

KENTUCKY  
AGRICULTURAL EXPERIMENT STATION

OF THE  
STATE COLLEGE OF KENTUCKY.

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BULLETIN No. 80.

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- 1. Some Pests Likely to be Disseminated from Nurseries.**
- 2. The Nursery Inspection Law.**

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LEXINGTON, KENTUCKY,

March, 1899.

**KENTUCKY**  
**Agricultural Experiment Station.**

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ADDRESS :

KENTUCKY AGRICULTURAL EXPERIMENT STATION,  
LEXINGTON, KY.

## BULLETIN No. 80.

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### 1. SOME PESTS LIKELY TO BE DISSEMINATED FROM NURSERIES.

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BY H. GARMAN, ENTOMOLOGIST AND BOTANIST OF THE  
STATION, AND STATE ENTOMOLOGIST.

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In preparing the following accounts of pests likely to be disseminated on nursery-grown plants, I have been guided solely by a desire to help Kentucky nurserymen and fruit growers to recognize the most dangerous diseases and insects of this sort likely to be encountered in the State. With the exception of the Rosette of peach trees, all of the pests considered in these brief sketches have been observed by me in Kentucky, either in nurseries or orchards, or in both.

We have other insects and some fungus pests that with great carelessness on the part of dealer and buyer might become established in this manner in orchards. The large *Cecropia* moth, familiar to every farmer's boy because of its extraordinary size and attractive colors, places its big silken cocoons on the twigs of young fruit trees in the nursery, but is commonly so widely scattered that but little harm is done by it, and the cocoons are so striking in size and character that no nurseryman of intelligence would offer his customers trees to which they were attached. But while most that do serious mischief are noticed, there are others that are liable at any time to put in an appearance and claim attention. These may be treated in future publications, as occasion arises.

I might mention here, just to call attention to it, the occasional presence in Kentucky, of what is known as crown

gall on peach and raspberry. It is not yet known what causes the disease. The galls resemble somewhat those caused by the woolly aphid of apple. They appear on the underground part of the stem and on the roots.

A second disease, the nature of which is not yet known to me, causes the bark of young apple trees to become rough, corky, and finally to split, having thus in its effect a resemblance to potato scab. These rough places appear about the origins of lateral branches and about buds. It has been noticed as especially prevalent on Northern Spy, Rambo and Williams' Favorite.

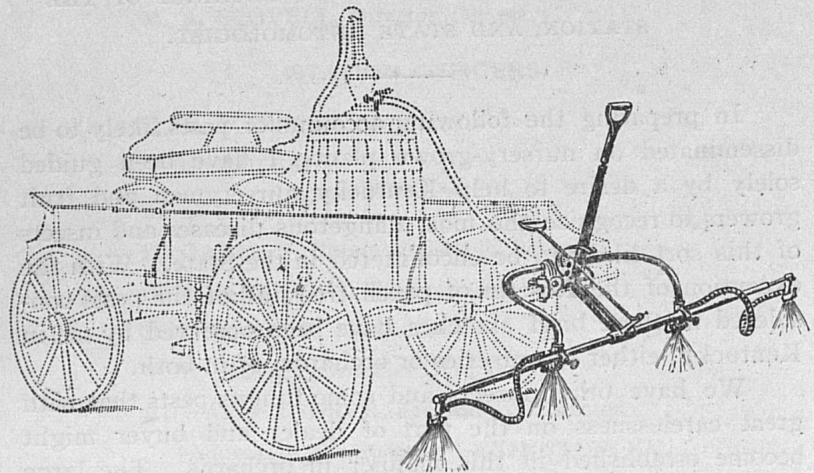


FIG. 1.—A field sprayer, suitable for spraying young trees or other low-growing field crops. The distributing bar bearing the nozzles can be attached to any ordinary spray pump. Manufactured by the Deming Company.

*Spraying Machinery.*—The subject of spraying machinery and insecticides and fungicides has not been discussed in our bulletins for some time, and since the directions for treating diseased trees given below imply a knowledge of such things, it may be well to give recipes for the preparations most often mentioned, and to say a few words about sprayers.

Spraying machinery has been greatly improved recently, and special forms have been devised suited to different kinds of crops. If one wishes to spray grapes only, perhaps the

best he can do is to buy one of the knapsack sprayers, made of copper and brass. But for spraying orchards this form does not throw the spray with sufficient force and does not furnish it freely enough. To spray an orchard of a thousand or more trees, one wants a strong pump with a large barrel or tank attached, holding at least forty gallons, since this provision saves time in making up fresh lots of the spraying mixture. The pump should in all cases be made of brass. Most pumps intended for orchard work are constructed so that they can be conveniently connected with a barrel or specially constructed tank, and the whole be hauled about in a cart or wagon. Some are attached to a barrel mounted on two wheels, with a handle and iron rest so that they can be hauled about by hand. As to which one of these methods is preferable will depend somewhat on the number of trees to be sprayed. The hand-cart arrangement serves very well even for a small orchard. For very large orchards or for nurseries, a horse to do the hauling is a great help and will save time. Without wishing to discriminate in favor of any firm or firms, but solely because I happen to have personal knowledge of their pumps, I mention from among those known to me the two following manufacturers of spraying machinery as able to furnish good spraying outfits of almost any sort the fruit grower or nurseryman is likely to want:

The Deming Company, Salem, Ohio.

The Goulds Manufacturing Company, Seneca Falls, N. Y.

*Whale Oil Soap.*—When a large number of trees are to be treated with soap solutions it is well to get this soap because it does not vary so much in quality as the various brands of laundry soap. Leggett & Brother, of New York City, some time ago gave me the following prices on their "Anchor Brand Whale Oil Soap:" 1 lb. boxes, 10c.; 50 lbs. \$3.25; 100 lbs. \$5.50; 1 barrel of about 400 lbs. \$15.00.

*Kerosene Emulsion.*—To make an emulsion dissolve  $\frac{1}{2}$  pound of soap in one gallon of hot water; add to this while still hot two gallons of coal oil, then churn for 10 minutes by passing the two through a force pump, returning to the same

vessel whence sucked up by the pump. People are heard sometimes to direct that in the absence of a pump the emulsion be made by stirring vigorously with a stick. I very much doubt if a genuine emulsion can be made in this way, without an unreasonable expenditure of energy and a severe tax on one's patience. When the soap solution and oil have been churned together long enough they will not separate when

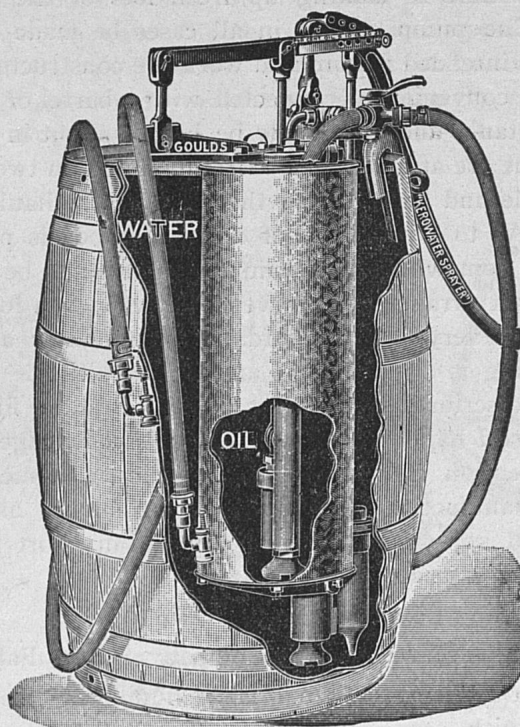


FIG. 2.—A new barrel pump with coal-oil tank in the barrel. Constructed so that the quantity of oil used can be made to vary from 5 to 25 per cent. Manufactured by the Goulds Company.

allowed to stand, and in this shape can be diluted at will with water. The extent of the dilution will vary with the use to which the emulsion is to be put. On the trunks and branches of trees during fall and winter it can be used much stronger than on foliage during summer. The three gallons of emulsion prepared as above directed may be diluted to make from 15 to 30 gallons.

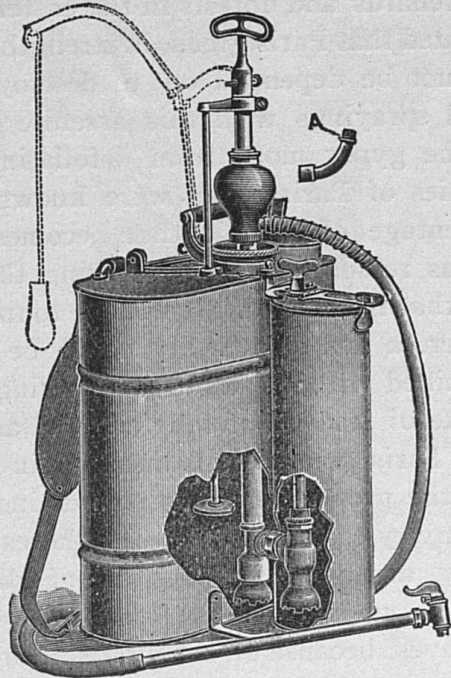


FIG. 3.—An improved knapsack sprayer, with a detachable kerosene tank. Provided with a foot-rest, so that it can be used as a bucket pump. Manufactured by the Deming Company.

*Bordeaux Mixture.*—The recipe generally given by me to those who write to the Station inquiring about this mixture is the following: Bluestone,  $6\frac{1}{2}$  lbs.; fresh lime,  $3\frac{1}{2}$  lbs.; water, 32 gallons. I like strong mixtures where the number of plants to be treated is not large. They increase the cost, of course, and on this account for extensive spraying, a dilute form of the mixture is preferable. The lime is slaked, and, a little water being added from time to time, is worked with a wooden paddle until it is about as thick as cream. Kentucky limes slake so completely that it is not absolutely necessary to strain them through a sieve, as is sometimes recommended. The bluestone being dissolved in four or five gallons of hot water, the lime is stirred slowly into it, and then water is added to make 22, 32, or 42 gallons, as may be desired. The bluestone should cost about 8 cents per pound.

*Arsenate of Lead.*—The work done by the State of Massachusetts in destroying the gypsy moth, which has proved

destructive in orchards and forests in the eastern part of that State, demonstrated that Paris green, in strengths not injurious to foliage, can not be depended on to destroy some caterpillars. Several sprayings with this arsenite did not in all cases prevent the gypsy moth from defoliating trees. The burning properties of Paris green were known to be due to the small percentage of arsenic that becomes dissolved in water, and it was reasoned by those having the gypsy moth work in charge that if something could be found that did not dissolve in water, a larger quantity could be used and the worms thus be killed without any accompanying injury to the leaves. Arsenate of lead was finally adopted as having these advantages over Paris green: It is insoluble in water and can be used even in the proportion of 30 pounds in 150 gallons of water, without injury to the leaves. It adheres to the foliage more tenaciously, and with the addition of glucose a single application can be made to last throughout a season. It is visible on the leaves, because of the whitish coating left when the spray dries.

It has its disadvantages, too, one of which is the danger to stock from strong mixtures when these drip upon grasses beneath trees. However, as suggested by Messrs. Forbush and Fernald in their report upon the gypsy moth, the strong mixtures necessary for the gypsy moth are not required for many other insects, and arsenate of lead can be used for these latter in about the same proportions as the more soluble Paris green.

The arsenate of lead is prepared by dissolving arsenate of soda in water, in which it is completely soluble, then adding to the solution sufficient lead acetate to form a precipitate, the arsenate of lead, which remains suspended in the water. In their field work the Massachusetts workers used 29.93 per cent. of arsenate of soda to 70.07 per cent. of lead acetate. Prof. Fernald himself advises the use of 4 ounces of arsenate of soda to 11 ounces of lead acetate. Two quarts of glucose was used in 150 gallons of water.

*Paris green.*—This useful insecticide should contain about 50 per cent. of arsenic. Imitations are on the market, and



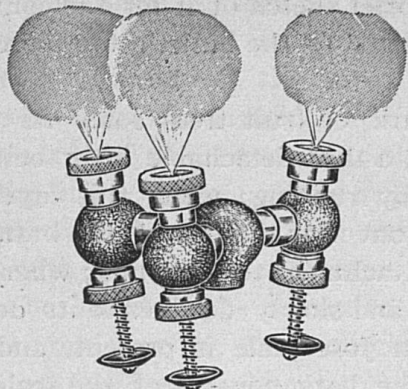


FIG. 4.—A three-discharge nozzle of the Vermorel type. Manufactured by the Goulds Company.

account for some failures to get the results which Paris green gives when it is properly made. The price varies from season to season, but in small quantities it should cost from 20 to 30 cents per pound. It is important to keep it stirred up while using.

*Bisulphide of Carbon.*—This may be bought in pound bottles from druggists, or in larger quantities from Edward R. Taylor, Cleveland, Ohio. In a circular issued by Mr. Taylor I find the following prices quoted :

50 lb. cans, 10 cents per lb.

30 lb. cans, 11 cents per lb.

10 lb. cans, 12 cents per lb.

This insecticide is sold in the form of a fluid. When exposed to the air its fumes escape and at the same time the fluid evaporates very quickly. No animal can breathe the fumes for any length of time, hence its destructive effect upon weevils when poured upon infested grain, and upon woolly aphis and grape Phylloxera in the ground. The fumes are inflammable, and must not be allowed to escape in the vicinity of fire.

#### SAN JOSE SCALE.

(*Aspidiotus perniciosus*.)

Bulletin 67, published in May, 1897, by this Station, contains a full account of this insect, and gives the best methods of treating infested trees. It will not be necessary to give

here more than a brief sketch of it for the convenience of the reader, who is referred to the bulletin for more detailed information.

When the bark of fruit trees loses its clean, healthy, glossy appearance, a thin detachable layer being present that can be removed by rubbing; when this layer is found over much of the tree, out near the tips of the branches as well as down near their attachment to the trunk; when the tree ceases to grow and bear, and slowly declines to its death, the probability is that San Jose scale is present, and that the thin scurfy layer on the bark consists of the scale-like coverings and flat bodies of this singular insect. The insects become fastened to the bark shortly after being born and do not afterwards move about. To the unaided eye the insect nature of the layer is not apparent. It is only with the compound microscope that it can be studied properly.

The pest is present in Kentucky, in Fayette, Jefferson, Grayson and Muhlenberg counties to my certain knowledge, and probably in isolated orchards elsewhere. *It is not in our nurseries.*

We are endeavoring to locate all infested orchards in the State. Will not our friends notify us of any suspected trees in their neighborhoods, sending us by mail a few twigs for examination when possible? Bulletin 67, giving directions for treatment, can be obtained by application to the Station.

#### THE WOOLLY APHIS OF APPLE.

(*Schizoneura lanigera.*)

*Character of Injury.*—The effect of attack by this insect is often visible chiefly as a general enfeeblement and gradual decline, resulting, when very severe, in the death of the tree. When the roots of such trees are exposed they are found to be extensively deformed by the growth of knot-like or wart-like masses of irregular shape and size. The main roots (now before me) of a young apple tree obtained at Winchester, are completely covered with such knobs and must have been of very little use to the tree. The aphides with their white

cottony covering may often be seen in crevices of the bark, especially where this has been injured, and often appear on the sprouts that grow up at the bases of trees. Their attacks cause the bark to become rough and warty, and sometimes fissures appear that admit water and thus induce decay. In this country the injury above ground is generally not serious, but in England and on the Continent the trees often become covered with the insects and even the twigs are so badly stung as to be killed. The injury to the roots is relatively slight there, but here the chief mischief is done by the insects working on the roots. The latter are not only distorted so that they do not perform their functions properly, but are often so injured that they die and rot away.

