them in nurseries and young orchards. It also enters the fruits and twigs of producing trees.

**Hosts:** Peach, apricot, plum, and occasionally cherry and apple.

**DESCRIPTION:** The larvae are chocolate brown in color and about 12 millimeters long when full grown. The head and anal shield are shining black. The moths are steel gray in color and have a wing expanse of about ½ inch. The eggs are oval in shape and are white when first laid but turn yellow to orange before hatching.

**LIFE HISTORY AND INJURY:** The winter is passed as a very small larva in little frass covered silken tubes in the crotches of the tree. The larvae leave these hibernaculae as the buds begin to open in the spring, and burrow into the tender tips, killing them back. They may kill several tips before they are full grown. There is some question about the number of generations per year, but most writers agree that there are two in Oregon. The first brood of moths emerges in June and the second probably in August and September. This second brood of worms often enters the fruit if there is any present. The eggs are laid on twigs, small leaves, and often on the fruit. Pupation occurs in the burrows of the twigs, in dead leaves, or under bark scales.
INSECT PESTS OF TREES AND SHRUBS IN OREGON

Figure 48. Peach twig borer injury to young shoot.

**CONTROL:** Dormant lime sulphur sprays applied before the buds open in the spring have been said to give good control, but this is doubted by many workers. Nicotine-soap spray or lead arsenate spray applied after the larvae become active in the spring have given fair control.

*Glyphipterygidae*

**Apple and thorn skeletonizer**

*Anthophila pariana* (Clerck)

The apple and thorn skeletonizer pest has recently been imported to the Northwest. Its distribution in Oregon is not definitely known, but it is common in Multnomah and Clackamas counties.

**Hosts:** It appears to work only on apple, crab apple, cherry, and hawthorn. It has been reported found on pear trees elsewhere but has not been found on this host in Oregon.

**Description:** The moth is dark brown in color and has a wing-spread of a little less than $\frac{1}{2}$ inch; the antennae are very long and
ringed with white. The larvae are yellowish to greenish in color, are about ½ inch long when full grown, and are beset with many black tubercles. The cocoons consist of a double silken covering; the outer cover is more or less loosely woven and is superimposed on the lower tightly woven silken true cocoon. These cocoons are spun principally on the upper leaf surfaces.

LIFE HISTORY AND CONTROL: The winter is spent in the adult stage in protected places. The moths in the late fall are often so numerous in dwellings and greenhouses as to be obnoxious pests. The young caterpillars appear in May and feed first on the lower leaf surface. In succeeding months there appears to be a series of overlapping generations. The older caterpillars feed on the upper surface of the leaf and draw the sides together with silken webs to make a sort of funnel. The upper surface of the leaf is then skeletonized and the injury is filled with a dirty mass of webs and droppings. There is often more than one larva per leaf. The injury of this pest is very characteristic and cannot be mistaken for any other pest. Where infestations are severe, entire trees may be covered with silken webs.

CONTROL: Lead arsenate sprays applied when the larvae are present give good control. DDT dusts and sprays are effective but they cannot be recommended at this time.

CLEAR-WINGED MOTHS
Aegeriidae

Raspberry root borer*, Bembecia marginata (Harr.), infests the canes and crowns of Rubus spp. in Oregon. It is seldom serious in plants grown for nursery purposes.

The cottonwood crown borer, Aegeria tibialis Harris, larvae is common throughout Oregon and works in poplars and willows.

The peachtree borer, Sanninoidea exitiosa (Say), has been reported from Oregon and may be identical with the western peach tree borer.

Western peach borer*
Sanninoidea opalescens (Hy. Edw.)

The western peach borer is the most serious insect pest of peaches and prunes in Oregon. It is apparently present wherever these trees are grown. It becomes very serious in orchards at times but also is quite common in nurseries.

HOSTS: The preferred hosts are peach and prune, but it also attacks apricot, cherry, choke cherry, Portuguese laurel, and occasionally apple.
Figure 49. A: Peach tree practically girdled by continual attacks of the root borers. B: Adult moth, at rest. C: Eggs on prune bark (magnified). D: Larva (magnified). E: Larva in winter cell magnified.
DESCRIPTION: The adults are beautiful day-flying clear-wing moths and resemble wasps. They are steel blue in color with black and white markings. They have a wing expanse of a little over 1 inch. The larvae are whitish yellow in color with a brown head, have very few hairs, and are 1 inch or more in length. The eggs are biscuit-shaped, brownish red, and are laid singly or in small groups on the bark of the host where they are very hard to see.

LIFE HISTORY AND INJURY: The winter is spent in a partially grown larval state which becomes fully developed from May to July. The moths emerge from June to August to deposit their eggs. The larvae work mostly about the crown of the tree just under the bark. The mines generally extend some distance under the ground level and may continue up the trunk from one to two feet. Large amounts of sap, gum, and frass—ample evidence of the presence of this pest—are generally exuded from the burrows. The frass-covered cocoons may be found protruding from the burrows after the moths have emerged. Small trees may be killed in a single year by the girdling of this borer while the larger trees gradually lose their vitality and are often killed. The amount of damage is, of course, directly proportional to the severity of infestation.

CONTROL: The most satisfactory means of control developed to date is the treatment with paradichlorobenzene (P.D.B.). The ground should be leveled off at the base of the tree, and the P.D.B. scattered in a ring about 1 inch wide and 2 inches from the base of the tree. If the material is placed too close it may cause tree injury; and if placed too far away, it may produce poor control. The material should be applied between August 15 and October 1, so that the soil temperatures are 55°F. or over. Treatments during May may be of value if the fall treatments have not been completely satisfactory.

The amount of material to be used is found in the following table:

<table>
<thead>
<tr>
<th>Age of tree</th>
<th>Amount of paradichlorobenzene</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 3 years</td>
<td>½ ounce</td>
</tr>
<tr>
<td>4 to 5 years</td>
<td>¾ ounce</td>
</tr>
<tr>
<td>6 years and over</td>
<td>1 ounce</td>
</tr>
</tbody>
</table>

After the P.D.B. has been applied, the ground should be mounded up against the base of the tree for a distance of about 6 inches and thoroughly packed. The mound should be taken down in a month or six weeks to prevent tree injury. Young trees are easily injured; but if the directions for treatment are closely followed, no injury will result.
A 25 per cent ethylene dichloride emulsion applied at the rate of 1/2 pint per tree, either by pouring or spraying the liquid on the base of the tree has given excellent control in some instances. In this treatment, no preparation of the soil at the base of the tree is necessary except there should be no large cracks in the soil and the soil should be in condition so there is no excessive run off. Stock emulsions with directions for their use may be purchased from insecticide dealers. The trees may be treated in the fall or spring. Some cases of injury with this material have been reported so caution should be exercised in its use.

Worming the trees by digging out the larvae is a satisfactory method of control if one has only a few trees.

Other clear wing moths

The wild cherry borer, Sanninoidea graefi Hy. Edw., has been reared from wild cherry and from cherry on Mahaleb root stock.

The strawberry crown moth*, Synanthedon bibionipennis (Bdv.), is a serious pest of strawberries. It also attacks blackberries and black and red raspberries.

The imported willow borer, Synanthedon tipuliformis Clerck, burrows in the canes of currants and gooseberries and has also been reported as occurring in box elder, sumac, and hazel. This species may be a serious pest at times. Cutting out and burning infested canes is of some value in control.

The Douglas-fir pitch moth, Synanthedon novaroensis Hy. Edw., is common in Oregon in Douglas-fir and Norway spruce. It has been reported from western larch, also.

The larvae of Synanthedon albicornis Hy. Edw., species works in the trunk and limbs of willow and is often associated with the poplar and willow borer.

The American clearwing, Synanthedon americana Beut., works in the heart wood of alder in eastern Oregon.

The Sequoia pitch moth, Vespaniima sequoiae Hy. Edw., is common in yellow and sugar pine in Oregon. Elsewhere, it has been reared from knobcone, lodgepole and Monterey pines and from Douglas-fir and redwood.

The larvae of the locust clearwing, Paranthrene robiniae Hy. Edw., work in various willows and poplars in Oregon and are reported from locust elsewhere.
TWIG AND LEAF MINERS

_Yponomeutidae_

Cedar tip moths and needle miners

Argyresthia spp.

Several species of small caterpillars belonging to the *Argyresthia* genus mine and web the needles and twigs of western red cedar, incense cedar, Lawson false cypress, Nootka false cypress, Arizona cypress, and Italian cypress.

The following species have definitely been reported from Oregon:

- *Argyresthia libocedrella* Busck., mines incense cedar.
- *A. plicipunctella* Wshm., mines in Arizona cypress.
- *A. tarceuthobiella* Busck., mines incense cedar.

There may be other species that occur in Oregon. The life history and definite control of these species has not been definitely determined.

An undetermined species on Italian cypress transforms to the adult stage during late April and May and lays eggs on the needles during May and June. The small larvae mine the individual needles while the larger larvae mine the twigs. The winter is spent in the mines as immature larvae. The injury is very apparent during the early spring months by reason of severely infested trees becoming reddish brown. Later in the season the trees again take on a more or less natural color.

Various control measures such as a summer oil and nicotine spray applied early in the spring or lead arsenate sprays applied throughout spring and summer have been suggested as controls. To date, however, these measures have been observed not to give very good results.

SHIELD BEARERS

_Heliozelidae_

Madrone shield bearer

_Coptodisca arbutiella* Busck

The larvae of the beautiful little madrone shield bearer moth mine the leaves of madrone. The winter is spent as larvae in the mines, and during March and April they cut oval cases out of the leaves in which to pupate. Where infestations are severe, the leaves look as if they have been perforated by buck shot. The larvae spin down from the leaves in these shields and fasten themselves to the bark and other protected places. Little is known about this insect.
CASE BEARERS

*Cigar casebearer*

_Coleophora occidentis_ Zell.

This interesting little casebearing moth, _cigar casebearer_, is quite often abundant on hawthorn, apple, pear, quince, and cotoneaster. The larvae live in small grayish brown cases somewhat resembling a pistol. The adults are grayish in color and have a wing expanse of about \( \frac{1}{2} \) inch. The eggs are yellow and are laid promiscuously on the under sides of the leaves. The life history and injury caused appear to be almost identical with the _cherry casebearer_. A lead arsenate spray applied in late April or early May will control this pest. No instances of serious infestations have been noted in Oregon, but it occurs very commonly on neglected orchard and ornamental plants.

*Cherry casebearer*

_Coleophora pruniella_ Clem.

The cherry casebearer is reported from various parts of the Willamette Valley. At times it may cause quite serious leaf injury.
HOSTS: Cherry and apple are hosts.

DESCRIPTION: The larvae are brownish in color and live in odd-shaped little cases from which they feed. The eggs are yellow and are laid singly on the under sides of the leaves.

LIFE HISTORY AND INJURY: Hibernation takes place in the case as a partially grown larva attached to the bark of the host. In April, the larvae migrate to the leaves where they feed by making a tiny circular hole on the under side of the leaf. After this hole is made, the larvae stretch from their case and mine between the upper and lower leaf surfaces. The larvae reach maturity about the first of June and pupate in their cases on the upper leaf surfaces and branches. The moths emerge during June and the first half of July to lay their eggs. These eggs hatch and the first-stage larvae feed at first as miners under the egg shell; the later stages are all case-bearers. Hibernation takes place during the latter part of September and the early part of October. The injury of these little caterpillars is very characteristic. On neglected trees, leaf injury may become severe if control measures are not undertaken.

CONTROL: A spray of lead arsenate applied during late April or early May should give good results if directed at the under sides of the leaves.

LEAF BLOTCH MINERS

Gracillariidae

Apple leafminer

Lithocolletis (Phyllonorycter) crataegella Clemens

The small apple leaf miner moth is common throughout western Oregon and at times becomes quite abundant but has never caused any really serious damage.

HOSTS: Apple, wild and cultivated hawthorn, crab apple, wild cherry are hosts.

DESCRIPTION: The larvae are lemon yellow in color with a brown line extending the length of the body. The wings of the moths are deep golden brown in color with silvery streaks margined with black.

LIFE HISTORY AND INJURY: The winter is passed in silken cocoons in the leaf mines on the ground. The moths emerge in the spring and lay their eggs on the leaves. The larvae make blotch mines between the lower and upper epidermis of the leaves. These mines show brown on the upper surface and are generally open and webbed over on the lower surface. There is usually more than one generation a year.
CONTROL: Plowing under the fallen leaves is the most obvious means of control. The under part of the mine is quite often open and therefore poison sprays may be of some value in control.

**Salal leafminer**
*Lithocolletis (Cameraria) gaultheriella* (Wishm.)

The larvae of the small salal leafminer moth form blotch mines on the upper surface of salal in the coastal counties of Oregon. The mines are whitish in color and are unsightly in appearance. The winter is spent in the larval stage in the mines. Nothing more is known of its life history or control.

**Madrone serpentine leafminer**
*Marmara arbutiella* Busck

The madrone serpentine leafminer makes extensive serpentine mines that are conspicuous on the upper leaf surfaces of madrone (*Arbutus menziesii*). The frass-packed mines are white in color. The winter is spent as larvae in the mines and the cocoons are formed in March and April. The white cocoons are placed on the under sides of the leaves and are covered with small globular bubble-like decorations. The adults emerge in April and May. Nothing more is known about this insect.

Figure 52. Cocoons of madrone serpentine leaf miner.

Figure 53. *Marmara sp.*
Huckleberry leafminer
Lithocolletis (Cameraria) nemorisi (Wlshm.)

The larvae of the huckleberry leafminer moth form large blotch mines on the upper surface of the leaves of Vaccinium ovatum on the Oregon coast. It is not unusual to find the whole upper surface of the leaf destroyed. The winter is spent as larvae in the mines. No control is known.

