OREGON
Agricultural Experiment
STATION.

BULLETIN NO. 5.

ENTOMOLOGY.

I.---Introductory.

II.---Some Injurious Insects and Remedies therefor.

III.---Experiments with Grain Beetle.

ZOOLOGY.

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APRIL, 1890.

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ENTOMOLOGY.

F. L. WASHBURN.

INTRODUCTORY.

IT is estimated that insects annually destroy over $300,000,000 worth of crops in the United States. Hence the importance of acquainting oneself with the best means of exterminating them, or, at least, lessening the injuries caused by them, cannot be over-estimated.

Less than ten years ago Oregon was comparatively free from injurious insects, but, as we now see, immunity from insect pests cannot always be expected, and the large numbers of the Codling Moth, Peach Borer, Woolly Aphis and other insects present here to-day, are only precursors of more destructive pests which will, almost inevitably, reach us. It is a well authenticated and depressing fact that insects always thrive better in a new home than in the old. Many reports of injuries by the following insects came from different parts of this state and remedies are asked for:

Codling Moth, Woolly Aphis, Green Aphis, Pear Slug, Peach-tree Borer, San Jose Scale, Flat headed Apple tree Borer, Gooseberry Fruit Worm, Currant Borer, Flea Beetle, Pea Weevil, Strawberry crown Borer, Cut Worms and Grain Beetle.

It is in compliance with this demand that the following articles are published, being, necessarily, largely compiled from work done by the government elsewhere and in part the result of work of officers of this Station.

The article on the Grain Beetle (Silvanus surinamensis) contains the results of some observations and experiments at the Station during the past three months, the beginning of a series of experiments to determine some inexpensive and effective means of ridding granaries of this pest.

The article on Gophers and Rabbits is the result of some observations here during the fall and winter just passed, supplemented by the experience of many others in this State, in California and in the East. Many letters reporting injuries by these animals, and asking urgently for remedies, called for a special effort in that direction.

It is the plan to make the Station publications on Entomology, appearing from time to time, a continuous treatise on insects injurious to farm and orchard, on their habits and life histories, and the best means of exterminating them. With this end in view, we suggest that farmers of the State preserve these publications for future reference.

It is confidentially hoped and expected that all active workers will not hesitate to communicate their experiences in combatting insect pests, for it is by such co-operation with the Station force that the best results are obtained.

In the following pages references are made to Bulletin No. 3, issued in October, 1889. That Bulletin was largely taken up with descriptions of spraying machines and cost of same, and with a discussion of insecticides and their uses.

Past Bulletins can be had on application.

Acknowledgments are due Prof. C. V. Riley, of Washington, Mr. B. M. Lelong, of the California State Board of Horticulture, Profs. Wickson, of California and Lugger of Minnesota, for courtesies extended.

THE CODLING MOTH.

So much has been said in Bulletins, through the press, and by lectures, of the habits of this pest, that we will content ourselves here with saying that this moth, producing the apple worm, is about ½ in. long with waving transverse lines of gray and brown on the fore wings and a round tawny spot near the hind border, marked with bronze streaks. The hind wings are brown. It flies entirely at night or in the evening dusk, and is rarely seen; hence the few words of description given above.

REMEDIES.

1. **Spraying.** The first spraying should be done one day after all the bloom has fallen, while the apples are still standing and no larger than peas. Paris Green has given the best results so far, and until we are convinced of a better poison we shall use this. One pound of Paris Green to two hundred gallons of water is the right proportions for this part of the country. Should this burn the foliage, which is not likely, more water should be added. For accounts of the machinery for spraying fruit trees, and suggestions regarding handling of the poison, see Bulletin No. 3, from this station.

As to the number of sprayings to be applied this can be said; if all the orchadists in one locality would unite in the first spraying, and do that thoroughly, that would so effectually kill off the first brood of catterpillars, that subsequent injury would be little or nothing. This would mean, however, most thorough work, in which every man, though owner of only a few trees, should faithfully do his share.

Unfortunately in almost every locality there are some who will not co-operate. They thus allow their orchards to become a breeding place for the moth, and force their neighbors to a continual warfare with this pest.

This being the case, and until the matter is put upon a better basis, we advocate a number of sprayings, as many as seven or eight in this country, where the warm season is so long and the moth so many brooded. We are convinced that before long when the matter is more thoroughly understood and the necessity for concerted action realized, that fewer sprayings will accomplish all that is to be desired, but for the present we think the case calls for very vigorous measures.

We would recommend then, that, after the first spraying, and let that be a thorough one, at the time above indicated, another spraying follow, after an interval of ten

days. Should rain have occurred within two or three days after the first spraying, another spraying should be given immediately, that the poison washed off by the rain may be replaced. The strength of the solution for all sprayings after the first, should be weaker than the first; 1 lb. of Paris Green to from 250 to 300 gals. of water, would be better than a stronger mixture, because of the increased leaf surface and consequent greater liability to burn the foliage. A third, fourth and fifth spraying, with intervals of twenty days between them, should follow the second spraying. A sixth spraying might be applied about the middle of August, and a seventh, on winter apples only, about the middle of September. This ought to suffice if the band system and destruction of windfalls, as outlined below, is faithfully attended to. Of course fewer or more sprayings are necessary according as to whether all or but few farmers in one locality patronize it. I have no hesitation however, in saying that *if every apple tree in one locality were thoroughly sprayed at the proper time, one application, or two at the most, would be sufficient.*

One caution is not out of place here, viz.: Apples on sprayed trees should not be eaten within three weeks of application of the poison.

The poison should be kept well mixed during application. To this end, and to insure a more even spreading of the fluid over the fruit, we would suggest the addition of 3 or 4 lbs. of soft or hard soap to each barrel of spraying solution.

Four gallons of the liquid ought to be enough for a good sized tree, and when that quantity of the poison is used, the cost per tree, for the entire seasons spraying, would be about seven cents. This includes the soap, the expense for which would be trifling, but does not, of course, include cost of labor.

Two extracts from the report of Prof. Forbes, of Illinois, who spent two years on this problem may be interesting; they are certainly to the point. Speaking of the examination of apples from poisoned trees and from others not poisoned he says:

"As a result of the examination of 2,418 apples from trees which had been sprayed with Paris Green, and of 2,964 others from check trees which had not been so treated, it appeared at the end of the season, that 21 per cent. of the poisoned apples had been infested by the codling moth and 67.8 of those not so treated."

And again, as a result of his experiments:

"Attending only to the picked apples and condensing our statement of results to the last extreme, we may say that under the most favorable circumstances, Paris Green will save to ripening at a probable expense of ten cents per tree, seven-tenths of the apples which must otherwise be conceded to the codling moth."

2. Bands. This goes hand-in-hand with spraying, the one supplementing the other. It consists in placing about the trunk of the tree two bands of twisted hay or burlap, the lower band about one foot from the ground; the upper band one and one-half feet above the lower. These bands should be on the trees from June 1st, until as late as Oct. 15th, and should be examined at least once in every five days; the larvae concealed under them should be killed and the bands replaced. The larvae or worms will be found to have made small oval white nests or cocoons between the band and the tree trunk. During the summer months they remain in

this "cocoon stage" only a very few days before becoming moths, hence the necessity of frequent examination of bands.

3. **Destruction of windfalls.** Fence your orchard, if not too large, and let hogs range through it to pick up fallen apples containing the worms; and turn the poultry in to eat the straggling worms which have left the apples and are looking for a place in which to spin their cocoon. Sheep, if not heavily fed otherwise, are better than hogs for they are always on the alert to hear, and run to a fallen apple. They should be supplied with plenty of drinking water, otherwise they will gnaw the trunks of even old trees. This habit of gnawing the trees renders it unsafe to put them in a young orchard. *

In orchards too large to fence the windfalls should be gathered at least twice each week and destroyed by feeding to stock or otherwise. To insure the killing of the worm in these apples, and that none may escape it is desirable to boil the fruit before feeding.