*The Aphis.*—The woolly aphis is a small brown or black, stout, soft-bodied louse, which secretes from its surface the white cottony material by which its presence on the bark is most often detected. The young are somewhat paler in color, but otherwise are not especially different from the adult. Fully grown wingless examples measure about .07 inch in length and about .05 inch in diameter. Late in the fall dark colored examples with relatively large thin and fragile wings, and with little trace of the cottony substance on their backs, are found among the wingless lice; but ordinarily on both roots and branches the most of the lice are without wings, and have to depend solely on six rather feeble legs for getting about. Their motions are rather clumsy as a consequence, and once established they do not move about much.

The young are born alive during much of the year, *and no males appear*, but toward winter a sexual generation of wingless egg-producing individuals is developed, and each female leaves its single egg, sometimes enwrapped in its skin, on the trunk of the tree attached to the bark close to the ground. These egg-laying individuals are very small, and when adult have no beak, their sole function being to produce eggs; this accomplished, they disappear.

*Distribution.*—For many years this aphis has been distributed throughout most the globe, wherever the apple is grown. The British are disposed to regard it as of American

origin, call it, in fact, American blight, and suggest that it may have lived before the advent of the white man in America, on our native crab-apple. It does attack this tree, it is true, but is known not to be partial to sour apples, and on other grounds its American origin has been questioned. The discussion of the subject is profitless at this late date, and indeed the only fact of economic value thus far brought out by the discussion is that the unrestricted sale of infested nursery stock is chiefly responsible for its present wide distribution.

The woolly aphid is often said to be particularly troublesome in countries where the mean temperature is low, this view seemingly having been adopted because of its prevalence in New England. I do not see how the root-infesting form could be more abundant than it is on neglected trees in Kentucky. It is abundant also in Missouri, as attested long ago by Dr. Riley, and more recently by Prof. Stedman. The twig and trunk-infesting form is abundant, too, in England, where the winters are probably even milder than our own. When all the facts are known it will probably be found to thrive wherever any considerable number of apple trees are grown.

As to the kind of soil and situation in which it is most at home, opinions of practical men vary. Some assert that it cannot do much injury in a stiff clay soil, still others that it is most injurious in such soil. A free use of stable manure, by loosening the soil, encourages it according to one man, and discourages it according to another. One man is very sure that low damp ground is just the place it prefers to all others, while his neighbor is just as positive that it is much more destructive on slopes where the natural drainage is good. The explanation of this conflict of opinion and experience is to be found in the fact that the woolly aphid thrives in a variety of situations, low and high. I believe that here in Kentucky it has oftenest been observed destructive on level land, but one of the worst infested lots of trees that has come under my observation in the State grew on rather high and sloping ground.

One of the most thorough-going of the early accounts\* was published in 1830 by Mons. Blot, a Frenchman. He advises growers of trees to avoid for nurseries, low and humid places, because of the greater danger there from aphid. It is possible that the rank and succulent growth of both root and branch in places where there is abundant moisture may be inviting to the woolly aphid, not only as affording it tenderer food, but because of the concealment which a rank growth offers it. It is a common belief, at any rate, that the trees that are permitted to sprout at the base are most commonly the ones upon which the egg-laying females are produced. It is with this idea in mind, apparently, that Blot advises that in both orchard and nursery the heads of the trees be kept open to favor circulation of the air and drying of the soil. Rubbish and twigs should, he says, be removed from under the trees, and the plow be employed frequently.

#### Treatment.

The form which appears on the trunks and branches may be destroyed by spraying with a diluted coal-oil emulsion, or in some cases simply by rubbing the infested places with a cloth saturated with the emulsion. Mons. Blot advises using a torch made of straw, but suggests that it must be employed with some caution to avoid injury to the tree. As being more completely under control for this purpose, the gasoline blast-lamp used by mechanics for burning off old paint, melting metals, etc., may be mentioned. Such lamps are now made for insect work, selling for from \$3.50 to \$4.00, and are useful about a farm for other purposes. The air pump with which they are provided produces a large jet of intensely hot flame that can be passed quickly over infested trees, killing insects on the bark, but not penetrating the latter.

In this region the root-infesting lice are so much more prevalent that treatment must, in the majority of cases, be directed towards them. For the greater part of a century

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\*I have not seen the original publication, but have before me Amyot et Serville's *Histoire Naturelle des Insectes*, 1843, in which Mons. Blot's work is quoted (p. 612).

tobacco dust has been employed by fruit growers about the roots of infested trees. Blot, in 1830, recommended putting about the bases of trees a mixture of tobacco and fine sand. Some experiments recently made at the Missouri Station by Prof. J. M. Stedman, suggest that ground tobacco stems is more effective for woolly aphids than has been supposed. His method of using it was to dig away the earth for several feet about a tree, to a depth of from four to six inches, and in the depression spread from 2½ to 5 pounds of tobacco dust, this being covered with the earth taken out. Fifteen trees treated in this way on the 29th of June were treated again in the same way August 15. When they were inspected on the last of October only two of the trees had any trace of aphids on the roots, and these but one colony each, where possibly the tobacco had not been as thickly spread as elsewhere. Fifteen badly infested trees in another orchard were treated in the same way and were found in October to be entirely free from woolly aphids.

It is practicable to treat nursery trees in the rows with the same material, by plowing or hoeing furrows alongside. Prof. Stedman advises dusting tobacco in the earth in which young trees are being set.

*Gas Lime.*—In 1886 Mr. W. G. Klee published the results of his experience with this substance in a bulletin from the California Station, claiming that it is a very satisfactory remedy for use on orchard trees. In his first experiment with it he placed it close about the trunk and removed the earth, to bring it near the roots, with the result that the trees were in some cases injured by it, although it cleared the roots of aphids. He next put ashes about the trunk of the tree to keep the gas lime away and simply spread the latter on the ground. This was done in October. He says :

“On the trees examined thus far, the result has been very satisfactory. They show by the knots and swellings on the roots that they were once badly infested; still, there is no aphid on them now, while on a few other trees left without treatment the insects are crowded.”

The quantity to be used varies with the size of the tree and the character of the soil. A porous soil which allows the

matter washed out of the gas lime to pass through readily requires more, while a clayey soil keeps it about the roots longer, and if much is used they are liable to be corroded. One shovelful for a small tree and four for a large one is, he says, about what is needed.

*Hot Water.*—Boiling water, used on the roots after removing the soil so that it can reach them, is strongly advocated by some of our best horticulturists.

*Bisulphide of Carbon.*—This fluid can be introduced into soil either with a specially made injector (like a large syringe) or by driving a round stake into the ground and pouring the bisulphide into the hole thus made, then filling with earth. Prof. Stedman, who has experimented with this substance, also, advises using two or three ounces to a tree and injecting it a couple of feet from the trunk on two or more sides. A too free use of this fluid is liable to injure the trees, especially if injected too near the trunks.

*Treatment of Nursery Stock.*—Nurserymen are not likely to send out very badly infested trees. The conspicuous knots on the roots attract the attention of the purchaser at once and lead to complaint. But some of the less careful ones still neglect to treat trees that have some of the aphides on the stems. I had one complaint from a buyer this year concerning trees he had bought of a Virginia nurseryman and had not yet planted. *No infested trees*, no matter how slightly they are affected, should be allowed to go from the nursery. It is such a simple matter to dip trees, where suspected, in a dilute coal oil emulsion kept in a vat for the purpose, that there would seem to be no excuse for neglecting this precaution. Buyers should examine trees before planting to see if they are infested with the insect. As I have said in other connections, they will never after planting the trees have so good a chance to get rid of the insects.

The nurseryman is urged to burn promptly all refuse trees. It is not enough simply to take them up and throw them aside. Neglected, overgrown stuff attracts such pests, and thus keeps a nursery infested. When trees are past the

salable age the sooner they go to make up a good bonfire the better. The same may be said of all useless apple trees, old or young, growing about a place; they often serve as breeding places for pests of this sort.

#### Resistant Varieties.

It is very commonly held that there are resistant varieties, among which Rawles Janet is often mentioned. The subject is worthy of closer attention than it has yet received in this country. It is not improbable that varieties exist that might be used as stocks that would be but little injured by woolly aphis, just as American grapes are largely immune to the attacks of Phylloxera. Mons. Blot, the French writer referred to, among other "precepts" adopted as a result of his observation along this line, says: "Use for planting only the seed of sour varieties." Sweet apples are believed to be especially subject to attack. In Australia this subject of resistant varieties has been given a good deal of attention, and fruit growers there sometimes claim that they have mastered the subject so far as injury to the roots is concerned. As one writer expresses it, by the intelligent use of resistant stocks they can snap their fingers at the American blight.

In his work on the destructive insects of Victoria, published at Melbourne in 1891, Mr. C. French, the Government Entomologist, writes in explanation of the discovery of resistant varieties:

"According to the late Mr. Treen, the first systematic experiments with the non-blighting stock, the 'Majetin,' were carried out by Messrs. T. Lang & Co., the well-known nurserymen of Melbourne and Ballarat, in 1868-70, their attention having been drawn to this apple in 1862, and to the descriptions thereof given by Geo. Lindley in his 'Guide to the Orchard.' Lindley says that, at the time of the publication of his book, 40 years ago, it was noticed that an old apple tree growing at Norwich, in England, which had been grafted three feet high, had been attacked by the '*Aphis lanigera*' or 'American Blight,' below the grafted part, but never above it; the limbs and branches continuing perfectly free, although all the other trees in the same garden were infested, more or less, with this blight. The variety was a Norfolk apple named the 'Winter Majetin,' and the Messrs. Lang & Co. concluded that, if this variety was so



very free from blight as described, it should form a valuable stock for the apple, and they accordingly procured some trees from England; and such, I understand, and have no reason for doubting, is the history of the introduction of blight-resisting stocks into Victoria."

"The variety called the 'Northern Spy' was raised in America, and was also introduced by Messrs. Thos. Lang & Co. It is said to be superior in every way to the 'Majetin,' and but little else is now used on which to work young trees of the apple."

Still another new variety, the "Perfection Paradise," is mentioned by Mr. French as even better than the Northern Spy. In concluding his account of the insect Mr. French gives a list of blight-proof varieties, which will be of interest to our nurserymen and fruit growers:

"Appended is a list of those varieties of apples which are not susceptible to blight. I am indebted to Mr. George Neilson, the well known curator of the Royal Horticultural Society's Gardens, of Melbourne, for this list, which may be useful to those about to plant new orchards throughout the colony."

APPLES PROOF AGAINST ATTACK OF WOOLLY APHIS.

Autumn Tart.	Magg's Seedling.
American Golden Pippin.	New England Pigeon.
Chastatee,	Northern Spy
Early Richmond.	(The best blight-proof stock.)
Fall Beauty.	Primate.
Golden Queen.	Ruby Pearmain.
Irish Peach.	Stubbart Codlin.
Lord Wolseley.	Striped Beaufin.
Lincolnshire Holland Pippin.	Tetofsky.
(Nearly blight-proof.)	Winter Majetin.
Menagere.	Yarra Bank.

Of the above varieties, American Golden Pippin, Irish Peach, Menagere, Northern Spy, Primate, Striped Beaufin, Tetofsky, and probably others, are handled by American nurserymen.

A clue to the reason why one variety is distasteful to the aphid while another is not, is perhaps revealed by the results of a chemical analysis which Mr. French had made of young trees, one a "Majetin," the other a crab that was not blight-proof. The analyses showed that the crab contained only 7.5 per cent. of carbonate of lime, while the blight-proof

Majetin contained 16.3 per cent. Otherwise the two were very nearly alike, except that the crab contained considerably more clayey and siliceous matter.

At the Cape of Good Hope, South Africa, too, the resistant stocks are being used, and nurserymen demand a higher price for them than for others. The Northern Spy and the Majetin are most used.

With a view to learning to what extent the observations of our own nurserymen confirm those of the Australians and South Africans, I applied to Mr. H. F. Hillenmeyer, of Lexington, for his views on the subject of resistant varieties and soil influence. To render intelligible the first sentence quoted below, it is necessary to say that Mr. Hillenmeyer contends that the injury of woolly aphis is not very serious to bearing trees. He writes as follows:

"The injury of the aphis is to the trees in the nursery row; and here it is, or may be, a source of much loss and annoyance. It is not so often found on the twigs, but on the depressions of the stems, formed by pruning, and not yet grown over, it is sure to be found in abundance after wet or warm winters. No protuberances are here formed, there is no apparent puncturing of the bark, and perhaps little injury follows.

"The underground work of the aphis begins on the crown roots, gradually extending outward and downward until the entire system is, or may be, a mass of knots and protuberances.

"It is well known to all nurserymen that the aphis of the apple is affected by season, soil and variety; that in some years it may be found almost anywhere, and then in others it has entirely disappeared; that in some blocks it is prevalent, and in others nearly absent, and that some kinds are more prone than others. In an experience of over twenty-five years, during which millions of apple trees have passed through the writer's hands, convictions have naturally forced themselves on his mind, hardly open to change.

"His first practice was to plant on clover sod, but the soft, fluffy mould of this preparatory crop seemed to be so favorable to the rapid spread of aphis, that clover was entirely discarded in his rotation. All subsequent experience indicated that the humus of legumes, as also that of barnyard manure, invited loss, and his practice was changed in accordance. Rich soil is required for a healthy and vigorous growth, but for the apple, let the manure, if needed at all, be applied the year before.

"There is as much difference in the firmness and texture of the twigs of apple trees as that of oak and poplar. Each kind has a root

system all its own, and both these characteristics determine exactly to what extent they are liable to injury by the aphid. Milam and Northern Spy, with their hard wood and deep-plunging roots, in any soil, season, or situation, may be expected to turn out free of aphid, while Rome Beauty and Golden Sweet, with soft wood and fibrous or shallow root structure, are likely to be just the other way.

"Some varieties of the apple have very soft wood, but very deep-extending roots, and from these we may learn a lesson of value in combating the aphid. Stark and White Winter Pearmain are as liable as any to be infested on their crown roots, and very certain to be exempt where these deeply penetrate the firm soil below. And then, in the undulations of the ground and its varying texture, and the impaction at the ends of the rows, this same fact is presented. It is for these reasons that we have discarded soft soils and manures, and have made the needed preparation the year before.

"Tobacco dust and tobacco stems are said to be a perfect remedy. Two blocks were treated with these—every row in one block, and alternate rows in the other. The growth has been vigorous, and there is no aphid, or very little. A third block of equal size, was not so treated, but all three have been washed with a mixture of kerosene emulsion and strong potash soap. This block is equally exempt, and the interesting question arises, whether the slow washing down of the kerosene-potash compound destroyed the aphid that may have been present. I am not familiar with the life-history of the aphid, but assuming that the insect makes its way from the stem to the crown, the kerosene would have destroyed it.

"In conclusion, while we may not hope to exterminate the aphid, its control by the use of firm soil, by refraining from loosening the surface where the stem enters the earth, by the application of tobacco, and washes that stimulate growth and destroy lichens, scales and aphides, is quite within our power."