California laurel leafminer
Lithocolletis (Cameraria) unbellulariae (Wlshm.)

The larvae of the small California laurel leafminer moth mine the leaves of California laurel in southern Oregon. Nothing is known of its life history or control.

Cane miner
Marmara sp.

The larvae of an undetermined moth of the Marmara species makes long whitish serpentine mines on the canes of brambles and roses throughout Oregon. It apparently causes very little damage except for making the canes unsightly. Very little is known of the life history, and no control measures have been developed.

Azalea leafminer*
Gracillaria azaleella Brants

The small azalea leafminer moth is the most common and destructive pest of certain evergreen varieties of azaleas found in Oregon. It is widely distributed throughout greenhouses and outdoor plantings.

Hosts: Many varieties of evergreen azaleas are hosts.

Description: The moths are about \( \frac{3}{8} \) inch in length and are golden yellow in color. They are very secretive and hide under the leaves when disturbed. The larvae in the mining stages are much flattened with the jaws pointing forward while the last stage larva that rolls the tips of the leaves has the characteristic caterpillar shape. The eggs are very small, white, and disc-shaped and are laid along the midrib or veins on the under sides of the leaves.

Life History and Injury: The winter is spent mostly in the last larval stage in the curled-under leaf tips although there are some which undoubtedly overwinter as pupae and a few as small larvae in the mines. The moths begin emerging during the latter part of March and continue throughout April. The newly hatched larvae enter the leaf directly under the egg shell and form linear mines which cannot be seen from the top side of the leaf.
The second stage larva enlarges its mine to form a blotch on the lower side of the leaf and the next stages continue these blotch mines, feeding in such a way as to make the blotches visible from above.

The last stage larva is free-living, and rolls under the tips of the leaves where it feeds externally, skeletonizing the lower leaf surface. Pupation takes place on the under sides of the leaves in white, double, silken cocoons. During the summer months, all stages of this moth may be found at any time, and it appears that there may be a number of generations.

In the greenhouse this pest breeds continuously. Injury of leaf surface due to mining and tip rolling where infestations are severe, may result in complete destruction of the leaves.

Control: Lead arsenate spray has been suggested as a control but this has not proved to be very satisfactory. Nicotine sulphate spray gives some control but is also far from being a suitable remedy.

Fumigation with methyl bromide used at the rate of 2 pounds for 3 hours at 70° F. has given excellent control of all stages. This is the best method of control on potted plants except that measures must be taken to prevent reinestation. Certain varieties of azalea are not tolerant to methyl bromide so care must be exercised in its use. Trial tests should be run to ascertain the tolerance of those varieties one wishes to fumigate. After fumigation, the plants should be stored for several days in a well-ventilated, shaded place.

Figure 54. Azalea leaf miner injury to azalea leaves.

Figure 55. Lilac leaf miner mine and leaf roll on lilac.
In the greenhouse it has been found that infestations can be kept down by spraying lightly with a pyrethrum fly spray whenever the moths are in evidence.

**Lilac leafminer**  
*Gracillaria syringella* Fab.

The small lilac leafminer moth, the larvae of which mine and roll the leaves of lilac and privet, is widely distributed in Oregon. Where it is abundant the bushes have the appearance of being scorched.

**Hosts:** Lilac and privet are the principal hosts. It has also been reported from *Deutzia, Fraxinus,* and *Fusus.*

**Description:** The adult moths have a wing expanse of about \( \frac{1}{2} \) inch. The forewings are brown mottled with silver, and they have two silvery bands across the middle. The larvae are greenish white in color and while in the leaf mines are more or less depressed. The full grown larvae found in the rolled tips have the typical caterpillar form. The eggs are flattened and oval in shape and are laid in small groups on the under sides of the leaves, generally along the midrib.

**Life history and injury:** The winter is spent in debris-covered cocoons in the ground under the plants. The moths usually emerge during May, and the larvae from these moths are mature in July. During the latter part of July and in August another batch of eggs is laid, and the larvae from these eggs mature in September, drop to the ground, and form their overwintering cells. During the first stages the larvae mine between the epidermal layers of the leaves forming a large unsightly brown blotch; there are generally from 3 to 8 larvae in a common mine. When the larvae are nearly full grown, they emerge from the mines and roll down the leaf tips and feed therein until they are full grown. The injury consists entirely of the mining and leaf-tip rolling, and when infestations are severe injury and browning may result on nearly every leaf.

**Control:** Nicotine sulphate sprays, applied at the time the larvae are in the mines and rolled tips, have given the best control of any of the materials that have been used.

**LEAF MINERS AND RIBBED CASE MAKERS**  
*Lyonetiidae*

**Rhododendron leafminer**  
*Lyonetia candida* Braun

The larvae of the small rhododendron leafminer moth form winding mines ending in a large blotch in the leaves of rhododendrons in Oregon.
LEAF MINERS
_Tischeriidae_

**Apple leaf trumpet miner**
* _Tischeria malifoliella_ Clemens

The injury of the interesting little apple leaf trumpet miner moth is seen only occasionally in nurseries, but in orchards, especially old abandoned ones, it becomes quite abundant at times. The eggs are laid on the leaves, and the larvae begin to burrow out from there. As the larva grows larger the mine on the upper side of the leaf gradually enlarges to form a trumpet-shaped injury. The winter is spent in the fallen leaf as pupae, so normal cultural operations generally take care of its control. There are several generations. So far as is known, it confines itself entirely to apple trees.

BLISTER BEETLES
_Meloidae_

The adults of the blister beetles often become abundant on flowers, in gardens, and on a few nursery plants during the hot summer months. They are ravenous feeders and are capable of inflicting severe defoliating injury. The larvae of these beetles feed on grasshopper eggs and live in the nests of bumblebees. The adults are black, gray, green, or bluish beetles with soft wing covers. They may be controlled by spraying or dusting with lead arsenate.

WIREWORMS
_Elateridae_

The smooth, round, hard, shiny, yellowish to brown wireworms are known to anyone who is familiar with the growing of crops. These worms are often found in nurseries and in a few instances have done quite a bit of damage. They scarify and chew off the roots of woody plants and bore into the more tender underground parts of other plants such as bulbs, tubers, fleshy top roots, and non-woody roots such as spinach.

The adults are known as "click" beetles or "snap" beetles and are often quite abundant during April and May. They are elongated, gray, black, or brown beetles, about ½ to ¾ inch in length. They feed on the developing buds and flowers of many nursery and ornamental plants and at times produce quite serious damage by causing misshapen plants and flowers.

Control of these pests is not an easy matter. Crop rotations which include grain and row crops tend to reduce their numbers. Crude naphthalene thoroughly worked into the soil at the rate of 300
pounds to the acre in the spring after the soil has warmed up has given satisfactory controls. Spraying with a heavy lead arsenate spray (6 pounds per 100 gallons) has given fair control of the adult beetles. Several of the newer insecticides give very good control of the larval forms. For further information consult your county agricultural agent.

**FLAT-HEADED BORERS**

*Bupresidae*

The larvae of the members of the flat-headed borer family of insects bore in the wood or in the cambium of many nursery, ornamental, and forest trees. For the most part they attack only those plants that have been weakened for some reason or other. Some of the injuries which may induce attacks are fire, cultivation, and other mechanical injuries, wind breakage, sunscald, weakening due to transplanting, drought, and winter injury.

**DESCRIPTION:** The beetles are more or less oval and flattened in shape, and are often colored with a beautiful metallic luster. They vary from ¼ to 1 inch in length. The larvae are white to yellowish in color and have an enlarged, flattened anterior region reminiscent of the head of a rattlesnake. The larvae for the most part work between the bark and the wood, thus cutting off the flow of sap by girdling the tree.

**CONTROL:** The control consists mostly of indirect measures to prevent the cause of infestation. Small trees transplanted in the open may be prevented from having sunscald by placing a shingle or other shading device on the sunny side of the tree. Removing the larvae from the injury and then painting over the wound is of some value. Destruction of all infested trees and plant parts will help in reducing probable future infestations.

Species injuring nursery and ornamental plants

**Flat-headed apple tree borer**, *Chrysobothris femorata* (Oliv.), is probably not quite as important as the next one listed, but at times it causes considerable injury in Oregon. The larvae work in many broadleaf plants, some of which are apple, apricot, ash, mountain ash, maple, cherry, plum, poplar, elm, linden, oak, pear, peach, willow, alder, and many less common hosts.

**Pacific flat-headed borer**, *Chrysobothris mali* Horn., is probably the most common in broadleaf nursery and ornamental trees. It attacks the same hosts in general as the foregoing species.

*Chrysobothris nixa* Horn. What is supposedly this species is often very common in nurseries in various varieties of junipers and
Figure 56. Flat-headed borer injury to European mountain ash. Note the roughened area near the base of the tree.

Figure 57. Flat-headed borer working on young prune tree.

arborvitae. The attacks always seem to be in plants that have been injured by hoe, by cultivator, or by breakage of the limbs from the main trunk.

**Flat-headed prune tree borer**, *Dicera pecterosa* Lec., is somewhat larger than the foregoing *Chrysobothris* and attacks peaches and plums in many parts of the state. The attacks are limited largely to the lower part of the tree trunk.

*Dicera horni* Crotch is slightly larger than the *Dicera pecterosa* and attacks many native and cultivated plants among which are alder, cascara, cherry, ceanothus, madrone, oak, peach, plum, poison oak, snowberry, walnut, and a number of less common plants.
Figure 58. Flat-headed borer injury to woodward arborvitae. Figure 59. White grub injury to birch roots. Note the absence of fibrous roots.

*Anthaxia aeneogaster* Cast., larvae work in the twigs and limbs of various broadleaf trees.

*Agrilus politus* (Say), and its variety *burkei* Fisher, is a slim elongate species that is bronze green to blue in color. It is an extremely common species in willow and is occasionally found in maple. The larvae generally work in twigs and often make a characteristic U-shaped injury.

**Bronzed birch borer**, *Agrilus anxius* Gory is a common species in birch and poplar.

*Agrilus populi* Fisher is not uncommon in alder and poplar.

The most common species of the genus *Acmaeodera* is *A. connexa* Lec. that bores in oak. A number of other species are present and mine in alder, oak, *Ceanothus*, poison oak, and other native trees and shrubs.

The species of *Poecilonata* work largely in poplars and are quite common.

*Polyccesta californica* Lec., works in a large variety of fruit, ornamental, and native broadleaf trees.

Numerous species of the following genera of flat-headed borers
attack coniferous trees of various species in Oregon: *Dicerca, Trachykele, Buprestis, Melanophila, Chrysobothris, Chrysophana.* These beetles are generally found under forest conditions but may occasionally be found in ornamental and nursery plantings.

**BRANCH AND TWIG BORERS**

*Bostrichidae*

**Branch and twig borer**

*Polycaon confertus* Lec.

The adults of the *Polycaon confertus* Lec., or its relative *P. stouti* (Lec.), may be the cause for the destruction of buds of Lambert and Bing cherries, although this fact is not definitely established. The buds of these trees are not uncommonly found to contain small holes which, of course, renders them useless for budding purposes. The larvae ordinarily work in the wood of apple, cherry, apricot, currant, laurel, madrone, manzanita, peach, pear, prune, rose, and many other native and cultivated plants.

The same injury in the buds may be caused by *Scolytus rugulosus* but none of these beetles have been apprehended at work in the bud sticks.

**JUNE BEETLES OR WHITE GRUBS**

*Scarabaeidae*

**Ten-lined June beetles**

*Polyphylla decemlineata* (Say)

Occasionally the larval stages of the ten-lined June beetles, known as white grubs, do serious damage in small areas, especially where the ground is sandy and most generally where grains have been included in the crop rotation. This beetle is largely a pest in western Oregon and is replaced in eastern Oregon by a similar species.

**Hosts:** These grubs attack a large variety of hosts and have been found to do serious injury to strawberry, birch, and grain crops in Oregon.

**Description:** The adults are approximately 1 inch in length and are light brown, striped with white. They are often attracted to lights in July and August. The larvae are dirty white in color and are 1½ inches or more in length when full grown. They have 3 pairs of legs which are always half-curled in repose, and always have the back part of the abdomen filled with soil which can be seen through the skin.

**Life History and Injury:** The immature stages live entirely in the soil and destroy the underground parts of plants. The adults...
emerge during July and August to lay eggs. The injury on birch, where it has been found, consisted of the destruction of the fiber roots and the de-barking of the larger roots. On strawberries, the root system is often entirely destroyed and many times the crowns are also nearly eaten up. Time of life cycle is not definitely known but it probably takes three years to complete.

**CONTROL:** Since these grubs cause the greatest injury in light sandy soils, it is advised that nursery crops not be planted in such types, especially if they are known to be infested. The grubs can usually be seen when the land is plowed. Summer fallowing of infested land will definitely help in cleaning up infestations. Growing of clean cultivated row crops also is of value in reducing infestations. Pigs like the larvae and pupae and will root out many for food. There are no definite direct control measures.

**Other white grubs**

*Serica* sp; *Dichelonyx* sp.

The larvae of the two genera *Serica* and *Dichelonyx* are about ½ inch long when full grown. The adults of *Serica* sp. are brown in color, often have a metallic sheen, and are about ½ inch long. The adults of *Dichelonyx* sp. are about the same size as *Serica* but as a rule have bright green or bronze shining wing covers.

The larvae and adults of *Serica* confine themselves largely to broadleaf plants and are commonly found on nursery, ornamental, and orchard plants.

The adults of *Dichelonyx* are found largely on coniferous plants. They are seldom abundant enough to be of much concern.

No definite control measures are known, but those outlined under the ten-lined June beetle would probably be of value. Hand picking of adults, where infestations are localized, has been suggested.

