1-1-1908

Starting Young Orchards

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WEST VIRGINIA UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
MORGANTOWN, W. VA.

BULLETIN 116 APRIL 1, 1908

STARTING YOUNG ORCHARDS

This bulletin contains notes upon culture and mulching; crops and cover-crops; pruning; spraying; insect and other enemies; and poultry in the orchard.

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Figure 1. Young orchard under cultivation, showing cover crop.
(Courtesy *Rural New-Yorker*).

ORCHARD NOTES.

W. M. Munson.

Among the more important problems attendant upon the starting of a young orchard, are those of cultivation, mulching, cropping, winter-cover for the soil, pruning, and the control of insect and fungous enemies of the trees. To these may be added the question of pasturing; but, except as a run-way for poultry, the young orchard should never be used as a pasture. Orchards of bearing age, on rough or hilly land, may often be pastured to advantage with hogs or sheep.

Culture Versus Mulch.

There are strong advocates of both cultivation and mulching as methods of orchard management, and strong arguments may be advanced in favor of each. As a result of personal observation, extending over a period of more than ten years, the writer would favor cultivation upon those lands which are susceptible of culture, without unnecessary expense, and mulching upon all other lands. What that cultivation shall be, and what that mulch shall be, will of course be determined by local conditions, to be discussed later.

In New York State, the questions of tillage as opposed to "sod-mulch" are being studied by the Experiment Station at Geneva. These investigations, which have been under way for four years, have been conducted in mature orchards, and thus far the results obtained show marked results in favor of cultivation and cover crops. It must be acknowledged, however, that the cost of cultivation is very considerable, and on many orchard sites cultivation is wholly impracticable.

By the advocates of "sod-culture" it is claimed that, by

* For full accounts of the studies referred to, see Bulletins 89, 122, 139 and 155, Maine Agr. Expt. Sta.

setting free too much nitrogen, cultivation renders the wood spongy and the fruit soft. It is also claimed, and not without apparent reason, that certain varieties, like Alexander and Yellow Transparent, which are subject to blight, exhibit a marked increase of this blight tendency under cultivation. This contention is supported by Mr. George T. Powell, himself an advocate of high culture.

There is no doubt that fruit from trees not under cultivation is of higher color, and usually of firmer texture. That it will always keep better in storage, however, has not been fully proved.*

The general principles involved in the two methods are very simple. In the mulching, the aim is to accumulate all of the vegetable matter possible in the soil; thus not only feeding the plant, but holding the moisture as well. Under cultivation, the organic matter is used as rapidly as possible and more is added in the way of cover crops and green manures.

CULTURE: WHY AND HOW.

The soil is a vast storehouse of plant food, and the first effort of the husbandman should be to make this store available to plants. Now a plant derives the greater portion of its food from the soil in the shape of solutions of inorganic materials. These solutions, in the form of sap, ascend to the leaves of the plant through the young wood, and then, by the action of sunlight, become changed into starch, sugar, etc., which are used in the repair and growth of all parts of the plant. The growth of the roots, therefore, is largely determined by the amount and vigor of the leaf-bearing surface; while the latter is also dependent upon the ability of the roots to secure the necessary inorganic elements.

As set forth by Professor F. H. King, of the Wisconsin Experiment Station, the objects of tillage are, briefly: To render

* Bulletin 122, Maine Agr. Expt. Station, p. 200, 1905.

the soil uniform; to increase depth of soil; to increase the amount of humus; to improve physical condition; to conserve and regulate soil moisture; to render plant food more available; to provide a sanitary abiding place, drained, ventilated and warmed, for the life processes incident to plant growth; and lastly to destroy weeds.

For practical purposes, the benefits of tillage may be concisely given under three general heads, viz.:

(a) Tillage improves the physical condition of the soil.
(b) Tillage conserves moisture.
(c) Tillage may augment chemical activities.

The chemical composition of a soil is not necessarily a measure of its productive capacity, since plant food is of no consequence unless the plant can make use of it. The Station chemist may tell what elements a given soil contains, but he cannot predict whether that soil will grow good crops. Every farmer knows that a hard, lumpy soil will not grow good crops, no matter how much fertilizer he may apply. Any clay soil may be so injured by one season's injudicious treatment as to render it comparatively worthless for several succeeding years; and it is useless to apply commercial fertilizers to lands which are not in proper physical condition for the best growth of crops, whether trees or grain or grass.

By fining the soil, and thus increasing the feeding surface of the roots; by increasing the depth, and thus giving greater foraging area; by warming and drying the soil in spring; and by reducing the extremes of temperature and moisture, the physical condition of the soil will be rendered most suitable for giving up the store of fertility contained therein.

As already stated, the food materials must be in solution in order to be of use in building up plant tissue. Now the amount of water which falls during the growing season is entirely inadequate to the growth of plants during that time. For this reason it is important that the water holding capacity of the soil be increased as much as possible, and that some means of checking

evaporation be adopted. Both of these conditions are best brought about by tillage.

Naturally those soils which are most open and most porous, which contain the largest number of spaces between the particles, will retain the moisture to the best advantage and will give the best opportunity for the roots of plants to penetrate them and take up the moisture there stored—in the same way that a sponge will take up a larger amount of water than a block of wood. By deep plowing and thorough working, and by the addition of organic matter, either in the form of stable manure or as crops plowed under, this spongy condition is obtained. It is obvious, however, that deep plowing should be performed before trees are planted; and in no case is such practice allowable in an old orchard.

Having provided a reservoir for moisture, it is important that some means of retaining that moisture be provided; some means of conserving it for the needs of plants during the growing season. In addition to the continual pumping of moisture by the roots of plants, to supply the loss by transpiration from the leaves, there is constant evaporation from the surface of the soil. There is no better way to check this evaporation than by breaking the capillary pores near the surface by frequent shallow cultivation; in other words, by providing a blanket of fine, dry earth.

The value of tillage in aiding chemical processes can readily be seen. By opening the soil, admitting warmth and oxygen, the organic matter is rapidly decomposed, plant food is set free, and the development of the organisms necessary to plant growth is promoted. The simple statement of these facts is, perhaps, sufficient at this time.

In the management of orchard lands it is not so much a question of how the tillage shall be performed, as that it be given. For the first few seasons after the trees are set out, on land which is not subject to washing, fairly deep plowing, with a plow heavy enough to turn under heavy crops, weeds, etc., is advised. The heavier clay soils should be handled very carefully, to avoid puddling. In no case should such

Figure 2. Straw-mulch in the orchard.
(Courtesy *Rural New-Yorker*).

soils be handled when wet. In the early part of the season, heavy implements. like the spring-tooth or the disc harrow, should be used; later in the season, when the object is merely to conserve moisture, the spike-tooth drag or the smoothing harrow should be substituted. Short whiffletrees with the ends protected by cloth, or better still traceless harnesses, should be used; and in no case should the ordinary long hames be permitted in an orchard.

Cultivation should be given after every heavy rain, or as often as once in two or three weeks, until about August 1st, when a cover crop of vetch or clover should be sown, using about 1½ bushels of the former or 15 pounds of the latter to each acre. The question of cropping the young orchard is discussed in another connection.

MULCH.

The effect of an old board or a log, or a stone wall, in encouraging the growth of grass or weeds along the roadside, is a familiar sight. The reason for this effect is that the moisture underneath this board, or stone wall, is unable to escape, except as it is pumped out by means of the roots of the plants. The grass in the open fields is stunted because of the excessive number of plants crowding one another in the struggle for existence, and the fact that there is nothing to hold moisture accumulated in the soil. The practice of mulching trees is based upon the principle here suggested.