#### THE OYSTER-SHELL BARK-LOUSE.

(*Mytilaspis pomorum.*)

This scale insect is large enough to be recognized without being magnified. As the name implies, it looks like half of the shell of a small oyster fastened closely to the bark. When it becomes abundant the scales touch each other and overlap so that a layer is formed consisting of the closely crowded scales of numerous individuals. To the eye the bark of such infested trees looks rough and discolored, as is the case when San Jose scale is present, but the surface appears more

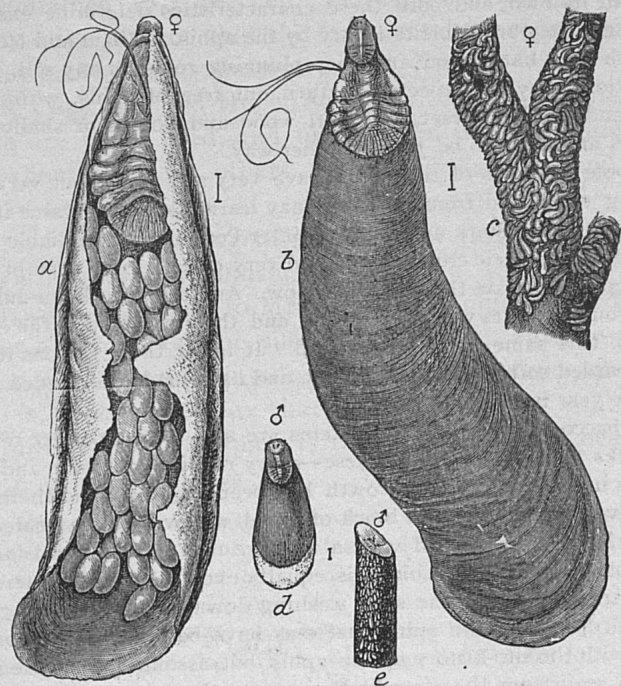


FIG. 5.—The oyster-shell bark-louse. *a*, showing female scale from below; *b*, female scale seen from above; *c*, female scales, natural size; *d*, male scale; *e*, male scales, natural size. (From L. O. Howard, Division of Entomology, U. S. Dep. Agr., 1894 report.)

uneven. The oyster-shell bark-louse is in fact a closely related insect, and injures the trees in exactly the same manner—by sucking up the sap. Its large size and peculiar shape will always distinguish it from the recently imported pest. Examples sent to the Station by F. O. Rives, of McCracken Co., Ky., measure .125 inch in length with the greatest diameter about one-third of the length. Others sent me by W. J. Crandall, of Chattanooga, Tenn., are about the same in size, as are still others from Henderson Co., Ky. When closely examined individual scales are seen to be umber-brown in color, verging upon chestnut, the surface somewhat shining, the shell decidedly convex from side to side. Before the tree becomes thickly covered with them they are generally most abundant in the forks of branches; on young trees

in the nursery during the winter a few may be found in the axil of each bud. Such positions are chosen by the young probably because of the concealment and protection they afford.

As in the San Jose scale, the shell-like part visible is largely a secretion, serving for the protection of the insect beneath it. The latter adds to the shell only at one edge, and hence builds a long shell instead of a round one. The insect differs, too, from the San Jose scale in its manner of producing young. The recently imported scale brings forth living young, while the oyster-shell bark-louse lays eggs, and during the winter if a scale is detached from the bark, these will be found beneath.

At the North the young hatch and leave the mother scale late in May or in early June. In my rooms at the Station at Lexington the young became active on the 14th of April. Two broods are developed during a season at the North, and at least two are produced here.

While this scale insect prefers apple or pear, it is found on other trees at times, and occasionally is very destructive to them. It seems to thrive on willows. One of the worst infested branches I have seen came from a tree of this sort and was given to me some years ago by Prof. H. E. Weed. The scales on this specimen are so crowded that the bark cannot be seen.

*Distribution.*—Like the woolly aphis, this insect has an almost world-wide distribution. It occurs throughout this country wherever the apple is grown, in England and most of its colonies, in continental Europe, and doubtless elsewhere. Its natural means of dispersion are limited, and it would probably never have become so widely known as a pest if it had not been for its dissemination on nursery trees.

*Injuries.*—At the North and in Europe the oyster-shell bark-louse often kills trees outright, and in consequence is greatly feared by fruit growers. It is found in this country as far south as Mississippi, but is not prevalent south, does not thrive there seemingly. In Kentucky it has been found in isolated orchards and nurseries, but always in rather small numbers. Possibly

its scarcity is due to an abundance of its parasites, such as the small 4-winged fly (*Aphelinus mytilaspidis*) which attacks it in other parts of the country. Some of the scales sent me from this section were perforated with small round holes, such as parasites of this sort make when they emerge. Whatever the cause may be, our experience with the chinch-bug warns us that it is unwise to trust to this general immunity, and our fruit growers and nurserymen will do well to keep in mind the fact that the oyster-shell bark-louse is capable of doing as severe injury as its cousin, the San Jose Scale, and cannot with safety be ignored.

*Treatment.*—Infested trees should be treated exactly as if they were infested with San Jose scale. Strong soap solutions, made either with soft soap, or, whale oil soap, should be brushed over the trees during the fall or early spring when they are inactive. If it seems desirable to treat the trees at other times coal oil emulsion is recommended as the safest, because it appears to be rather more effective in the dilute form required to avoid injury to the leaves. Prof. A. J. Cook long ago claimed that he had repeatedly proved by practice that strong solutions of soft soap rubbed over the infested bark in early June with a cloth, repeating the treatment about three weeks afterward, were completely effective in clearing trees of the scale. In his later practice he used a quart of soft soap in two gallons of hot water, and at once stirred into this a pint of crude carbolic acid.

#### THE SCURFY BARK-LOUSE.

(*Chionaspis furfurus*.)

This is another relative of the San Jose scale, but, unlike that species and the oyster-shell bark-louse, this is a native of this country, where in the days of the buffalo and red Indian it probably lived upon our native crab-apple. It is about as large as the oyster-shell bark-louse, but it is generally broader in proportion to its length, and its form is only remotely suggestive of the shell of a clam or oyster. Yet now and then an individual approaches the oyster-shell bark-louse very

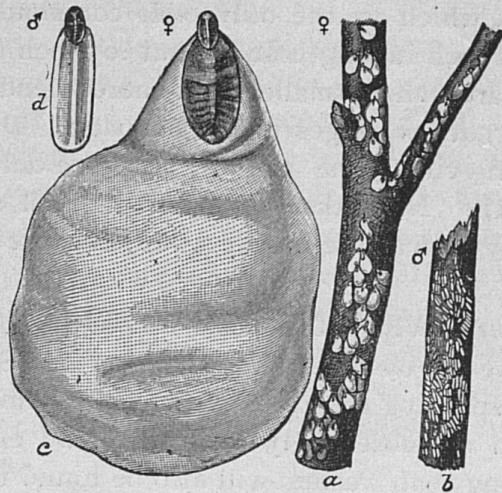


FIG. 6.—The scurfy bark-louse. *a*, females, natural size; *b*, males, natural size; *c*, female; *d*, male. (From L. O. Howard, Division of Entomology, U. S. Dep. Agr., 1894 report.)

closely in shape. It is pure white or grayish white in color and this alone will distinguish it from either of the other species. Besides apple and pear it attacks quite a list of related plants, among which are crab-apple, mountain ash and cherry.

It occurs everywhere in the United States, wherever the apple is grown, and has been carried abroad. It infests both young and old trees, and so far as observed has no special favorite among the varieties. In Kentucky it has been observed by me in most of the localities I have visited, from the Valley of the Big Sandy to the Mississippi River. But while it is generally distributed I have never known it to occasion extensive loss in the State. Upon most old trees a few scattered individuals may be found, but these do not commonly increase in numbers as they would if any large proportion of their eggs hatched and the young reached maturity. Now and then a neglected tree is encountered that is pretty badly infested, but taking the State as a whole and one season with another the scurfy bark-louse is not with us a dangerous pest.

Its life history is similar to that of the oyster-shell bark-

louse. One or two\* broods develop each year. The larger female scales, which are the only ones commonly seen, measure about .12 inch in length and about .05 inch in width. The male scales are much smaller and more slender, and have besides three narrow ridges along the back. Dried examples taken at Shelbyville, June 5, 1897, measure only about .0533 inch in length. Notwithstanding their small size they are quite as easily seen as the female scales, because of their snow-white color.

*Treatment.*—Where this scale becomes common it should be treated like the oyster-shell bark-louse and San Jose scale. Brushing or spraying the trees with coal oil emulsion is to be recommended as most likely to destroy the eggs under the scales. Strong soap washes will also be found useful, though it is questionable if these are as effective for the destruction of eggs as is the coal oil.

I have frequently seen this scale in nurseries in small numbers, and while it is not at the present time a dangerous insect, it is so easy for nurserymen to avoid future trouble by destroying them on infested trees that there would seem to be no excuse for sending them to buyers. The simplest way to treat young trees that are infested is to dip them in a tank containing dilute coal oil emulsion.

#### THE APPLE APHIS.

(*Aphis mali.*)

Small, soft-bodied green lice are seen at times thickly crowded on the tender new leaves and twigs at the ends of branches of either young or old trees. The largest measure only about .09 inch in length, but among the hordes usually associated in these colonies are all sizes from the largest to those just born and not more than 1-5 as large. At times

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\*So far as I know the number of broods has never been determined by careful methods for either of these insects. The fact that the oyster-shell bark-louse is sometimes found on nearly mature apples and out at the tips of the twigs on the latest growth, led Lintner to believe that two broods were developed annually, even in Canada.



winged adults are interspersed with the others, which they resemble in general character.

The habits of this aphid are like those of other common species infesting familiar plants of the garden and conservatory. The injury is done by puncturing the tender growth and abstracting the sap, resulting in a curling up and unsymmetrical development of the leaves and dwarfing of the growth. Late in the fall (in November at Lexington) egg-laying lice are produced and place small black eggs in the axils of buds and on the outer scales, leaving them to hatch the following spring. These egg-laying individuals have been observed by me only on old trees, but the lice frequently appear in the nursery, where in all probability they sometimes lay their eggs.

*Treatment.*—A good eye can detect the eggs, small as they are, and where the lice have been abundant among blocks of trees during the summer it is well to examine them with reference to the presence of eggs before they leave the nursery. If eggs are present, dipping in coal-oil emulsion is to be recommended as the treatment most likely to destroy them.

Of course the destruction of the lice is to be accomplished if possible before the egg-laying season comes. This can be done either by using a spray of coal-oil emulsion, diluted to avoid injury to the leaves, or of strong tobacco decoction. The former is to be preferred as the more effective. If the tobacco is used, several applications are ordinarily required to complete the destruction of the aphid.

The apple-leaf aphid is not ordinarily a destructive pest, and can be controlled without much difficulty by adopting the precaution of destroying such colonies as appear from time to time, and thus keeping it from gaining headway.

Lady beetles are generally found among the colonies, and should be carefully preserved, since they are the natural foes of all plant lice and are correspondingly useful to the fruit grower. Not a great while ago a gentleman of intelligence informed me that he had seen numbers of these insects among plant lice on certain of his fruit trees, and considering them

the adult of the lice had destroyed every one he could find, flattering himself at the same time that he was laying his ax at the very root of the trouble.

#### THE APPLE LEAF-SKELETONIZER.

(*Canarsia hammondi*.)

Orchards and blocks of young trees in the nursery may assume a rusty appearance in late summer, due to the work of small brown or dull green worms resembling in shape and general structure the apple worm. They gnaw away the green substance from the upper surfaces of the leaves until nothing is left but a brown network of veins and veinlets; in other words, the leaves are skeletonized. Several leaves are generally drawn together by silken webs, and concealed in this shelter the worm or worms, for they often show a disposition to be social, work their will. The greater part of a nursery has thus sometimes been overrun, and orchards upon which the skeletonizer is at work can sometimes be recognized at a distance by their brown appearance. The adult insect is a small gray moth with two conspicuous silvery white cross-marks, the outer one not reaching entirely across the wing. Wing expanse a trifle less than half an inch. The insect is frequently observed in Kentucky, and is very abundant among the nurseries and orchards of the upper Mississippi Valley. At the East it is not known to fruit growers.

*Treatment.*—In the nursery the best treatment is spraying the leaves with Paris green, or arsenic in some form, together with a little air-slaked lime to make the poison stick. The worms sometimes lurk about the trees until November, and since they generally pupate among crumpled leaves, are liable to be carried into the orchard on young trees unless these are carefully cleared of all dead leaves before they leave the nurseryman's hands. They are not difficult to detect, and it is only by gross carelessness on the part of tree dealers that their patrons ever receive this unwelcome guest.

**THE APPLE LEAF-CRUMPLER.**

(*Mineola indiginella.*)

The adult of this is a moth with wing-expanse of about 0.75 inch, the front wings pale brown with lines and spots of white; the hind wings whitish. In June these moths visit apple trees to deposit their eggs. The small worm which hatches from these eggs constructs and lives in an odd-looking case, more or less twisted, and conceals this by drawing down to it the leaves near by. From this retreat it comes out when hungry, oftenest at night, and feeds on the leaves. When fall comes the cases, still containing immature worms, remain attached to the twigs, and the worms lie torpid in them all winter, to complete their growth in the spring, change to pupæ, and eventually become adult moths, as already recounted. The singular protective cases are very commonly seen, even where the insect is doing no great harm, and are doubtless familiar objects to most of our fruit growers and nurserymen. It is not rare in Kentucky, but I have not thus far had complaints of serious injury due to it.

The conspicuous character of the cases, with the crumpled leaves often attached, suggests to most growers the desirability of plucking off and burning them when handling the trees. During the summer while the worms are actively at work on the foliage they are not so easy to find, and one can only deal with them conveniently by putting some poison, such as Paris green, on the leaves, where it will catch them sooner or later. This treatment has been tried in the nursery and found all that could be desired. It is advisable to add a little lime to the fluid so as to keep the poison longer on the leaves. I would use the proportion commonly recommended for codling moth—1 pound of Paris green to 140–160 gallons of water. Four or five pounds of lime added will help the mixture, but this is not absolutely necessary.

**APPLE-TREE TENT-CATERPILLAR.**

(*Clisiocampa americana.*)

Now and then the forks of young apple trees in the nursery are seen to be occupied by a close-spun, glistening, whit-

ish web, with openings at its angles next the branches. Such webs may appear before the leaves are fully expanded, and gradually grow until they are of considerable extent, eight inches or more across. These tents differ from loose webs produced in large numbers here in Kentucky in the fall of the year by the fall web-worm. These latter are made to enclose a good deal of foliage, upon which the worms feed while enjoying the protection of the web. The insect we are considering, on the contrary, makes its web solely for concealment and shelter from inclement weather. It goes out to feed, through the openings left for the purpose, generally once in the forenoon and once in the afternoon, and may be found at home during the night, during storms, and when not feeding at other times.

The worms become grown in June, when they have attained a length of nearly two inches, are thinly clothed with soft hairs, through which the colors of the skin show clearly. The general effect of these is a rather dark ground color, marked by a pale line along the middle of the back, with less conspicuous markings on the sides of blue, yellow and black. The head is black.

These worms desert the web and find, about fences and elsewhere in retired nooks, places to spin their rather long oval cocoons in which the pupæ are formed, and from which come the adult moths during July. The latter have a wing expanse of from about 1.12 to 1.50 inch, the male being decidedly the smaller of the two sexes. Among our numerous small moths they may be recognized by their uniform, purplish brown color, with two clearly marked, nearly parallel white lines near the middle of each forewing.

The eggs which these moths place on the twigs of apple and other trees during the summer are entitled to special mention, because of the fact that they remain over winter and are so conspicuous that they are very likely to attract the attention of one who is at all observing. Several hundred are placed by each female in a broad band or girdle completely encircling the twig, and are then covered with a gummy coat

that hardens and serves to protect them from the weather. When finished the mass looks like a swelling on the twig.

*Treatment.*—These egg-masses left on the trees over winter give origin to the worms that appear so promptly in spring. They are always removed by careful fruit growers while the trees are bare, a certain preventive of injury the following season. The insect has a special fondness for wild black cherry (*Prunus serotina*), a common tree along Kentucky roadsides, and if these are allowed to grow about a place they ought to be carefully searched each winter for the egg-masses.

If the eggs have not been destroyed during the winter, or have escaped inspection, the early spring is a good time to find and destroy the webs with their owners, although care must be exercised to destroy the tent when the worms are at home, *i. e.*, very early in the morning, or in the evening.