**LONG-HORNED OR ROUND-HEADED WOOD BORERS**

*Cerambycidae*

The beetles of the *Cerambycidae* family confine themselves almost entirely in the larval stages to boring in wood and cambium of various species of coniferous and broadleaf plants. Very few are of any importance to ornamental or nursery plants in Oregon, although they are extremely important in forest trees, especially in logs, timbers, and slashings.

The beetles vary much in size and color. The larvae are generally yellowish white and make round holes in their host in contrast to the flat or oval mines of the flat-headed borers.
California prionus*
*Prionus californicus* Mots.

The larvae of the California prionus beetle are commonly found boring in the roots of oaks, alder, cherry, madrone, peach, plum, poplar, and walnut. When full grown, the whitish larvae are 2 1/2 to 3 inches long. The adults are large brown beetles about 2 inches or more in length. What is suspected to be the work of this pest has been found in the roots of horsechestnut in nurseries.

Black gooseberry borer*
*Xylocrion agassizi* (Lec.)

The round-headed black gooseberry borer mines in the stems and roots of gooseberries in both nursery and commercial plantings. At times it is a very serious pest. It is quite common throughout western Oregon.

The beetles are black in color and are about 1/2 inch long. The larvae are yellowish white with a brown head capsule and are a little over 1/2 inch in length when full grown.

There is no known control except by destroying plants that are infested.

**LEAF BEETLES**

*Chrysomelidae*

**Syneta leaf beetle**

*Syneta albida* Lec.

The small syneta leaf beetle is at times very abundant in cherry and prune orchards and is not uncommon on nursery and ornamental plants. The adults feed on a large variety of plants in western Oregon.

**Hosts:** Apple, cherry, peach, pear, prune, quince, maple, oak, currant, gooseberry, filbert, crab apple, hawthorn, and willow are hosts.

**Description:** The adult beetles have dirty white wing covers and yellowish brown appendages. They are about 1/2 inch long. The larvae are white and have brown heads. The eggs are pearly white and oval in shape and are apparently dropped indiscriminately over the ground.

**Life History and Injury:** This pest overwinters in the larval stage around the roots of its host. Pupation takes place in earthen cells in early spring and adults begin emerging about mid-March and can be found till about mid-June. There is one generation a year. The larvae feed on the fiber roots of the host, and the adults feed on the leaves, flowers, and fruits. The main injury is done to
developing fruit where pieces are chewed out making it unsalable. Entire buds are often destroyed, and on young grafts this is particularly injurious.

**Control:** Lead arsenate sprays applied when the beetles are in evidence have given satisfactory control.

**Other syneta beetles**

Two other syneta beetles are commonly found feeding on shrubs and trees in western Oregon. These are *Syneta carinata* (Mann.) and *S. simplex* Lec. They look somewhat like *S. albida* but are larger and yellowish to brown in color. The adults are present in early spring and at times are quite abundant.

Numerous species of small oblong chubby beetles belonging to the genera *Pachybrachys*, *Cryptocephalus*, and *Saxinis* feed on leaves of broadleaf and coniferous shrubs and trees in Oregon. At times they cause considerable defoliation and bud injury. They are about 1/6 inch long and may be gray, brown, blue, or black with various color markings. Lead arsenate spray is suggested for controlling.

**Bronze willow flea beetle**

*Diachus auratus* (Fab.)

The adults of the little bronze green willow flea beetle are common on roses and willows. The adults are about 1/12 inch long. They are not flea beetles in the true sense of the word as they are not able to jump.

**Western willow leaf beetle**

*Galerucella decorata* (Say)

In parts of Oregon, the larvae and adults of the western willow leaf beetle often become very abundant on willows and poplars. The beetles are about 1/5 inch in length with wing covers striped with yellowish brown and black.

**Willow flea beetle**

*Chalcoides fulvicornis nana* (Say)

The small bright green or bluish metallic willow flea beetle is very common on willows in Oregon. The adult is about 1/10 inch long. It skeletonizes the leaves but seldom causes serious injury. Nothing is known of its life history.

**Other willow leaf beetles**

Several species of the genus *Glyptoscelis* are commonly found feeding in the adult stage on various species of broadleaf and coniferous plants. These gray to brownish beetles are about 1/8 inch long. They feed on leaves and needles.
Calligrapha multipunctata (Say) adults and larvae resemble C. bygsbyana except that the ground color of the adults is yellowish orange. They are common on willow in eastern Oregon.

Calligrapha bygsbyana (Kby.) adults and larvae are pale yellowish hemispherical black-spotted beetles that are common on willow in western and eastern Oregon.

Lina aenicollis Schffr. adults are oval in shape and have a dark yellowish brown ground color heavily marked with black spots. They feed on willow. These beetles are common in the higher altitudes.

Disonycha quinquevittata (Say) are about 1/4 inch in length. They are common on willows at times. They are bright yellowish orange, with black longitudinal stripes.

Rose flea beetle
*Haltica probata* Fall

The rose flea beetle is about 1/6 inch long. It is a metallic bronze color. The larvae and adults are known to skeletonize the leaves of roses and raspberries. It has not been found to be of any particular economic importance in Oregon.

Elm leaf beetle*
*Galerucella xanthomelaena* (Schr.)

Elm leaf beetle is a common and serious pest of elm in Oregon. It is widespread throughout the state and often causes severe defoliation.

**Host:** The host is elm.

**Description:** The adults are dull olive green with a darker stripe on the side of each wing cover. They are about 1/4 inch long. The young larvae appear nearly black. The older larvae are yellowish brown with a black stripe running down each side of the body. When full grown they are about 1/2 inch long.

The eggs are spindle-shaped, orange yellow, and laid in rows in small groups on the under sides of leaves.

**Life History and Injury:** The beetles spend the winter in the adult stage under bark, moss, outbuildings, and other protected places. They emerge early in the spring when the first leaves begin to show. After feeding for several weeks they begin laying eggs. The first young appear about the first of June and skeletonize under sides of leaves. This brood of larvae becomes mature in early July. These larvae transform on or around the base of the tree and produce another brood of larvae that feed during July and August.
There is probably a third generation of larvae or at least a partial generation during late August and September.

The injury may result in the loss of all or most of the leaves.

CONTROL: Lead arsenate sprays, if properly applied, will give good control of this pest. The first spray should be applied in early spring to kill the overwintering beetles before they lay their eggs. A second spray is generally necessary to kill the young larvae that hatch from eggs laid by beetles that were not killed by the first application. The second spray should be directed at the under sides of the leaves where the larvae are feeding. Subsequent sprays may be necessary if the first sprays fail to give good control.

Alder flea beetle*
*Hallica binarginata* Say

The black spiny larvae and the steel blue adults of the alder flea beetle skeletonize the leaves of alder and willow commonly in Oregon. They often become so abundant as completely to defoliate isolated trees or groups of trees. The adults overwinter in protected places and emerge in early spring to lay their eggs on the leaves. There is but one generation a year.

Western spotted cucumber beetle*
*Diabrotica (soror) 11-punctata* Mann.

The adults of the green black-spotted cucumber beetle are about ¼ inch long and are known to many people as ladybird beetles. The adults feed on a large variety of plants, however, instead of on plant lice and other harmful insects. Very few plants are not acceptable as food. The greatest destructions by the adults is done to flower gardens and vegetable gardens, but trees and shrubs are often quite seriously attacked. The larvae work in the soil on the roots of many plants, some of which are rose cuttings, potato tubers, sprouting beans, corn, etc.

The winter is spent in the adult stage in any place where protection is afforded. They appear on the earliest spring days to deposit their eggs. These spring eggs have developed to adults by July and August and at least a partial second generation may be produced.

Dusting with 3 per cent DDT where it can be used has given excellent control. Undiluted calcium arsenate dust used on plants that this material will not burn has given good results. In California, 0.1 per cent pyrethrins combined with 1.0 per cent Lethane in talc has given good results if applied when the temperature is 65° F. or over.
Figure 60. Rose curculio adults and injury to thimbleberry buds.

SNOUT BEETLES OR WEEVILS

Curculionidae

Rose curculio*

*Rhynchites bicolor* (Fab.)

The long-beaked rose curculio weevil is often very common on the buds of roses and bramble fruits. It is distributed widely in Oregon and, where it is abundant, may cause the loss of many flowers.

**Hosts:** Rose and bramble fruits are hosts.

**Description:** The adults are about 1/4 inch in length and have a long snout in comparison to the body length. There are two color forms; one is red except for the head and appendages; the other is entirely black. The larvae are curled, legless grubs and work in the rose hips and developing buds of bramble fruits.

**Life History and Injury:** The winter is spent in the soil in an immature stage, and the adults emerge about the time blackberries, thimbleberries, and roses are well in bud. The adults make punctures in the sides of the buds and often riddle them so completely that they fail to open. The eggs are deposited in these bud punctures. When mature, the larvae drop to the ground and remain there until the following spring.
Control: Lead arsenate spray has been suggested as a control. This should be applied when the beetles are in evidence. Handpicking the adults is practicable in home gardens.

**Native strawberry root weevils**

*Dyslobus* spp.

Several root weevils of the genus *Dyslobus* have been found damaging nursery and ornamental plants in Oregon. The larvae and adults work in the same manner as the *Brachyrhinus* group; however, the life history differs. The adults emerge early in the spring, generally about the latter part of March and the first of April.

For control of these pests, poison baits, as used for other root weevils, should be spread in early spring.

The species involved in nurseries are generally *Dyslobus decortatus* Lec. and *D. granicollis* Lec. although *D. ursinus* Horn, *D. willocoxi* Van D., *lecontei* Csy., and *D. simplex* Van D. are fairly common and may become pests. These weevils are gray and brown in color and vary from $\frac{1}{4}$ to $\frac{1}{2}$ inch in length.

The adults of the members of the genus *Scyrophus* are often very abundant on the needles of various conifers. The beetles are about $\frac{1}{4}$ inch long and are reddish brown to bright bronze green in color.

![Figure 61. Adult *Dyslobus granicollis* injury to holly leaves.](image-url)
Fuller rose beetle*
Pan/otnorus godmani (Crotch)

The grayish brown Fuller rose beetle is often abundant in southern Oregon. It attacks a large variety of hosts and is obnoxious at times because of its habit of entering dwellings for hibernation quarters.

Hosts: The larvae and adults have a long host range, some of which are apple, apricot, azalea, blackberry, camellia, currant, gardenia, oak, peach, pear, prune, raspberry, and rose.

Description: The adult is a grayish brown snout beetle about 3/8 inch long. The adults are wingless. The larvae are white, curled, legless grubs with brown heads. The eggs are oval in shape, pale yellow in color, and laid in irregular groups around the base of the host or in cracks of the bark.

Life History and Injury: Winter is spent in the adult stage in the soil, under debris, or in any other suitable hiding place. The adults appear in the spring and lay their eggs as described above. They feed on the buds and leaves. The larvae feed on the roots, snipping off the feeder roots and chewing off the bark of the larger roots.

Control: Lead arsenate sprays have given fair control. Adults can be prevented from climbing up the plants by banding the trees with tanglefoot or placing tin shields on the trunks.

Strawberry root weevils

Strawberry Root Weevil*—Brachyrhinus ova/itus (L.)
Rough Strawberry Root Weevil—Brachyrhinus rugosostriatus Goeze
Black Vine Weevil*—Brachyrhinus sulcatus (F.)

The strawberry root weevils are without a doubt the most serious pests of nursery and ornamental plants. Their attacks are insidious and are generally not noticed until serious damage has been done. They are widely spread and attack a large variety of hosts.

Hosts: All three species seem to prefer plants of the rose and heath families but many other plants are seriously attacked. Among nursery plants, the following are most severely injured: rose, camellia, azalea, rhododendron, cherry, plum, arborvitae, and yew.

Description: B. ova/itus is the smallest species of this group. The adults are black to dark brown in color and are about 1/5 inch in length.

The adults of B. rugosostriatus are generally dark brown in color and are about 1/4 inch in length. The adults of B. sulcatus are black in color and often speckled with white. They are about 2/5 inch in length.
The adults of all three species are evenly sculptured with small round protuberances assuming the appearance of shagreen. They are all wingless, and all possess plainly visible snouts. There are no males.

The larvae are all very similar in appearance and are legless, half-curled in lateral view, white to pinkish in color, with brown head capsule. When full grown, they vary from ¼ to ½ inch in length.

The eggs are oval to spherical in shape, are generally pearly white in color, and are laid on the ground under clods and other objects around the crown of the plants.

**Life History and Injury:** The seasonal life history of all three species is very similar. The large majority spend the winter in the larval stage, but many, especially *R. ovatus*, overwinter in the adult stage and emerge to lay eggs as soon as warm weather begins in the spring. Most of the larvae, however, change to adults during June and lay eggs through June, July, and August. The overwintering adults, of course, lay eggs throughout late spring and also in the fall before they overwinter. There is but one generation a year of any of these species.

The injury consists in chewing off the fibrous roots and barking the large roots. In the less woody plants, such as strawberries, the larvae bore directly into the plant crown and often consume it entirely.
Figure 64. Adult strawberry root weevil injury to red cedar. 
Note the girdle.
The adults of *B. ovatus* sometimes do serious injury to arborvitae by girdling young twigs, causing them to die. The leaf injury to broadleaf plants is very characteristic as all three species feed on the leaf edges, cutting out small semicircular sections. The adults feed at night and hide under clods and debris in the daytime.

**CONTROL:** Control measures consist of poison baits to kill the adult weevils and thus prevent the deposition of eggs. To insure good success when using these baits, accurate timing of their application is necessary. There are several ways in which accurate timing may be accomplished:

1. Examine the soil about the base of the plants for the immature forms. If 75 to 90 per cent of the pupae have changed to the adult stage, it is time to apply the bait.