There are certain cases where mulching is of unquestionable advantage; but there are also certain objections to the practice. Some of the best apple sections of the state include steep hillsides, where cultivation is entirely out of the question. In such cases a mulch of straw, meadow hay, weeds, or any coarse material, may be used to advantage. With young trees, too, a mulch of stable manure is often useful; but care should be used that the manure does not come in close contact with the bark of the tree, or serious injury will result.

To be of value, the mulch should be constantly maintained, that is, should be renewed as soon as the grass begins to come up through it; and should cover an area of several feet in diameter. In the case of newly set trees, a circle four feet in diameter will be ample. The diameter of the circle should be increased as the trees grow. The custom of piling manure several inches deep in a small circle about the base of a bearing tree, is both ridiculous and wasteful, as the feeding roots of the tree are at a considerable distance from the body.

The mulch about plants furnishes a harbor for injurious insects, field mice, etc. Injury from the latter, however, may be prevented by placing a cylinder of wire netting about the base of the tree. The wire should be somewhat larger than the tree, to allow for the expansion due to growth.

In case of fire, mulching greatly increases the risk of damage to the trees. but this danger is usually somewhat remote.

Another danger in the practice of mulching, on the lighter soils, is the tendency to encourage the development of surface roots, which are liable to suffer in time of drought unless the mulch is properly renewed.

SOD-MULCH.

The so-called sod-mulch, or the Hitching's method of growing orchard trees, is quite different from the system of mulching mentioned above. By this method the trees are planted in sod land and the soil is never afterwards disturbed. Such grass as grows upon this land is cut each year, and while the trees are young is placed as a mulch about their roots. Later the only attention given is to mow the grass twice during the season and leave it upon the ground as it falls. This method has the merit of economy of labor, and of being adapted to rough lands. It also results in highly colored fruit, but on most soils an addition of some form of plant food will be required. The particular fertilizer to use, and the amount per tree or per acre, will naturally be governed by local conditions. In

most cases which have come under the writer's observation, in West Virginia, nitrogen and phosphoric acid, rather than potash, seem to be the elements required.

Crops and Cover Crops

The question: "What crops may be grown in a young orchard?" is of frequent occurrence. In general terms the answer must be: Any hoed crop which will not interfere with the growth of the trees; hay or grain, never.

Of course there are qualifying factors entering into every problem. The soil, the aspect, the markets, the capability of the manager, insect and fungous enemies, the time of maturity of crop, all have an important bearing. Beans, potatoes (if care is taken that the rows are not too close to the trees), tomatoes, sweet corn, and in some sections sweet potatoes, may be safely planted. Oats, barley, wheat, hay, and in most cases tall field corn, should be avoided.

The reason for this distinction in the crops for an orchard is evident. Those of the first class permit of cultivation early in the season, mature in time so that cultivation may cease late in summer and that a winter cover crop may become established before the ground freezes; do not unduly shade the young trees. Those of the second class absorb the soil moisture, just when it is most needed for the growth of the trees, and, in the case of the field corn, actually shade the trees to an injurious extent.

Methods of culture of the various crops mentioned are so familiar as to require no special detailed account at this time. Because of its importance, however, and the possibility of fostering a new industry, as well as because of its special adaptation to the purpose of an orchard crop, particular attention is called to the tomato.

THE TOMATO AS AN ORCHARD CROP.

In many respects, particularly in the eastern part of the state where the conditions seem specially adapted to this crop,

the tomato is one of the most promising crops for use in the young orchard. The period of culture is just about right for the trees; there is an active demand for the product at profitable prices; there is ample time for the establishment of a winter cover crop of rye after harvesting the fruit.

As indicating the importance of the tomato industry already under way, it may be said that in Morgan County, which is the leading tomato district, at present, there are now nineteen canneries; the largest of which, that of W. A. Rockwell, at Berkeley Springs, has a capacity of 1,000 bushels per day. On an average, each of these canneries will pack the product from 150 acres of land. The average yield is 150 bushels per acre, and the price paid 30 cents per bushel. In other words, by planting tomatoes in the young orchard, the farmer may reasonably expect a return of $45 per acre; which will pay all expenses of fertilization and cultivation of trees, and still leave more profit than would be obtained from a crop of grain without the trees.

It is unnecessary at this time to go into the details of the culture of tomatoes. Suffice it to say, the practice of the writer has usually been to sow the seed in greenhouse or hot bed not later than April 1st and preferably about March 15. Transplant to 3 or 4 inches apart as soon as the plants begin to crowd. While some of the best cultivators combat the idea that transplanting is of advantage in securing stocky plants, in our own experience the practice has always been found beneficial.

The notion often expressed, that the tomato is specially susceptible to a chill early in the spring, seems to be without foundation; the check at time of transplanting being more often due to poor soil and to improper handling, both at the time of transplanting and previously, than to "shock". In general, best results are obtained if the plants are removed to the field, which should first be thoroughly pulverized, as soon as the ground is well warmed and danger from frost is past.

The old notion that tomatoes do best in relatively poor

soil, was long ago exploded.* Comparatively little work has been done, however, toward determining the specific elements which will produce the best results. Deductions from work conducted in Maryland** indicate that potash has a tendency to produce a relatively large per cent of acid in the fruit, while phosphoric acid seems to have a similar effect upon the sugar content. Voorhees *** has found that nitrate of soda, while increasing the yield, does not do so at the expense of earliness of maturity, if used in small quantities or in two or more applications; but if large quantities of nitrate were used in one application, maturity was retarded. Moreover, it was concluded that nitrogen is the ruling element in the growth of the tomato, though its effect is dependent upon the presence or absence of a full supply of the other elements.

In general, while heavy fertilizing does not lessen productiveness, the best fertilizers for tomatoes are those which act quickly, or hasten growth early in the season. This fact, together with the the cultural factor already mentioned, makes the tomato a specially good crop to use in the young orchard.

By this combination, two most important industries may be developed side by side; the one paying the expense of the other until such time as the orchard shall demand the whole time and attention of the grower.

COVER CROPS.

The importance of a winter cover for orchard lands that are given clean culture during the summer, should in no case be overlooked. Some of the advantages following the use of such crops may be briefly summarized as follows:

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*Bailey and Munson, Bul. 21, Cornell Univ. Expt. Sta.

**Patterson, Bul. 11, Md. Expt. Sta.

***Voorhees, Bul. 63, N. J. Expt. Sta.

(1). The cover crop utilizes soluble fertilizers which would otherwise be wasted.

(2). Prevents washing of the land.

(3). Adds organic matter to the soil.

(4). Protects roots during the winter and holds the snow.

(5). Helps to dry out the soil in the spring, thus permitting earlier working of the land.

(6). In some cases adds directly to the store of nitrogen in the soil, as when vetches, clover and other leguminous crops are used.

(7). Checks growth of trees late in autumn, thus preventing winter injury by cold.

KIND OF COVER CROP.

What to sow for a cover crop, depends largely upon soil and location. On good strong land, which is not specially in need of additional nitrogen, winter rye is very satisfactory. It germinates quickly and, even in cold seasons, when frosts come early, will form a very satisfactory mat before winter. On "thin" soils, however, rye does not stool freely, and fails to make a good cover. Such soils are usually in need of more nitrogen, and will be benefitted by the use of some leguminous crop like vetches or clover.

One of the best cover crops for the lighter soils is winter vetch (*Vicia villosa*), sown at the rate of 1½ bushels per acre, as early as July 15. Within six weeks this plant develops nitrogen accumulating nodules, and contributes directly to the fertility of the land. The price of seed of this vetch is so high, however, as to be almost prohibitive.

Spring vetch (*Vicia sativa*) is another nitrogen gathering cover crop which makes a vigorous growth in the fall, often forming a perfect mat a foot thick, when sown August 1. It is apparently even more efficient than the winter vetch as a nitrogen gatherer, but it does not survive the winter; hence is not

as valuable in preventing washing by the spring rains, and does not help dry out the land in spring.