4. **Killing in Storehouses.** Orchardists who have storehouses for their fruit, if they screen the windows and make the building otherwise moth proof, will find in the spring hundreds of codling moths escaping from their cocoons under barrel-hoops, in cracks of fruit boxes, etc., and flying about the store room. These can then be easily killed.

Buildings of this sort, more especially if they are not closed up as above suggested, should be carefully cleaned in March of each year, and all the cracks and crevices should be thoroughly wet with a solution made by saturating chloride of lime with all the coal oil it will take up and thinning with water until it can be applied with a brush. This will penetrate the white cocoons or nests and effectually destroy the larvae or pupae within.

5. **Disinfecting Fruit Boxes.** Boxes in which fruit has been stored through the late fall or winter, should, when emptied, be freed from any trace of cocoons by dipping for two minutes in a *boiling* solution of ¾ lb. of concentrated lye in 20 gals. of water.

WOOLLY APHIS OR WOOLLY LOUSE OF THE APPLE.

Familiar to every owner of an orchard. Found in colonies on both branch and root, and in either place looking like particles of bluish white down. If one crushes a colony under his finger, the latter is smeared with a red fluid which comes from the bruised bodies of the insect. This aphis, as well as others of the family, subsist on the juices of the trees affected, and the woolly aphis, when present in large numbers seriously weaken the trees, and even cause their death. An alarming feature in connection with this insect enemy is the marvelous rapidity with which it produces its young, the colonies spreading quickly from old neglected trees to some of the choicest in the orchard.

NOTE:—Mr J. S. Woodward, of Lockport, N. Y., has kept sheep from gnawing his young trees by washing the trunks once each month with a solution of soap-suds, whale-oil soap, and sheep manure, and giving them plenty of fresh water.

REMEDIES.

See article on woolly aphis in Bulletin No. 3, in which cut of the insect is also found. The remedy given there, 1 lb. of concentrated lye to 3 gals. of water, has proved effectual.

Another excellent remedy is as follows: Melt 4 lbs. of rosin and add to it 3 lbs. of washing soda, then enough water to make 36 pints of the compound. Use one part of this compound to six parts of water. The above is for the branch form. For those frequenting the roots we would recommend the heaping of wood ashes plentifully about the base of tree. And gas lime about two shovelfulls placed around the tree so as not to touch the bark, is excellent. Should gas lime be used, place wood ashes between it and the tree and in contact with the trunk for two or three inches. This prevents infection from the root to the branches.

Cut off and burn all infested shoots coming from the roots.

GREEN APHIS.

The several species, and allied forms, are generally known. For remedies applicable to affected house plants in green houses and conservatories, see Bulletin No. 3.

For the aphids on the plum, prune, apple, turnip, cabbage, etc., use 1 pt. of the rosin compound (given under woolly aphis) to eight of water. Apply thoroughly as spray.

THE PEAR TREE SLUG.

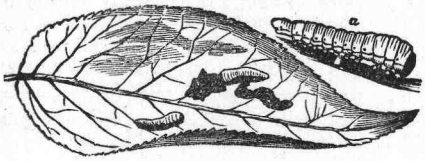

FIG. I.
Pear tree Slug on leaf. *a*, worm enlarged

A small worm, a little over half an inch long when full grown, olive brown and covered with a slimy coating. It feeds principally on the leaves of the pear though found on the cherry, plum and other trees. It eats the upper side of the leaf causing it to wither and fall to the ground. The tree, having to put out new foliage, in consequence, is seriously weakened and the fruit crop impaired. See Fig. 1.

When the slug is ready to transform, it falls or crawls to the ground, enters it a few inches and shortly after changes to a four-winged fly, Fig. 2, which, in turn, lays its eggs in incisions it makes on the leaves.

FIG 2.
Saw Fly Producing Pear tree Slug.

REMEDIES.

Spray the tree, when foliage is full with a solution of one tea-spoonful of Paris Green to 2 gallons of water, using a syringe or watering pot for the purpose. Spray

until the tree drips. This is a very effectual remedy. Fresh air slacked lime dusted on the leaves is good. Dusting the leaves with sand, ashes or road dust, will do some good, but the first remedy is the best. Fruit from the trees treated with Paris Green should not be eaten, of course, for some time after spraying. If no rain follows, two weeks or more should elapse before the fruit is used.

THE PEACH TREE BORER.

A pale yellow grub boring in the bark and sapwood of peach trees at the base about the collar and below. These grubs have a brown head and blackish jaws, and when full grown are half an inch long. Cherry trees and plum trees sometimes suffer from their attacks. Early in May, and probably in the latter part of April, as

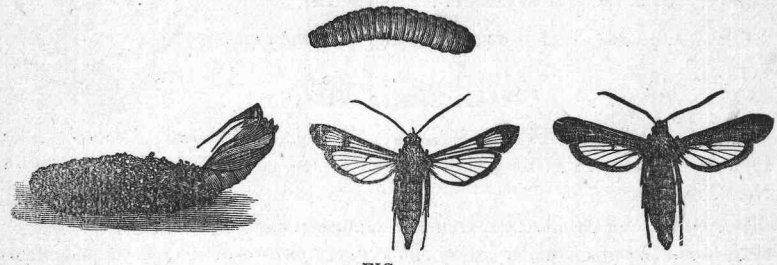

FIG. 3
Male and Female Moth of Peach tree Borer and Larva and Cocoon.

well, the grub turns into a wasp-like moth which at once lays the eggs, usuallly near the roots of the peach trees, which produce the borers or grubs above mentioned. The colors of this moth are still blue and yellow and its wings expand from one, to one and a half inches. A copious exudation of gum from the tree, either just above the ground or just below it, indicates the presence of the grub beneath the bark. This is without doubt one of the worst pests with which Oregon orchardists have to contend.

REMEDIES.

With a knife remove the worm from under the bark in early spring and late fall. Plaster the wounds thus made with clay or wax. Then, to prevent the moth from depositing her eggs on the tree, heap leached ashes or sand round base to the height of twelve inches, or wrap tarred paper about the base of tree extending six inches up the trunk above the surface of the ground, and a few inches below the surface.

Carefully and frequently examine your young peach trees for the grub, looking even at the very base of the trunk below the ground among the roots for the gum which betrays the presence of the worm.

SAN JOSE SCALE.

This is a scale insect which from present reports, seems to be alarmingly on the

increase and bids fair to give Oregon fruit growers as much trouble as it has caused in California.

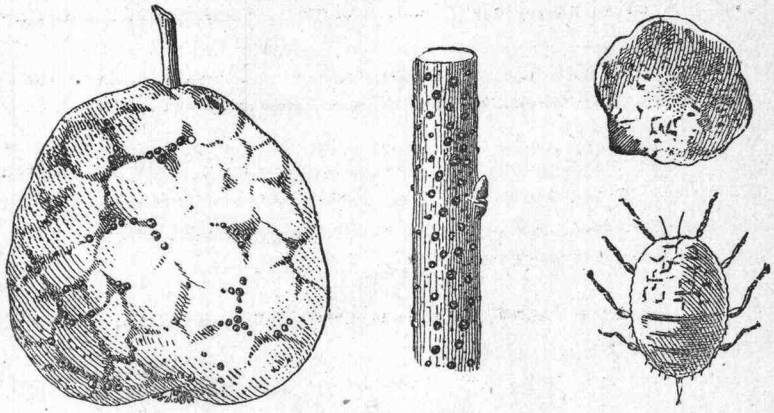

FIG. 4.

Infested Pear and Twig, natural size. The Scale and six legged Larva much enlarged.

The scale is round or oval, about 1-12 in. in diameter and gray, brownish or black and is found congregating in large numbers over branches, twigs leaves and even fruit. It is said not to touch the apricot but does work great injury to the apple, pear and many varieties of plum, prune and cherry. Where the insect is at work there are apt to be red blotches on the bark or fruit. See Fig. 4.

REMEDIES.

The best treatment of affected trees is undoubtedly made in the winter season when it is safe to apply to the dormant trees the stronger remedies mentioned below under winter washes. Nevertheless a remedy which has proved very useful can be applied in summer. This we will call the

SUMMER WASH.