The tent-caterpillar is not a difficult one to control, and it continues to hold its own to some extent in orchards chiefly because fruit growers are not familiar enough with its habits to know when it is most completely at their mercy.

It attacks a variety of plants belonging to the same family as the apple, and works both in the nursery and orchard in Kentucky.

#### THE WHITE-MARKED TUSSOCK MOTH.

(*Orgyia leucostigma*.)

Its habit of leaving its masses of eggs attached to the twigs of various fruit trees over winter makes it necessary to include this insect among those liable to be disseminated from nurseries. The female moth, which is wingless, places her eggs on the outside of her small cocoons, spun among the leaves on the tree, so as to cling there all winter. If one examines the scattered tufts of dead leaves and other rubbish attached to the twigs of orchard trees at that time he is likely in most Kentucky orchards to find some of the eggs of the tussock moth. Winter, as in the case of the tent caterpillar, is the time to get rid of the insect, and it can be done with special ease because of the fact that the female moth has no

functional wings, and hence the species is very slow in migrating from orchard to orchard. The male moth has ample wings of a dull brownish gray color, each front wing with a small white dot near the hind angle, and some obscure dusky and gray markings elsewhere. It measures from about 1.12 to 1.25 inch from tip to tip of the front wings.

The moths are not often seen by the fruit grower, but the worms, or larvæ, are so strikingly ornamented with long brushes of hairs that they more often attract attention, and this is the more likely to be true because they are the mischief workers. The head is a bright coral-red in color; a long black plume of hairs extends outward and forward from each side of the head, and a third of the same character arises near the hind end of the body; a short distance behind the head are four large but short tufts of whitish hairs, ranged along the back; elsewhere the body is rather loosely clothed with long, pale hairs.

When abundant the worms are very destructive to plum, apple, willow and other trees in Kentucky. They are very easily controlled, however, by keeping the trees free from egg-clusters.

#### **APPLE SCAB.**

Attacks cultivated apple and native crab-apple. Forms soot-colored spots with indefinite outlines, generally on the upper sides of the leaves; spots varying from an eighth to one-half inch in diameter, often fusing and occupying most of the surface, then causing leaf to blacken, curl up and fall; deadened part sometimes falls out, leaving holes; growth sometimes follows the veins and thus assumes a branched form. Petioles and young growth of twigs are attacked. Fruit stems are occasionally injured so that young apples fall. Spots also appear on growing fruit, producing there what is known as scab, or black spot; restricted to the skin and tissue immediately beneath, but checks the growth of the part attacked, making fruit one-sided and small; gradually extends if season is damp so as to occupy most of surface; during droughts its growth may be checked, and then does little injury.

The scab fungus is known to botanists as *Fusicladium dendriticum*. It attacks both young and old trees, being especially prevalent in nurseries among trees that have been left in the rows after they are too old to sell, and have thus become crowded and, it may also be, weedy. Some varieties are more subject to it than others, but crowded trees and those on low or badly drained soil are liable to it without much regard to variety. Its injury to the foliage consists in reducing the size of the leaves, in causing them to fall prematurely, and thus checking growth and preventing proper ripening of the wood and maturing of the buds. The injury to the fruit consists in reducing its size, rendering it unsymmetrical and unsightly, and thus lessening its value in the market. The scabbed apples are more liable to rot, also, when stored, than are sound ones.

The object for which this bulletin is prepared makes it undesirable to go deeply into the facts of the development and life history of this fungus. It is sufficient to say that it is a plant parasite very similar to others that are here described and probably identical with one that causes scabbing of pears, though this latter has received a different scientific name. It remains alive on the twigs and branches in crannies of the bark, and on the fallen leaves under the trees, during the winter, and is conveyed from these to the new leaves and fruit the following spring.

*Distribution.*—The disease probably occurs wherever the apple is grown. It is prevalent everywhere in Kentucky, where it constitutes a most serious hindrance to raising first-class market apples.

*Treatment.*—The statements made concerning the conditions under which the apple scab fungus does most injury will suggest to most people what should be done to save the trees from its attacks. Tile-draining low land, on which young trees are grown, is to be suggested. Overgrown, crowded trees should, of course, be taken up and burned, to prevent the spread of the disease to the valuable stock in their neighborhood. Too often such trees are left in the rows to work mischief of this sort. In the orchard the disease is less

likely to be troublesome when the trees are planted well apart and are properly pruned and cultivated.

Experiments made by me (See bulletin 44, p. 25.) at this Station show that the scab can be controlled to a great extent by spraying the trees with Bordeaux mixture. They should be sprayed once before the leaves expand in the spring. As soon as the fruit sets, a second application can be made, when it is desirable to add a quarter of a pound of Paris green to each barrel full of the mixture, as a means of preventing codling moth injury. During dry seasons a single additional spraying, about two weeks later, should be sufficient, but when frequent and heavy rains prevail, four applications in all is nearer the right number. With a mixture containing  $6\frac{1}{2}$  pounds of bluestone,  $3\frac{1}{2}$  pounds of lime and 32 gallons of water, no fear need be entertained that either fruit or foliage will be injured by the spraying. The leaves should appear of a decided gray color when the spray is dry.

#### APPLE LEAF-RUST.

(Red rust of apple, orchard rust, cedar apple.)

Attacks apple, crab-apple, hawthorn, red cedar, etc.

*Characters.*—Rust-colored spots, with a rather indefinite outline, but clearly visible because of their sharp contrast of color with the green of the leaf, appear on the upper sides of leaves of both young and old plants in the early part of the growing season. By the middle of July they have reached a diameter of one-fourth inch or more, and then show a cluster of black dots at the center, under a hand-magnifier appearing as small swellings; the color of the spot beneath is at this stage brown, and each of the swellings has a round opening with a series of minute threads extending outward from its edge; in other cases, instead of a little cup like that described, each swelling produces a tube, the extremity of which splits apart and curls up like the stem of a dandelion in the mouth of school boy, the curled parts of the tube remaining attached about the opening in the swelling.

Two distinct fungi are concerned in this injury in Ken-



tucky, but the common one in nurseries is *Gymnosporangium macropus*. The second species has been most often observed by me on the leaves of various hawthorn trees, but has sometimes been found on apple leaves associated with the other species, and doing most of the injury. We have other species of the same genus in the State, but they have not thus far been found on cultivated fruit trees.

A singular fact about the parasites belonging to the genus *Gymnosporangium*, is that they have two very different forms, one of which is found on the red cedar (*Juniperus virginiana*). The form growing on cedar is the well-known cedar apple, a brown, corky, more or less spherical body, often seen clinging to the twigs in winter, and which in early spring, during rainy weather, puts out numerous long, soft, orange-colored processes like fingers. These processes bear the spores which, after germinating produce still smaller spores (sporidia), and these falling upon apple leaves, produce the rust-colored spots already described. The spores from the latter develop in turn on the cedar, producing cedar apples, and thus the round is kept up. The cedar apples produced by the two rusts are as unlike as are the little cluster-cups on the under side of apple leaves. The one (*G. macropus*) most often seen in Kentucky on cedars is in some cases fully an inch in diameter and its soft finger-like processes are from three-fourths to an inch in length. The rarer rust (*G. globosum*) produces a wart-like growth on red cedar that, in specimens now before me, measure about an one-eighth of an inch in diameter.

Some varieties are attacked by the rust more freely than others. It is not restricted to the leaves, but attacks fruit as well, though it is not so often observed on the fruit of cultivated apple as it is on native crab-apple and hawthorn. It is not at all uncommon also on the young growth of twigs.

*Distribution.*—Occurs with the red cedar throughout much of Eastern North America. Common everywhere in Kentucky.

*Treatment.*—On several occasions badly rusted leaves of apple have been sent me by correspondents, and on inquiry it was shown that red cedar trees were growing in close

proximity to the affected trees. It is, I believe, invariably the case that badly infested orchards are near cedars. I remember on one occasion passing a small orchard near Hickman, Ky., and observing that the leaves were so badly blotched with rust spots that they were falling prematurely, looked about for the cause, which was soon revealed in the shape of a clump of cedars on which were numerous cedar apples. It is known that the sporidia are carried for miles by winds, yet as suggested many years ago by Prof. Thaxter, of the Connecticut Station, the abundance of the rust spots on apple leaves is proportionate to the distance of the trees from cedars, and hence it is desirable to destroy cedars growing close about orchards when they are evidently harboring the parasite. Where it is desired to keep a few cedars about a place, the rust can doubtless be kept from being destructive on the apple trees by going over the cedars every year and removing all cedar apples that may develop.

Spraying orchard trees with Bordeaux mixture is recommended where the disease is already established. Some experiments made with copper compounds have shown that while the number of rust spots on the leaves is not always decidedly reduced, yet the yield of fruit is perceptibly increased.

#### THE BAG WORM.

(*Thyridopteryx expemeraeformis*.)

During the winter leathery cases, or sacks, with bits of leaves fastened over the outside are often seen suspended to the twigs of various trees. When one attempts to remove them they prove to be securely fixed to the twigs, it having evidently been the intention of their owners that they should not be detached by the storms of winter. Each one is securely held in place by a band of silk that passes around the twig. Some of the cases will at this time be found empty, but now and then one proves heavier than the others and when cut open a cylindrical brown object which it contains is seen packed with small whitish eggs. These are the bags that were occupied by females the preceding summer; the empty ones were inhabited by males.

The insect which makes these bags was described and figured in 1893 in our bulletin 47 on shade tree pests, and it will not be necessary to give it further attention here than to say that the adult male is a small moth with four wings, and the female is without wings, and must consequently remain at all times in her bag until her eggs are laid, when she wriggles out out of the lower end and drops to the ground, leaving the eggs to carry her kind through the winter.

The insect is especially fond of red cedar, but spreads from this tree when abundant to trees of almost any sort, evergreen or deciduous, in the immediate neighborhood. It is a common object on the twigs of shade trees along the streets of Lexington, and has been observed wherever I have been in the State, from Ashland to Hickman.

The bags are now and then seen in nurseries, but they are so conspicuous that they rarely fail to attract the attention of those who handle the trees and so are very rarely allowed to go out to the buyer.

*Treatment.*—The bag-worm is very easily dealt with when the general features of its life history are known. In the nursery and on the lawn there is for most cases no simpler or better means of getting rid of it than to have boys go over the trees in winter and remove and burn all of the sacks. This disposes of the eggs that will, if left, produce a new crop of worms the next spring.

In the height of an outbreak, when the foliage is still on the trees and the worms are devouring it, the best treatment is spraying with Paris green, to which a little whitewash is added, using one pound of Paris green in 150 gallons of water.

The bag-worm and one stage of the red rust of apple, are sometimes left to flourish on neglected and worthless cedars in a fence corner, to the hurt of valuable fruit and shade trees near by. A little familiarity with these two pests will reveal the importance of getting rid of such breeding places.

**THE CHERRY TREE APHIS.**

(*Myzus cerasi*.)

A deep brown, almost black, plant-louse, resembling the black peach-aphis in the general features of color and structure, infests cherry trees of all ages to such an extent as to prove very annoying at times. Leaves, young twigs, blossoms and even fruit, may become blackened with multitudes of these lice. Sometimes they are abundant during the early part of summer and then suddenly disappear, and are not again seen until the following spring. The infested leaves curl up in the manner common to injury by puncturing insects, and growth may cease completely. Adult lice measure about .06 inch in length, are rather broad, the abdomen almost rotund, and shining. They may easily be mistaken for the peach aphis, though details of structure have led entomologists to put them in different genera. Unlike the peach aphis, the cherry-infesting species does not infest the roots of the trees. It is not restricted to cherry, but severely injures plum trees and may occur on other trees of the genus *Prunus*.

The eggs are said to be laid in the fall about the buds, as is the case with the apple-leaf aphis.

*Treatment.*—For this, as for other insects of the same family, I have only one suggestion as to treatment when the aphides live exposed on the leaves, and it is to spray with coal-oil emulsion, diluted so as to avoid burning the foliage, or with tobacco decoction. Either can be made to kill the aphides, but the former is more certain and prompt in its effect.

**CHERRY LEAF-SPOT.**

(Cherry-leaf blight, plum-leaf blight.)

Attacks cherry (cultivated and wild), plum (cultivated and wild), apricot, peach, and in fact most or all members of the genus *Prunus*.

*Character.*—Appears as small purplish or dusky dots which soon show on both sides of the leaves; outlines indefinite at first, but when old the centers may become blackish and

break away at one side, eventually falling out and leaving a round hole in leaf, this result appearing most often on plum; at this stage surrounded by a narrow rim, sometimes lighter in color than the rest of the spot. Spots scattered unevenly over leaf, when abundant causing it to turn brown at length and to fall long before the proper season. Young trees especially subject to it, and suffer extremely from premature loss of foliage, leaving them unprepared for winter. Especially destructive to cherry and plum, so much so in Kentucky that some varieties of the former are considered in some quarters hardly worth planting. Early Richmond less injured here than the sweet cherries. Appears very early in the season, and may cause most of leaves to fall before end of July.

The spots are due to the attacks of a fungus known to botanists as *Cylindrosporium padi*. Small swellings or pustules develop in the diseased regions within which grow the fruit of the parasite. Certain threads of the parasite bear at their extremities long, somewhat curved spores which are set free by the rupture of the leaf-cuticle and are carried elsewhere to continue their destructive attacks. A second condition of the fungus develops in the fallen leaves, where a winter form of fruit appears and carries the disease over to the following spring. This winter form occupies the same position as the pustules already described. In spring the third and last stage of the fungus appears in the form of little sacks in which are seen slender thread-like spores, which in time germinate on the young leaves and produce the spotted appearance by which the fungus is generally known.

*Distribution.*—The cherry and plum spot-disease is perhaps as widely scattered in the country as any plant ailment known to us. It has long been the cause of complaint from Eastern fruit men, is everywhere in Kentucky, where it is particularly destructive, and occurs throughout the Western States to the Pacific coast. It is known also in European countries, but I find no mention of it in a general work on the parasitic fungi of Australia, published in 1895.

*Treatment.*—The fact that the parasite lives in the dead leaves under the trees during the winter suggests at

once the advisability of raking up and burning the leaves under infested trees as soon as they are all on the ground.

Thorough spraying of the naked tree with Bordeaux mixture in the spring might then be expected to destroy any traces of the fungus left upon the twigs or trunk. After the leaves expand one or two additional applications of Bordeaux mixture should be given. Careful experiments by several workers in this country have demonstrated the value of spraying in preserving the foliage of young trees.

If the fungus is in the dead leaves on the ground it may be suggested that nursery trees are not likely to carry the fungus on the bare twigs. I have observed some cases of the disease on young trees taken from the nursery, that had every appearance of having been brought to new ground, to which the trees were transplanted, on the trees, though I am unable to speak positively with regard to how the disease was conveyed, whether by summer spores on the bark or on a few old leaves that by some chance adhered to the branches.

#### **CURRENT LEAF-SPOT.**

(Currant rust.)

This disease manifests its presence by the appearance of spots irregularly scattered over the leaves. They are evident both above and below, are soon whitish or grayish at the center and are surrounded by a brown ring. They show at first as very small brown dots, of indefinite outline, but the pale center appears when they are not more than .04 inch in diameter. They increase about .28 inch in diameter when isolated, maintaining a more or less circular outline, but when abundant become confluent, forming large discolored areas often involving most of the leaf. Their general appearance is much like that of the rust spots of strawberry leaves, and they are caused by a similar fungus parasite.

The disease is so common in Kentucky that it makes the raising of currants very uncertain in many sections. The bushes become deprived of most of their leaves long before the proper season, and the new growth is thus shortened and the buds for the next season are enfeebled.

The treatment to be suggested is spraying the naked bushes with Bordeaux mixture early in spring before the leaves unfold, and again several times at intervals during the growing season.