Clover, sown July 15 to August 1, makes a satisfactory cover for winter, and is one of the best nitrogen gatherers and soil renovators.

Oats, peas, and these two crops combined, are sometimes used to advantage. All things considered, however, the three first mentioned are most satisfactory.

A WORD OF CAUTION.

While in general the use of a cover crop in cultivated orchards is advantageous, there are cases where, if used injudiciously, it may be actually detrimental. One such case is the use of rye upon a soil naturally dry and gravelly; especially if the crop be left late in the spring before plowing under. This treatment may result in so drying the soil as to seriously interfere with the growth of the trees. On soils of the nature indicated, one of the vetches, oats, or clover is to be preferred; particularly if the land is not to be plowed promptly in the spring.

Suggestions as to Pruning.

Intelligent pruning, at the right time, is absolutely essential to the production of the best fruit. An unpruned tree may, in many instances, produce a larger number of apples than an adjacent pruned tree; but the percentage of merchantable fruit will invariably be smaller. Small apples or peaches contain just as many seeds as do large ones, and therefore make practically as great demands upon the store of plant food. They do not, however, fill the basket, nor the pocketbook, so rapidly as the others.

METHOD OF PRUNING

The amount of pruning necessary depends largely upon the location and exposure of the orchard. Trees on a warm

southern slope, freely exposed to the winds, require much less pruning than do those in a cool sheltered location which is lacking in sunshine. Plenty of light is essential to the production of highly colored fruit. It is desirable that trees should be pruned intelligently from the time they are set, but old trees may often be given a new lease of life by judicious management. If the trees have been long neglected and require heavy pruning, do not remove all of the wood the first year. Removal of a portion of the top, thus distributing the food gathered by the roots to a smaller number of branches, tends to produce rapid growth and renewed vigor of the tree. The removal of too much at one time will start the growth of watersprouts and defeat the very purpose in view.

The method of shaping the top of young trees will depend upon the natural habit of the variety, the ideal of the grower, and the local conditions. No attempt should be made to make all varieties conform to a given type, like trees in a hedge. In general, limbs which are parallel and close together, or limbs which cross and interfere with each other, should be removed or thinned. Trees of an upright habit, like Sutton or Maiden Blush, should have the center of the top opened, while trees of a spreading habit, like Jonathan or Rhode Island Greening, should have the lower limbs removed. To keep the trees within bounds, the leading branches may be cut back one to three feet about every other year until the bearing age is reached; after which the production of fruit should sufficiently check superfluous growth of wood.

The question of high heads or of low heads is a perennial one. In general, however, the tendency at the present time is to maintain as low heads as is consistent with cultivation. The ideal tree is vase-formed, the lower branches starting about 2½ feet from the ground, and ascending in such a manner as to permit of reasonably close approach to the tree in cultivating. This may be accomplished by cutting off those limbs which tend to grow out horizontally or which hang from the lower side of the leaders.

WHEN TO PRUNE

The best time for pruning is on warm days from January to May. More can be accomplished in the longer days of April and May, but if there are many trees to be pruned, the work should be commenced earlier in the season. The time of year when the cut is made has little effect upon the readiness with which the wound heals, but more care is necessary to prevent injury to trees pruned when the wood is frozen.

A wound made by removing a limb heals best if the cut is made close to the trunk or branch. A stub two or three inches long does not heal, and becomes a lodging place for spores of fungi and bacteria which cause decay and death of the tree. The splitting down of large limbs may often be avoided when pruning by sawing in from the under side first; but, in every case, see that the wound is left clean and smooth. Wounds should also be covered immediately with a coat of paint, shellac or grafting wax, to keep out the moisture and spores before mentioned. Nothing is better for this purpose than pure white lead and linseed oil.

The whole philosophy of the pruning of plants rests upon the fact that the various parts are unlike; that each branch is, in a measure, independent and capable of becoming a new individual; that by lessening the conflict between the parts, the growth of the whole is promoted. Pruning is a necessity, and the pruning given by Nature, in a neglected orchard or forest, is more severe than the average man would dare to attempt.

It is often urged that pruning should be commenced when the tree is planted, and continued annually throughout the life of the tree. It is doubtful, however, whether equally good results may not be obtained by removing superfluous branches at four or five years of age, rather than by severe pruning very early in the life time of the tree. In other words, it is contended by some that it is better to permit the root system to become thoroughly established before disturbing the top. This

question is under consideration at the Experiment Station at the present time.

WHY PRUNING IS IMPORTANT

It is astonishing to find how little the average orchardist thinks, when pruning his trees, of the actual problems at issue. Pruned trees are almost always more vigorous than unpruned ones, because the food taken up by the roots is concentrated into a smaller number of branches.

Pruning is practiced to produce larger and better fruit; to keep the plant within manageable limits; to remove superfluous or injurious parts; to facilitate spraying, tillage and harvesting; to train the plant to some desired form.

Plants naturally grow from the uppermost buds. By pruning in one way this tendency is augmented, in another way it is checked. As a rule, in dealing with fruit trees, the latter end is desired, since the principle that "checking growth induces fruitfulness" is universally recognized. The heading in of young growths tends to develop lateral and dormant buds, or to thicken the top; so the question of heading resolves itself into a question of personal ideals. To secure thick topped trees, heading is necessary. It has, however, the very marked advantage of inducing the development of fruit buds near the body of the tree, rather than far out on the limbs. This, in the case of plums and other tender wooded plants, is an important consideration.

Fruit bearing is determined more by the habit and the condition of the tree, than by the extent of pruning. In other words, it is to a certain extent an individual characteristic. Pruning, however, may be made a means of thinning the fruit, and thus improving the size and quality of that which remains by removing superfluous shoots upon which fruit buds are borne. Heading back the annual growth thins peaches; but with the apple, pear and plum, which produce fruit on spurs or miniature branches, on wood of more than one season's growth, older

limbs must, of course, be removed in order to effect the desired thinning.

Control of Orchard Pests.

The importance of watchfulness, and the direct value of spraying, as a means of holding in check insect and fungous enemies of the orchard, have been repeatedly urged by this Experiment Station, and in so far as the suggestions made have been followed, the results obtained by the fruit growers of the state have been satisfactory.

SPRAYING IS PLANT INSURANCE

Spraying is a form of insurance, and should in most cases be applied before the plants are attacked, as a preventive measure, rather than as a remedy. It has been shown beyond doubt that, by spraying at the proper time, and in the proper manner, the canker worm and tent caterpillar may be held in check; that the "apple worm" or codling moth may be controlled; that scale insects may be destroyed; that the green aphis or plant louse may be killed; that bitter rot, apple scab, cracking of pears, and rotting of plums may be very greatly reduced in this simple way. This being the case, spraying, in an intelligent and thorough manner, should be just as much a part of the regular work of fruit growing as is cultivating, pruning, or even harvesting. As a rule it is impossible to get the best fruit without spraying, and at the present day only the best fruit is profitable. During the past year thousands of barrels of apples were put upon the market in this state, which were hardly fit to feed the hogs—all for the want of intelligent spraying.

REASON FOR SPRAYING.

The leaves of plants have two functions essential to life and health. They act, in a measure, as both lungs and stomach

for the plant. Consequently if they are destroyed or diseased, the whole plant suffers; the crop of fruit is lessened; and the vitality of the plant is weakened. It is for this reason that spraying is of importance, even in those seasons when there is no fruit. As before suggested, spraying is an insurance, not a remedy, and there should be a definite purpose in view for every application. Specific directions for controlling the leading insect and fungous enemies of the orchard are given in Bulletins 66 and 107, and in Special Bulletin 4.

PRACTICAL SUGGESTIONS.