(*a.*) Dissolve 1 lb. of concentrated lye in one gallon of water, add to this 1½ lbs. of sulphur and boil until sulphur is dissolved.

(*b.*) Dissolve 14 lbs. of the best whale-oil soap in fifty-four gallons of water, add solution *a* to *b* and boil for a short time. Use at 130° Fahrenheit, thoroughly washing the trunks and larger branches and spraying the smaller branches and twigs. The above should be applied when the first brood is hatching, about the time the cherries are turning red. About this time look sharply for the young, they are very small yellowish in color, and will be found creeping over the tree. (Fig. 4.)

When discovered use the above wash.

WINTER WASH.

Dissolve 25 lbs. of Sal soda (carbonate of soda) in 25 gals. of water, heating it to boiling. When boiling add to it 1¼ gals. of whale-oil. Apply wash at 130° Fahrenheit.

Three weeks after application, wash the same trees with the following solution: 1 lb. American concentrated lye and ½ lb. of commercial potash dissolved in six gallons of water.

If the trees treated are very large, with much rough bark it will be found difficult to have the spray, penetrate to every part. Hence the need of most thorough work.

Messrs. Baldwin, Taylor & Co., 112 Front St., San Francisco, sell whale-oil for 42½ cents per gallon, and whale-oil soap for 3 cents per lb.

THE FLAT HEADED APPLE-TREE BORER.

This bettle is about half an inch long, somewhat flattened, an oblong in shape, and of a greenish black color. The under parts have coppery lustre.

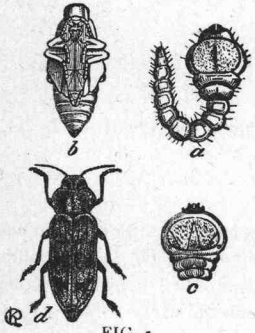

FIG. 5.
The flat headed Apple tree Borer *a*, larva or "borer," *b*, pupa produced from larva, *c*, head of borer, *d*, beetle produced from pupa. (after Riley.)

It lays its eggs during the spring and early summer in cracks and crevices, and under pieces of bark on the apple trees, especially affecting those parts of the trunks of young trees newly transplanted, which have been injured by the sun. It does not confine its attacks to the trunk alone, but also lays its eggs to some extent on the lower branches. It sometimes attacks the pear, the plum, and even the peach.

The egg, hatching, gives rise to the larva, familiarly known as the "borer," which works in the bark and sap wood, often causing great injury. The larva is a yellowish, footless grub, three-fourths of an inch long, with a large, flattened, somewhat rounded head. It bores in the solid wood as well as in the sap wood.

REMEDIES.

Protect the trunks of newly transplanted trees from sun-scald. Examine the trees in the fall and look for the borer where a dried patch of bark, a little oozing sap or sawdust-like castings indicate its presence. Remove it with the knife and kill it. Stop the wound with grafting wax.

In April or May, preferably in the former month, paint the trunk and lower branches with soft soap thinned to the consistency of paint by the addition of a solution of washing soda and a little crude carbolic acid, about one-half pint to a pailful of the mixture.

This should be repeated once or twice during the warm weather.

During the winter months scrape the trunk and larger branches with a three cornered bark scraper, or what is known in meat markets as a block scraper. This removes the old bark in the crevices of which eggs are apt to be laid, at the same time it lays bare to the weather the cocoons or nests of the codling moth.

THE GOOSEBERRY FRUIT-WORM.

This is a green worm about three quarters of an inch long which feeds on the interior of gooseberries and currants. It will often bind, with its silk, a number of gooseberries and currants together and within this snug retreat feed at leisure.

A gooseberry so infested, if not very young, will turn red prematurely, or will, if very immature, become white and withered. These worms are very active and if disturbed will quickly let themselves down by a thread and hide among the leaves, etc., on the ground.

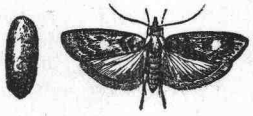

FIG. 6.
Cocoon and Moth produced by Gooseberry Fruit-worm.

REMEDIES.

Pick and destroy all berries coloring before they are matured. After the crop has been gathered, let fowls run among the bushes to seek out and devour the chrysalids or "nests" of the worm. Gather and burn all leaves and other rubbish collecting under the bushes, which might shelter the chrysales through the winter.

Then in the spring when the young fruit is forming, dust air slaked lime over the bushes, repeating it whenever a rain occurs which washes off the lime placed there before.

Or, and this is perhaps better, spray the bushes when the fruit is forming. two or three times at intervals with the following compound:

Boil 1½ gallons of water, add ⅓ lb. of sulphur and boil 15 minutes. To this add a pound of whale oil soap and boil for five minutes. Let stand for a week. When wanted for use mix 1 lb. of the compound to a gallon of water, and apply as a spray at a temperature of 130° Fahrenheit.

THE CURRANT BORER.

A bluish black moth, whose wings, when expanded, measure about an inch from tip to tip.

The female lays her eggs on the stems of currant bushes, and often on those of gooseberries, the egg being deposited usually near a bud. The larva or "worm," on hatching, bores into the center of the stem and feeds on the pitch. It is in this discolored pith cavity, partially filled with castings, that the worm can be fonud.

FIG. 7.
Moth of Currant Borer.

It is half an inch long, white, with a brown head, and a few very small hairs are scattered over its body.

Stems containing the borer become so weakened that a light wind will often break them. Otherwise, somewhat withered leaves and poor fruit indicate the presence of the pest. It is said not to attack stems under one year old. In April or May the borer or worm transforms into a moth, which at once proceeds to lay eggs, from which new borers are produced.

REMEDIES.

During spring and autumn cut out and burn all affected stems. Be sure you burn them. Do this effectually. This pruning and burning prevents the spread of the insect.

Spray the bushes two or three times during April and May with the following mixture of sulphur and whale oil soap, viz: Boil ⅓ lb. of sulphur in two gallons of water for fifteen minutes; add 1 lb. of whale-oil soap and boil for five minutes more. Let it stand a week before using. Apply in some form of spray at a temperature of 130° Fahrenheit. This will keep the moth from laying her eggs on the bushes.

Further, the moths can frequently be caught and killed during the late spring and summer on cool mornings, when they are apt to be sluggish.

It would probably be impossible to completely exterminate this pest, but the above remedies will prove to be a great help.

THE FLEA BEETLE.

FIG. 8.
A Flea Beetle and its larva and pupa.

A small black beetle about ⅛ inch long, which feeds on leaves of turnips, cucumbers, beets, cabbage, etc. I have found them also on potatoe vines. When one attempts to catch them they escape by jumping, which habit gives them the above name.

REMEDIES.

Collect and burn in the fall and early spring all rubbish in corners of gardens which might offer a retreat for this beetle or its larva.

Wood ashes dusted over the leaves drives them away. It has to be repeated. Sprinkling with a solution of lime is effective for the time being.

Sprinkling with a weak solution of Paris Green, 1 oz. to 8 gals. of water is recommended.

THE PEA WEEVIL.

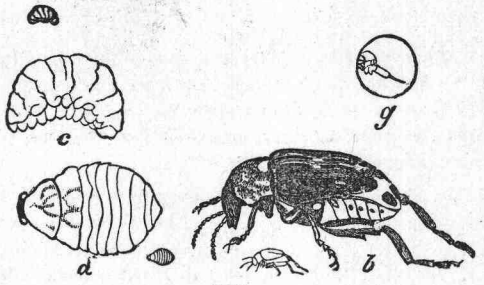

FIG. 9.

b, Pea Weevil enlarged and natural size. *c*, larva, *d*, pupa.

A small beetle about one-fourth of an inch long, grayish, mottled with black and brown, found in seed peas. A round hole is left on one side of the pea, and through this, in most affected peas, the insect can be seen snugly nestling within.

The eggs are laid on the pods of growing peas, and when the larvae or "worms" hatch they bore through the pods into the peas, there feeding until they transform into the beetle described above.

Neither the worm nor the beetle injures the germ of the pea, and infested peas are nearly, if not quite as sure to grow as those not touched.

REMEDIES.