#### GRAPE MILDEW.

(Downy mildew.)

During wet seasons, such as that of 1898, the cultivated grapes are badly injured in Kentucky by a disease which in its later stages gives rise to whitish patches of a mealy or floury nature scattered unevenly over the under sides of the leaves. Sometimes a leaf shows only small patches, but in large numbers; again the patches may become  $\frac{1}{4}$  to  $\frac{1}{2}$  inch in diameter and may grow until they meet and cover the whole under side. This mealy substance is the fruiting part of a fungus known as *Peronospora viticola*, a near relative of the blight fungus of the potato, so destructive in Eastern States and in European countries. As the patches grow old their position becomes marked above by a brown spot, and when the attack is severe the whole leaf is killed, curls up and becomes brittle. Quite often the mildew attacks the tender growth of vines, and sometimes the fruit is so badly injured that it shrivels and turns brown. Some of the less vigorous varieties, such as Catawba, are especially subject to the disease, but any neglected vines are likely to be attacked, especially such as are not kept free from weeds or are not properly pruned and trained.

The disease occurs everywhere in the United States, from the Atlantic to the Pacific. It is said to be less common in the elevated plains west of the Mississippi River; but, while it is favored by a moist, warm atmosphere, it endures drought very well, and can be counted on to make its appearance wherever there are vines not properly cared for. As to its bad effect on the vine and fruit, even when the latter is not directly attacked, there can be no question. The claim that it does no more than destroy the surplus foliage and thus permits the sun access to the fruit, to the advantage of the latter, certainly does not hold for Kentucky. I have seen the fruit of whole vines rendered worthless by its attacks.

*Treatment.*—The disease can be controlled if taken in season, i. e., before the downy patches appear on the under sides of the leaves. In regions where the mildew appears every season more or less abundantly I would advise spraying with Bordeaux mixture before the leaves expand in the spring, and two or three times later, once shortly after the fruit has set. In fact, the treatment commonly recommended for black rot of the fruit serves equally well for this ailment, and the two diseases can, luckily, be controlled by the same applications.

The fungus passes the winter within the old leaves and shriveled berries. Infested vines should therefore be carefully overhauled during the winter, all dead and unnecessary wood be pruned away, and the refuse in the shape of shriveled fruit, destroyed either by black rot or mildew, should be removed and, together with all trimmings, be burned.

The disease is not a difficult one to manage when taken in season.

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Another disease known as the Powdery mildew (due to *Uncinula necator*) causes whitish patches of indefinite outline on the *upper surfaces* of leaves and has been seen by me on bearing vines on several occasions in Kentucky. It thrives best during rather dry weather and seems to be rather rare in the State. It has not been observed on nursery plants. Flour of sulphur dusted on the plants is a safe treatment for this trouble. Potassium sulphide may be used, if preferred, and is quite as effective. Prof. Galloway, of the Department of Agriculture, states that he obtained excellent results with  $\frac{1}{2}$  ounce of potassium sulphide in a gallon of water. This disease also attacks Virginia creeper, and is supposed to be the same as the notorious *Oidium tuckeri* of European vineyards.

#### THE BLACK PEACH APHIS.

(*Aphis persicæ-niger*.)

A small dark brown or black plant louse infests the roots and leaves of the peach, occurring in such large numbers at



times as to blacken the parts on which it is crowded, and preventing growth—not infrequently killing young trees. The insect when mature is stout-bodied (.065 to .095 inch long, by .040 to .060 inch broad), the broadly oval body shining as if polished. It is rather sluggish in motion, remaining motionless much of the time with beak inserted in the twig, leaf, or root, sucking up the sap. Winged lice sometimes appear among the wingless individuals, which are also dark brown and black in color, the wings relatively large, hyaline and with a slight play of colors (iridescence). Young lice are paler in color, but do not otherwise differ in any very important respect from the adults.

The insect is very much like a dark aphid sometimes seen on the tender growth of cherry, and somewhat resembles also the louse often troublesome on chrysanthemums. The eggs are believed to be placed under the bud scales in fall.

It undergoes no transformation of consequence, living the year round in some condition on the peach, either in or above the ground. When abundant its effect is a general weakening of the tree, visible in a sickly appearance and lack of vigorous growth. Yellowing has sometimes been thought to be induced by its attack, but that disease is known to appear when no aphids are about. Its injury is exactly like that caused by the rose aphid, the chinch-bug, and other puncturing insects.

The twig and leaf-infesting form is most common very early in the spring; at other times the lice are most likely to be encountered on the roots. It is most injurious to young trees in the nursery or to those recently set out in the orchard. These latter suffer especially from the presence of the aphid during the first two or three years after they are transplanted from the nursery.

The black peach aphid has long been known to growers of peaches because of the severe injury it does in the nursery and orchard, but was not described scientifically until 1890, when it was recognized by Dr. Erwin F. Smith, of the U. S. Department of Agriculture, who was led to study it while investigating the yellowing of peach trees. Subsequently Dr. C. V. Riley suggested that the peach aphid had been previously

described by the German entomologist Kaltenbach, under the name *Aphis prunicola*.\* It is becoming common in Kentucky near Louisville.

*Treatment.*—This is one of the species most likely to be distributed with young trees, and in fact is known to have been introduced in this way into orchards. It is easy to avoid, however, by treatment like that suggested for the woolly aphis.

Young trees can be cleared of the insects on the leaves and twigs by spraying with a very dilute coal-oil emulsion, or else with a strong and warm tobacco water. This latter is rather less effective than the coal-oil, and in case it is used several applications may be required to rid the young trees of the aphides, whereas a single spraying with coal oil emulsion can be made to do the work. When the aphides are on the roots the whole plant should be dipped before it goes out of the nursery in a tank containing the coal-oil emulsion. Ground tobacco stems should be used along the rows for the root-infesting form, by making with a hoe or plow a furrow along each side of the row, then dusting the ground stems in it and covering it with earth. This practice brings the tobacco near the roots while it is still strong, and prevents its being scattered by the wind and rain.

In the orchard similar treatment is to be recommended, namely, spraying the twigs and leaves with coal-oil emulsion and digging away a few inches of earth about the bases of infested trees and putting in the depression four or five pounds

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\*Kaltenbach's description (Monographie der Familien der Pflanzenlause, 1843, p. 122) is so brief and general that it might apply to any one of a half dozen known species of the genus *Aphis*. No clue is given by Kaltenbach to the food plant except that contained in the specific name *prunicola*. While therefore Riley may have been right in his surmise, there is not sufficient evidence in Kaltenbach's description to warrant one in adopting his name for the peach aphis. Kaltenbach's description is as follows:

Wingless form: Broadly oval, somewhat rotund, blackish brown and very glossy; tubes (cornicles) at hind end of body short, black. Tail scarcely visible. Length  $\frac{1}{2}$  inch.

Winged form: Shining black. Abdomen black, at base and tip brownish yellow. Cornicles short, black, yellowish at base. The brown tail (cauda) very small,  $\frac{1}{3}$  the length of the cornicles.

of ground tobacco stems, after which the tobacco may be covered by the removed earth.

Tobacco stems, when within reach, should be used in preference to anything else. They are worth what they cost as a fertilizer alone, and can be used with the greatest freedom without fear of injury to the plants about which they are placed.

#### PEACH ROSETTE.

Attacks peach, almond and plum.

*Symptoms.*—*Fruit*, none when the disease is very severe; often shriveling and falling while still green; sometimes ripening in the normal way when only a part of the tree is affected; not blotched with red. *Leaves* develop in close tufts or rosettes, often several hundred in a tuft; color yellowish; somewhat rigid, and rolled together; mostly small; not concealing the branches. *Flowers* expand later than normal. *Roots* often with cavities filled with gum; rootlets soon dead. No tufts of fine twigs. Course rapid—six to eighteen months, commonly.

An infectious and contagious disease, resembling yellows in its general character. Manner in which contagion is carried in nature, not yet determined. Conveyed artificially in buds, and by root-grafts. Appears to attack all varieties. No germ or fungus yet proved to be the cause of it, but probably a germ disease.

*Distribution.*—Rosette has thus far been discovered only in Georgia, being very destructive in the northern part of the State, in the western part of South Carolina, and at Manhattan, Kansas. Dr. Smith says it has been reported also from Arkansas. It has never been observed in Kentucky, but is liable to be introduced, hence it is important that our fruit growers should familiarize themselves with its characteristics.

*Treatment.*—The rapidity with which this disease runs its course, invariably resulting in the death of affected trees, is an advantage to the fruit grower, since he is not long left in doubt as to what he is dealing with. Rosetted trees are worse than none, and the sooner the ax and pick are

brought into use when they are discovered the better. They should not only be dug up but every fragment of branch, root and fruit ought to be burned. One frequently sees heaps of diseased or insect-infested trees that have been dug up and thrown aside. This procedure is better than doing nothing, but one who has taken this trouble should make sure that his labor is not wasted by making a good bonfire of the stuff at the earliest possible moment. Fire has no equal as a disinfectant; it should be brought into requisition on the farm and in the nursery more frequently than it is.

#### PEACH YELLOWS.

Attacks peach, apricot, nectarines, almonds and Japanese plum.

*Symptoms.*—*Fruit* ripens prematurely, from three or four days to as many weeks before healthy fruit; blotched with red, the flesh beneath the blotches also red, and with more than the normal amount of red about the pit, the extent of red coloring varying with variety; taste insipid or bitterish; fruit worthless; often of normal size; affected fruit sometimes appearing on a single seemingly healthy branch, but later the disease spreads to whole tree. *Buds* develop prematurely, sometimes in latter part of summer, sometimes in spring shortly before the normal buds unfold; produce feeble growth, with more or less yellowish, and often narrow, leaves. Branches normal at first, but gradually checked in growth, while numerous slender twigs push out at their sides, and sometimes at a late stage tufts of fine twigs develop in the interior of trees. Foliage finally yellowish or reddish; dwarfed.

An infectious and contagious disease which gradually extends spontaneously throughout an orchard and eventually a whole neighborhood; manner in which the taint is carried not understood; insect-diseased pollen and the pruning-knife have each been considered as possible agents for conveying disease from tree to tree, but thus far proof against any one of them has not been secured; believed not to be conveyed by the soil, since healthy trees planted where diseased ones

have been grubbed up are not more subject to yellows than when planted elsewhere. Conveyed artificially, and invariably, by using buds from diseased trees whether characteristic symptoms have appeared in latter or not. Pits do not develop, as far as known; should not be planted in any case. Not due to character of soil. No variety proof against it. Attacks either strong or feeble trees. Affected trees helped only temporarily by fertilizers; always die sooner or later, no matter what the treatment—sometimes in one year, but oftener in four, five, or more. No germ or fungus thus far discovered that has anything to do with the disease, but has much the appearance of a germ\* disease, and may yet prove to be such.

*Distribution.*—Yellows has thus far been observed only in the Eastern and Middle States. It has not been encountered outside of this country. The disease is known to occur in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Virginia (northern and central part), Pennsylvania, West Virginia, Ohio (northern and southern), Indiana (northern and southern), Michigan (southern), Illinois (southern), and possibly in Kentucky along the Ohio river. Careful fruit growers tell me they have seen occasional cases of yellows in this State, but no unquestionable case has ever come under my own observation. Quite frequently trees have been pointed out to me in different parts of the State as possibly suffering from the disease, but the enfeebled condition and yellow foliage proved to be due to something else. Scores of young peach trees left in nursery rows and neglected, have been seen, that bore some appearance of yellows, the foliage being dwarfed and yellowish, the trees themselves stunted. The trouble was due to neglect and the consequent depredations of the borer. While the disease probably does occur in the State, it is certainly not common, and has in some instances unquestionably been reported as occurring here by people who did not know.

*Treatment.*—Since trees that are affected are certain

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\*Dr. Erwin F. Smith, of the National Department of Agriculture, has somewhat recently announced his belief that the disease is akin to what is styled *variegation* in plants.

to die and will not produce fruit fit to use, the only reasonable thing to do is to cut them down, grub up their roots, and burn them as soon as it is known that they are diseased. This is the only treatment that has proved in any degree satisfactory ; persistence in practicing it enables growers still to raise peaches in regions where yellows is most prevalent. The disease is most often introduced into orchards in young trees obtained from infected regions. But it is impossible in the present state of our knowledge of the disease to recognize it in very young trees. They may be perfectly sound as far as appearance goes, and yet contain the taint. Probably in many cases it has been introduced into them in buds taken from trees that were supposed to be healthy. It sometimes happens that a single branch or twig of a tree shows signs of the disease, the greater part of it appearing to be in excellent condition. Yet that branch marks the tree as unfit to be used for propagating. Buds taken from any part of the tree will convey the disease. It should not only be avoided for propagating, but should be destroyed without hesitation. This is a matter of primary importance to the nurseryman, but should be known to everybody.

#### **PEACH FRUIT-SPOT.**

(Black-spot, peach-freckle, plum-scab, cherry-scab, gun-shot peach-leaf blight.)

Attacks fruit, twigs and leaves of peach ; attacks the fruits of almonds, apricots, plums and cherries.

*Character.*—Dull brown or black spots, at first more or less circular in outline appear on fruit, gradually increase in size and often blend so as to occupy most of the skin on the upper side, then sometimes causing skin to crack, admitting rot fungi which complete the work of destruction. Spots do not ordinarily extend deep into flesh of fruit. Attacks twigs when these are young, especially of neglected nursery stuff, producing purple blotches on the bark which, like the fruit, may split when the attack is severe. Checks growth of young trees, but objectionable even when not abundant, because it is conveyed from twigs to any fruit that

may subsequently develop. Attacks the leaves, at times producing what are known as shot-holes.

An unmistakable fungus disease, similar in its effects to the scab fungus of apple, and due to the attacks of *Cladosporium carpophilum*. Very destructive to fruit some seasons. It is often perpetuated about farms on seedling peach left growing along fences; the fruit of such trees is often nearly all destroyed by it. Smocks are said to be especially liable to its attacks. Twigs of young trees are sometimes badly blotched by it during the growing season, and from them spores are developed in the spring to be scattered to leaves and fruit in their vicinity.

*Distribution.*—The fungus has been observed throughout much of the Eastern United States, from Canada to Texas, and probably occurs on peach in the fruit-growing sections of the West. Common in Kentucky on both fruit and twigs. It has long been known in Europe.

*Treatment.*—Where prevalent, spraying with Bordeaux mixture in early spring just before the leaves unfold, is to be recommended. Seedling trees which harbor the disease ought to be burned and their places given to something better. Other trees that show the marks of the disease on the recently-grown twigs should be made the subject of some careful pruning with a view to getting rid of the worst affected parts, after which an application of Bordeaux mixture should follow. All affected twigs from seedling stock in the nursery should be burned as promptly as possible, to prevent the spores being carried to the budded trees. To those buying from nurseries it may be suggested that the trees should be examined for traces of the disease on the young bark.

#### PEAR LEAF-BLISTER MITE.

(*Phytoptus pyri*.)

The leaves of pear trees often show numerous very slight swellings irregularly scattered over the surface and raised so little above the general level of the leaf that they would not be observed at all were it not that they differ a trifle in color from the rest of the surface. They appear very early in the

spring, when they are often red in color, being visible before the leaves are fully expanded. As the leaves grow older the blisters assume very nearly the same color as the rest of the leaf, and in mid-summer they become dark and, somewhat later, quite black and dry.

If one of these galls is examined attentively with a hand magnifier a minute round opening will be visible on the under side of the leaf. If it is cut open a slight cavity will be seen within the swollen part of the leaf, and if it is placed in a drop of water, teased apart and then examined with a compound microscope its owners and occupants, very minute, slender, four-legged mites, will be revealed. They are exceedingly small, and dozens might creep across a leaf before the eyes of an untrained observer, and not be perceived. Even when located with a hand magnifier and one afterward looks for them without its aid, the most that can be seen, is a moving whitish speck. They are pigmies even among mites, and for a long time were regarded as young of other eight-legged forms of larger size. This has proved not to be the case, for they have been observed to produce eggs and their whole round of existence from the time they hatch has been carefully followed.