Cleanliness is one of the first considerations in fighting orchard pests, whether of animal, insect or fungous nature. So every effort used in raking up and burning diseased leaves, and in picking and destroying dried and decaying fruits in the fall, is labor well expended.

It is now too late to spray with the lime-sulphur mixture this season, but in general the application of this mixture late in the fall, or early in spring, before the buds begin to swell, and before the land is too soft to prevent driving over it, is of marked importance in controlling both scale and fungous enemies. If the lime-sulphur spray has been used this season, no other spraying is required until just before the blossoming period, when Bordeaux mixture and arsenate of lead* should be applied.

Another application of Bordeaux mixture (3-5-50 formula) and arsenate of lead should be made soon after the blossoms fall, and again 2 or 3 weeks later, as an insurance against codling moth, also against apple scab and other fungous enemies.

In August and September, if Bitter Rot makes its appearance, all diseased fruits should be carefully picked and destroyed as fast as they appear, and the trees should be sprayed every 10 days or 2 weeks with Bordeaux mixture. The gathering and

* For formulas see Special Bulletin 4 of this Station.

destroying of infected fruits are of special importance, and in no case should be overlooked. In large orchards it will pay to have one or more men whose whole time should be given to this one work of gathering and burning diseased fruit.

While further experiments are necessary in the control of the so-called "frog-eye" fungus, it is probable that much benefit will result from the treatment suggested.

Another serious pest, in some sections of the state, is the woolly aphis. Young trees with the characteristic root galls should not be planted. A liberal application of tobacco dust to older trees which are thus affected may sometimes be useful.

Twig blight often appears to a destructive extent upon young thrifty apple and pear orchards. This is a bacterial disease, and no amount of spraying will be of service. Cut and burn all affected parts, and avoid highly nitrogenous fertilizers.

Canker is another serious pest. Carefully cut out and burn all canker spots, and paint the wounds with pure white lead and linseed oil. The same may be said for black Knot of plum and cherry.

ENEMIES OF YOUNG FRUIT TREES.

W. E. Rumsey and Fred E. Brooks.

This paper deals with several kinds of insects and mammals that injure young fruit trees before they have reached a bearing age.

The treatment which an orchard tree receives during the first few years of its growth often determines to a considerable degree the profitableness of its bearing life. If allowed to become weak and stunted, as a result of the attacks of borers and other insects, it may live on from year to year, but will probably never fully recover. Many young trees are killed outright by such pests, or are so seriously injured that they soon succumb to droughts or are broken down by storms.

A young orchard that is not protected from these enemies is likely soon to show many missing trees, and those remaining will be irregular in size and will lack uniformity in shape, vigor and productiveness. If the neglect is continued, these defects will become more and more apparent as the orchard advances in age. It is essential, therefore, in establishing a good orchard, that the trees not only come from the nursery free from hurtful insects and insect injuries, but that they be kept so.

Young trees are less able to withstand severe injuries than are old ones, but they are, likewise, more easily protected. Their small size makes it an easy matter to examine them for, and to remove, borers. They can be sprayed quickly and effectively, and such insects as tent-caterpillars and web-worms can be removed from their branches by hand with but very little trouble or expense. It is possible, too, with very little cost and labor, to protect their bodies from the ravages of mice and rabbits, and from the adult borers during the egg-laying season.

In this article a few of the more important enemies of such trees are described. For convenience the different species are divided, according to their methods of attack, into six groups, as

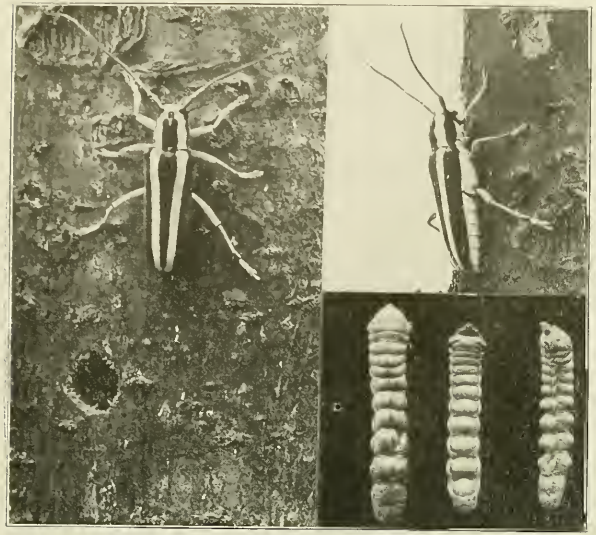

Figure 3. Round-headed Apple-tree Borer. Larvae, adults and exit hole. (All natural size).

Figure 4. Peach-tree Borer. Larva and adults.

follows:—Borers, leaf-eating caterpillars, scale insects, cicadas, plant-lice and mammals.

Only such species as are known to be common in West Virginia are considered. For directions for preparing the different sprays that are recommended, see Special Bulletin 4, of this Station.

Borers.

THE ROUND-HEADED APPLE-TREE BORER, *Saperda candida* Fab. (Figure 3).—The adult of this destructive insect is a handsome, elongate beetle which flies by night and secretes itself by day. Specimens in our collection range in length from five-eighths to seven-eighths of an inch. The color of the back is a soft shade of brown with two silvery-white stripes extending the full length of the insect on either side of the middle of the back. The underparts are white; the antennae long and conspicuously jointed.

The beetles appear in June and July, and deposit their eggs on the trunks of trees near the ground. The young borers hatch from the eggs in two or three weeks, and begin at once to eat their way through the bark. The first year is spent by them in burrowing about through the sapwood. The second year they penetrate the heart-wood, and in young trees will often almost sever the trees near the surface of the ground. The third year they transform to beetles and deposit eggs for another brood of borers.

This species is especially troublesome to apple and quince, and somewhat less so to pear. It also breeds in crab apple, thorn and other nearly related trees. In feeding the borer throws out sawdust-like chips, by which its presence may usually be detected.

If trees are examined carefully every fall and spring, the borers may be found and removed with a sharp-pointed knife while they are yet feeding in the sap-wood. If, however, the trees are neglected for a single year the borers will work their way into the interior of the body and can not be removed without danger of seriously adding to the injury already done.

The attacks of this borer may be prevented quite effectively by covering the lower portion of the trunk with wire mosquito-netting. At least two feet of the trunk should be covered and the netting tied close to the bark at the top and hilled with earth at the bottom. Such a screen will shut the adult female borers away from their favorite point for depositing their eggs. Wrappers of heavy paper may be made to answer the same purpose.

THE FLAT-HEADED APPLE-TREE BORER, *Chrysobothris femorata* Fab.—This insect attacks a great variety of fruit and forest trees. The adult is a beetle, but in appearance it is very unlike the round-headed borer, just described. It resembles more closely some of the "snapping-bugs" or "click-beetles." Different individuals vary greatly in size, the average length being about half an inch. The color of the back is dark, metalic-bronze blotched with gray. The underparts are burnished copper and the antennae green.

The insect flies by day in midsummer and glues its eggs to the bark, preferably of young trees that are diseased, or about wounds or sunscald spots. The eggs may be laid at any point on the body or larger limbs. The larvae, or borers, are light yellow in color, and when full grown are nearly twice as long as the mature insect. The segments at the head end are greatly enlarged and flattened, hence their common names of "flat-heads" and "hammer-heads."

The borers work just beneath the bark, where they excavate broad channels which are left partly filled with powdery excrement. When nearly full grown they eat deeper into the wood, but return again to the bark to pupate. This species is said to remain in the pupal state about three weeks. On reaching maturity the beetle cuts its way out, leaving an elliptical exit hole in the bark.