2. Examine the top layers of soil and clods around the base of the plants (the weevils hide here during the day); if live weevils are found, baits should be applied.

3. Examine the leaves occasionally for ragging of the leaves. If ragging is evident, weevils can be found in the soil as described above.

The number of applications of bait to apply will depend largely on the seasonal occurrence of adult beetles. If adult beetles are numerous during April and May, baits should be applied at this time as well as in June when the greatest number of weevils generally are present.

Individual fields will vary greatly as to beetle population either as a whole or in certain parts of the field. Sometimes large populations are encountered adjacent to sources of infestation such as old strawberry plantings, fence rows, and other places where suitable host plants occur. Much bait and time can be saved if these heavily infested areas are located early and baited. This will prevent spread to the remainder of the field and often obviate the necessity of baiting the entire field.

Several methods of application of the bait may be used. Broadcasting the bait has proved to be satisfactory but is quite wasteful. The placing of a teaspoonful or tablespoonful in the crown of each plant is the most economical and efficient method. The amount of bait applied per acre will depend on the method of application but 15 to 25 pounds per acre is generally sufficient.

There are a number of proprietary baits on the market, most of which will give good control. Most of these use some type of fruit-waste product as a carrier for the poison. The poisons generally used are sodium fluosilicate or calcium arsenate. Some of these baits
contain other substances designed to enhance the value of the bait that may or may not be desirable.

Home-made bran baits can be prepared on the farm and have proved entirely satisfactory for weevil control. The formula for making such bait is as follows:

- Bran .................................................. 50 pounds
- Water .................................................. 5 gallons
- Sugar† .................................................. 5 pounds
- Calcium arsenate or sodium fluosilicate .............. 5 pounds

This bait may be mixed by dissolving the sugar in the water; incorporate this with the bran; and add the poison last. Thoroughly mix. Or the sugar and poison can be dissolved in the water together and then thoroughly mixed with the bran. Either method has proved satisfactory.

**Bud weevils**

*Sciopithes obscurus* Horn  
*Paraplocus sellatus* Boh.  
*Thricolepis inornata* Horn  
*Peritelinus oregonus* V. Dyke.

In the spring, the adults of the four species of weevils mentioned above often occur in immense numbers on the buds and developing leaves of tree fruits, caneberries, strawberries, and native shrubs and trees. The species are generally not mixed in any one place at any one time. Quite often on young trees the buds are

![Figure 65. 11-spotted leaf beetle or cucumber beetle.](image)

![Figure 66. Bud weevil adult. (*Sciopithes obscurus.*)](image)

† Molasses at the rate of 2½ gallons in this formula may be substituted for the sugar. When molasses is used the amount of water is reduced to 3½ gallons.
nearly all destroyed or are so badly deformed that the plant receives a serious setback. On older plants the injury is not so severe as the feeding is spread out over a much larger area. Nothing of importance is known of the larval habits.

Control measures are usually not necessary, but a lead arsenate spray is of some value. Banding the trunks or bases of the trees with a sticky material has been suggested as a measure to keep the weevils off the plants.

Many species of the weevil genus *Pissodes* are found in Oregon. The adults are all about 1/4 inch long and vary in color from brownish red to black and are often marked with white spots. The larvae of some species work in the bark and cambium of coniferous trees while others work in the terminal shoots. One species is very destructive to the terminal shoots of white pine in the east, but this pest is not as yet present in Oregon.

**Bronze apple tree weevil**

*Magdalis aenesens* Lec.

The bronze apple tree weevil is not a serious pest, but it is quite commonly reported. The most noticeable injury is the dry sunken areas on small limbs under the bark of which the larvae may be found feeding. The eggs are laid in groups, and the holes in the bark appear like a salt shaker. The weevils are black with a bronze sheen and have noticeable ridges on the wing covers. They are slender and measure about 1/5 inch in length. Winter is spent in the larval stage, and the adults emerge in the spring to lay their eggs. There is one generation a year. The common hosts are apple, birch, hawthorn, alder, cherry, and prune. Control consists of pruning out and destroying the infested plant parts or painting over the affected area.

**Other Magdalis beetles**

The following weevils of the *Magdalis* genus are found in Oregon and do noticeable injury at times.

*Magdalis alutacea* Lec. is silvery black to brown and feeds on Engelmann spruce.

*M. lecontei* Horn is steel blue to black and feeds on yellow and sugar pine.

*M. proxima* Fall is black and feeds on pines.

*M. gracilis* Lec. is black and feeds on prune and other broadleaf trees.

The larvae of these beetles bore into the twigs, and the adults feed on the foliage and make punctures in the twigs to lay eggs.
A small gray weevil, *Cylindrocopturus longulus* (Lec.), in its larval stage works in the bark of twigs of pine and Douglas-fir. It is not uncommon on wood piles and has been seen on nursery plants, but no serious damage has been reported.

**Poplar and willow borer***

*Sternochetus lapathi* (L.)

The *Sternochetus lapathi* (L.) weevil is the most serious pest of willow in certain parts of western Oregon. It is widely distributed in the northern Willamette Valley, and is especially serious in the Portland area.

**Hosts:** In Oregon it is a serious pest of willow and poplar and is not uncommon on birch. It is reported from alders elsewhere but has not been found on this plant in Oregon.

**Description:** The adults are about \( \frac{3}{8} \) inch in length and are black mottled with white. They are rather sluggish insects and are unable to fly. They often make a squeaking noise when picked up. The larvae are white legless grubs with brown heads and are about \( \frac{3}{8} \) inch long when full grown. The eggs are white in color and look like miniature oblong blocks; they are deposited in the roughened bark of the trunks of smaller trees and about the bud scars higher up on the trees. They do not lay eggs in the newer wood and seldom very far from the ground.

**Life History and Injury:** The winter is spent as small larvae between the bark and wood of the host. In early spring, generally beginning about mid-March, the larvae begin to feed as miners in the cambium and make winding tunnels therein. As the larvae grow larger, more and more of the wood is eaten; finally, in the later stages, tunnels are made directly in the wood. The outside of the bark is often covered in early spring with frass and sap oozing out of the galleries beneath the bark. Many trees are killed outright by these beetles, and dead limbs are very common. Pupation takes place in the pith as a rule and the tunnels behind the pupae are filled with excelsiorlike borings. Pupation takes place mostly in June and adults emerge in July and August. The eggs are laid throughout the latter part of July and through August. Most of them are hatched by late September and October. The young larvae do not feed much until the following spring.

**Control:** In nurseries, attacks of these beetles can be prevented by planting susceptible hosts away from infested native plants or by destroying the native host plants in the vicinity of nursery plantings. If infested plants are found in the nursery, these should
Figure 67. Poplar and willow borer egg punctures at base of tree.

Figure 68. Poplar and willow borer overwintering larvae in egg niche.

Figure 69. Poplar and willow borer larval tunnels in bark.

Figure 70. Poplar and willow borer tunnels and pupae in willow.
be pulled out and destroyed before the first of June to prevent adults from emerging and infesting more trees.

The young larvae may be killed in dug nursery stock by fumigation with methyl bromide used at the rate of 4 pounds for 4 hours at 70° F. This treatment does not give complete control but approximates 98 to 99 per cent.

Growing trees infested with these borers may be sprayed in the spring after the borings are evident with a 25 per cent ethylene dichloride emulsion. The infested areas should be given a thorough spraying, allowing the spray to run over the areas where borings are in evidence. This treatment does not give complete control but will often help to prevent the death of valuable trees. Some injury has resulted from this spray but in no instance have trees been killed.

**BARK BEETLES**

*Scolytidae*

The members of the *Scolytidae* family are extremely important in forest trees, especially coniferous species. They generally confine their attacks to weakened sickly trees. Very few species of importance are found on broadleaf plants in Oregon. The family is divided into two more or less distinct groups according to their habits. The *bark beetles*, to which the large majority belong, work in the cambium
and bark and often scar the sapwood; the gallery of each species is characteristic. The *ambrosia beetles* work in the wood of the plant and make small round holes that are usually stained black; this black stain on the galleries is caused by a fungus on which the larvae of the beetles feed.

No direct control measures are applicable as a rule. Keeping plants in a healthy, thrifty condition, and preventing mechanical injuries is the best insurance against attack.

Following is a brief discussion of the species which attack nursery and ornamental plants.

The clover root borer*, *Hylastinus obscurus* (Marsh.) is not uncommon in the base of scotch broom and cultivated lupine although it does no particularly serious injury.

The Ash bark beetle, *Leperisinus californicus* Sw., is common under the bark of Oregon ash.

The alder bark beetle*, *Alniphagus aspericollis* (Lec.) is common under the bark of Oregon alder.

Members of the genus *Dendroctonus* are very destructive to coniferous forest trees and are not uncommon in ornamental trees. They often attack healthy trees when there is an extremely high population of beetles emerging from infested trees in the surrounding area.

Many members of the genera *Ips*, *Scolytus*, *Pseudohylesinus*, *Phloeosinus*, and *Pityophthorus* occur in Oregon. The large majority attack coniferous forest trees and at times are found in ornamentals.

**European shot-hole borer**  
*Anisandrus pyri* (Peck)

The small European shot-hole borer beetle is often a concern to nurserymen and orchardists. It is a widespread species. It is most commonly thought to attack only devitalized trees or trees that are suffering from drought or other causes making them weak. Some authorities, however, believe that it sometimes attacks perfectly healthy trees.

**Hosts:** Apple, pear, alder, apricot, ash, beech, cherry, chestnut, grape, elm, hawthorn, maple, oak, peach, plum, poplar, quince, sycamore, tulip tree, willow, pine, cedar, and hemlock are hosts.

**Description:** The adult female is dark brown to black and is 3.5 millimeters long and 1.5 millimeters wide. The male is more or less oval in shape and is much smaller than the female—1.75 millimeters long and 1 millimeter wide. The eggs are pearly white in color and are 1 millimeter long and .06 millimeter wide. The larvae
are white, curled, legless grubs about 5 millimeters long when full grown.

**Life History and Injury:** The winter is spent in the adult stage in the wooden tunnels of the host. Eggs are laid between mid-April to mid-June. Development is completed from June to August, there being one generation a year.

The adult beetles make their entrance holes about the bud scars or some other roughened place. *After burrowing* into the wood for about a quarter of an inch they make branched tunnels. At the end of each tunnel they deposit eggs. The larvae of the beetles do not eat wood themselves but feed on fungus growths that the adults introduce at the time of egg deposition. The blackening of the so-called shot holes is due to fungus discoloration. The tunnels in the wood of the tree cause the tree to be weakened; this allows for considerable wind breakage. These tunnels also make excellent places for pathogenic fungi to enter.

**Control:** It is fairly certain that only weakened or dying trees are attacked. Some of these reasons may be drought, winter injury, transplanting, mechanical injuries, and poor growing conditions due to soil deficiencies, cultivation, etc. Notable attacks are generally made on espalier trees.

The only means of reducing attacks by these beetles is to keep the plants in a thrifty growing condition. Pruning out and destroying any affected plant parts early in the spring may be of some value in preventing further attacks.

**Shot-hole borer***

*Scolytus rugulosus* (Ratz.)

The bark beetle, shot-hole borer, is widely distributed and attacks many orchard and nursery broadleaf trees. It is rarely of any consequence except where trees become devitalized for some reason or other.

**Hosts:** Apple, mountain ash, apricot, cherry, choke cherry, elm, hawthorn, peach, pear, plum, quince.

**Description:** The adults of this beetle are dark brown to black in color and are 2 to 3 millimeters in length. The back end of the body is undercut, giving these beetles a very odd appearance. The larvae are legless, white, curled grubs about 3 millimeters long when full grown.

**Life History and Injury:** The adults emerge during the spring and deposit their eggs underneath the bark of sickly or dying trees. The eggs are laid along the sides of large straight galleries, and the larvae work out from there at more or less right angles, making a
double comb effect. The larvae feed partly on the bark and partly on the wood. This girdling cuts off the sap stream and causes the twigs and branches to die. Quite often the adults burrow into the buds and destroy them, thus making them useless for budding purposes.

**Control:** Suggestions for control consist of the same measures as found under the European shot-hole borer.

**Lesser shot-hole borers**

The *Xyleborus saxoseni* (Ratz) species is very similar in appearance to the European shot-hole borer, but it is only 2.5 millimeters in length. The hosts are very similar to that of the European borer and must be in weakened condition before attacks occur.

The tunnel made by the adults differs greatly from that made by the European borer in that all the eggs are laid in one large cavity rather than in a branched tunnel. The winter is passed in the larval stage, and the adults emerge during late spring and summer.

Trees should be kept in good vigor to prevent attacks.

The bark beetle, *Phloeosinus punctatus* Lec., often attacks arborvitae in nurseries and home plantings when the plants have had some setback. It attacks only injured or sickly plants. The small brown beetles lay their eggs in the cambium, and the larvae then work out in a fan-shaped pattern and girdle the twigs and trunks.

There is no direct control. Attacks may be prevented by keeping plants in a vigorous growing condition and by preventing mechanical injuries.

**Gall Midges**

*Cecidomyiidae*

**Boxwood leafminer**

*Monarthropalpus buxi* Labou

A very serious pest, boxwood leafminer, occurs in spotted infestations in the Willamette Valley. It does not appear to be too common, but where it is found it causes severe damage.

**Host:** The host is boxwood.

**Description:** The adults are tiny orange yellow two-winged flies about \( \frac{3}{4} \) inch in length. The small white oval eggs are deposited in the leaf tissue of the lower leaf surface. The larvae are yellowish white to green and are found between the upper and lower leaf surfaces.