Many other species of the same genus have been described, some of which produce deformities on the leaves and twigs of other plants, but this is the only one that has thus far proved very troublesome on deciduous fruit trees. In England another species attacks the buds of currant.

The pear blister mite was long ago described in Europe, where it is probably native, in which case it has most likely been brought to us on nursery trees. It was observed first in the United States by Townsend Glover who in 1873 described it and its work in his report as Entomologist of the U. S. Department of Agriculture (Report of 1873, p. 113). Prof. T. J. Burrill of the University of Illinois next discovered it and wrote it up in the *Gardeners' Monthly* for January, 1880. The third notice of it appeared in an article of mine, on various species of the genus, in the report of the Illinois State Entomologist for 1882, p. 123, the matter on the pear



Phytoptus being furnished by Prof. Burrill. Since then the mite has become generally prevalent over the Eastern states, and has been frequently noticed by writers.

*Injury.*—The injury consists in dwarfing the growth of the leaves and otherwise disturbing their functions. Leaves are frequently badly galled, so that but little of their substance is not affected. The mites are provided with puncturing and sucking mouth apparatus, and hundreds of them are constantly engaged in pumping out the sap, while they are at the same time protected in the interior of the galls they produce. I have not observed that they prefer any particular variety, nor are they restricted to young trees. The blister mite is not to be regarded as a dangerous pest, since its attacks do not result in the death of the trees, at least I have never observed anything more than an enfeebled appearance as a result of attack. But there can be no doubt that they affect the bearing power of trees when they become abundant and should on this account be avoided if possible. They are to be seen on the young trees of many of our nurseries, and from the fact that its power of locomotion is so poor I judge it has been introduced into our orchards in the majority of cases from the nursery.

*Treatment.*—During the summer the mites remain most of the time in the blisters on the leaves, and it is not easy to reach them then so as to check their injuries. When the leaves are about ready to fall the mites betake themselves to the buds and creeping under the outer scales remain there over winter, or in some cases find shelter under loose bark. This would seem to be the best time to apply mixtures that will kill them and coal oil emulsion diluted with about three parts of water, applied to the trees a couple of times early in the spring, before the leaves unfold, is believed to be a fairly effective treatment for the injury done by the mite.

#### **PEAR BLIGHT.**

(Pear blight, frozen sap blight, twig blight, anthrax of fruit trees.)

Attacks pear, quince, apple, crab-apple, mountain ash,

service berry, hawthorn, raspberry, blackberry, and other plants of the same family.

*Symptoms.*—A sudden dying and blackening of the new growth of twigs, beginning generally at or near the tips and extending thence downward. Leaves and twigs soon assuming an inky black color, and remaining among the green and healthy leaves during much of the growing season. Attacks the trunk sometimes, when this has been bruised or otherwise injured. Extends rapidly at times, and again but slowly. Sometimes attacks only one or two branches, but often destroys much of the new growth. Attacks twigs and blossoms mainly, but does not often invade leaves, though these turn black with the affected twigs.

A contagious disease, caused by the attacks of a microscopic organism known as *Bacillus amylovorus*, discovered in 1879 by Prof. T. J. Burrill, of Illinois. Contagion carried by insects, by winds, and sometimes probably by pruning knife. Organism easily cultivated artificially on gelatine or on cut surface of fresh twigs, and the disease may be induced by inoculating healthy twigs with such cultures. Remains dormant over winter in some of the affected trees, to be carried from blossom to blossom the succeeding spring by insects. Attacks both young and old trees. No variety entirely free from it, but Keiffer and Duchess are commonly less subject to its injury. Most prevalent in damp hot weather and in early part of season, but is found active on trees throughout the summer. Checked very largely during droughts. Severe pruning favors it by encouraging luxuriant growth of new twigs. Free use of fertilizers also encourages it for same reason. Differs markedly from yellows and rosette of peach in its injury being local, and affecting only the part attacked.

*Distribution.*—Pear blight or fire blight, as it is sometimes called, occurs throughout this country wherever the pear is grown. It is more prevalent at the South, very probably because the winter temperature there does not so often kill the microorganism, though this latter is known to endure zero weather at times. It does not however thrive when weather is cool, and extreme heat always encourages its most

rapid and destructive invasion of the trees. Troublesome on apple trees during very hot weather following periods of excessive rainfall.

*Treatment.*—The treatment calculated to be most effective is here, as in most other cases, preventive. Fruit growers should go over their trees systematically when other work is not pressing and cut off and burn all affected twigs, no matter how small, and without regard for the value of the tree. A worthless tree standing in a fence corner may during a season convey the disease to a whole orchard of valuable trees. The cutting should be generous also, the affected branches being severed some distance below the diseased wood. Keep the knife free from the taint; if by any chance it cuts into diseased wood, wash it thoroughly with formalin (1 part of formalin to 1 part water) before cutting other trees. When the trunk becomes affected, as sometimes happens where it has been cut, bruised, or blistered by the sun, cut away all diseased wood, then wash thoroughly with Bordeaux mixture and wrap with ordinary newspaper until the wound heals.

A good many of the injured branches contain no living germs when winter comes, but Mr. M. B. Waite, of the National Department of Agriculture, has discovered that in some of the diseased wood living Bacilli remain over winter. If the blighted twigs can be removed at this time, the chances of injury during the following season are very greatly lessened, for the germs must be brought from a distance if they attack the trees at all.

#### PEAR SCAB.

Attacks cultivated pear.

Pear scab is so like the scab disease of apple that the description of one applies very well to the other. There are some microscopic differences between the fungi as they appear on the two plants, which are considered of species value by botanists, though they may be merely the effect of differences in the host plants. Whether they are really distinct might be decided by some carefully managed artificial cultures in which spores from scab on one plant were made to grow on the other.

It is not a question of special practical interest, however, since the two parasites are so much alike in character and life history that the same treatment serves for both. My own preference is for applications of Bordeaux mixture as recommended under apple scab, but at the Delaware Station, potassium sulphide ( $\frac{1}{2}$  ounce in one gallon of water) was found, by Prof. F. D. Chester, to increase the yield of marketable fruit 25 per cent., while at the Vermont Station ammoniacal copper carbonate was found to increase the value of the fruit one-half, the sprayed trees yielding 69 per cent. smooth fruit as against only 28 per cent. smooth fruit from unsprayed trees. The spraying was begun May 19, and continued until August 8, seven applications being made at as many different dates. The copper carbonate preparation used, was made by dissolving 5 ounces of copper carbonate in 3 pints of the strongest ammonia, then diluting with 45 gallons of water.

#### BLACK KNOT.

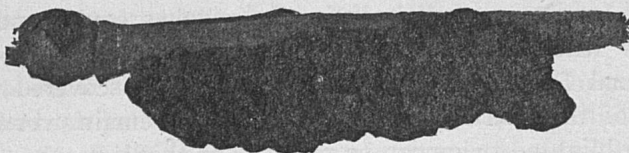


FIG. 7.—The black knot of plum. Slightly enlarged.

Attacks plum and cherry.

Produces large wart-like black growths along the twigs and branches. Affected limbs gradually swell up, generally more on one side than on the other, until finally the bark where most distended breaks apart and reveals the cause of the swelling in a spongy mass which now pushes up between the edges of the ruptured bark and at length becomes thicker, it may be, than the limb itself. It is at first of an olive color, with felt-like surface, and retains this color for some time, the growth meanwhile extending along the limb for several inches, or in some cases for a foot or more. When old the growth becomes a dull coal-black, and the uneven, slightly granular surface becomes broken by deep fissures, mostly run-

ning across the growth. Growth of the knots occurs in the spring, at which time the old knots extend under the bark and subsequently the extension breaks through, or else new centers develop from spores that have by some means reached the inner layer of bark, and thus new and independent knots are formed. Since the knot generally occupies only one side of the limb, it does not entirely check the life processes, and the part of the limb beyond continues to grow and put forth leaves. It is only where the knot extends completely around the twig or branch that the part beyond is killed at once. When the knots are abundant trees may be killed in a couple of years, and indeed whole orchards may in the course of a few years become so infested as to be worthless, although the injured trees may survive in a feeble way for a longer period.

At a late stage the knots are often mined by various insects, the grubs of which being found in the swollen wood gave rise to a notion, not yet completely eradicated, that the knots were galls due to the attacks of insects. The plum curculio itself is known to lay its eggs in the knots sometimes, and its young develop there. But some knots have no insects of any sort in them, and it is now well known that black knot is due to the attacks of a fungus, bearing the name *Plowrightia morbosa*.

The new knots break through the bark early in the spring, during the growing season for the tree. They at once produce over their entire surface myriads of minute spores (conidia) which are carried by the air to other trees. This method of increase continues for some time, but ceases before fall and the surface of the knot then becomes smoother, though under a hand magnifier it is seen to be minutely roughened by little mounds each with a pit at its center. Each one of these mounds represents another style of fungus fruit and when cut into and inspected with a microscope is found to contain a number of small sacs in which are the oval, two-celled winter spores (ascospores). These are regarded as the fruit of the mature fungus. They develop slowly and do not ripen until about the middle of January.

It is believed that all the varieties of plum are attacked

by black knot. The sour or morello cherries are, among cultivated sorts, most subject to the disease, but the sweet or mazzard varieties are not exempt. The bird cherry (*Prunus pennsylvanica*) of northern woods is especially subject to it, as is also the native choke cherry \*(*P. virginiana*). The common wild black cherry (*P. serotina*) of Kentucky is rarely attacked by the fungus. Years ago B. D. Walsh of Illinois, claimed that he had in one instance encountered it on peach. He was a fairly accurate observer, yet may have slipped, as suggested by Prof. Farlow † later.

The capacity of black knot for mischief is not as fully appreciated in Kentucky as it should be. It is an American disease and began its destructive work when fruit growing was in its infancy in the Eastern States, probably having hitherto affected only the native cherry and plum trees of our forests. It has proved especially troublesome in the New England states. Writing in 1879, Farlow says: "An idea may be formed of the small crop of plums now raised in New England from the fact, that two dollars and a half were given in Boston last autumn for a peck of Damsons for preserving." A thriving plum-growing industry once existed along the Hudson River below Albany, New York; single growers receiving as much as \$1,980.00 for a single week's picking, and netting in one season as much as \$8,000.00. The knot became very destructive in 1869, and in the course of a few years ‡ had destroyed thousands of trees, and soon put a stop to the business.

The disease is to be observed in all parts of Kentucky on cultivated and wild plums. It has never been observed on nursery stock, and is probably very rarely sent to the fruit grower on young trees. But in two instances it has been observed on orchard trees belonging to nurserymen, where the spores from the knots could readily be conveyed to the

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\*Although the choke cherry is a native Kentucky species, the Station herbarium contains no specimen. Will not some kind friend send us during the summer of 1899 material from which dried specimens of the leaves, flowers and fruit can be prepared?

† Bulletin of the Bussey Institution, 1876, Part V, p. 440.

‡ See Bulletin 40, 1892, New York Station.

young trees near by. The importance of keeping the disease from the neighborhood of young trees cannot be too strongly insisted on; for although no evidence of the disease may be apparent on such young trees when sold, yet they may have received upon their bark the spores that will subsequently develop into the dreaded knot.

*Treatment.*—The parasite does not extend far beyond the extremities of the knots, and hence by cutting off all affected parts the disease can be kept from extending, excepting as it appears at newly infected centers. When a tree is badly affected about the main branches it is often best to remove and burn the entire tree to prevent the disease spreading. It is not enough simply to cut off the knot, unless the cut is deep enough to take out all the growing parts of the parasite, and I would not advise such treatment except in case of a specially valuable tree. In all cases the cut surfaces should be washed from time to time with Bordeaux mixture. Nor is it sufficient simply to cut away diseased wood and throw it on the ground about the trees. It has been shown that the spores of the fungus develop on such severed knots as abundantly as if they were on the trees. Burn all such trimmings. Make a habit of it.

Since the spores are developed both in the summer and winter, it does not matter greatly when the cutting and burning is done. It is perhaps most conveniently attended to when the leaves are gone, but it is a good plan to go through orchards from time to time, in both summer and winter, and remove in this way any pest of this character that may have appeared. Quite often the knots are perpetuated on a place on neglected trees, wild or cultivated, that are of no value whatever.

Painting the forming knots with turpentine, coal oil or linseed oil, prevents the maturing of the fungus fruit; but owing to the spreading of the oils over the bark, injury is done to the tree. To avoid this a pigment of some kind may be mixed with the oils to form a thick paint. This treatment was first adopted at the Hatch Experiment Station in Massachusetts, where red oxide of iron was employed to thicken the

oils. The time required to go over the knots in this way, one by one, is against the method, excepting where a few trees are to be treated. The fruit grower will find spraying with Bordeaux mixture more convenient and just as effective.

My own preference is for prompt cutting out and burning all diseased wood. This treatment may be supplemented to advantage in some cases by spraying or painting, but I wish to be understood as *recommending* nothing but the most heroic treatment.

One of the greatest difficulties in dealing with black knot comes from the common lack of familiarity with the disease. Trees sometimes stand for years in a fence corner bearing the unsightly black knots and no attention is paid them, because their dangerous character is not understood. It was to meet this difficulty that our black knot law was enacted some time ago (1894), and it is to be hoped that all nurserymen and fruit growers will take it upon themselves to have the law enforced. For convenient future reference the law is quoted below :

[From Kentucky Statutes, Sections 1918-1925.]

*AN ACT to prevent the spread of a disease known as "black knot" in plum, cherry and other trees.*

*Be it enacted by the General Assembly of the Commonwealth of Kentucky:* § 1. It shall be unlawful for any person, knowingly or willfully to keep any plum, cherry or other trees infected with the contagious disease or fungus known as the "black knot"; that every tree so infected is hereby declared to be a public nuisance, and no damages shall be awarded in any court in this State for entering upon premises and cutting away or severing the diseased part or parts of any tree so infected, and destroying the same, or cutting down or removing such infected tree altogether, and destroying the same, if done in accordance with the provisions of this act.

§ 2. In any county in this State in which such contagious disease exists, or where there is good reason to believe it exists, or danger may be justly apprehended of its introduction, it shall be the duty of the county judge of any county, upon the application made in writing and signed by at least three freeholders, who are residents of said county, to appoint forthwith three competent freeholders, who are residents of said county, who shall be fruit-growers of said county, as commissioners, who shall hold office during the pleasure of said county judge, and such



order of appointment and of revocation shall be entered at large on the county records.

§ 3. It shall be the duty of said commissioners, within ten days after appointment as aforesaid, to file their acceptances of the same with the clerk of the county court of said county, and said clerk shall be *ex officio* clerk of said board of commissioners, and he shall keep a correct record of the proceedings of said board in a book to be provided for the purpose, and shall file and preserve all papers pertaining to the duties and actions of said commissioners, or either of them, which shall be a part of the records of said county.

§ 4. It shall be the duty of the commissioners, or any one of them upon or without complaint, whenever it comes to their notice that the disease known as the "black knot" exists, or is supposed to exist, within the limits of their county, to proceed without delay to examine the trees supposed to be infected, and if the disease is found to exist, a distinguishing mark or marks shall be placed upon that part or those parts of every tree so infected, which, in the judgement of the commissioner or commissioners should be removed and destroyed; or if in the judgment of such commissioner or commissioners any tree so infected should be entirely removed and destroyed, then the trunk of such tree shall be thoroughly girdled, and a written notice given to the owner personally, or by leaving the same at his usual place of residence, or if the owner be a non-resident, by leaving such notice with the person in charge of such trees. The notice shall contain a simple statement of the facts as found to exist, with an order to effectually remove and destroy by fire the part or parts of every tree so marked and designated, or every such tree entire which shall be so girdled as the case may be, within ten days from the date of the notice above required. Such notice and order to be signed by the commissioners, or any two of them.