The remedies advised for the round-headed borer may also be used against this species. When the borers are once at work in the tree the only remedy that can be employed with satisfactory results is the process known as "worming," which consists of cutting the borers out with a knife. Washes made of

home-made or fish-oil soaps and applied to the trees during June and July will, to some extent, prevent the females from depositing their eggs on the bark.

THE PEACH-TREE BORER, *Sanninoidea exitiosa* Say. (Figure 4).—The adult of this well-known pest of peach and plum trees is a wasp-like moth which flies by day, being wholly unlike either of the preceding species. The male is about five-eights of an inch in length. The wings are transparent and bordered with blue, which is the general color of the body. The female is larger and the hind-wings only are transparent. The fore-wings and body are of a more lustrous shade of blue than in the male and a broad band of orange yellow encircles the abdomen at the middle. The flight of moths is so rapid that they seldom attract notice.

During the summer of 1907 the moths were flying in Upshur county from the middle of June to as late, at least, as the first of September, the bulk of them appearing during the last half of July and August.

The eggs are deposited on the bark, usually near the ground. The larvae feed only on the bark of the lower part of the trunk and the roots. The wounds which they make in feeding are marked by gummy exudations, with which is mixed the reddish-brown frass of the borers.

After a period of about ten months of feeding, the borers leave the roots and, near the surface of the ground, construct cocoons, which are composed chiefly of grains of excrement held together with gum and threads of silk. Within these cocoons in a short time they transform to moths.

From observations made last year, we have reason to believe that occasionally a borer which hatches very late in the season will remain in the tree over two winters. The greater part of them, however, change to moths in about a year from the time the egg is laid.

The most satisfactory way of dealing with this insect is the cutting out process. The work should be done in the fall, to secure the young borers, and should be repeated in the spring,

with equal thoroughness, to make sure of any that might have been overlooked in the first "worming." The tools needed for this work are a gardener's trowel for removing earth, a stiff wire for prodding into cracks between roots where borers are lodged, and a sharp, long-bladed knife for cutting away the bark.

If trees are mounded with earth about the first of June, the eggs will be laid and the borers will enter higher up on the trunk. This will greatly facilitate the work of "worming."

Protecting the bodies of the trees with mechanical devices and washes can be resorted to with partial success. Such measures, however, should always be accompanied by the use of the knife to secure the few borers that are almost sure to gain entrance to the trees in spite of precautions.

THE FRUIT-TREE BARK-BEETLE, *Scolytus rugulosus* Ratz.— This is a small beetle, about one-tenth of an inch long, of a uniform black color, except the tips of the wing-covers and parts of the legs, which are reddish. It attacks apple, pear, plum, peach, cherry, quince and other fruit trees. Its presence is indicated by minute circular holes in the bark, the holes being about one-sixteenth of an inch in diameter. In the early part of the growing season these holes will more often be found at the base of the buds in young orchard trees, but later they will be scattered promiscuously over the trunk and branches.

In the spring the females make longitudinal burrows, from an inch to an inch and a half in length, between the bark and the sap-wood. Along the sides of these burrows minute chambers are cut and an egg placed in each. In three or four days these eggs hatch, and the larvae mine about beneath the bark for about twenty days, when they construct cases in the outer sap-wood in which they transform to pupae. This dormant stage lasts for about a week, when the beetles appear and mine out through the bark. In badly infested trees the inner bark is converted into powder, and after a brood emerges the outer bark is filled with small holes as though bird shot had been fired into the tree.

It is usually conceded that this insect prefers to attack trees that have become weakened by other insects or by disease. The advent of the San Jose scale seems to have greatly favored the work of this pest, for when trees become weakened by the scale the beetles find in them congenial breeding places and hasten their death. Trees weakened by over-bearing, or injured by untimely freezes, are likewise sought by the beetles for breeding places.

The other borers mentioned here can be controlled by "worming" the trees, but the process is wholly impracticable with this species, owing to its small size, great abundance, and its habit of attacking all parts of the tree. About all that can be done in the way of preventing injury is to keep the trees in a vigorous condition. Whenever a weak tree is attacked by this pest, it should be cut and burned at once. Prunings or dead trees should never be left lying about the orchard. Such wood is almost sure to be utilized by the beetles for breeding places.

There are several parasitic and predacious insects that help to check the multiplication of this pest, but they cannot be relied upon to prevent damage without the assistance of the orchardist, especially when local conditions favor the spread of the beetles.

Leaf-eating Caterpillars.

THE APPLE-TREE TENT-CATERPILLAR, *Malacosoma americana* Fab.—During the spring and early summer, the white tents of this insect are conspicuous features of the landscape in some parts of this state. The tents are especially numerous in wild cherry and apple trees, but are liable to be seen on almost any kind of cultivated or forest tree.

The moth which is responsible for the caterpillars that construct these tents is a robust, night-flying species, with a wing expanse of from one to two inches. The color is a dull reddish-brown, with two parallel white lines extending obliquely across the forewings of both sexes. The moths appear in June and lay their eggs by night in thimble-like masses near the ends of small

twigs. The eggs remain on the trees over winter, and hatch as soon as warm weather comes in the spring. The caterpillars begin at once to feed on the young leaves, constructing meanwhile a tent of silken web in some convenient crotch of a limb in which they rest when not feeding. In about six weeks the caterpillars become full-grown and wander away from the nest. In a few days they find some sheltered corner or crack, where they spin their cocoons and pupate. The cocoon is about an inch long, oval in shape, and is composed outwardly of whitish threads of silk through which is mixed a little sulphur-colored powder. About three weeks later the moths emerge from the cocoons and the life-cycle is thus complete in a year from the time it began.

The egg masses on the twigs are covered with a frothy, glistening substance, which makes them somewhat conspicuous when the trees are bare of foliage. This renders it an easy matter to collect them from young trees in the winter and spring. Every egg mass destroyed in this way means one less tent in the spring. The tents may be torn out with a stick and the caterpillars destroyed. The caterpillars succumb readily to sprays of Paris green or arsenate of lead.

In dealing with this insect it is a good plan to remove all useless wild cherry trees that may be growing in the vicinity of the orchard, as they serve as breeding places for the moths.

THE FALL WEBWORM, *Hyphantria cunea* Drury. (Figure 5). The caterpillars of this species, like the ones just described, construct tents and feed gregariously. The tent is large, and loosely woven, and the caterpillars feed only on leaves that are enclosed in the web. When the supply of leaves within is exhausted, the web is enlarged to take in more and, in this way, the entire top of a young tree may be webbed over and defoliated.

The form of the tent and the manner of feeding of the worms will enable the orchardist to distinguish this species from the tent-caterpillar.

The eggs are laid in masses on leaves, and the larvæ begin feeding as soon as they are hatched. These larvæ, or caterpillars

Figure 5. Nest of Fall Web-worm on young pear-tree.

Figure 6. Bag-worm cases. (Natural size).

are covered with long, yellowish hairs. They grow rapidly, and when ready to pupate seek some sheltered place and construct fragile cocoons of web and hairs. The moths are nocturnal in their habits. They vary considerably in color, some being pure white and others white with black spots on their wings.

Two broods of the caterpillars appear in a single season; one in the spring and the other in the fall. The fall brood is usually much more numerous and destructive. The caterpillars attack a great variety of trees and shrubs, but seem to be especially fond of the leaves of apple, pear and quince.

In some sections of this state there is a midsummer brood which feeds almost exclusively on the leaves of the "sour-gum" or "sorrel-tree," *Oxydendrum arboreum.* This seasonal form produces but one generation of caterpillars annually.

Webworms, as well as tent-caterpillars, are likely to be excessively abundant for a period of a few years and then become so reduced in numbers, by parasites and other natural enemies, that for a corresponding period they will scarcely be seen. The decrease of the caterpillars, however, causes a famine among the parasites, and they in turn die off, when the caterpillars at once begin another period of increase.