**Life History and Injury:** The winter is spent in the larval stage within the tissue of the leaf. About the last of the third week in April the adults begin emerging. Emergence continues for about
three weeks. The pupae of the fly protrude from the leaf mines and the cast skins are very noticeable after any number of flies have emerged. The flies live but a very short time after oviposition. The eggs hatch several weeks after being laid and the larvae spend the rest of the year in the leaf mines. The injury is apparent on the upper surface of the leaves by the bleached, sickly yellow appearance. The lower surface of the leaf has the appearance of being beset with green flat blisters with a small central depressed area where the eggs were laid and evidently where the pupal case will protrude. The mines themselves are not very noticeable as they do not extend entirely to either surface of the leaf as is the case with most other leaf-mining injuries. The injury often results in severe leaf drop.

Control: The timing of the control of this pest is very critical and the spray must be applied at the proper period. The recommended spray is 25 gallons of stock molasses, 75 gallons of water, and 1½ pints of nicotine sulphate. The first application should be made when or just before the first adults emerge, and two subsequent applications should be made at 7-day intervals. If rain should occur
between sprays, the plants should be covered with canvas or muslin to protect the spray material or another application should be made as soon as possible. Thorough coverage on both sides of the leaves is necessary. As this spray traps the adults in the sticky residue and the nicotine kills them on contact, it is necessary to have the plants covered with spray throughout the time of emergence.

Methyl bromide used at the rate of 2 pounds for 3 hours at 70° F. has given complete kill of the larvae in the leaves during the dormant season of the plant. This treatment is applicable to potted and balled plants and may be adapted to specimen plants in the field.

**Rose midge***

*Dasyurga rhodophae* (Coq.)

To date the rose midge pest is not known to be present in Oregon. Since it is a very important problem where it does occur, and since several rose growers have expressed deep concern over its possible importation, a brief discussion of its biology and control seems advisable.

It has occurred in the eastern states in greenhouses for many years and within the last several decades has begun to infest outdoor roses also.

The adult insects are small fragile yellowish flies about 1/16 inch long. The eggs are yellowish in color and are deposited in crevices of the flower buds and in the axils of developing leaves. The orange yellow, legless maggots work in the base of the flower buds and on the upper sides of the young leaves. The infested
flower buds produce malformed flowers and often turn brown and die; the tender shoots and leaves are distorted and are often killed.

The complete life cycle under favorable conditions may be completed in 12 to 18 days; thus there would be a varying number of generations a year. Transformation and overwintering take place in silken cocoons in the soil under the plants.

There have been a number of control measures suggested. Under greenhouse conditions, the following practices have been found of value:

1. Rotation of crops within individual houses.
2. Mulching the soil with tobacco dust.
3. Soil sterilization and cleaning up and destroying infested stock.
4. Planting of clean stock and careful removal of soil from roots of stock which may be infested.
5. Fumigation with hydrocyanic-acid gas or nico-fume at regular intervals to kill the adults. (Fumigation does not kill the other stages.)
6. Hand-picking and destruction of infested buds and leaves.

Under outdoor conditions the following control measures have been practiced:

1. Care in obtaining noninfested stock.
2. Mulching the soil with tobacco dust.
3. Treating the soil with nicotine solutions.
4. Spraying or dusting infested plants with nicotine.
5. Destruction of infested buds, shoots, and leaves.

Birdseye pine midge

Retinotylaspis inopis O.S.

What is assumed to be birdseye pine midge is common in southern Oregon. The larvae kill the lateral tips of yellow pine by working under the bark in pitch pockets. The larvae are small pink maggots, and the adults are miniature two-winged flies. When abundant these maggots may kill entire trees although the injury is generally less severe. Infestations may be recognized by the dead tips and needles. In finished lumber the injury results in what is known as "birdseye pine" (Keen 1939).

LEAF MINERS

Phytomyzidae

Holly leafminer*

Phytomyza ilicis (Curtis)

Holly leafminer has been intercepted on holly shipments and has been reported from Oregon, but the writer has never seen the
injury on Oregon-grown holly. It could be a very troublesome pest if it ever became established here.

**Host:** The host is holly.

**Description:** The adult is a small grayish black, two-winged fly about 1/12 inch long. The larvae are white legless maggots that are found in the leaf mines. The eggs are very small and are laid in the midrib on the under sides of young leaves.

**Life History and Injury:** The winter is spent in the leaf mines as maggots. In early spring transformation takes place in the mines. The flies emerge throughout the month of May. The eggs in the midrib hatch and the larvae form small linear mines by fall. Most of the larval feeding is done in early spring, and it is not until then that the long winding mines become very noticeable.

**Control:** Breakey (1939) reports that Downes (1931) suggests the use of a 2 per cent nicotine dust while the flies are present on the trees—that is, during May. This dust should be applied at weekly intervals until the fly emergence is complete. Breakey (1939) outlines a poisoned bait spray as used for cherry fruit fly, but does not indicate whether trials were actually made on the leafminer.

**SAWFLIES**

*Pear slug*

*Caliroa cerasi* (L.)

The pear slug is one of the most serious pests of cherry, hawthorn, and pear in nursery plantings. It is widespread and often causes much concern.

**Hosts:** Cherry, hawthorn, mountain ash, pear, prune, and quince are hosts.

**Description:** The adult sawfly is a four-winged, wasplike insect, shining black in color, and about ½ inch long. The wings are slightly tinted with brown. The larvae are covered with a heavy coating of shiny slime, are olive green to black in color, and are about ½ inch long when full grown. The eggs are white and disk-shaped and are laid in the upper surfaces of the leaves where they look like small blisters.

**Life History and Injury:** The winter is spent in the soil within earthen cells. There are usually two generations a year. The first brood of larvae is most abundant during June and July and the second brood in August and September. The larvae work on both sides of the leaves but mostly on the upper side where they eat the
leaf surface, leaving nothing but the leaf veins. This skeletonizing often gives a badly infested plant the appearance of having been scorched.

**CONTROL:** This insect is very easy to control. Any of the poison sprays such as lead arsenate, cryolite, or nicotine and soap give good results.

Dusts of lime alone or lead arsenate with an inert carrier also give excellent control.

**Bristly rose slug**
*Cladius isomerus* Norton

**Rose sawfly**
*Caliroa aethiops* (F.)

Bristly rose slug and rose sawfly, two species of rose slugs, often cause serious injury to rose leaves in Oregon. At least, it is certain that there are two species answering the description of these pests.

The larvae of the bristly rose slug are sluglike, greyish white in color, and are covered with many stout hairs. The eggs are laid in slits in the midrib on the upper leaf surface. The larvae first feed by skeletonizing the undersides of the leaves but make holes in and devour entire leaves as they get larger. In summer, transformation takes place in trash on the ground or on the bushes, while the winter cocoons are found in the soil. There are generally several generations a year.

The rose slug larvae are yellowish green in color and have a slimer appearance. They feed on the upper surface of the leaf only, and remove the entire surface except the veins and lower epidermis. The eggs are laid in slits on the underside near the edges of the leaves. Transformation takes place in the soil, and there is but one generation a year.

These pests are easily controlled with any poison dust or spray. Lead arsenate is the most common poison used.

**Coiled roseworm**
*Enophylus cinctipes* Nort.

There are no known records of coiled roseworm occurring in Oregon on growing plants but what has been taken to be its injury in rose stems has been intercepted. It is very likely that it may at some time become established.

The larvae are similar to the other two rose slugs but are not covered with hair. The eggs are laid in the blade of the leaf in the upper surface. The young larvae at first skeletonize the lower leaf
surface, but devour the entire leaf as they grow larger. This insect gets its name from the characteristic coiled position the larvae take when at rest. The larvae transform in the pith of the pruned ends of the host.

This pest may easily be controlled with poison sprays or dusts. The destruction of winter prunings is helpful in keeping them in check.
Native currant-worm

_Gymnonychus appendiculatus_ Hartig

What is supposedly the native currant-worm often causes severe defoliation to gooseberries and often currants. The life history is very similar to the imported currant worm and so is the control. The larvae in this species are uniform green in color instead of being spotted.

California pear slug*

_Gymnonychus californicus_ Marliatt

The California pear slug is not common but occasionally occurs on pears in nurseries. It is a green worm about ½ inch long when full grown. It eats more or less circular holes in the edges or the middle of the leaves. Hibernation takes place in parchmentlike cocoons in the soil, and the adults emerge in early April to lay their eggs in the leaves. The larvae feed in April and May and when mature drop to the ground to emerge again the following spring. Lead arsenate spray is the recommended control.

Cherry stem borer

_Sintylenphytus pacificus_ MacGill

The cherry stem borer sawfly has been reported from Multnomah County in Oregon. The larvae bore down the pith of cherry stubs left by pruning. They do this to transform to the pupal stage. The larvae, when full grown, are bright green from above with a series of dark brown transverse lines along the body. The body of the adult insect is coal black with white to yellowish markings on the legs. It is 7 to 9 millimeters long. They pupate about the latter part of February and emerge during March. Nothing more is known about the life history, hosts, injury, or control.

Willow leaf gall sawflies

_Pontania parva_ (Cresson) and other species of _Pontania_

The group of sawflies of the genus _Pontania_ make globular to oblong greenish to red galls on the leaves of various willows. The eggs are laid in the leaf tissue and cause a swelling to form. The larvae work in these galls and, when development is complete, drop to the ground to transform. Little is known about the life history and control of these pests.

Imported currant worm*

_Pteronidea ribesii_ (Scop.)

The imported currant worm sawfly, the adults of which are brownish black and about ¾ inch in length, is often abundant in the
larval stage on currants and gooseberries. The larvae are green with black spots and about ¼ inch long when full grown. The larvae cause severe defoliation at times. The winter is passed in cocoons in the ground, and the adults emerge about blossom time and attach their eggs end to end in rows on the under sides of the leaves. There are at least two generations a year.

Control consists of a lead arsenate spray applied when the worms are in evidence.

_Pteronidea thoracica_ (Harrington) larvae feed on the leaves of service berry and chokecherry in Oregon. Nothing is known of the life history or control.

**Hemlock sawfly**

*Neodiprion tsugae* Midd.

The hemlock sawfly is at times a very important defoliator of western hemlock in Oregon. The larvae are green in color and about 1 inch long when full grown. They transform in papery cocoons on the needles and debris on the ground. The adults are only about ¼ inch long; the males are blackish and the females green to brownish.

**CIMBICID SAWFLIES**

*Cimbicidae*

**Pacific sawfly**

*Cimbex pacifica* Cresson

The large caterpillar-like Pacific sawfly feeds on the leaves of willow in Oregon. The adults are reddish in color, are nearly 1 inch long, and look very much like an over-sized drone bee.

**ANTS**

*Formicidae*

Numerous species of ants occur in Oregon, many of which are more or less closely associated with plant lice. Definite instances are known where ants actually care for aphids in one way or another but in most cases ants are associated with aphids for the reason that aphids secrete a sirupy substance called "honeydew" that ants apparently like very much. The ants may therefore be considered a nuisance in most instances rather than a pest on nursery and ornamental plants. There are, of course, some species of ants that are actual pests such as carpenter ants and others that occur in houses.

For those ants that build mounds or nests, an ounce of granular calcium cyanide, placed in the mound and then covered up, will usually kill out the colony. Carbon bisulphide poured into the en-
trance at the rate of one ounce per mound, and the entrance thoroughly plugged up, has also given satisfactory control.

Most species of ants that consort with aphids like sweetened materials. Sweetened baits containing tartar emetic is useful for destroying these ants. A bait consisting of one ounce of sugar and \( \frac{1}{4} \) ounce of tartar emetic dissolved in \( \frac{1}{2} \) pint of water has given good results. This bait can be placed in small containers where the ants are present, care being taken to keep children and pets away.

**RED SPIDER MITES**

*Tetranychidae*

**Common red mite**

*Tetranychus spp.*

The mites of the genus *Tetranychus* are very common and destructive to a large variety of hosts in Oregon. There are a number of distinct species but since all species are more or less similar in appearance and mostly so in habits, injury and control, they will all be discussed together.

**Hosts:** These mites attack nearly all deciduous trees and shrubs, many evergreen broadleaf plants, and most of the common varieties of juniper, arborvitae, spruce and so-called cedars. In fact, there are very few plants that do not at some time or other suffer injury from this group of mites.

**Description:** The adults are eight-legged and average about \( \frac{1}{30} \) inch in length. The immature forms are six-legged. The color varies all the way from light yellow to pink, red, green, and dark brown; many have paired blackish spots on the abdomen. The eggs are straw-colored and more or less globular in shape; they are laid on the undersides of the leaves among the webs.

**Life History and Injury:** Most or all of these mites overwinter as adult females in the trash and debris near their host plants. In the spring, beginning about May, they migrate to the leaves where they lay eggs. In the spring, while the weather is cool, reproduction is slow but as the weather becomes warmer, a complete generation may develop in 10 to 14 days. There are several generations a year, the number depending on weather conditions. Mites generally reach their greatest abundance during the latter part of July and in August.

Injury consists in devitalization of the plants by the spiders scraping and sucking the juices from the under sides of the leaves. In the injury of these species the leaves are generally profusely covered with webs on the under sides where the mites feed and repro-
duce. The upper sides of the leaves generally have a stippled effect, and where injury is severe, a grayish silvery cast develops. In many cases, the leaves curl up and drop prematurely. On conifers, the bright green or blue color of the needles turns to a dirty grayish brown.

CONTROL: Cultural operations which tend to keep plants in a vigorous, healthy condition help greatly to prevent injury by these mites. In the summer, when mites first begin to appear, a light-medium summer oil spray (1 1/2 gallons of oil to 100 gallons of water) gives good control if the mites can be contacted. Dusts sold under the trade names of DN-4 and DN-8, if properly applied, give excellent control. (These dusts consist of the dicyclohexylamine salt of Dinitro-ortho-cyclo-hexylphenol diluted with an inert carrier.) Care must be exercised in their use as severe burning may result during
hot weather; many plants are susceptible to injury by these dusts so preliminary trials should be run before large numbers of plants are dusted. Sulphur dusts and sprays have been recommended for control of these mites, but under the conditions in the Willamette Valley the results are not satisfactory because of the relatively cool climate.