Use care in selecting seed; a patch on a pea a little darker than the rest of the surface indicates that the insect is inside.

If infested seeds are placed, before planting, in an air tight jar, say a quart fruit jar a few minutes, into which two teaspoonsful of bisulphide of carbon has been poured, all the beetles will be killed and the seeds not injured. This method would of course, allow the seed to be planted the same season.

A second remedy is to soak peas in water poured from a boiling tea-kettle for two minutes before planting. Another way is for all the farmers in one neighborhood to omit planting peas one year, if seed is infected, and keep such seed in perfectly air tight vessels until the following season. This kills all the weevils, but the first and second remedies are plainly more practical. In using bisulphide of carbon do not bring it near a light.

A closely allied weevil, the bean weevil, is found in beans. The same remedies apply to it as to the pea weevil.

THE STRAWBERRY CROWN BORER.

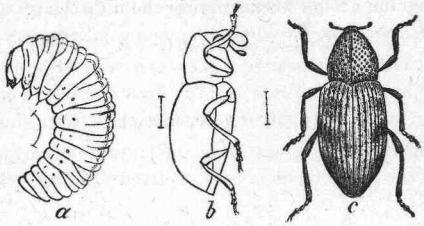

FIG. 10.

a, larva of Strawberry Crown Borer *b*, pupa, *c*, beetle. The lines beside the figures show natural size of insect.

This is a beetle about one sixth of an inch long, and brownish. Its white grub, about one-fifth of an inch long, has a horny yellow head, and bores down into the crown of strawberry plants. It infects chiefly old plants, and at present the only remedy known to us is to destroy old plants infested, or better, the whole bed directly after the fruit is gathered before the grub has time to turn into a beetle.

CUT WORMS.

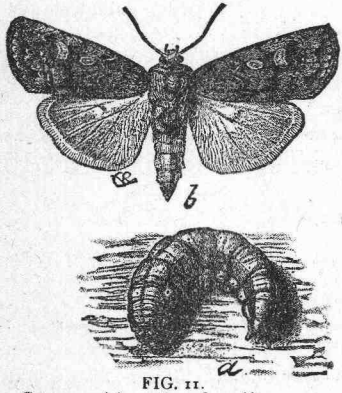

FIG. 11.

Cut-worm (*Agrostis cochranii*). *a*, worm, *b*, moth. (after Riley.)

These are the larvae of a number of different moths which fly at dusk and during the night. The worms are very destructive, eating the roots of strawberries, melons, cabbage, etc., and even climbing trees and vines and feeding on the buds. They are greenish, gray, brown or almost black, and smooth skinned. They work at night and hence are rarely seen.

The sudden wilting and death of a plant is an indication that a cut-worm has been at work there, and he can often be found near the scene of his depredations, not more than a few inches away, buried a short distance below the surface of the ground.

REMEDIES.

Sticking tender pieces of cabbage which have been staked in a solution of Paris Green and water about the infested plants is a very good remedy, and dusting air-slacked lime or ashes over plants will kill some.

Numerous holes with perpendicular sides made round a plant or tree will entrap many, which may be taken out and killed.

Large cabbage leaves spread around the roots of infested plants furnish a good means of destroying them; the worms hiding under the leaves and not entering the ground. The leaves should be raised and the worms killed every morning.

Where trees are seriously threatened the worms can be prevented from climbing them by a piece of tin or zinc cut in a circular form and placed round the trunk, just above the ground, in such a way that it resembles an inverted funnel.

If trees are infested in early spring when the buds are opening, the cut-worms can then be jarred off the limbs upon a sheet placed beneath. This should be done about mid-night.

THE GRAIN BEETLE. (Silvanus surinamensis.)

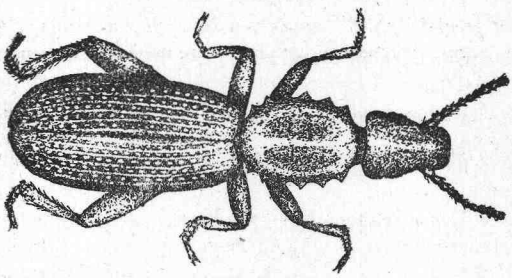

FIG. 12.
Silvanus surinamensis. Enlarged. (W. R. Hull, del.)

This beetle, about one-tenth of an inch long, and reddish brown, is shown much enlarged in Fig. 12 adjoining. It masquerades throughout this state under the name of "Grain Weevil." With it, in varying abundance are found true weevils, which are at present represented in this locality by the species shown in outline in Fig. 13. This weevil is considerably larger than Silvanus.

As flouring mills will not take wheat containing either of these beetles, or any trace of them, it has been a constant cause of expense to owners of granaries to rid their wheat of the pest.

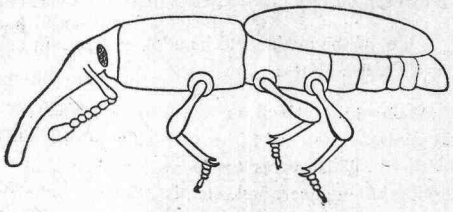

FIG. 13.
Calandra remote-punctata, in outline. Enlarged
(W. R. Hull, del.)

If the wheat is allowed to heat ever so little, or if the granaries are not kept scrupulously clean, the beetles will thrive and depreciate the value of the grain to a considerable extent. Even when these conditions are not present, the little animals will get a foothold and defy the most streunous efforts to remove him. The first named beetle, (Fig. 12) infests not only wheat, but corn, bean, flour, and, it is said, sugar. It is reported to me also as being found in oats. They are found within the kernels in the larva or "worm" stage and in the resting or pupa stage.

The beetle feeds on the interior of broken kernels. A mass of wheat which shows no evidence on the exterior may be infested in its warmest and dampest part with thousands.

The cost of freeing wheat of the beetle, where the conveying is done by steam, is about ½ cent per bushel.

REMEDIES.

The general remedies for both of these pests, when found in stored grain, the result of work done in California and elsewhere, were published by us in various papers a few months since and we repeat them here.

1. Keep granaries clean and dry within, and well ventilated.

2. Whitewash the interior in the spring of each year.

3. Grain in storehouses or granaries should be piled so as to allow a free circulation of air around the rows of sacks, (supposing that sacks were used, and their uses seems desirable.)

4. Thorough ventilation is important, that a low temperature may be maintained.

5. Grain kept in bulk should be turned over occasionally by "shovelling" to prevent its becoming heated.

6. Stored grain should be kept free from damp, and kept perfectly covered to prevent its becoming wet from rains, etc; avoid a high temperature by every possible means.

7. When flour or middlings in sack are infested with Silvanus, place sacks in sun and sweep off and kill beetles gathering on outside.

Some of the methods to be adopted by grain men in the valley to secure the above ends, are as follows:

When storing wheat one bin is to be left empty. This will allow an opportunity to occasionally turn over the wheat in all the other bins, transferring from one bin to another. This seems to be an excellent plan. The cost of this process, including services of engineer, fuel, etc., is estimated to be about one-tenth of a cent per bushel.

Another idea to be put into execution is to run a Λ shaped tunnel, covered with wire screening part way through the bin at the bottom, opening to the exterior on the side of the granary; its inner end in the bin, terminating in a wooden flue bored full of two inch auger holes, which are covered with fine wire screening. This flue to run up through the bin or bins, affording with the above mentioned tunnel a current of cool air through the wheat. The opening of the tunnel on the side of the granary may need a little roof to prevent entrance of rain. This method of ventilation is already in use in some sections.

In remedy number three above, applicable to those who can afford it, and who are willing to mend after the mice, the sacks should be so disposed that cats frequenting the granary can have means of passing through the spaces intervening between sacks or rows of sacks. This will give them a chance to lessen the number of mice.

EXPERIMENTS AT THIS STATION.

It is apparent from what has been said before, that the main object to be attained is to find some inexpensive and effectual remedy not to kill the beetles in the grain, which would necessitate further cleaning by the grain merchant, but to either prevent its entering the grain or to cause it to leave that already infested. Camphor and bisulphide of carbon have been suggested, the latter very effectual under some conditions. It was to test the efficacy and practicability of applying these and other agents in granaries of the state that a series of experiments, lasting through a period of three months, was begun here. The following is a report of the beginning, only, of these experiments. It is the intention of this department to continue the experiments another winter.