The webworms may be destroyed by burning or tearing out their tents, or by the use of the same sprays suggested for the tent-caterpillars.

THE FALL CANKER-WORM, *Anisopteryx pometaria* Harr.— This is a northern insect that is found in West Virginia only in restricted districts. We have records of its occurrence in Hampshire, Hancock and Morgan counties. In some parts of these counties it has been very destructive for several years.

The adult is a small, gray moth, the females of which are wingless. Eggs are deposited on the bark of the branches, and the larvæ, which are "span-worms" or "measuring-worms," hatch in the spring at about the time apple-trees are putting forth their first leaves. The worms scatter over the trees and feed ravenously on the leaves. When they are numerous, orchard

and forest trees will sometimes be almost defoliated over considerable areas of country.

Spraying the trees when the worms first appear, with a stomach-poison, preferably arsenate of lead, is the best remedy.

THE YELLOW-NECKED CATERPILLAR, *Datana ministra* Drury. —It frequently happens that in September, or early October, the owner of a young apple orchard will find here and there a tree that has been entirely denuded of foliage by some insect which has eaten the leaves and then disappeared. Often the pellets of excrement scattered thickly over the ground under the injured trees will furnish the only clue for determining what species has committed the offense. There are several kinds of caterpillars that attack young apple-trees in this fashion, one of the more common of which is named above.

These yellow-necked caterpillars hatch from eggs laid on the leaves by a good-sized moth, of a brownish-yellow color. The caterpillars feed in companies and grow rapidly. Very often they will not leave a scrap of green leaf upon the tree. When full-grown they descend and enter the ground to transform, in due time, to moths.

The caterpillars attain a length of nearly two inches. The head is black, the neck yellow and the rest of the body is yellow and black spotted.

This species can very readily be destroyed by hand or by spraying with one of the arsenates.

THE RED-HUMPED PROMINENT, *Oedemasia concinna*, S. & A. —The manner of feeding of this species is very similar to that of the one just described. The caterpillars are of a yellowish-brown color, with black lines extending along the sides. The head is red and the fourth segment of the body is prominently humped and of the same color as the head.

Remedies, same as for the yellow-necked caterpillar.

THE BAGWORM, *Thyridopteryx ephemeraeformis* Haw. (Figure 6).—This peculiar insect has caused some alarm in certain sections of the state during recent years. They have appeared in great numbers on apple and other fruit trees, and a fear has been felt that they might prove to be a serious orchard pest. It is a native species, however, whose habits are well known,, and, judging from the past, it is not likely to do serious damage to any trees except evergreens.

The life-history of the species is about as follows. It winters in the egg stage in the old female bag. In spring the young hatches and begins at once to feed on the nearest leaf, constructing meanwhile a case to cover its own body. The case is composed of web and bits of stick and is carried by the caterpillar wherever it goes. As the caterpillar grows the case, or bag, is enlarged, and when growth is completed it attaches the bag to a twig by a strong, silken band and changes within to a pupa. In about three weeks the male emerges as a dark-colored moth with transparent wings. The female never develops wings but remains as a grub-like object in the bag, where she is fertilized by the male. The eggs are laid in the bag, and then the female drops out and dies.

The favorite food of the bagworm is arbor-vitae and other evergreens. The caterpillars multiply on such trees and become exceedingly abundant, when they often extend their ravages to fruit and other deciduous trees.

The bags hanging to the branches are conspicuous objects during the winter months, and one of the best ways of ridding trees of this insect is to collect and destroy the bags while the trees are bare. Spraying infested trees in the summer with Paris green or arsenate of lead is also an effective remedy.

CICADAS.

THE PERIODICAL CICADA, OR SEVENTEEN-YEAR LOCUST, *Tibicen septendecim L.*—This insect sometimes does serious damage to young fruit trees. For full description see Bulletin 68 of this station.

Plant Lice.

Insects of this class do considerable damage to young fruit trees. Especially is this true of the species known as the woolly aphis of the apple, which is described in detail later on. Most of the species that attack fruit trees are some shade of green in color and attack only the tender, growing twigs and foliage.

The life-history of the plant lice is similar in the different species. The winter is passed in the egg stage. These hatch, in the spring, agamic females which give birth to living young without the intervention of a male. These young, like the parent brood, are all females, and they in turn give birth to the same kind, and so on through the summer, until many generations have been produced. In the fall perfect males and females appear and pair, after which the females lay eggs and die. The eggs thus produced carry the species over winter. The small, black, shining objects which are frequently found on the terminal branches and water-sprouts of fruit trees are the aphis eggs referred to.

The eggs hatch in the spring at about the time the leaf-buds are opening, and the young lice suck nourishment from the tender growing parts. On badly infested trees the leaves curl and the growth is checked.

Sometimes in nurseries and young orchards these lice become so numerous that treatment is necessary to prevent serious injury to the trees. Kerosene emulsion and tobacco tea are the materials recommended for use in such cases. These may be applied as a spray or by dipping the infested parts in a vessel of the liquid carried from tree to tree. The latter method will prove most effective for the reason that the curled condition of the leaves makes it difficult to reach the lice with a spray.

THE WOOLLY APHIS OF THE APPLE, *Schizoneura lanigera* Haus. (Figure 7).—This familiar louse confines its attacks almost exclusively to the apple. Its presence on trunk or branch is very noticeable, owing to the white, woolly matter which is ex-

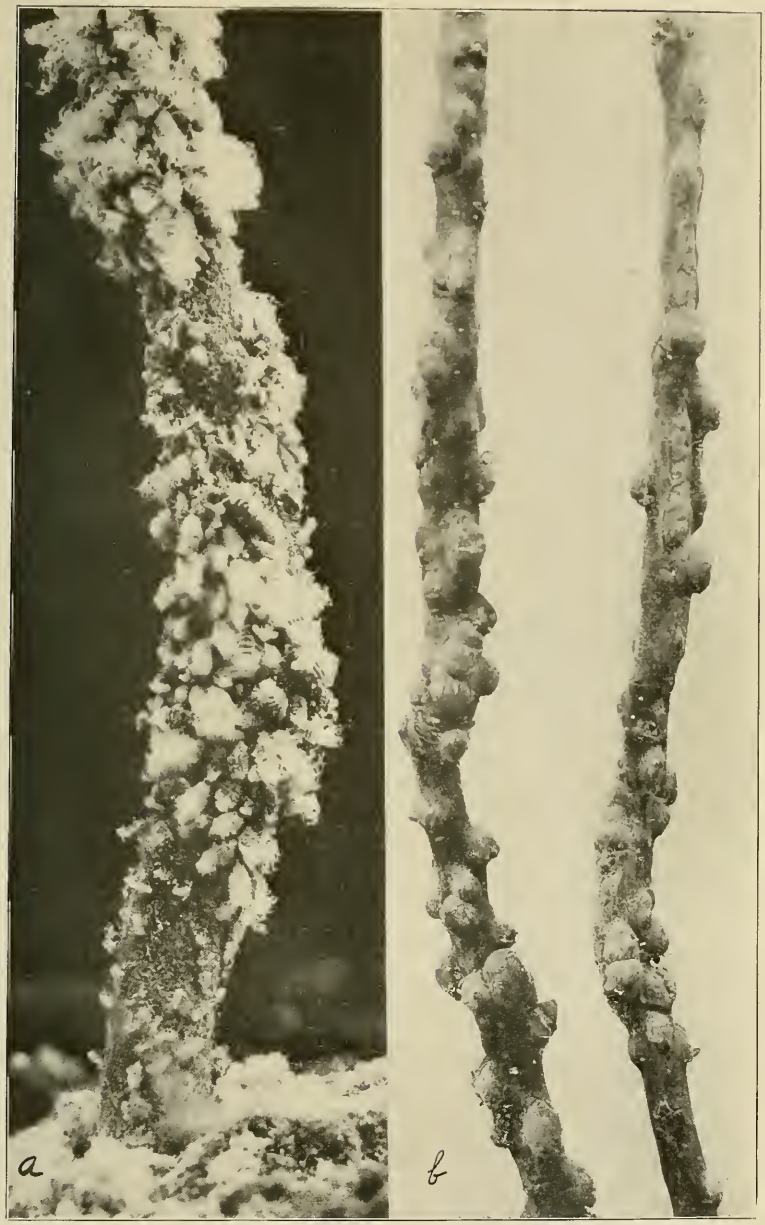

Figure 7. The Woolly Aphis of the Apple. *a*, Insects on stem of seedling tree. (Magnified three times). *b*, Knots on twigs caused by the aphis. (Natural size).