**European red mite**

*Paratetranychus pilosus* (C. & F.)

The European red mite is very common throughout Oregon and causes considerable damage to many species of plants.

**Hosts:** Attacks most species of fruit trees and many broadleaf and coniferous ornamental and nursery trees and shrubs.

**Description:** These mites are slightly smaller than the common red spider mites and are reddish brown in color. They have several rows of conspicuous spines on the back. The eggs are red, onion-shaped little objects with a white curved stalk about the height of the egg located on the central top side. The eggs are not usually associated with a great deal of webbing as in *Tetranychus*.

**Life History and Injury:** The winter is passed in the egg stage. The eggs are laid in large numbers in the axils of branches, twigs, buds, and around other roughened areas. The eggs hatch in the spring when the leaves are forming and the mites begin feeding on the under sides of the leaves and lay their summer eggs there. These mites spin very little webbing in contrast to the *Tetranychus*, but the leaf injury and resulting symptoms are similar. There are a number of generations annually.

**Control:** Dormant oil sprays applied for the eggs give very good control if thorough coverage is obtained. The summer control measures are the same as for the common red spider mite.

**The spruce mite**

*Paratetranychus ununguis* Jacobi

The spruce mite is reported by Chamberlin (unpublished notes) to occur occasionally on Sitka spruce in western Oregon and in large numbers on lodgepole pine in eastern Oregon. Elsewhere, it has been reported on pine, spruce, hemlock, and arborvitae. What is taken to be this species is at times very abundant on spruce in the Portland area.

The mites are dull green to nearly black with a pale stripe on the back. The eggs are brownish and more or less flattened. The winter is passed in the egg stage. This mite spins rather profuse webs and causes a graying or browning of the needles. See the European red mite for control.
Southern red mite*
*Paratetranychus ilicis* McG.

What has tentatively been determined as the southern red mite is very common on camellia in greenhouses and at times under outdoor conditions.

Hosts: In Oregon this species has so far been found only on camellia while elsewhere it attacks a number of other hosts.

Description: The appearance of the mites and eggs is very similar to the European red mite.

Life history and injury: In greenhouses this species breeds continuously; under outdoor conditions, the winter is passed in the egg stage. The eggs are laid on the under sides of the camellia leaves, and the mites work on the upper side causing a reddish brown russeting.

Control: Same as for European red mite.

Boxwood mite
*Neotetranychus buxi* Ries

The injury of this small greenish to brown boxwood mite is very common throughout the Willamette Valley. The injury consists of small whitish streaks on the upper surface of the leaves, giving the appearance of pin scratches. The eggs apparently are always laid on the under sides of the leaves, and the mites seem to do all their damage on the upper surface. The life history and control of this mite has not been investigated in Oregon.

Clover mite*
*Bryobia praetosa* Koch

The clover mite attacks practically the same hosts as the European red mite and in many ways is similar in biology and injury. It is a common species though it is seldom seen.

Hosts: Many fruit, ornamental, and garden plants are hosts.

Description: The mites are about 1/40 of an inch in length and are generally reddish, brownish, or green in color. The legs are nearly as long as the body, which characteristic easily distinguishes this mite from other common forms. The eggs are similar in appearance and are laid like those of the European red mite.

Life history and injury: The mites overwinter as eggs on the crotches and other portions of their hosts and hatch about the time the leaves are breaking out. There are a number of generations a year. The mites feed on the upper surface of the leaves at night and hide on the twigs and branches in the daytime; for this reason
the injury is often noticed long before the mites are discovered. The injury consists in a silvering of the upper leaf surface.

CONTROL: The same as for the European red mite.

**BLISTER OR GALL MITES**

*Eriophyidae*

**Pear leaf blister mite***

*Eriophyes pyri* Pgst.

The microscopic pear leaf blister mite is widely distributed and occurs abundantly where no regular spraying schedule is followed.

Hosts: The most important host by far is pear but the mite has also been observed on apple, mountain ash, cotoneaster, and *Amelanchier.*

Description: This mite is only about 1/100 inch in length and can barely be seen with the naked eye. It is whitish in color and long and slender.

Life History and Injury: The mites overwinter under the bud scales as adults or nymphs. The mites become active at the time the buds swell or soon after and attack the developing leaves. The eggs are laid in the buds and among the small hairs on the leaves. There may be a number of generations a year, depending on the locality and weather. The feeding of the mites on the surface of the leaves causes a scabbing and erinose condition and the feeding
Figure 81. Pear leaf blister on pear.

Figure 82. Walnut blister mite on English walnut.

inside the leaves causes a green or reddish blister which turns brown or black toward the end of the season.

**CONTROL:** Effective control can be obtained by spraying with a dormant lime-sulphur solution. Sprays may be applied any time after most of the leaves have dropped in the fall or in the spring before any buds have begun to open.

**Linden gall mite**
*Eriophyes abnormis* (Garrman)

Linden gall mite forms beautiful red to greenish pocket galls on the upper surface of the leaves of linden. The galls are about 3/16 inch long. It is quite common in the Willamette Valley but is of no particular importance. Dormant lime-sulphur sprays are suggested for control.

**Filbert bud mite***
*Eriophyes avellanae* (Nal.)

The very small filbert bud mite attacks and causes an enlargement of the buds of filberts and hazelnuts in the Willamette Valley. When it becomes abundant, it may attack most of the buds on a tree and prevent formation of leaves and nuts. No proved remedy is known but dormant lime sulphur spray has been suggested as a control.

**Grape erinose mite**
*Eriophyes vitis* (Landois)

Grape erinose mite makes a yellowish to brown erineum on the under sides of the leaves of grapes and thus causes the upper surface
of the leaves to become distorted with swellings. It has been found in various parts of Oregon but has not been of any economic importance. The mites overwinter under the bud scales. Dormant lime sulphur spray is said to be an effective control.

**Walnut blister mite***

*Eriophyes tristriatus erineus Nal.*

The walnut blister mite is widespread in Oregon. English walnut appears to be its only host. It causes a dense yellow or brownish erineum in a concave pocket on the under sides of the leaves. This makes a convex blisterlike swelling on the upper sides of the leaves. This is an extremely small mite which is of no particular economic importance. It overwinters in the buds and may be controlled with dormant lime sulphur sprays applied late in the fall or early in the spring.

**Blackberry mite**

*Eriophyes essigi Hassan*

The blackberry mite is widespread in various species of *Rubus* in Oregon. Its main injury occurs on evergreen and Himalaya blackberries where it causes the so-called “red-berry disease.” Nurserymen growing blackberries should spray the plants with lime sulphur (8 gallons to 92 gallons of water) late in the fall to prevent spreading of the mite. These mites are microscopic in size and overwinter in the buds.

**Maple bladder gall**

Greenish or reddish bladderlike leaf galls about ½ inch in diameter and about ¼ inch long are often very abundant on the leaves of silver maple. No definite determination of these mites has been made but the galls are probably formed by *Phyllocoptes quadripes* Shim. or *Eriophyes confusus* Hodgk. as listed by Felt (1940). The winter is passed under the bud scales and may be controlled with a dormant lime sulphur spray.

**Prune bud mite**

*Vasates fockei* (N. & T.)

Prune bud mite has been found doing serious injury to young prune trees in Oregon. It is similar to the rusty leaf mite.

**Hosts:** Prune is the only host so far noted in nurseries.

**Description:** This mite is barely visible to the naked eye and is tannish brown in color. It is humpbacked, more or less, long, and triangular in shape.
Life History and Injury: During the summer this mite inhabits the developing buds, tender tips and under sides of young leaves. Where infestations are severe the growing tips and buds may be killed, but as a rule the branch development is only stunted. The young leaves and developing buds turn brown or black when severely attacked. It is doubtless spread through budwood as mites can be found in the buds at budding time. It presumably overwinters in the buds.

Control: Summer lime sulphur or wettable sulphur sprays have given good control. Dormant lime sulphur sprays no doubt also give good control.

Rusty leaf mite

Phyllocopites schlechtendali Nal.

The minute rusty leaf mite is widespread and at times causes serious injury to its nursery and ornamental hosts.

Host: Apple, pear, and prune are hosts.

Description: This mite is barely visible to the naked eye, is light tan to whitish in color, and measures less than one-hundredth of an inch in length. It is more or less pear-shaped with numerous transverse striae on the abdomen.

Life History and Injury: This mite overwinters in the buds like the pear leaf blister mite. It works on the surface of the leaves and bark and in the developing buds. It is generally found on the under sides of the leaves, causing a russetting and silvering of the leaves and cracking of the bark. At times it causes the leaves to roll longitudinally, especially young pear leaves.

Control: Dormant lime sulphur sprays give excellent control of this mite. Summer sprays of lime sulphur or wettable sulphur also give good results.

SLUGS

Several species of slugs, of which the gray garden slug, Agriolimax agrestis, is the most important, are serious pests to leguminous cover crops and vegetable and flower gardens. The greatest damage is generally done in cool, moist summers and mild winters.

The other species of slugs of importance occurring in Oregon are listed by Thompson (1942) as: the greenhouse slug, Milax gagates; the reticulated slug, Prophysaon andersoni; Arion hortensis; and Arion ater.

Hosts: The hosts are numerous and varied, and under the proper conditions no plant seems to escape injury.
Figure 83. 1: The recticulated slug, Prophysaon andersoni, enlarged 1½ times. 2: The greenhouse slug, Milax gagates, enlarged 2 times. 3: Eggs of the gray garden slug on soil. 4: The gray garden slug, Agriolimax agrestis, natural size.
DESCRIPTION: Slugs are snails without any apparent shell covering. The gray garden slug is from \( \frac{1}{4} \) to \( \frac{1}{2} \) inch long and varies in color from gray to black. They are covered with a slimy coat which protects them from drying out.

LIFE HISTORY AND INJURY: Slugs apparently reproduce at all times of the year but mostly during mild, moist weather. Each individual is bisexual and is capable of laying eggs. The eggs are pearly yellowish white and are about 1/10 inch in diameter. They are laid singly or in groups under clods and debris.

The greatest amount of injury is no doubt done to plants in the seedling stage. They are especially fond of the leguminous cover crops, but may wreak serious havoc to other seedlings as well as to larger plants. The slugs feed by rasping the tissues from the leaf surface or other plant part and can almost always be connected with their injuries by the trail of whitish shiny slime that they leave in their wake. They often make circular holes in leaves and stems of the tougher plants and may devour tender plant parts entirely.

CONTROL: Most nurserymen and other farmers plant cover crops to enrich their land; it is therefore important to protect these crops from the ravages of these pests.

The most effective method of control is the application of a poison bait to be applied whenever the slugs are present in damaging numbers. This bait usually consists of 1\( \frac{1}{2} \) pounds metaldehyde and 5 pounds calcium arsenate in 100 pounds of bran. The bait may be used either in the loose bran form or in pellets, but the pellet form seems to give more uniform results. The bait should be uniformly broadcast at the rate of 4 to 5 pounds per acre. Several applications of bait may be necessary to obtain satisfactory control.

The ready-made baits may be purchased from most insecticide dealers.

In the home garden, the cleaning up of plant debris, boards, and other places where the slugs hide in the daytime will aid in reducing the numbers of these pests.

SYMPHYLIDS OR GARDEN CENTIPEDES*

_Scutigerella immaculata_ (Newport)

The small centipede-like soil-inhabiting Symphylid pests are often very destructive. They are widespread in Oregon and attack a large variety of hosts.

HOSTS: Roots of an extremely large number of plants are hosts. They do their greatest damage to seedlings but may often attack and severely stunt many nursery trees and shrubs.
DESCRIPTION: The adults are pure white in color and are about 1 inch long. They have 12 pairs of legs when full grown and possess antennae or feelers very similar to those of insects. They are very active and spend their entire time in the soil.

LIFE HISTORY AND INJURY: In Oregon the complete life cycle has not been worked out. The eggs are white and netted and are laid in the soil. These hatch into small white young that are similar to the adults. They apparently follow the soil moisture in the soil. In the spring, or when the ground is moist, they are near the surface and in dry weather may be found farther down. Their injury consists in chewing off the small rootlets and root hairs. In this way they are especially destructive to seedling plants. They often severely stunt older plants also and in nurseries may cause severe losses. As a rule they are found in localized spots of a field, but in many cases large areas may be seriously infested.

CONTROL: Control of these pests is rather difficult and expensive if feasible at all. Flooding in winter has been suggested but has not always proved successful. The use of carbon bisulphide emulsion or treatment with chloropicrin has given good results in some cases. Several new soil fumigants being tried at the present time give some promise of giving fairly cheap successful control. As the control of these pests is rather uncertain in Oregon, and new methods are constantly being tried, the Experiment Station should be consulted for the latest information.

NEMATODES

Heterodera sp.

The miniature white wormlike nematodes are not insects but are generally discussed with them. Therefore, they are included here.

The root-knot nematode is a worldwide species and attacks nearly all ornamentals, fruit trees, and herbaceous plants. The roots of affected plants are generally deformed in some way or other by the presence of galls or other enlarged swellings. The worms live in these galls, and the resulting injury causes the plants to become sickly and often die, especially if the infestation is severe. Many other types of galls found on plant roots are caused by fungi, bacteria, and insects. Careful examination of these galls should be made to determine the real cause, as the nematode, once introduced into the soil, is very hard to eliminate.

These nematodes may be disseminated on the roots of plants or in infested soil.
Control measures are mostly negative. The roots of all imported plants should be closely examined for the galls and rejected if they are found to harbor them. Soil known to be infested should be sterilized before it is transported for use elsewhere.