A minature bin was built, 2 ft. by 2½ ft. by 3 ft., by "cribbing" with split laths. A small square opening was made in the floor in one corner to allow of the grain being drawn off. The bin was whitewashed without and within, and placed on a stout table in a room whose average day temperature was 68° Fahrenheit. The object of this procedure was to subject the wheat to the same conditions, though on a smaller scale, which it is subject to when stored in granaries in bins 12x14x22 feet, and in a temperature favorable for the beetles' working. This bin was then filled with ten bushels of wheat infested with both of the above beetles, though only scattering individuals of *Calendra remote punctata* (Fig. 13) were seen. The description of this bin is given here that the reader may understand references below; most of the following experiments, however, were made in wide-mouthed jars holding 1 pint, and in 2 oz. bottles.

A. TO DETERMINE TO WHAT EXTENT THE ACTIVITY OF BEETLES IS DEPENDENT UPON TEMPERATURE.

Several hundred beetles (Silvanus) were placed in pint jars with a supply of wheat. The top of jar was covered with veiling to prevent their escape, and a Fahrenheit thermometer for recording temperature attached. The experiment ran through two weeks with the following results: 69°, beetles very active. 64°, active. 60°, fairly active. 56°, sluggish. 57° (but observations made in morning after a cool night, and only one hour after fire was started) semi-torpid.

B. KILLING BY DROWNING.

Exp. No. 1. A specimen of Silvanus kept in water in open glass bottle 72 hours without drowning.

Exp. No. 2. Four beetles in water as above. Water shaken up once. In 18 hours all were dead.

Exp. No. 3. Several beetles put in water as above indicated. Bottle not shaken. Examined after 3 hours, all alive. After 31 hours, one or two still alive. All dead the following day.

The reason for this experiment will be seen later.

C. EFFECT OF GUM CAMPHOR.

Exp. No. 1. Seven specimens put in open wide-mouthed bottle containing wheat, with a small piece of camphor the size of a pea. Alive after 19 hours. All dead after 60 hours.

Exp. No. 2. Seven or eight beetles placed in wide mouthed 2 oz. bottle half full of wheat. The bottle was left open except for veiling over top, and beneath the wheat was placed a piece of camphor the size of a pea. After a few minutes the beetles hurriedly left the wheat and ran up the sides of the bottle, evidently in some distress. They remained at the top of the bottle just without the rim, under the veiling for one week, alive, without returning to wheat.

Exp. No. 3. In 2 oz. bottle half full of wheat containing beetles, a very small piece of camphor the size of a pin head was placed. No effect.

Exp. No. 4. 2 oz. of gum camphor ground to size of coffee grains and divided into three equal parts. One part strewn over bottom of bin above described. One part strewn over wheat after one third of the wheat had been put in; and one part strewn over wheat after the second third of the grain had been put in. The bin was then filled with the remaining wheat. Pieces of bagging were pinned around the outside of bin near the top to afford a hiding place for bettles leaving the grain. The daily temperature average, just outside of bin was about 74°. During the night it would naturally fall much lower. After 24 hours, bagging removed and a large number of beetles found congregating beneath. A slight but plainly perceptible odor of camphor discerned on moving top of wheat, which odor was more perceptible if one brought up handfuls of wheat from the center of the bin, about sixteen inches below surface. Handfuls of wheat brought up in this way contained numerous lively beetles.

Bin then left for a few days, and again examined. Some active beetles in center of wheat and a large number in the corners. A strong odor of camphor in bin. The numbers of beetles found throughout the wheat indicate that they are not very seriously affected by the odor of camphor.

D. EFFECT OF CONTACT WITH KEROSENE.

Kills in two minutes.

E. EFFECT OF KEROSENE VAPOR.

Exp. No. 1. At bottom of pint jar 2 teaspoonsful of kerosene on sponge. Over that a little paper and cotton to keep grain from coming in contact with sponge. Then some wheat containing a number of beetles. After 5 days no marked effect.

Exp. No. 2. About 2¼ oz. of kerosene put in a pint jar, as in Exp. No. 1. After 15 minutes the beetles left the wheat and hurried to veiled top. Next day all still living.

Exp. No. 3. 2 oz. of kerosene placed in each of six bottles with wide open tops. These placed in bin in two planes, three near bottom and three midway between top and bottom. Each bottle in upper plane came over the space between two bottles in lower plane. The tops of bottles were veiled to prevent wheat falling into coal oil. This was March 10. March 17 bin examined, wheat not removed. But few beetles found. This result probably affected by the fact that the beetles are getting much less numerous on account of many and repeated experiments.

F. FUMES OF BISULPHIDE OF CARBON.

Exp. No. 1. On February 26, about 2 oz. of bisulphide of carbon put in lower part of bin near the center, in wide mouthed bottle. Bin emptied and wheat examined February 28. Beetles much fewer on sides and through wheat. No odor of bisulphide. On the bottom of the bin were hundreds of dead beetles.

Exp. No. 2. ½ oz. of bisulphide of carbon placed in pint jar, and jar half filled with wheat. Beetles in wheat killed at once.

Exp. No. 3. About 2½ oz. of bisulphide of carbon placed in bin March 4, pretty evenly distributed in four places near bottom of wheat by pushing a somewhat pointed ½ in. glass tube down through the grain and pouring the liquid into tube. March 5, a number of beetles found to have left the wheat and gone under sacking. No odor of bisulphide given off surface. Bin emptied March 7, three days after application. Sides of bin seem considerably freer, yet a large number are still scattered through wheat. I should judge that their numbers are somewhat lessened.

Exp. No. 4. About 1 teaspoonful of bisulphide poured on bottom of pint jar, then wheat containing beetles, separated from the liquid by pieces of muslin. All killed by vapor in about three minutes.

G. TO SHOW RATE OF EVAPORATION OF BISULPHIDE OF CARBON AS COMPARED WITH THAT OF KEROSENE.

One watch glass filled with pure kerosene (1.) One watch glass filled with 3 parts kerosene and 1 part bisulphide (2.) One watch glass filled with pure bisulphide of carbon.

In about 16 hours. (1) 1–20 gone. (2) ⅓ gone. (3) all gone.

H. LIQUID APPLICATION OF BISULPHIDE OF CARBON.

Kills if thoroughly applied. But not so deadly in this form of application as kerosene.

I. TO DETERMINE HOW SMALL A PROPORTION OF BISULPHIDE OF CARBON MIXED WITH KEROSENE WILL KILL BY VAPOR.

The three jars in which the following proportions were placed, were pint jars with

wide open tops. About two handfuls of wheat containing many beetles were put in each and kept from contact with the liquid.

(*a*) 1 part bisulphide, 20 parts kerosene. Kills in 30 minutes.

(*b*) 1 part bisulphide, 20 parts kerosene. Kills in 15 minutes.

(*c*) 1 part bisulphide, 6 parts kerosene. Kills in 6 minutes.

J. TO DETERMINE WHAT EFFECT TREATMENT OF WHEAT WITH BISULPHIDE OF CARBON, CAMPHOR, AND KEROSENE HAS UPON BREAD MADE FROM THE WHEAT.

In the case of wheat treated with bisulphide of carbon, the grain was thoroughly wet with the liquid and confined, thus, in an air tight jar for one week, then aired for about the same length of time. The wheat was then ground and sifted and made into graham gems. No taste of bisulphide.

In the case of wheat treated with camphor, the method of procedure was practically the same, a large quantity of gum camphor being confined in jar with wheat. No taste of camphor in bread. Wheat subjected to kerosene vapor for one week, then aired and cooked entire, tasted very slightly indeed, of kerosene. Wheat confined in air tight jar and thoroughly wet with kerosene for one week, then aired, ground and made into graham gems. Tasted strongly of kerosene, as might have been expected. These were, of course, very rigid tests.