§ 5. Whenever any person shall refuse or neglect to comply with the order mentioned in the last section, it shall become the duty of the commissioners to carry out the directions of said order, and forthwith to remove and destroy by fire, every tree, or part of tree so girdled or marked aforesaid, employing all necessary aid for that purpose, the expenses of such removal and destruction to be a charge against the county; and for the purpose of such removal and destruction, the said commissioners, their agents and employes shall have the right and authority to enter upon any and all premises within their county.

§ 6. If any owner, or if such owner be a non-resident, then, if any person in charge of such trees neglects to remove and destroy by fire every tree, or part of tree, so found to be infected, and marked or girdled as aforesaid, after notification, and within the time hereinbefore prescribed, such person shall be guilty of a misdemeanor, and punished by a fine not exceeding twenty-five dollars, or by imprisonment in the county jail not exceeding ten days, or both, in the discretion of the court; and any justice of the peace of the county in which such offense

shall be committed shall have jurisdiction thereof, and all such fines so collected shall be turned over to the treasurer of said county, or other proper officer, to be designated by said county judge, to be held by him subject to the order of said court.

§ 7. The commissioners shall be allowed for services under this act, two dollars each for each full day and one dollar each for one half day, and other reasonable charges and disbursements hereunder to be audited, as well as any other charges and disbursements under this act by said county judge, to be paid to such commissioners as other county claims are paid. Such fees and all reasonable charges and disbursements of said commissioners in each case may be recovered by the county in its own name from the owner of the diseased trees on account of which such fees, charges and disbursements became payable or were incurred.

§ 8. In counties where there are cities of the first and second classes, the mayor shall discharge the duties, and the cities make the payments provided for in this act, so far as said disease exists in any of said cities.

#### QUINCE LEAF SPOT.

(Pear leaf spot disease, pear and quince fruit spot.)

Attacks quince, pear, and a few other related plants.

*Character.*—Small reddish or purplish illy-defined dots appear on the leaves and increase to about one-eighth inch in diameter when isolated, finally becoming nearly or quite circular in outline and clearly defined; when numerous, uniting and forming extensive patches of irregular shape, the union occurring soonest at the tip of the leaf which then becomes entirely brown, while the spots remain separate elsewhere; sometimes the whole leaf becoming involved; old spots often appear of an ash-gray color; visible on both sides of leaf; center of each spot occupied by a minute black dot, a pustule, containing the fruit or spores of the fungus (*Entomsporium maculatum*), which causes the disease. When attack is severe leaves fall, so that the branches may be bare early in July; new leaves often take the place of these before end of season; blossoms also sometimes expand in fall. Attacks tender twigs, sometimes killing them. Fruit of both quinces and pear attacked, causing at first spots of red, which at a later period blacken and when abundant result in extensive fissures; when attacked early in the season fruit becomes unsymmetrical; fungus does not penetrate very deeply into

fruit, but checks growth and mars its appearance so as to make it unfit for market. Attacks young and old trees, but is especially destructive to seedling pear trees, so much so that it is in some sections very difficult to raise them. Attacks all varieties, but some, such as Keiffer, not as much injured as others.

*Nature.*—As intimated above this is a fungus disease, due to the invasions of one of the more highly organized parasitic fungi. The little black pustules at the center of each spot are at first covered by the cuticle of the leaf, but when mature the fungus fruit beneath ruptures this and leaves the curious jointed spores exposed, to be carried by wind and on the feet of insects to other plants. The spores are completely invisible to the eye, but are seen with the microscope to consist of about four little bodies (cells) attached together and mounted on a short stalk, the upper body being provided with a small bristle. Spores remain in leaves on the ground over winter. They remain also about twigs, as demonstrated by the fact that young seedling pear brought from abroad are sometimes very badly affected as soon as leaves appear, whereas the disease is not present on other plants in the neighborhood. It is especially destructive on quince when these are crowded, or weeds and other vegetation are allowed to grow up about them. On pear the disease is sometimes wrongly thought to be the same as pear blight.

*Distribution.*—Very common in Kentucky, becoming more and more destructive towards the western end of the State. In some parts of Eastern Kentucky trees are but little injured by it. Common throughout the United States. Prevalent also in European countries, where it has been known for more than a century.

*Treatment.*—All leaves about affected trees should be raked up and burned either in the summer, in case they fall at that season, or at any rate in the fall. An application of Bordeaux mixture when the twigs are bare is also desirable as a means of destroying the spores remaining about the bark, and may be followed by two or three applications to foliage or fruit during the season. Of course any badly diseased twigs

should be cut away and burned. It may be suggested that seedling pear, and young quince in any shape, that have been bought and whose history is not known, might well be immersed in Bordeaux mixture before planting as a precaution against the disease. Plants treated in this way and subsequently planted on land that has not become infected, ought not to suffer greatly from leaf-spot, since it is known to spread from tree to tree somewhat slowly. For young trees in the nursery rows and for bearing trees, three or four sprayings with Bordeaux mixture, as suggested above, one of them being applied just before the buds expand in spring, are to be recommended. This treatment has proved effective in saving both foliage and fruit.

#### RASPBERRY ANTHRACNOSE.

(Blackberry anthracnose, raspberry and blackberry cane rust.)

Attacks raspberry, blackberry, and other plants of the genus *Rubus*.

*Character*.—Appears on the canes at or near the ground as very small purple spots which spread and soon acquire a grayish-white center and finally grow to a large size, then with a clearly defined purple rim; often uniting and covering much of the bark; spreads to the petioles of the leaves when abundant and eventually to the leaves themselves, occasionally even to the fruit; spots often a quarter of an inch in diameter; not penetrating the wood to any distance; surface opaque, slightly ribbed longitudinally when old and assuming a scab-like character; when at an advanced stage splitting and admitting water so as to cause rot to extend into the underlying wood. Due to a well-known fungus (*Glaeosporium venetum*) which causes the scab spots by attacking the bark, in which it remains dormant over winter. Young shoots attacked by spores as soon as they appear in spring and most of the growth and development takes place during the growing season. Attack results in dwarfing growth and reducing quality and yield of berries. When very bad, berries may shrivel up about time of picking, and not infrequently the canes themselves die when the disease is of long standing.

Black raspberries especially subject to it, in some cases to such an extent that whole plantations are ruined. Anthracnose must not be confounded with black spots, due to attacks of pear-blight *Bacillus*, such spots sometimes occurring among spots due to attacks of the anthracnose fungus.

*Distribution.*—Occurs throughout eastern North America, also in Europe. Appears to be most prevalent on low and ill-drained soil, but occurs everywhere. Common and destructive in Kentucky, where it is the occasion of frequent complaints sent to the Station by small fruit growers. I have seen less of it in the western end of the State. It is especially common along the Ohio river.

*Treatment.*—This disease is certain to be sent out of the nursery on canes of raspberry and blackberry, if it is present there. It is highly important, therefore, that our nurserymen keep a close watch on their stock to prevent its becoming established; and if by chance it is introduced, to get rid of it promptly. It can be exterminated. It is only necessary to burn all trimmings and to remove and burn old canes when they cease growing, rake up all leaves and burn them, and spray with Bordeaux mixture as soon as the young shoots push out in spring; following this up by two or three later sprayings with the same preparation. It is my judgment that no diseased canes should be sent out by the nurseryman.

The buyer is advised to examine any plants he may receive, and if any of the characteristic blotches appear the whole lot should be dipped in Bordeaux mixture before planting, the plants being observed closely when they begin to grow and applications of Bordeaux mixture be made with a sprayer if any appearance of the anthracnose is witnessed.

It is so serious a matter to get the disease established on a place that one may well hesitate about setting out plants that are in any wise affected.

The disease is encouraged by too rank a growth of canes or of other vegetation about them. They should be set well apart, in the first place, and carefully pruned and cultivated to guard against its introduction after the patch is once established.

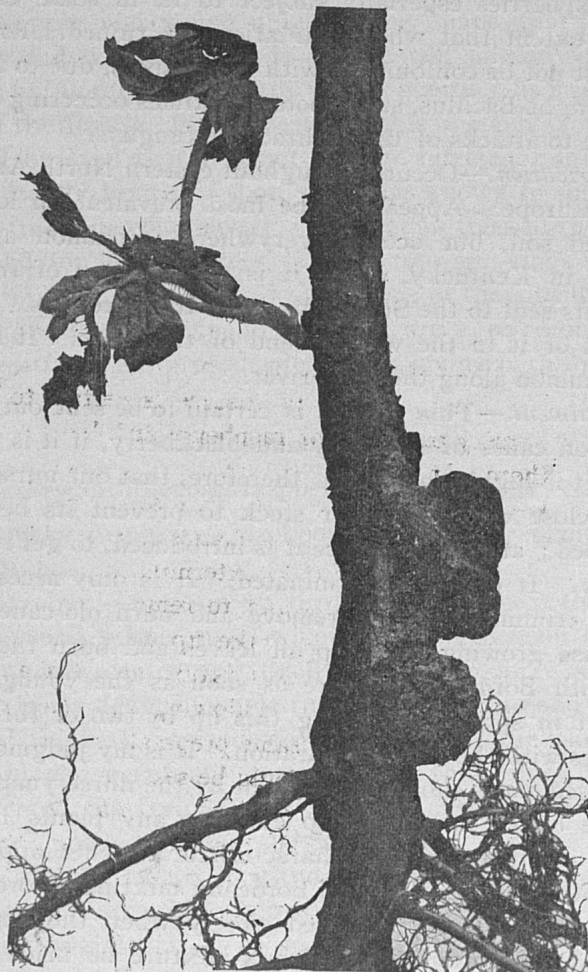


FIG. 8.—The crown-gall of raspberry, referred to on page 201. Natural size.

Here at the Station we have generally used a Bordeaux mixture containing  $6\frac{1}{2}$  pounds of bluestone,  $3\frac{1}{2}$  pounds of lime and 32 gallons of water. If properly made *and applied* it can be used freely on a variety of plants without injuring them in the slightest degree. I have had no opportunity to test it on raspberry leaves, which are said to be more tender than those of many other plants, but Mr. William T. Green,

of the Ohio Station, after some experience in treating anthracnose, recommends a weaker mixture as follows :

Bluestone, 4 pounds.

Lime, 4 pounds.

Water, 50 gallons.

Dilute mixtures such as this are easier to spray because of the smaller proportion of solid matter to pass through the pump and nozzle, but I have sometimes had results that indicate that they are not as effective in checking disease as the stronger ones. Mr. Green's conclusion is, however, the result of an actual test of the question and it is just as well to follow him in using the weaker mixture for anthracnose until the two can be thoroughly tested side by side and a comparison be made of their effects.

#### THE STRAWBERRY CROWN BORER.

(*Tyloderma fragariae*.)

*Character of injury.*—Strawberry plants are killed or greatly enfeebled at times by a small white grub which works in the interior of the underground stem where it is concealed from observation. If an infested plant is cut open lengthwise a broad mine filled with refuse is disclosed extending from the bases of the petioles of the leaves down towards the lower end of the stem. After the grub has been at work for some time the whole interior of the stem may be eaten away.

*The borer.*—Generally but one grub is found in each plant. It lies at the lower end of its burrow with its body bent upon itself like that of the large "grub worm" common in manure heaps. It looks in shape much like a very small grub worm, but it is unlike all grub worms in lacking jointed legs. It does not travel from plant to plant, and so has no use for legs. Its head is yellowish brown, the jaws dark at the tips; the rest of the body is white. The length of a specimen preserved in alcohol and taken from a plant August 11, 1897, is  $\frac{1}{4}$  inch; its body measures about 1-12 inch in diameter.

*The pupa.*—During the latter part of August the grubs

change to pupæ, singular white objects with antennæ, legs, and wings folded against the body and incapable of motion. The insect is now without a mouth-opening and lies at the lower end of the burrow, the cavity at this point having been slightly enlarged for its accommodation. It remains here as if dead until about the first of September when it undergoes its final change and becomes adult.

*The adult beetle.*—The fully developed crown borer is a small curculio or snout-beetle. If infested plants are cut open about the middle of September, instead of grubs or pupæ small light-brown insects will be found, each with its three pairs of legs which it can use for a rather sluggish locomotion. When disturbed it trusts to its obscure colors to escape observation and curls up its legs and remains motionless. Its wings cannot be used for flight, because of their small size. An example measures .18 inch in length. The colors of these recently transformed individuals are very light, at first almost white, with little or no trace of markings. With age they grow darker, finally assuming a dark brown color, with the head and thorax nearly black. On each side of the back are three black blotches, the middle one of each side being largest and squarish; it is separated from the spot in front and behind by a pale line. The impression one gets by ordinary examination is of a smooth-bodied insect, but under a hand-magnifier the head and thorax are found to be very closely punctured, and the wing covers are coarsely punctured in longitudinal lines.

The beetles seem in no hurry to leave the plants, but late in the fall they bore straight through the plant and escape into the earth, where they pass the winter months.

*Treatment.*—Because of its imperfect powers of locomotion the crown borer is not as generally distributed as are many more active insects, but its small size, obscure colors, and manner of attack make it dreaded notwithstanding. Once it becomes abundant on land it is exceedingly difficult to get rid of it again. The grubs, pupæ and beetles are during the summer months so completely protected by the plant that it is impossible to apply any fluid, powder or gas that would not



destroy the plant as soon or sooner than it would the insect.

When it is decided to destroy an infested bed it should be done in summer, and all the plants ought to be taken up and burned. Even this will not make the land at once safe for a new planting, for during a considerable period in spring the beetles are engaged in laying their eggs on the plants. (They seem to be placed at the bases of the leaves.) August is a good month in which to destroy such beds, because the egg-laying season is then past, and the young beetles have not yet left the plants.

In starting new beds plants should never be taken from beds already infested with the pest. Of course the young plants formed from runners during the summer are least likely to be infested, but the older ones even of these are sometimes found to have been visited by an egg-laying adult. Very late plants formed from runners are generally without borers. Yet it is so serious a matter to get the borers established in land that it is only safe to follow the advice given above, namely, get young plants for new beds only where the borer has not appeared, and, it may be added, make your new beds at a distance from any that may have become infested.

It is of special importance that nurserymen should not get the pest among their stock, and their attention is called to it in the hope that they will familiarize themselves with its injuries. It must not be confounded with the small grubs that sometimes destroy the fibrous roots and occasionally gnaw into the crown from the side. We have several such insects in Kentucky, but while they are troublesome locally at times, they are not likely to be disseminated with the plants.

#### **STRAWBERRY LEAF BLIGHT.**

*(Strawberry leaf spot, strawberry rust.)*

*Character.*—When strawberry leaves are nearly grown in spring small black spots appear on their surface, and somewhat later become light brown or even white at the center and are surrounded by a purple ring. By spreading and uniting these spots soon occupy much of the foliage and may kill it

completely. While the spots are likely to appear during either dry or wet weather, they become most abundant immediately after showers of rain in hot weather. Young plants are not much injured the first year unless planted near badly affected old plants. The disease is much more destructive to some varieties than to others. It varies in prevalence with the character of the season and to some extent with the location and soil; soil which does not retain water tenaciously, either because of artificial or good natural drainage furnishing the best sites for beds.

It is, like others here described, a fungus trouble, due to a special parasite (*Ramularia tulasnei*). The disease is known throughout America, Europe and Australia. The fungus is believed to remain over winter in the old leaves.