Under field conditions, satisfactory control may usually be obtained in several ways. Summer fallowing with frequent cultivations to keep the weeds down and the soil as dry as possible will eliminate the pests if the practice is followed for one or more years. Growing of nonsusceptible crops such as wheat, barley, oats or other grains combined with summer fallow has been found to clear the soil of these worms.

Chemicals have recently been discovered that will control these pests. For further information the Agricultural Experiment Station should be consulted.

**SOWBUGS AND PILLBUGS**

*Porcellio* sp.; *Armadillidium* sp.

The familiar sowbugs and pillbugs are often destructive in greenhouses and around flower and vegetable gardens. They prefer moist dark places in which to live. The pillbugs are grayish black in color and roll up in little balls when disturbed; the sowbugs are generally uniformly gray in color and do not roll up. They feed mostly at night and are seldom seen except when they are disturbed under boards on the ground and similar hiding places. They do not seem to be particular about what they eat. They are especially abundant in greenhouses where regular watering is done and they often become a nuisance in the basements of houses.

They feed on the roots and tender stems of plants and often injure young seedlings severely.

Control of these pests is generally accomplished with poison baits. The following bait has been found to be very effective:

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<tr>
<th>Bran</th>
<th>12 pounds</th>
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<tr>
<td>Molasses</td>
<td>½ gallon</td>
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<tr>
<td>Paris green</td>
<td>½ pound</td>
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<tr>
<td>Water enough to make the bait rather sloppy.</td>
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</table>

This bait should be placed in small piles where the pests are abundant. Sprinkling powdered sugar containing 10 per cent paris green over the ground has also been found to be an effective bait. Destroying the hiding places of these pests, such as boards, plant debris, etc., will aid in keeping them from congregating in serious numbers at any one place.
THOUSAND-LEGGED WORMS

Millipedes

The thousand-legged worms are often found in immense numbers in gardens and greenhouses. They usually hide in the daytime and feed at night. There are many species that occur in Oregon, some of which are known to attack the roots and stems of living plants, while others feed mostly on decaying vegetation. They often become so abundant as to be a nuisance by their presence in houses, basements, and greenhouses.

Adequate control in most cases may be obtained by spreading a poison bran bait as recommended for sowbugs. Destroying the shelters in which they ordinarily hide, such as under boards and debris, will aid in their elimination.

PLANT GALLS

Many insects and mites cause malformations of various plant parts that are called galls. These galls may be formed on all plant parts and may assume a variety of shapes and colors. Very little is known of a means of prevention of galls or control of the pests that cause them.

An enumeration of the various noneconomic galls would be a major work in itself, so we will here make only a summary of the most pertinent facts. The gall insects and mites of economic importance have been discussed elsewhere.

Several families of insects and one family of mites confine themselves largely to gall making.

The gall wasps, Cynipidae, are small four-winged insects. They make an extremely large variety of galls on oaks. They also make many galls on roses and other plants of this family.

The gall midges, Cecidomyiidae, are small fragile two-winged flies many of which are gall formers. The most important nursery pest in this group in Oregon is the boxwood leaf miner. These midges form galls on a large variety of plants.

The fruit flies, Trypetidae, have two pictured wings. Many of these are gall formers. Many live in the heads of flowers. Other species are important economic pests of fruits, the most familiar of which is the cherry fruit fly.

The plant lice, Aphididae and Phylloxeridae, form many galls on the leaves of plants. The true plant lice (aphids) confine themselves largely to broadleaf plants; the most familiar galls in Oregon are probably those on poplar leaves. The Phylloxeridae confine themselves almost entirely to conifers in Oregon; the most familiar species of this group forms galls on the tips of spruce.
The jumping plant lice, *Psyllidae*, are not important gall-formers in Oregon unless the cupped leaves of the boxwood *psyllid* may be called a gall.

The blister or gall mites, *Eriophyidae*, are an important group of gall formers in Oregon. The most familiar species of this group is the pear leaf blister mite. There are many others in Oregon of economic importance that are discussed elsewhere.

**MOSSES AND LICHENS**

Trees and shrubs often become covered with lichens and moss that give the plants an unsightly appearance. The following suggestions for control are standard recommendations:

Sprays should be applied during the dormant season when all danger of causing leaf injury is obviated.

**LIME SULPHUR**: Lime sulphur is used to advantage when there is also an insect pest problem with which to cope, such as scales, aphids, and other forms overwintering on the trees. Twelve gallons of 32° Baumé lime sulphur should be used in every 100 gallons of spray.

**BORDEAUX MIXTURE**: Where there is no insect problem, this material should be used at the rate of 12-12-100. Bordeaux is probably the more effective of the two sprays on the epiphytes as well as an aid in the control of fungus diseases.

**CAUTION**: Filberts should not be sprayed during pollination, but may be sprayed between pollination and leafing.

**SOURCES OF INSECT INFESTATIONS**

The nursery business offers an ideal means for the importation, exportation, and dissemination of noxious pests of plant materials. All imported plants, whether from within the state or from other states, should be carefully examined for pests. If pests are present, the plants should be properly treated for their destruction. Fumigation with methyl bromide or cyanide and dipping in various insecticidal solutions offer the best means of treatment. A little precaution at first may save untold trouble later. If any one should doubt this last statement, he need only to look at a list of economic pests—very few of the important ones are native to the state.

Pests may be imported in any stage—egg, larva, pupa, or adult. These stages may be found on almost any plant part, in the soil around the roots, or in packing cases. Careful examination of all imports and exports is good business for you and your customer.
The many and varied natural causes that help to keep our insect and related enemies more or less in check are not generally appreciated. If these natural control factors were not present, the struggle for existence between man and the insects might come out with the latter the winner. A few of the insect scourges that are ordinarily subdued by beneficial insects and other natural causes are here listed as examples of natural control.

**Beneficial insects**

Cutworms of several species have destroyed thousands of acres of growing crops in outbreak years. Parasitic wasps and flies ordinarily keep those pests under control.

Spruce aphid is a species of plant louse that has destroyed thousands of acres of Sitka spruce on the Oregon coast. It is ordinarily held in check by ladybird beetles, Syrphid flies, and small parasitic wasps.

Tent caterpillars often completely defoliate willows and alders at regular intervals in western Oregon. Parasitic flies and wasps generally keep these in check.

Hemlock looper on the Oregon and Washington coasts has caused the loss of nearly a billion board feet of hemlock, spruce, and Douglas-fir in the last 60 or 70 years.

The oak looper sporadically defoliates large numbers of Garry oak in the Willamette Valley. This and the hemlock looper are largely kept in check by parasitic insects.

Numerous other cases could be cited where insects suddenly appear in alarming proportions and then as suddenly subside.

**Natural control factors**

Following is a brief discussion of the more important natural control factors:

**DISEASES**: Numerous bacterial, fungus, and so-called virus diseases kill countless numbers of insects. The most familiar of these in Oregon is a fungus that kills aphids and causes them to turn yellowish brown.

**BIRDS**: A number of species of birds confine themselves almost entirely to insect food while others eat insects along with other fare.

**WEATHER CONDITIONS**: Climatic and weather conditions play an important part in keeping many potential pests from establishing themselves. Many of the serious pests of the south are unable to live under Oregon outdoor conditions. Extremely cold weather at times
contributes to the killing of noxious pests; this is especially true when temperatures take a sudden drop.

**Other pest enemies:** Snakes, frogs, lizards, centipedes, spiders, some mites, moles, many rodents, bats, and certain other animals destroy myriads of insects.

**Insect predators**

Insect predators are some of the most important insect enemies. They include the following:

Ladybird beetles, adults and larvae, confine all their activities in Oregon to the destruction of insects and other pests. They are partially responsible for keeping plant lice, scales, and mites under control.

Ground beetles, *Carabidae*, rove beetles, *Staphylinidae*, leather-winged beetles, *Cantharidae*, and soft-winged flower beetles, *Melryidae*, are some of the other predaceous beetles most commonly found in nurseries and on ornamental plants.

Lacewing flies of various families are voracious feeders on aphids and other small pests.


Many families of flies are all or in part predatory. The following are some of the more common:

Syrphid fly, *Syrphidae*, maggots are extremely important predators of aphids and scales.

Robber fly, *Asilidae*, adults devour many noxious pests, but they also destroy beneficial insects.

Beefly larvae, *Bombyliidae*, are common predators of grasshopper eggs, cutworms, and other insects.

Stiletto flies, *Therevidae*, dance flies, *Empididae*, and long-legged flies, *Dolichopodidae*, are common flies that are mostly predators as adults.

**Insect parasites**

The large majority of insect parasites are flies and wasps. These parasites are one of the prime factors in keeping insect pests under control. Man has introduced and propagated many of these artificially for the suppression of certain pests.

Tachinid flies, *Tachinidae* or *Larvaevoridae*, and other closely related families are extremely important parasites of many pests, especially moths and butterflies. In Oregon a species has been propagated for the control of the European earwig.
Many families of small wasps, most of which belong to the superfamilies Ichneumonoidea, Chalcidoidea, and Serphoidea, are the most common and important parasites of noxious pests. If it were not for these small wasps, it might indeed be a sorry world to live in.

In California and eastern United States a wasp is now being propagated and liberated for the control of the Oriental fruit moth. This very serious pest has only recently been found in Oregon.

INSECTICIDES AND THEIR USE

The following is a brief discussion of insecticides and materials used in conjunction with them: Their use, as here described, applies to Oregon conditions only. For a more detailed discussion, Oregon Agricultural Experiment Station Bulletin 393, Sprays, Their Preparation and Use, should be consulted. This bulletin discusses most of the commonly-used insecticides and how to use them.

CONTACT INSECTICIDES

Nicotine

Nicotine insecticides are compounded in various ways but the most commonly used form is nicotine sulphate in spray or dust form. Free nicotine is becoming quite common, but very little has been used in Oregon to date.

Nicotine Dusts: These dusts are usually made with hydrated lime as the carrier. The most common strength is 4 per cent actual nicotine (10 per cent nicotine sulphate). The weaker dusts of 2 and 3 per cent are at times suitable but are not usually recommended. Nicotine dusts are used almost entirely for the control of aphids and other soft-bodied insects.

Nicotine Sprays: Nicotine sprays are used for the same purpose as the dusts. The most common dilution is one pint in 100 gallons of water with 3 pounds of soap. The soap acts as a spreader and releases the nicotine from the sulphate radical.

The best results with nicotine are obtained when the temperatures are high. It should be used only when the temperature is 70° F. or over.

Rotenone

Rotenone is derived from the roots of several species of tropical plants. The three most common sources go under the names of Cubé, Derris, and Timbo. Numerous experiments have been conducted to ascertain whether rotenone derived from one source is more effective than others. There may be slight differences in effectiveness but for all practical purposes, rotenone is rotenone, provided
the proper concentration is present in the finished product. This insecticide apparently acts both as a contact and stomach poison and therefore finds a wide use.

**Rotenone Dusts:** The usually recommended concentration for rotenone dust is .75 per cent although .50 per cent is effective against a few insects such as spittle bug. Very little added control is obtained by stepping the percentage above .75 per cent, at least for the pests occurring in Oregon. Rotenone finds few uses in nurseries, but in garden, field, and fruit crops it is widely used.

**Rotenone Sprays:** These sprays may be made either with the concentrated powder form or from extracts of this powder. The powder is used in combination with a wetting agent while the extracts are usually proprietary products ready for use in the spray tank.

**DDT**

The new insecticide, DDT (dichloro-diphenyl-trichloroethane) has received wide publicity in the past two years. It deserves this publicity as this synthetic organic chemical offers great possibilities in certain fields of insect control. It seems to be "what the doctor ordered" in the field of control of many household insects and those affecting man and animals. For the control of agricultural insect pests, there are many instances where it can be used to advantage and with better results than other known insecticides. This field of research, however, is so new that DDT should be applied with caution and under the direction of competent authority. This note of caution is here added because of the danger of killing beneficial insect species. Where DDT is used promiscuously pests such as red spider mites may develop into a more serious problem than the one for which the control was originally used.

At present DDT is sold in many forms, the most common of which are:

1. Wettable powders containing 20, 25, 40, or 50 per cent DDT. These are used as water sprays.
2. Oil emulsions with varying percentages of DDT for use in water sprays.
3. Miscible oils with varying percentages of DDT for use in water sprays.
4. Oil solutions with varying percentages of DDT to be used as prepared for the control of flies and other household pests such as bedbugs, fleas, etc.
5. DDT dusts of varying strengths (mostly from 1 to 10 per cent). A number of inert diluents are used in these dusts depending on the intended use and the brand.
6. DDT in combination with other insecticidal materials are also manufactured in dust or liquid form.

The most commonly used materials for agricultural pest control are the 5 per cent dust and the 50 per cent wettable powder used at the rate of 2 pounds per 100 gallons of water.

**Sulphur**

Lime Sulphur (liquid) as ordinarily sold is made up in a concentrated form with a density of 32° Baumé. For dormant scale control, 12 gallons of lime sulphur should be used in every 100 gallons of spray. Ten gallons of lime sulphur is usually sufficient for pests other than scales. Summer sprays of lime sulphur are used at the rate of 3 gallons per 100 gallons of spray.

Lime Sulphur (dry): There is some disagreement as to the amount of this material that will be equivalent to 1 gallon of 32° Baumé liquid lime sulphur. Some authorities say 3 pounds, some say 4 pounds. It is, therefore, suggested that 3½ pounds be used to equal 1 gallon of the concentrated liquid.

Sulphur (dusting): Sulphur is often recommended for control of diseases and such pests as red spider mites. There are many brands on the market, most of which conform to the standards required for a good product. These sulphurs are generally sold with specifications that 90 per cent will go through a 325-mesh screen.