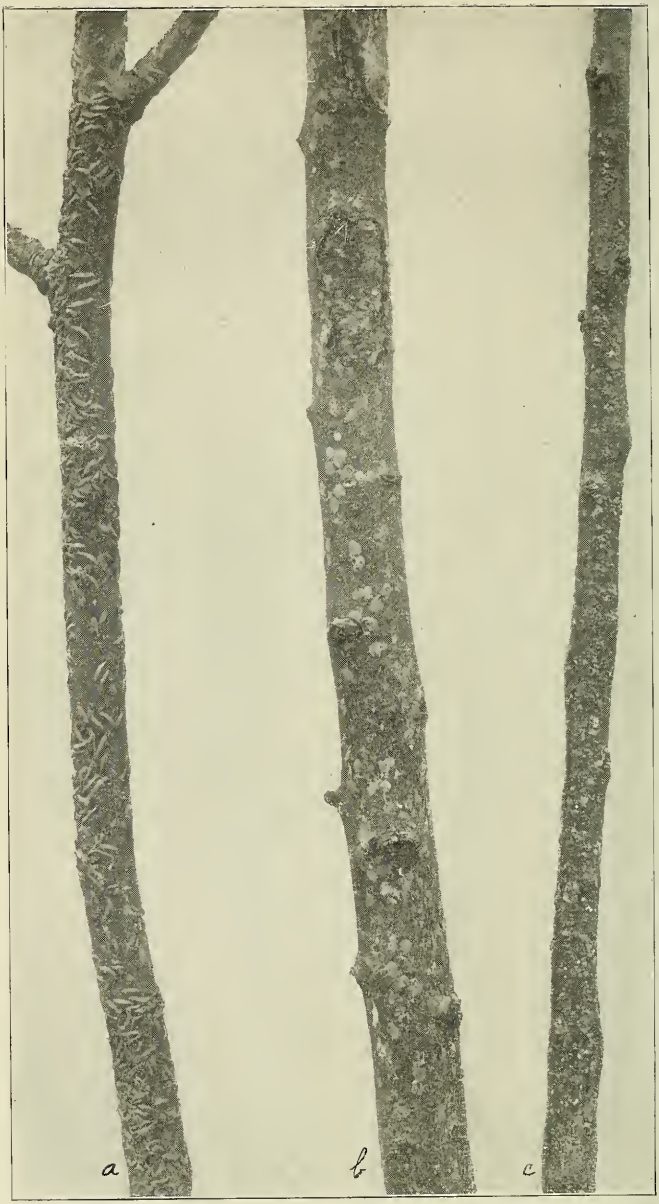

Figure 8. Three common scale insects. *a*, Oyster-shell Scale; *b*, Scurfy Scale; *c*, San Jose Scale. All natural size.

creted from the body. One not familiar with this insect might think that these fluffy masses were nothing more than flakes of wool or cotton that had accidentally lodged on the tree. An examination, however, would show that under these masses colonies of small, pinkish-colored lice were located, having their beaks inserted in the bark.

There are two forms of this insect, aerial and subterranean. Representatives of the former are usually found where there is a wounded or rough place on the body or limb; those of the latter attack the roots and are the ones that do the most damage. They are especially injurious to nursery stock and to young orchard trees. The root form secrets but little of the woolly matter mentioned above. Both forms cause wart-like growths at the point of attack, which disfigure and seriously injure the trees. Roots are sometimes found that are covered with these knotty excrescences. It is not unusual for such trees to die as a result of the injury. Others do not die, but become so impaired in vitality that they remain stunted and unprofitable. In planting young orchards all trees having badly knotted roots should be destroyed. Trees but slightly knotted should be root-pruned and dipped in lime-sulphur wash, or one of the soluble oils, mixed as for spraying. When the lice become established in a young orchard, the soil about the roots of the trees may be removed and tobacco dust applied to the roots with good results. Kerosene emulsion, of a 15% strength, may be used instead of the tobacco dust.

The aerial form may very readily be destroyed by spraying with kerosene emulsion, of the strength just mentioned. It is necessary, however, to apply the spray with considerable force so as to penetrate the woolly covering.

Scale Insects.

SAN JOSE SCALE, *Aspidiotus perniciosus* Comstock. (Figure 8, *c.*)—This insect continues to be a most dangerous foe to fruit trees.

For description and methods of control, see Bulletin 107 and Special Bulletins 3 and 4, of this station.

THE SCURFY SCALE, *Chionaspis furfurus* Fitch. (Figure 8, *b*). This common scale insect infests apple and pear, and is quite often mistaken for the San Jose scale. It differs from the latter, however, in being more elongate in shape, of a lighter color, less destructive to plants, and in several details of life-history.

It is a common thing to find small, whitish spots, a little larger than a common pin-head, on the bark of young apple and pear trees. These spots resemble diminutive pumpkin seeds and are often very abundant, especially on water-sprouts that grow up from the roots of old trees. The spots are the stationary, scale-like coverings that protect the insect, or the eggs, of the species under consideration. If one of these scales is lifted with the point of a knife-blade at any time when the trees are dormant, it will be found to cover a batch of tiny, red eggs, which, if pressed with the point of the blade, will crush with a grating sound.

With the coming of warm weather the eggs hatch and the young insect, which is of the same color as the eggs, crawls forth to find a suitable place on the bark where it may insert its beak and settle down to draw nourishment from the tree. When feeding begins the whitish scale, referred to above, soon forms and serves as a protection to the insect.

When trees become so badly infested that treatment is necessary, the lime-sulphur and soluble oil sprays described in Special Bulletin 4 will be found effective.

OYSTER-SHELL SCALE, *Lepidosaphes ulmi* Linn. (Figure 8, *a*). This native scale insect is named from its resemblance in shape to an oyster-shell. Its life-history is similar to that of the scurfy-scale. There is but one brood annually and the winter is passed as an egg. It does not spread from tree to tree very rapidly, and the damage which it does is slight as compared with that of some other insects. Where it becomes established on a tree, however, it will sometimes multiply until the bark of trunk and branches will be entirely covered, giving the tree a very peculiar appearance and really

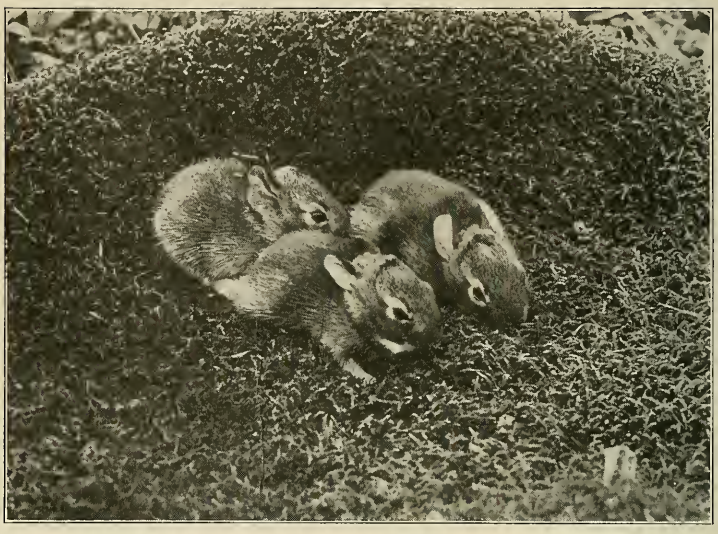

Figure 9. Young Gray Rabbits.