K. EXPERIMENT TO TEST SEED QUALITIES OF GRAIN TREATED AS IN EXP. J.

Wheat subjected to kerosene vapor grows well.
" " " " liquid " "
" " " camphor " "
" " " bisulphide " poorly, at least much more slowly than the three preceding. The above is the result of one experiment. The effect of bisulphide of carbon will be tested further in this respect.

L. EFFECT OF VAPOR OF CRUDE CARBOLIC ACID.

1 teaspoonful in pint jar for three days. At first fumes did not affect beetle, but subsequently, by March 24, beetles had left wheat in jar and congregated at top as far from grain as possible.

M. AN EXPERIMENT TO TEST THE ACCURACY OF A STATEMENT MADE BY GRAIN MERCHANTS.

I have been repeatedly told that *any* wheat, though apparently free from the beetle, grain which shows no trace of it whatever, will, if kept in a moderately warm temperature, generate the insect. To test this rather startling assertion, we half filled two wide mouthed bottles with some fine looking wheat sent us for that purpose.

Veiling was put over the top of the bottles, and the wheat moistened from time to time. One bottle was kept in a temperature the daily average of which was 71° Fahrenheit. The other in a slightly cooler place, averaging 57°. The experiment lasted from January 9 to the last of March, with temperature observations three times a day during January, from which the above averages are computed. No result beyond the fact of the wheat sprouting. Three other jars of the same wheat, not so carefully watched, gave the same result.

MISCELLANEOUS OBSERVATIONS.

A number of individuals of Silvanus, which had left bin, were found clustered on pieces of potatoe, evidently feeding with relish. This was frequently observed.

It should be noted, in considering the effects of the different agents used in preceding experiments, that the disturbance incident to preparing the experiments, would of itself cause the beetles to leave the wheat and crawl to the top of jar or bin, but where they persistently keep away from the wheat, then it is fair to presume that the agent used is repugnant.

Kerosene and bisulphide of carbon, when mixed, form a clear homogeneous liquid, readily spreading over white washed surfaces.

Messrs Langley and Michaels of San Francisco, sell bisulphide of carbon at 35 cts. per 1 lb. bottles, or a 6 lb. bottle for $1.50. Doubtless other wholesale dealers offer the same rates.

DEDUCTIONS.

One could not with justice, draw many and broad conclusions from the foregoing experiments, but a few things are evident which may be safely stated.

The temperature of stored wheat should be kept below 50° Fahrenheit.

The throwing of beetles when cleaning wheat, into standing water in the street or elsewhere, is not a safe means of disposing of them; (see B.) A large per cent will escape drowning and return to molest your wheat. It would be far better to burn them.

The vapor of camphor does not appear to be very effective. We, however, intend to experiment further with it.

The fumes of bisulphide of carbon are certainly very effective if distributed through the wheat, and the liquid is so extremely volatile that the grain is not injured for bread making. Moreover, from work previously done with this agent we are loath to believe that it injures the grain for seed, if properly used. The test above cited which resulted apparently in checking the growth of the seed, was unnecessarily rigid, purposely so, and not likely to occur in actual practice. Just how practicable this remedy is for granaries is a subject for further experiment. It is so effective that it would probably kill large numbers in the grain, which is not desired.

The vapor of kerosene or some more volatile allied liquid, as gasoline may accomplish something, if means are devised, for suspending firmly, in different places and at different heights through the wheat, open vessels (the mouths of which are covered with gauze) containing the liquid.

It is evident (from F No. 1) that however volatile a liquid may be, the vapor cannot penetrate effectually through a large and heavy mass of wheat, hence the necessity of having the liquid located in various places through the wheat. This might drive beetles out of infested wheat and keep them away during the few months the wheat is in storage.

After emptying a bin infested with the beetle, spraying the sides thoroughly with a mixture of kerosene and bisulphide of carbon (see I; also D) to kill the beetles that cling to sides in large numbers, seems desirable. A small and inexpensive spray pump or syringe, costing only a few dollars, would prove effective, and the liquid would quickly evaporate.

As regards the idea of "spontaneous generation" (?) (see M) it may be said that while some wheat which appears perfectly free may contain the larva or pupa, which will develop into beetles under proper conditions, it is absurd to make a general statement to the effect that all non-infested wheat will show the same phenomenon.

Owing to the very evident technical difficulties attending experiments of this character, and the limited time, the results are necessarily meagre. We should be pleased to hear expressed the views of the grain merchants of the state.

ADDENDA.

After the manuscript for this Bulletin had gone to press the following additional remedies were received from excellent authorities, and, through the courtesy of the printers, are inserted here.

For the Flea Beetle. Take two large handfuls of tobacco dust (this can be procured very cheaply from tobacco factories), and pour boiling water upon it. Sprinkle this over infested plants. One pound of tobacco to two gallons of water are good proportions and have proved very effective.

For the San Jose Scale. Resin 2 lbs. caustic soda, 1 lb., boil in about 30 pints of water. Then add tallow 1 lb. This amount of soap costs 11 cents. When wanted for use add 2 gallons of water to 1 pint of the soap. Apply in spray. This is cheap, easily used, and applicable for both summer and winter. The solution might be made weaker or stronger than the above, according as to whether the trees are very young or old.

As many scales, concealed under bark, moss, etc. will escape the first spraying, it is well to give a second a month later, and possibly, if necessary a third spraying two months after the second.

For Cut-worms. Spray a piece of grass or clover thoroughly with London Pur-

ple or Paris Green; cut it and strew it, when fresh, thickly in bunches (not more than one or two rods apart) over the infested piece of ground. Where tomatoes and cabbages are to be protected, distribute this poison just before the plants are transplanted. If corn is threatened the poisoned grass or clover is distributed just before or just after the corn is up. It is said that poisoned cut-worms will bury themselves a short distance in the ground before they die; do not expect, therefore, to find the ground strewn with dead worms after application of poison.

For the Grain Beetle. Advance sheets for the annual report of Prof. Cook, of Michigan, contains the following remedies for *Silvanus surinamensis*, resulting from work he has done with this beetle.

Where the beetles are in a small bin or a barrel and bisulphide of carbon has been introduced by means of tube, pipe or otherwise, a piece of oil cloth or a carriage robe spread over the top of bin or barrel will be a help. Prof. Cook suggests using a piece of gas pipe with a rod inside to keep it from being filled with grain when pushing it to the bottom, with drawing the rod from the gas pipe when the bisulphide is to be poured in.

It has been found that paper smeared with lard or other grease and placed where the beetles were very plenty, will attract a great many and they can then be easily destroyed.

From another source: A sudden heat (175° Fahrenheit) will destroy them. This is hardly practicable in granaries.

During the mating season, usually soon after winter, large numbers can be caught by spreading sheep skins, with fur down, near the grain.

The above additional remedies for the flea beetle and cut-worms were taken from Prof. Cook's report.

ZOOLOGY.

F. L. WASHBURN.

GOPHERS AND RABBITS.

The many letters received at this station asking for remedies for the Pocket Gopher, one of the worst pests with which the Oregon farmer has to contend, prompt us to reply by publishing the means now used to lessen their numbers and thereby decrease the injury done by them. Discussion of the Jack Rabbit and remedies therefor will be taken up at the end of this article.

The Pocket Gopher of this coast, while practically the same in its habits and injurious qualities as the Pocket Gopher of the Eastern States, is not identically the same, and, on account of structural and other differences, is placed in a different genus.

The injuries caused by our gopher are almost too well-known to need mention here. The mounds of dirt which disfigure our garden lawns and meadows are evidences of its presence, and its otherwise hidden burrowing. It attacks nearly all root crops. It will frequently nearly, or quite girdle young cherry trees after eating the roots, leaving nothing but a lifeless stub in place of a thrifty tree.

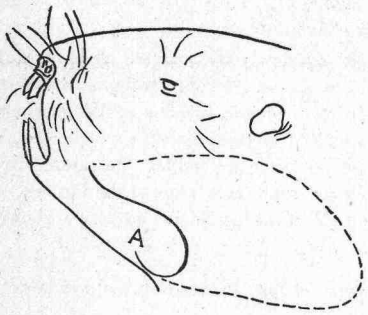

FIG. 14.
Outline of head of Pocket Gopher. The dotted line indicates the extent of the pocket, which opens at A.