Wettable Sulphur: Materials sold under the name of wettable sulphur are finely ground sulphurs in which are incorporated certain chemicals that make them wettable. They are generally used for disease control and for spider mites. The usual recommended dosage is 3 to 5 pounds per 100 gallons of water.

Many other sulphur insecticides and fungicides are in use, but those here discussed are the ones commonly employed under Oregon conditions.

**DN compounds**

DN compounds (trade name) contain the chemical dinitro-orthocyclo-hexyl-phenol or a dicyclohexylamine salt of this compound. Their use is generally recommended for spider mite control. They have a distinct tendency to burn certain plants, especially if the temperatures are high, so care must be exercised in their use. The most generally used materials contain from 1 to 2 per cent of active ingredient incorporated on an inert diluent.

Another series of compounds consisting of a cresol derivative instead of phenol are sold also for insecticidal use. In general, they are less efficient for spider mite control and have a greater tendency to burn.
Several spray materials sold under proprietary names contain the foregoing active ingredients. One material is commonly used for spider mite control during the growing season while the large majority are used as dormant sprays for scale and aphid egg control. None, or very few, of the dormant sprays are in general use in Oregon as yet.

Oil sprays

Most of the oils used by nurserymen and home gardeners are proprietary emulsions or miscible oils ready for use, so no mention will here be made of the making of home-made oil sprays. Directions for use by the manufacturer should be closely followed.

Dormant oil sprays: The oils used for this purpose are not as highly refined as the summer oils and therefore should be used only where recommended and only for dormant spraying on deciduous trees—not on conifers. The usual strength of dormant sprays is 4 per cent actual oil in 100 gallons of spray. They are used for scale control and for insect eggs of various kinds. Oil sprays should not be used during freezing weather and should be applied only when the plants are absolutely dormant.

Summer oil sprays: The oils used for this purpose should be highly refined to prevent plant injury. For general use on conifers and most broadleaf evergreens the oil specifications should be: Sulphonation test 90 or over and viscosity 65 to 70. These oils are generally used at the rate of 3 per cent actual oil in 100 gallons of water.

For use on the more tender plants such as deciduous trees and shrubs, the specifications of the oil should be: sulphonation test 94 to 96 and viscosity 55 to 60. These sprays are generally used at the rate of 1 to 1\(\frac{1}{2}\) per cent actual oil in 100 gallons of water.

Summer-oil sprays should not be applied during bright sunny days or when the temperatures are 85° or over as excessive plant injury may result.

Oil sprays in combination with other insecticides are often used to advantage. The combinations that can be used may be found in the compatibility discussion.

Thiocyanates

Several organic thiocyanate compounds, the most common of which are sold under the trade names Lethane and Loro, are widely used as contact insecticides for the control of plant lice and other soft-bodied insects.

The group of insecticides sold under the name Lethane insecticides are commonly used in either spray or dust form. No definite
recommendations are given in this bulletin other than that it often is advantageous to use these as a substitute or alternate for nicotine. Loro is usually used in spray form.

Directions for the use of the above products are given on the containers in which they are sold.

Selenium

One or more proprietary products that contain selenium are on the market. These products are recommended for the control of spider mites. Because of the danger in the use of compounds of this element, no recommended use of it has been made in Oregon.

Pyrethrum

Pyrethrum insecticide is a natural product derived from the flower heads of a species of Chrysanthemum. It is used as a contact spray or dust and finds its widest application in the control of flies and mosquitoes. These fly sprays are effective also against such pests as moths and may be used to advantage in greenhouses.

The only nursery and ornamental pest on which this material is recommended is the cotoneaster webworm.

STOMACH POISONS

Arsenicals

There are many different types of arsenical compounds used for insecticidal purposes. A few of the more common forms are discussed.

Lead arsenate (as also calcium arsenate) is colored pink to indicate that it is poison. It is used as either a dust or a spray. The dust is usually used in a 40 per cent form. The spray recommendations usually call for 3 or 4 pounds per 100 gallons of water.

The standard lead arsenate (acid lead arsenate) is the more common form and is used unless specific directions call for basic lead arsenate. The basic form is recommended for spraying peaches as the acid form causes severe injury.

Calcium arsenate is cheaper than the lead arsenates and is generally recommended for dusts when the plants on which it is to be applied are not susceptible to burning. The widest application in Oregon is for control of potato insects such as flea beetles. No recommendations for control of nursery or ornamental insects are advisable.

Paris green, sodium arsenite, and arsenic trioxide at the present time are used mostly in the formulation of poison baits. They are too toxic to plants to be used in either spray or dust forms.
Fluorine insecticides

Cryolite (sodium fluoaluminate) is widely used as an insecticide in both dust and spray form for the control of chewing insects. It causes very little plant injury and is therefore safer to use in certain cases than other common insecticides. The dusts are generally used in strengths varying from 40 to 70 per cent. Three to four pounds of cryolite in conjunction with an oil adhesive in 100 gallons of water are usually recommended for sprays.

Sodium fluosilicate is widely used in poison baits at the rate of 5 per cent.

Barium fluosilicate is often substituted for the sodium compound where there is danger of plant injury.

Sodium fluoride is used chiefly in cockroach and ant control.

Tartar emetic

Tartar emetic, an insecticidal compound chemically known as potassium antimonyl tartrate, is widely used in the control of thrips of various species. It is usually applied as a poisoned bait spray. The following formula is the standard recommendation:

- Tartar emetic ........................................ 2 pounds
- Cane or brown sugar ................................ 4 pounds
- Water .................................................. 100 gallons

Honey or sirup may be substituted for the sugar if this is not available. The amount of these materials to use will depend on the concentration of sugar in them.

Tartar emetic is rather insoluble in cold water, so hot water should be used to dissolve it rather than dumping the powder directly into the spray tank.

COMPATABILITY OF SPRAY MATERIALS

Compatibility of spray materials is an involved subject that is too detailed to discuss in this bulletin.

As commonly understood or used, the following spray materials should not be used together:

- Soap with arsenates, fluosilicates, cryolite, lime sulphur, and Bordeaux.
- Lime sulphur with oils or bordeaux.
- Lime with rotenone, pyrethrum, DN, soaps, DDT.

For further information, Oregon Experiment Station Bulletin 393, Sprays—Their Preparation and Use, should be consulted.
SPREADING, WETTING, AND ADHESIVE AGENTS

Spreaders and wetting agents are used in spray materials to increase the spreading or wetting action of the finished spray material. It is often advantageous to use these materials on certain plants and against certain insects that are hard to wet or on which the spray material does not give an even distribution of spray. Many products are on the market for this purpose and several home-made formulae are available. Wherever they are used, it is very important they be used correctly. In most cases, more of these materials are used than necessary, and the result is an undue run-off of spray material. A discussion of all the materials that may be used for the purpose of wetting or spreading would entail a lengthy discussion and is too involved for treatment here. The manufacturers’ recommendation or the recommendations of other informed authorities should be followed.

The materials called adhesive agents are used for the purpose of increasing the adhering properties of powdered spray materials. The most commonly used substances for this purpose are oils. A pint or quart of oil to 100 gallons of water is usually sufficient. In using straight oils the powdered insecticide is first made into a thin paste with water, then the oil is stirred into this paste so that no more free oil is apparent. Fish, vegetable, or spray oils may be used for this purpose. When using oil emulsions as stickers, the emulsion should be first mixed thoroughly with an equal amount of water, then slowly poured into the half-filled spray tank.

FUMIGANTS

Methyl bromide finds wide application in the nursery industry, especially in the exportation and importation of plants. Schedules can usually be worked out where plant pests can be killed without injury to the plant. A concentration of 2 pounds for 3 hours at 70° F. will give almost complete control of the large majority of nursery insects. For further information consult the Oregon Agricultural Experiment Station.

Ethylene dichloride is now being used in some cases for the control of the peach tree borer. The method of application is discussed under that pest. It also shows promise for controlling the poplar and willow borer and is commonly employed in fumigation of stored products.

Cyanide is widely used as a fumigant for the control of certain pests, but no direct application for its use is at hand for the control of nursery or ornamental insect pests under outdoor conditions in
Oregon. The commonly used forms are sodium cyanide and calcium cyanide.

**Paradichlorobenzene (P.D.B.)** is a white crystalline chemical that is commonly used for the control of the peach tree borer. The use of this material is described under that insect.

**Naphthalene** is another white crystalline chemical and is familiar under the name of moth balls. It is widely recommended for the control and repelling of agricultural insects. Most of the claims of its efficacy for the control of insects seem to be ill founded except for the control of wireworms.

**Chloropicrin**, a tear gas, is used extensively in fumigation of stored products and is used widely in agriculture for the sterilization of soil, especially for greenhouse purposes. It is a very effective agent in killing insects, bacteria, fungi, and weed seeds.

**DD mixture** (1, 2 dichloropropane 1, 3 dichloropropylene) is a comparatively new soil fumigant that is very effective for nematode control and for certain soil insects.

**Carbon bisulphide**, which is extremely inflammable, is used for many purposes such as fumigation of stored products, weed control, fumigation of rodent burrows, and for control of soil insects.

**Carbon tetrachloride** is often used in conjunction with inflammable fumigants such as carbon bisulphide and ethylene dichloride to reduce the fire hazard.

**Ethylene dibromide** is another new soil fumigant that gives promise of being very effective in control of wireworm and certain other soil pests.

**POISON BAITS**

Poison baits are used for the control of quite a number of pests. The formulae to be used are described under the respective species.

The ingredients should generally be mixed in a definite order. The dry ingredients first should be thoroughly mixed together in a barrel by turning it over and over, or on a flat surface where the materials can be turned with a shovel. When molasses, sugar, or similar soluble sweet materials are used, they should be dissolved in the water and mixed last with the dry materials. The solution should be slowly sprinkled on the dry materials with constant stirring to obtain an even crumbly product.

Baits containing water with a sweetening agent will mold if stored for any length of time, so no more should be mixed than can be used at any one time. They may be spread out and dried and moistened again when needed, but this is not a good practice.
Baits should never be applied in large lumps or placed in piles as this is a waste of material as well as a hazard to children, birds, and animals. The rate of application is variable, but 10 to 15 pounds per acre is sufficient for all baits discussed in this bulletin.

EQUIPMENT FOR THE APPLICATION OF DUSTS AND SPRAYS

DUSTERS: There are many makes of dusters on the market. The hand dusters are of two types: bellows and rotary fan. For the control of pests on individual plants that are more or less separated from each other (e.g., cabbage), the bellows type is more satisfactory. Where the plants are more or less grown together and there is no intervening space, the rotary fan type is probably more suitable.

Power dusters are of three types: traction, power take-off, and those with independent motors. Of these, the last-named type is generally the most satisfactory, but it costs more and is more expensive to operate. The power take-off type and the traction type are satisfactory for most purposes. The objection to them is that poor coverage is usually obtained at the ends of the rows and quite often variations occur in the amount of dust applied due to the lay of the land and other factors.

SPRAYERS: There are many types and sizes of power sprayers on the market, most of which meet the manufacturer’s guarantee. One of the most common mistakes made by growers is to buy a machine that produces too low a gallonage per minute. Other important factors to consider are the development of pressure, size of tank, width of wheels, and agitation.

Most hand sprayers lack proper agitation. This is very important in the application of oil sprays and those insecticides that must be kept in suspension. For soluble insecticides the agitator is not important.

HOW TO APPLY DUSTS AND SPRAYS

Much of the efficacy of an insecticide depends on how and when it is applied. Too often poor control is laid to the material when the fault is actually in the application.

Following is a brief discussion of some of the more pertinent facts that must be considered when controlling insects.

CONTACT INSECTICIDES such as nicotine and others must actually come in contact with the insect in order to kill. It is, therefore, important to know where the pests are located on the plant and to direct the materials at that place. The mistake most often made is to direct
the material at the upper leaf surface when the pests actually occur on the under side. Contact sprays should be so applied that the entire plant is thoroughly wet. This may take 100 gallons per acre or 500, but the important thing is to do the job right.

Contact dusts are usually applied at the rate of 30 or 40 pounds per acre; on small or low-growing plants this is usually adequate for good control.

**Stomach Poisons** are usually not as hard to apply to get good control as are the contact insecticides. An attempt should be made to get an even deposit over the infested plant part. Dusts are usually applied at the rate of 20 or 30 pounds per acre.

Timing of insecticidal treatments is important. Control should be started when the pests first begin to appear rather than waiting for damaging numbers. It is often cheaper to make several applications than to try to kill all pests at once.

The time of year when control measures for any one pest are undertaken is also very important. Certain pests are most easily controlled during the dormant period and vice versa. Scales as a whole and certain mites and moths are most easily controlled during the winter or early spring, while many other pests are not present on their hosts until the plants begin growing.

**SANITATION AND CROP ROTATION**

Sanitation is often an important means of keeping insect pests in check by destroying their hibernating, breeding, and hiding places. Specific cases may be cited to illustrate the best means of pest control. Slugs, earwigs, sowbugs, and many other pests hide under debris, boards, and similar places during the day; destruction of these hiding places will cause these pests to be scattered more widely. Many beetles and other pests hibernate under debris in fence rows and similar places; destruction of these hibernating quarters is often very helpful in keeping these insects from congregating in harmful numbers. Wild host plants growing near cultivated plants are often a source of infestation—e.g., wild willows infested with the poplar and willow borer serve as a source of infestation for cultivated plants such as birch and willow.

Crop rotation often is very helpful in preventing a serious build-up of certain pests, among the more important of which are root weevils, wireworms, and other soil pests. The practice of rotating crops is also of extreme importance in preventing build-up of certain fungus diseases.
REFERENCES

Much of the information contained in this bulletin has been taken from the references listed below. The author of this bulletin here wishes to express his appreciation for the use of this material.


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