*Treatment.*—Some experiments in treating this blight were reported by me in Bulletin 31 of this Station, published in 1890. It was found that it could be controlled very well by spraying plants from time to time after the berries were removed, with Bordeaux mixture. Mowing, raking up, and finally burning the old leaves late in the season is to be recommended as a means of getting rid of the fungus as it lies dormant in the dead leaves. When old beds are to be plowed up it may be wise, if they have been badly infested, to burn them over first, and this is of special importance if the land is to be used again for strawberries. Injury may be avoided in some cases by care in selecting plants, by removing all blighted leaves, and if possible putting them some distance from land on which the disease has become established.

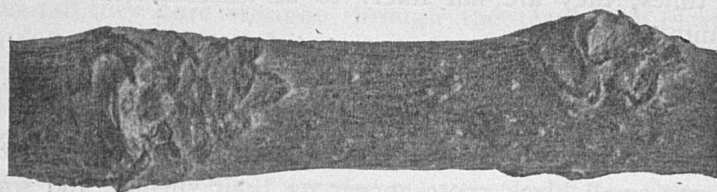


FIG. 9.—Showing rough places about buds and small lateral branches of young apple trees, mentioned on p. 202. Slightly enlarged.

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## 2. THE NURSERY INSPECTION LAW.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST OF THE  
STATION, AND STATE ENTOMOLOGIST.

At its special session held in the spring of 1897 the General Assembly of Kentucky enacted a law entitled "An act to provide for the inspection of nursery stock and to prevent the dissemination of noxious insects and fungi," which has for its object the protection of fruit growers and nurserymen from losses caused by insect and other enemies of young trees. The immediate and pressing need for such a law was occasioned by the introduction into some of the Eastern States of the very destructive San Jose scale,\* and the consequent danger that it would be brought to Kentucky on imported nursery stuff and spread among our orchards and nurseries.

The scale was already present in New York, New Jersey, Maryland, Delaware, Virginia, West Virginia, Ohio, Indiana, Illinois and other states, being especially prevalent in the coast states named, while it was present only in isolated spots in the interior. The danger that Kentucky orchards and nurseries would soon become infested was imminent, and it was the aim of members of the State Horticultural Society, who were chiefly instrumental in bringing the matter before the General Assembly, to have a law passed that would keep the scale out of the State; and hence the act that subsequently became a law was drafted† mainly with reference to this purpose.

It was anticipated that a trial of such a law might reveal defects not then apparent, especially since the time in which to put the act in shape for introduction was brief. The law

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\*See Bulletin 67 of this Station for an account of the insect and remedies for its injuries.

†The Kentucky law is the same in its general features as one that had previously been adopted by the State of Maryland.

has now been in force two seasons, during which every nursery in Kentucky has been inspected twice. The San Jose scale has not been discovered in any one of them.

But it is known to have been brought direct from the Pomona Nurseries at Parry, New Jersey, into an orchard at Highland Park, Jefferson County; into another orchard at Horntown, Grayson County; to a place at Bremen, Muhlenberg County, and to another at South Carrollton in the same county. It has been introduced also into the Lexington Cemetery on plum trees bought at the Star Nurseries at Dayton, Ohio. In all these cases the infested trees were bought several years before our law was enacted.

Cases such as these, coming to light from time to time, have drawn attention to that part of the law relating to people other than nurserymen, among whose trees destructive pests may find lodgment. Now, while Section 5 of the law makes it the duty of any one, whether a nurseryman or not, to notify the State Entomologist of any trees on his premises believed to be infested with destructive pests, no penalty is prescribed for failure to perform this duty, and hence an opinionated and obstinate person has it in his power to neutralize to some extent the work of inspection by maintaining on his place a center from which the scale may spread in the neighborhood. People of this character are fortunately the exception, but it is always the few that make stringent laws necessary. I would suggest that this section might appropriately be amended so as to *require* the extermination of destructive pests, wherever they may be found.

*Certificates of Inspection.*—The Kentucky law (See Section 3, below.) authorizes two kinds of certificates, one from the inspector to the nurseryman stating that the stock has been examined and found free from destructive pests, without which the nurserymen cannot sell in this State, and another made out and signed by the nurserymen himself to accompany each and every package of plants delivered by him.

Attention is directed to this matter because there has been some misunderstanding of the law in this particular. A glance at Section 3 (See below.) of the Kentucky law will

show that it is not intended that the nurseryman simply print on his shipping tags a copy of the inspector's certificate, but that he certify under his own hand that each separate package is made up of stock which has been examined by the inspector. Laws of other states are not the same in this respect and this has probably in some cases contributed to the misunderstanding. Yet the reason for the requirement will be plain when it is remembered that the inspector cannot be at hand when the packages are made up for delivery, and could not therefore honestly say that the contents of a given package were free from destructive pests. In other words, the nurseryman is, in the nature of the case, the proper person to say that his packages have been inspected and found healthy. The inspector simply pronounces on the growing stock belonging to a nurseryman, whereas his packages may be made up of stuff from several outside nurseries. This outside material has of course been received by him under a certificate, and our law requires him to certify to the fact as well as to the fact that his home-grown stock has been pronounced upon by an official inspector.

Inquiries sometimes reach me as to the proper form of this nurseryman's certificate. The law does not prescribe any special form, but the following may be suggested.

Have the inspection certificate printed on the back of your shipping tags and below it certify under your own hand that the stock bearing the tag is covered by this or other official certificates, as follows:

**CERTIFICATE OF INSPECTION OF NURSERY STOCK.**

No. 60.

AGRICULTURAL EXPERIMENT STATION OF THE  
STATE COLLEGE OF KENTUCKY,  
Office of the State Entomologist.

LEXINGTON, June 15, 1899.

I hereby certify that the nursery stock growing on the place of John Norwood at Williamsburg, Whitley County, Kentucky, has been inspected by me as required by law and I

believe the same to be free from San Jose scale and other destructive pests. This certificate is invalid after June 15, 1900.

H. GARMAN,  
State Entomologist.

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WILLIAMSBURG, KY., October 25, 1899.

I hereby certify that all of the stock in this package is covered by certificate from official inspectors.

JOHN NORWOOD.

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In case the nurseryman handles only home-grown stock he might, after printing the inspector's certificate as above, append in his own hand the following:

WILLIAMSBURG, KY., October 25, 1899.

I hereby certify that all of the stock in this package is covered by the above certificate.

JOHN NORWOOD.

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The law is printed below as it appears on page 25, Chapter 19, of the "Acts of the General Assembly of the Commonwealth of Kentucky passed at the Special Session of the General Assembly, which was begun and held on the Saturday the thirteenth day of March, one thousand eight hundred and ninety-seven."

*AN ACT to provide for the inspection of Nursery Stock and to prevent the dissemination of noxious insects and fungi.*

WHEREAS, The agricultural and horticultural interests of Kentucky have been injuriously affected in the past by the introduction from abroad of insects and fungi which destroy plants or their fruits; and

WHEREAS, A destructive insect known as the San Jose scale has been imported on trees into the United States and is liable to appear at any time in Kentucky,

*Be it enacted by the General Assembly of the Commonwealth of Kentucky:*

§ 1. That all nurseries in Kentucky, where trees, vines, plants or other nursery stock are grown and offered for sale, shall be inspected by the Entomologist and Botanist of the State Agricultural Experiment Station once each year at such time as he may elect, and he shall notify, in writing, the owners of such nurseries, the Commissioner of Agriculture and Statistics, the Director of the State Agricultural Experiment Station, and the President of the State Horticultural Society of the presence of any San Jose scale or other destructively injurious insects or

fungi on the trees, vines, plants or other stock of such nurseries, and shall also notify, in writing, the owner of any affected stock that he is required, on or before a certain day, to take such measures for the destruction of such insects or fungus enemies of nursery stock as have been shown to be effectual for this purpose. Said Entomologist and Botanist shall, for the purposes of this act, be, and he is hereby declared to be the State Entomologist, and shall serve without pay other than that he may receive as an officer of the State Agricultural Experiment Station, but his expenses shall be paid as hereinafter provided.

§ 2. The owner of this affected nursery stock shall, within the time specified, take such steps for the destruction of San Jose scale or other destructively injurious insect or fungus enemies present as will exterminate the same, and it shall be a misdemeanor to ship or deliver any of such stock, punishable by a fine of fifty dollars for every such offense, the fine recoverable before a justice of the peace or by indictment by a grand jury of the county in which the nursery is situated, or of that to which such stock may have been shipped.

§ 3. Whenever a nurseryman or seller of trees, vines, plants or other nursery stock, who is a resident of this Commonwealth, shall ship or deliver any such goods, he shall send on each package so shipped or delivered a written certificate, signed by him, stating that the whole and every part of such stock has been examined by a State or Government Entomologist and found free from San Jose scale or other destructively injurious insect or fungus enemies. Failure to furnish such certificate, or furnishing a false certificate, shall render him liable to the penalty of a fine of fifty dollars for each and every such shipment or delivery without such certificate.

§ 4. When the State Entomologist examines any trees, vines, plants or other nursery stock in this State under the provisions of this act, and finds such nursery stock free from San Jose scale and other destructively injurious insect and fungus enemies, he is hereby authorized and directed to make out and deliver, in writing, to the owner of such stock, a certificate stating that he has inspected such stock and found the same free from San Jose scale and other destructively injurious insect and fungus enemies, and he shall file similar certificates with the Commissioner of Agriculture and Statistics and with the President of the State Agricultural and Mechanical College, which certificates shall at all times be subject to public inspection.

§ 5. Whenever a nurseryman, fruit grower or agriculturist in this Commonwealth shall know or have good reason to believe that his trees, vines or plants are affected with San Jose scale, yellows, rosette or other destructive insect or fungus enemies, he shall have the privilege and it shall be his duty to notify the State Entomologist, who shall proceed to the premises designated and examine the same and suggest and recom-



mend the proper remedies for the destruction of such insect or fungus enemies as may be present.

§ 6. Every package of trees, vines, plants or other nursery stock shipped into this State from another State shall be plainly labeled on the outside with the name of the consignor, the name of the consignee, the contents, and a certificate, signed by a State or Government inspector, showing that the contents have been examined by him, and that such stock is free from San Jose scale, or other destructive insect or fungus enemies. Whenever any trees, vines, plants or other nursery stock are shipped into this State without such a certificate plainly fixed on the outside of each package, the fact may be reported to any justice of the peace of this Commonwealth, and said justice shall issue a summons for the consignee of such package, and the agent of the consignor, if he be known, to appear before him on a certain day, to be therein named, to show cause why such trees, vines plants or other nursery stock should not be seized, as being in violation of the provisions of this act, and on trial thereof, if said justice be satisfied that the provisions of this act have been violated, he shall order such agent or consignee to return such package of trees, vines, plants or other stock immediately to the shipper or consignor, unless said consignee or agent shall forthwith, and at his own expense, have such trees, vines, plants or other nursery stock examined by the State Entomologist, or such person as he may appoint to make the examination, and he certifies to the justice of the peace that such nursery stock is free from San Jose scale or other destructive insect or fungus enemies. If such consignee or agent fail to have such inspection made, or fail to return such packages to the shipper or consignor thereof, then the justice of the peace shall order and direct the constable or sheriff to burn and destroy, at the expense of the agent or consignee, all such trees, vines, plants or other stock as have been shipped into this Commonwealth in violation of law.

§ 7. The sum of five hundred dollars annually, or so much thereof as may be necessary, is hereby appropriated for the purpose of paying the expenses of the State Entomologist in the performance of his duties under the provisions of this act, and the Auditor of Public Accounts is hereby directed to honor requisitions made by said State Entomologist for expenses incurred in the performance of his duties, and the State Entomologist shall make annual report to the Treasurer of the amount expended.

§ 8. Inasmuch as the insect known as the San Jose scale has appeared in some sections of this Commonwealth, and great destruction of fruit and fruit trees is imminent, therefore an emergency is declared to exist, and the act shall take effect from and after its passage and approval by the Governor.

Approved May 20, 1897.

**KENTUCKY NURSERIES.**

Forty nurseries have been inspected by me in Kentucky this year (1898). They vary in extent from a few square rods to sixty acres or more, and though they contain a little of everything, are devoted in the main to growing apple, peach, plum, grape, and ornamental trees. Probably three-fourths of the nursery stock in the State at the present time consists of apple and peach trees. The condition of the trees in these different nurseries varies of course with the character and intelligence of the proprietor. Some are kept in excellent condition. Where not actually diseased, others are sometimes not in first rate condition because of neglect, this being true especially where they are grown only incidentally to some other business. One cannot buy first-class trees from ill-managed nurseries such as these, and I think it is to be regretted that they should continue in the business. Inspection and certificates cannot, however, control this matter, and they must be left to their fate. The subject is referred to here in the interest of fruit growing as an industry in Kentucky. For manifestly it would be much to the advantage of both buyers and nurserymen if there were but half the present number of nurseries in the State, and these were all conducted on approved modern methods. I cannot with propriety designate nurseries that are plainly going to their death, but with the intimation given above must leave the choice in buying to the intelligence of the buyer.

The following nurseries were inspected and received certificates in 1898. The names are arranged in alphabetical order:

- P. F. ADAMS & SON, Waco, Madison County.
- CHRISTIAN AEBERSOLD, Rockhaven, Meade County.
- J. A. ALLEN & SON, Bloomfield, Nelson County.
- W. S. ASHBY, Cloverport, Hancock County.
- L. Z. ASHLOCK, Hazelton, Muhlenburg County.
- ASHLOCK & DUNKING, Yelvington, Daviess County.
- BALDWIN & SUMMERS, Cairo, Henderson County.
- J. C. BINGHAM & SONS, Russell, Greenup County.
- BOWSER & VERNON, Elizabethtown, Hardin County.

- R. N. BROWN, Congleton, McLean County.  
JAMES CHILDRES, Auburn, Logan County.  
JOHN R. CHILDRES, South Carrollton, Muhlenburg  
County.  
O. & M. COMBS, Shepherdsville, Bullitt County.  
G. P. DIETRICH, Maysville, Mason County.  
DONALDSON & GIBSON, Warsaw, Gallatin County.  
DOWNER & BRIGGS, Bowling Green, Warren County.  
DOWNER & BRO., Pembroke, Todd County. (Nurseries  
at Fairview and Guthrie).  
GARDINER BROS., Deatsville, Nelson County.  
M. E. EDENS, Catlettsburg, Boyd County.  
B. G. ELLIS, Auburn, Logan County.  
MRS. A. S. HANCOCK, Casky, Christian County.  
S. G. HANSON & SON, Winchester, Clark County.  
H. F. HILLENMEYER, Lexington, Fayette County.  
HORACE KLINGLESMITH, Cecilian, Hardin County.  
J. W. KNADLER, Valley Station, Jefferson County.  
A. A. MCGINNESS, Bowling Green, Warren County.  
J. A. MCKEE & CO., Kingsville, Lincoln County.  
NANZ & NEUNER, 582 Fourth Avenue, Louisville, Ky.  
(Nursery at St. Mathews, Jefferson County.)  
R. H. PARKER, Cave City, Barren County.  
O. PIPER, Clinton, Hickman County.  
VIRGIL POPHAM, New Fruit, Hardin County.  
J. Q. A. RAHM, Leitchfield, Grayson County.  
THE REAM COMPANY, Hustonville, Lincoln County.  
(Nursery in Casey County.)  
R. G. ROLAND, Congleton, McLean County.  
J. M. SAMUELS, Clinton, Hickman County.  
W. A. SANDEFUR, Robards, Henderson County.  
EDWIN STOVALL, Vine Grove, Hardin County.  
E. K. TALIAFERRO, Newport, Campbell County.  
M. S. VAN METER, Meeting Creek, Hardin County.  
F. WALKER & CO., 644 Fourth Avenue, Louisville.  
(Nursery at New Albany, Ind.).