Its winter nest is very apt to be among the roots of apple trees, it finding there an abundant and easily accessible food supply in the shape of roots. It is said to be very fond of and destructive to alfalfa, when that is sown in ground suitable for its burrows. Whole garden crops of potatoes have been destroyed by its ravages.

REMEDIES.

A.—MECHANICAL.

1. **Gopher Traps.** Of iron, about eighteen inches long with a strong spring which drives two prongs through the back of the animal, can be purchased for about $1.00. They are, when set, thrust down the open hole of a gopher, the hole being en-

larged a little with a trowel if necessary. Gophers come to the surface during the night and early in the morning, and again about noon and again late in the afternoon, and it is at these times, when the branch burrow is open that the trap should be set, though one could, and some do, dig down to the main burrow and set the trap there. In the latter case two traps are really necessary, setting one on one side of the spading and the other on the other side, so that from whichever direction the animal may come, he finds a trap. The trap is sprung by the animal touching a plate with his nose or head.

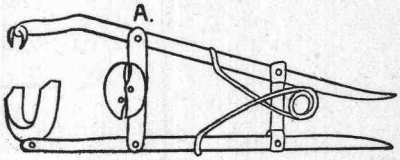

FIG. 15.
Gopher trap.

We have tried a limited number of experiments with this trap, and found invariably, that the gopher would spring the trap before reaching it, by pushing loose earth against the plate. This was the case whether the hole was closed with sod and the light thus excluded, or left open. Until we have tried this trap further, we hardly feel qualified to give a just opinion on its merits, yet, from the work we have done with it, we fear there are technical difficulties in connection with its use, which, combined with the wariness of the animal will prevent its being perfectly successful.

2. **Shooting.** A handy shot-gun is really very effective. One will often, at about noon, or late in the day, find himself close to a gopher burrow from which, if not disturbed, the animal is at intervals, showing his head. A few pellets of shot at such a time will put an end to him.

3. **Wire Netting.** Where injury to young, newly transplanted trees, is extensive, it is suggested as a remedy that, in the hole dug for the reception of the tree there be placed a wire netting in the shape of a cylinder, two feet in diameter, and two feet in depth. The upper end of this should be from four to six inches below the surface. The mesh might be ¾ in. Black iron is preferable to galvanized iron because it is cheaper, and would not last longer than three years at the farthest, by which time the roots would be large enough to withstand any attacks. Though rather expensive, this is said to be effective.

4. **Pitfalls.** The following excellent plan comes to us from California to be used in districts very much affected:

Dig a trench around the land to be protected the width of a spade and about sixteen inches deep; in this, about 100 feet apart sink five gallon oil cans, their tops, from which the tin has been removed, level with the bottom of the ditch. The ditch must not be of course, any wider than the cans. Gophers travel at night and, on trying to come into the inclosure tumble into the ditch, and run along until they drop into the cans. Prof. Wickson, of California, says: "As many as fifteen live gophers have been found in one can." These trenches should be made about July 1st, or when the animals rush from the drying vegetation outside to the cultivated areas.

B.—POISONOUS GASES.

1. **Sulphur.** A "smoker" or "sulphur gun" can be obtained, home-made, of the local hardware establishment for about $1.00. See Fig. 16 A. adjoining. This gun is made with two pieces of stove pipe, the one fitting inside of the other, and working up and down over the other piece, the latter being held firmly with its pointed end in the hole by one hand grasping the long handle, while with the other hand, one pumps, as it were, the fumes down the burrow. B, in the figure represents a perforated disk fitting into a smaller pipe, and held in place near the lower or conical end. It is on this plate that one places peices of old woolen rags which are set on fire. Upon this burning mass is poured powdered sulphur. When the gun is extended the air rushes through the hole in the top. When the gun is shut, this hole is closed by a leather valve within and the air is forced through the burning sulphur into the burrow. This treatment is most effective when the ground is damp. We are inclined to think favorably of this means of ridding a place of gophers. As far as it goes it is certainly effective, and we are convinced that in a number of cases of its use here, it has either killed the animal or driven it away.

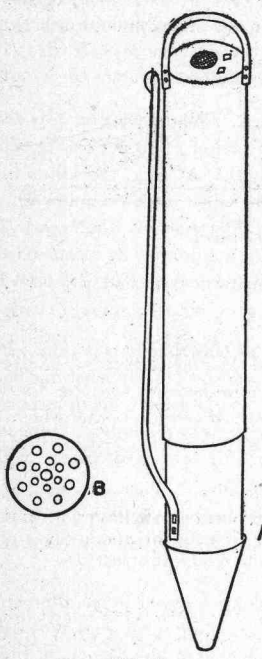

FIG. 16.
A "Smoker" or "Sulphur Gun."

2. **Bisulphide of Carbon.** This is a very volatile liquid, which can be purchased from druggists in one pound bottles. It should never be brought near a light, as it is extremely explosive. Saturate a piece of cotton half the size of one's fist with this liquid, thrust it into burrow as far as possible and stop the opening tightly with sod and earth. This remedy has been used successfully against the so-called ground squirrel and has been mentioned as a possible remedy for the Pocket Gopher. We have personally tried it on the latter and think it has been effective. We would reserve, however, our final judgment until further trial. Bisulphide of Carbon, like the preceding, is best used when the ground is damp.

C.—POISONS.

1. **Poisoned Wheat.** This agent, so successfully used against the "ground squirrel" or gray gopher, is sold by druggists in tin cans. The Wakelee brand is considered the best in the market. In the case of the ground squirrel, a few grains are placed at the entrance of the burrow, and the same procedure has been recom-

mended in the case of the pocket gopher. This poison is not expensive. It should be used in the early spring. If used later the animals would leave it for more succulent roots, etc. It is said to partly lose its effectiveness by lying for a length of time on damp earth, hence it would be well to place it on some natural object—a stone, a piece of stick or the like, when putting it at the entrance of burrows. It should of course be carefully kept away from children and others ignorant of its use.

2. **Strychnine.** We have found this very efficacious. Wholesale druggists sell it either powdered or in crystals in ⅛ oz. vials at the rate of $1.10 per oz. Retail dealers charge much more, about 35 cents per ⅛ oz. vial. A ⅛ oz. vial full of the poison, will, if properly used, last a long time. It would be far more economical for a number of farmers to unite and purchase one ounce (eight vials) at wholesale. If the crystals are purchased they can be easily reduced to a powder by means of an iron nail. We have poisoned pieces of potato with powdered strychnine and used it to very good advantage.

A piece of potato, twice the size of the end joint of ones thumb, is poisoned by introducing into two or three slits in it, a very small amount (barely what one can hold on the very tip of the knife blade) of the strychnine powder. Then a spoon tied to a small stick serves to introduce it for some distance into the hole. Gophers are passionately fond of potatoes and, apparently, eat the poisoned pieces with avidity. Mr. Clark Walters, of Athena, says:

"I have killed very many gophers by putting poisoned potatoes on the end of sticks and thrusting them down their burrows. So eager are they for the potato that they will often consume that part of the stick which is moistened with the juice."

In the experiments here, the poison was put out about noon, or in the afternoon when the animals are bringing out earth or, perhaps, nibbling what grass they can reach from the burrow opening. This opening is the opening of the branch burrow, which extends a foot or two in a slanting direction into the main runway, so it has been a comparatively easy matter to run the spoon down into the main burrow. Of course there are opportunities for failure in this method as in every other; the gopher may be pushing a lot of earth before him and shove the bait out of the hole before he has scented it, rendering it useless, hence the first attempt may be unsuccessful occasionally; but do not be discouraged, it may be necessary to try them several times. To render bait more attractive it might be touched with the cork from a bottle containing oil of rhodium. It is well to put two pieces of the potato in each runway, inserting, by means of the long-handled spoon, one piece on one side of the branch burrow, and a second piece on the other side.