Figure 10. A Field Mouse.

injuring it greatly, or even killing it. It is more abundant in the higher altitudes of the state. The remedy is the same as for the scurfy-scale.

Mammals.

COMMON COTTONTAIL RABBIT, *Lepus floridanus malurus* Thomas. (Figure 9).—The common, gray rabbit frequently plays havoc with young orchard trees by girdling the bodies near the ground. The damage is usually done in the winter or early spring when the supply of other foods is scanty.

Trees may be effectively protected with wrappers of heavy paper or with repellant washes. There are several kinds of tree protectors on the market that give good results when used against rabbits. Perhaps nothing is better than the wood-veneer wrappers that are frequently advertised in the horticultural papers.

FIELD MICE (Figure 10).—For descriptions and methods of control, see Bulletin 113 of this station.

POULTRY IN THE ORCHARD.

Horace Atwood.

Fruit culture and the production of poultry products can frequently be combined in a satisfactory manner. This is especially important during the first few years, before the orchard has come into bearing, and when any addition to the income is welcome.

There are several reasons why fruit and poultry can be produced economically together. In the first place fowls are very destructive to insect life, and if sufficiently large numbers are kept, few of the larger insects, which may spend a portion of their time on the ground among the dead leaves and grass, will escape. This destruction of insects tends, of course, to make the trees more healthy and the fruit produced more perfect.

The amount of fertility, too, which may be added to the soil through the droppings of the fowls, is a matter of no small importance, when considered for a series of years. Medium sized fowls, like the Leghorns, require about a bushel of grain per year, and larger fowls considerably more. The greater part of the nitrogen, potash, and phosphoric acid present in this grain passes into the excrement, and when this is scattered uniformly over the surface the soil should become more fertile from year to year, thus making the trees more thrifty, vigorous and productive. In these ways, then, will the fowls benefit the trees, while on the other hand the shade furnished by the orchard on the sultry days of summer adds to the comfort and well being of the fowls, and thus increases the profit which may be derived from them.

BREED TO SELECT.

In connection with orcharding it is important to have the poultry work so arranged as to interfere as little as possible when

the trees demand most attention, namely, in the spring, when it is necessary to spray, and in the autumn at harvest time. Keeping fowls for egg production can be made to meet this requirement more nearly than any other branch of the poultry business, hence an egg or general purpose breed should be selected. The Leghorns, Minorcas, Plymouth Rocks, Wyandottes, Rhode Island Reds or Orpingtons are all suitable for this purpose.

HOUSES FOR LAYERS.

Colony houses should be scattered through the orchard. The shape or size of these houses is quite immaterial, provided that the hens are not overcrowded, and that the houses are dry and comfortable. A house sixteen or eighteen feet wide and twenty feet long will accommodate about seventy-five fowls of the smaller breeds, and one house per acre would be sufficient. These houses should face the south or south-east, so as to receive as much sunshine as possible in winter. The back wall, on the north side of the house, should be double boarded, so as to be perfectly tight and warm, and the south side should be provided with an opening which can be closed in cold and stormy weather by a canvas or duck curtain. The porches should extend the entire length of the house at the rear, and should be provided with dropping boards, underneath which the nests may be located. For details of construction, and cost, see Bulletins 71 and 115 of this Station.

FEEDING THE LAYERS.

The dry mash system of feeding can be used. This reduces the cost of labor for feeding to a minimum. This system consists in keeping constantly available to the fowls a mixture of ground grains and beef scrap. A mixture which has been found to be very satisfactory at this station consists of equal parts by weight of corn meal, ground oats and wheat bran. To this mixture is added about ten per cent. of beef scrap. In addition

to the dry mash the fowls should be fed at least once per day some whole grain, such as a mixture of corn, wheat and oats. In the winter time, when the fowls are confined to the houses, this should be scattered in the straw or litter, which should cover the floors of the houses. In summer the whole grain may be scattered outside.

If a number of houses are constructed, a horse and wagon should be provided, so that the routine operations of watering, feeding and picking up eggs can be done without too much expense. In summer, when the hens have free range, one trip late in the afternoon will be all that is required, as the fowls can be watered, fed whole grain and the eggs gathered at the same time. In winter it is usually necessary to make two rounds daily.

AMOUNT OF FOOD REQUIRED.

Laying hens of the size of Leghorns require from sixty to seventy pounds of grain and beef scrap per head yearly. At the present prices for grain, this will cost about one dollar per fowl per year.

NUMBER AND VALUE OF EGGS LAID.

Young fowls, properly fed and cared for and given free range in an orchard, as outlined above, will lay, at the very lowest estimate, ten dozen eggs per hen per year. At an average price of twenty-five cents per dozen these would be worth two dollars and fifty cents, or a profit, above the cost of feed, of one dollar and fifty cents per hen per year.

REPLENISHING THE FLOCK.

Pullets hatched early in the spring lay more eggs during the following year than older hens. The pullets also lay more freely in winter, when eggs are high in price. In order, therefore, to obtain the greatest profit from a flock of fowls, it is necessary to raise a large number of chickens each year to take

the place of the old hens, which may then be disposed of. If the flock of layers numbers more than two or three hundred it will probably be wise to procure an incubator and a few brooders, so that the chickens can be raised without too much trouble and expense. It should be kept clearly in mind, however, that it is not nearly so easy to raise chickens successfully by artificial means as it is to raise them with hens in the old way; and, unless the attendant is willing to spend some time in learning how to hatch and care for chickens, it probably will be wisest to let the hens do this. If incubators and brooders are used, consult Bulletin 98 of this Station, entitled Raising Chicks Artificially.

After the chicks become old enough so that they do not need artificial heat, or after they have been weaned by the hens, they should be placed in colony houses holding small flocks and allowed unrestricted range in a portion of the orchard away from the laying stock. If insects are plentiful, and the range is not overstocked, they may be able to procure sufficient animal food, but frequently it is necessary to give them an additional supply of ground fresh meat and bone or beef scrap in order to keep them growing properly. After the chicks are six or eight weeks old, whole or cracked grain is better than too much ground feed. If they are intended for layers or breeders, they should be induced to take as much exercise as possible so as to develop strong vigorous constitutions.

When the chicks are twelve or fifteen weeks old the cockerels can be sorted out and sold for broilers. This gives the pullets additional room on the perches at night, and care should be exercised to see that the little colony houses do not become overcrowded at any time during the summer, through the growth of the birds, as the success or failure of the egg production during the following winter depends quite largely on whether the pullets are strong, vigorous and healthy.

A short time before the layers begin to moult in the fall they should be culled over, and a few of the best birds reserved for next year's breeders. The houses should then be cleaned, disin-

fected and put in readiness for the reception of the pullets, which should be moved into their winter quarters at the beginning of frosty weather.

MARKETING THE PRODUCT.

Eggs produced during the winter, spring and summer would be the principal product to be disposed of, and if the local demand is small, and the price consequently low, it should be borne in mind that the wholesale price of new laid fancy white eggs in New York City is frequently as high as forty-five cents per dozen during November, December and January, and that it costs only from two and one-half to three cents per dozen, in case lots, to ship eggs to that market from almost any place in this state.