Further, the poison might be disguised by making a syrup of sugar and water and adding the strychnine with perhaps a drop or two of oil of rhodium.

Strychnine is a deadly poison and we cannot be too careful with it, especially in a household where there are children. Keep it under lock and key, and intrust its use to no one who is not perfectly responsible and well aware of its dangerous qualities.

THE GRAY GOPHER.

This squirrel-like gopher (Spermophilus beecheyi) masquerades in this state and in California under the name of "ground squirrel." It is on the border line, as it were, between the squirrels and gophers, though really belonging to the latter family. Its wide spread devestations are too well-known to need comment here. Our wheat crop and fruit trees especially, are the sufferers.

REMEDIES.

"Smokers" or "sulphur guns" used as above outlined. Bisulphide of Carbon when the soil is damp, as directed for the pocket gopher, and poisoned wheat, are all effective.

To prevent "ground squirrels" from gnawing fruit trees or climbing the tree after the fruit, a California orchadist suggests tying newspapers round the tree trunk in such a way that four inches of the paper at the upper edge extends out. The rattling of the paper when the squirrels attempt to cross it will frighten them.

THE JACK RABBIT.

This rabbit and a few of its congeners which have been such a scourge in California, bid fair to be nearly as great a pest in parts of this state. Young fruit trees are the principal sufferers by their depredations.

REMEDIES.

A.—MECHANICAL.

1. **Protecting the Trees.** One thickness of burlap wrapped about the trunks of young fruit trees has proved perfectly successful in parts of Eastern Oregon. This is cheap and easily applied.

2. **Fencing.** The adjoining cut illustrates a wire net fence in successful use in California and cheaper than any kind of board fence serving the same purpose. The netting is galvanized wire No. 19, with a mesh of one and one-half inches. The posts are driven into the ground, around the piece to be inclosed, at intervals of ten

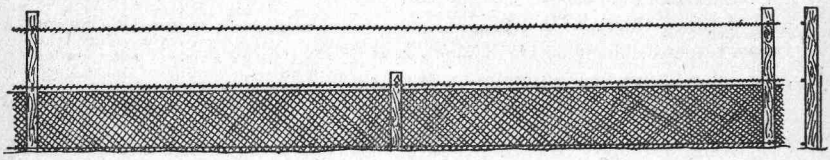

FIG. 17.
A combined Rabbit and Cattle Fence.

feet. If rabbits alone are to be feared, all of the posts should project from the ground two and one-half feet, but if the fence is to be used also as a protection against cattle, every other post should be from four to four and a half feet high.

The above cut is taken from Wickson's "California Fruits," and a poorly engraved reproduction of the original.

The netting is fastened to the posts, *on the inside, toward the inclosed piece, this is very important*, with small staples. Its lower edge lies along the ground. The ground in the vicinity of the fence is left hard, and not ploughed, otherwise the rabbits might dig under through the softened dirt. A barbed wire with barbs about 2 in. apart is stretched from post to post *on the outside, and just clear of the surface of the ground* (*these two points are important*) and fastened with staples to the posts. A *similar* wire, also *on the ontside* is stapled to the posts *just cne inch above* the netting. And, if the alternate posts have been left long, and a cattle fence is desired, a third wire is stretched from post to post near the top, *on the outside*. The exact cost of this fence is hard to determine; it would vary in different localities. Wire netting, 2 in. mesh, costs in Portland about 2¼ cents, per sq. foot. Barbered wire, as on opposite page, 6 cents per lb. There is a fraction over one pound in one rod.

B.—POISONS.

Pieces of poisoned melon scattered plentifully through a young orchard have proved effective in Eastern Oregon. Strychnine is the poison used. The rabbits prefer the melon to the bark. Any vegetable of which they are especially fond might be used where melons are lacking.

The following receipts are recommended as making very effective poisons:

(*a.*) Add 9 gals. of water to 100 lbs. of wheat. To this add 1 lb. of phosphorus, 1 lb. of sugar, and 1 ounce of oil of rhodium. Bring to a boil, and let stand all night. The next morning stir in enough flour to make a kind of paste. Scatter this over ground frequented by the animals.

(*b.*) ½ teaspoonful of powdered strychnine, 2 teaspoonfuls of fine salt, 4 teaspoonsfuls of granulated sugar. Shake well together in a tin box. If placed on boards this becomes hard and rabbits lick it eagerly.

(*c.*) **Rabbit Drives.** Thousands of rabbits are killed in California by driving them, by means of lines of horsemen into fenced enclosures and killing them with clubs.

NOTE.—An ingenious trap, said to be in successful use in parts of Oregon, has been described to us as follows: A piece of ground about 15 feet square in locality infested by rabbits, is surrounded by a board fence, high enough to prevent their jumping over. On one side a board plank runs from the ground, with an easy slope, to the top of the pen, and projects a foot over the inclosure. Above this projecting end and just enough in front of it to cause the animal to reach, lose his balance and fall into the pen, is hung some tempting bait. A little bait is scattered around outside of pen and along the plank to attract the rabbits. We cannot judge of the efficacy of his contrivance, never having seen one, but our informant, a reliable party, asserts that they have been in successful use. F. L. W.

DEPARTMENT OF CHEMISTRY.

P. H. IRISH, Chemist. W. D. BIGELOW, Assistant.

ANALYSIS OF BONE MEAL.

This substance is obtained by cracking up and grinding dry bones.

These contain as material valuable for fertilizers, phosphate of lime and certain complex substances containing nitrogen. The phosphate is the chief constituent, forms the frames of the bone, and is what might be called the mineral portion of the same.

The other plant food contained in bone belongs to that class of matter from which the plant obtains the material necessary for building the so called albuminoid substances, such as the gluten of wheat, and the legumin of the pea to which those substances owe their nourishing and flesh forming qualities.

The more finely divided a fertilizer is, the more valuable it is, on account of the greater readiness with which it goes into solution. Hence in determining the value of a fertilizer, the mechanical analysis is of considerable assistance.

The two samples of bone meal sent to us by Miller Bros., of Portland, showed on analysis the following composition.

ANALYSIS NO. 29.

Bone Meal from Glue Factory.

Moisture on drying at 100° C. (212° F.)	8.28 per cent.
Phosphoric acid	22.59 "
Nitrogen	3.15 "
Equivalent to ammonia	3.80 "
Sand, etc	2.16 "

ANALYSIS NO. 31.

Wickersham Bone Meal.

Moisture on drying at 100° C. (212° F.)	5.61 per cent.
Phosphoric acid	24.03 "
Nitrogen	3.01 "
Equivalent to ammonia	3.65 "
Sand	1.98 "

MECHANICAL ANALYSIS.

Amount held back by sieve No. 8 (8 meshes to one inch)	....	.61	per cent.
" " " " " " 16	....	27.60	"
" " " " " " 26	....	17.41	"
" " " " " " 40	....	20.44	"
" passing " " 40	....	34.49	"
		100.55	"

The above analysis would seem to show the two samples of bone meal to be of about average composition.

Fertilizer Control. At present there is no hindrance thrown in the way of dishonest companies placing upon the market worthless or poor fertilizers. The increasing use of these articles through the state would seem to show a necessity for fertilizer inspection, and would suggest the wisdom of a law compelling all fertilizer companies whose goods are offered for sale, to submit them for examination to some competent chemist to be appointed by the state, and obtain his certificate as to their compositions before placing them upon the market.

Until some further provision is made for this work, the Station will as far as time and means allow, examine, and report upon samples of commercial fertilizers sent to them. *Provided,* All samples sent shall contain at least one pound, be sent, carriage paid, in *clean*, tight tins or glass vessels, be taken from a lot of not less than one ton. The sample to be obtained as follows: From each parcel in the lot a small amount is to be taken, these several amounts placed upon a clean surface, thoroughly mixed and from this mixture the sample taken, placed in the tight vessel, sealed, and forwarded without delay. *Provided,* Also that the name of the fertilizer, a statement of the amount of fertilizing material guaranteed by the manufacturers, together with the name and address of the dealer, from whom the material was obtained, be forwarded.