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The New York Apple-Tree Canker.
(Second Report.)

Wendell Paddock.

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*Connected with Fertilizer Control.
†At Second Judicial Department Branch Station, Jamaica, N. Y.
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BULLETIN No. 185.

THE NEW YORK APPLE-TREE CANKER.
(SECOND REPORT.)

WENDELL PADDOCK.

SUMMARY.

Attention is called to the fact that the canker fungus, Sphæropsis malorum Pk., occurs on several hosts; viz.: Apple, pear and quince fruits, and apple trees, pear trees and hawthorn trees. It is probable that species of Sphæropsis occurring on a number of other hosts are identical with this, but inoculation experiments have not yet been carried far enough to show that this is so.

Sun scald and sun burn undoubtedly have much to do with the susceptibility of some varieties of apple trees to canker.

Spraying the trees in winter with a whitewash protects them to some extent from the heat of the sun's rays, and is a partial preventive of sun scald.

Training the trees to thick, low heads, which afford shade for trunks and branches in summer is a partial preventive of sunburn.

Spraying with Bordeaux mixture is recommended as a partial preventive of canker.

Nectria ditissima, a serious canker fungus of European orchards, has been found on apple trees in New York and in Nova Scotia.
INTRODUCTION.

Previous to the publication of Bulletin 163 of this Station the New York apple-tree canker was scarcely known. The injuries had attracted the attention only of the more observing and were regarded usually by them as being the result of sun scald, or as a condition peculiar to the growth of certain varieties of apple trees. It was only necessary, however, to call the attention of orchardists to the disease and to make known its appearance and effects, when it was recognized and found to be a serious pest in most of the apple-growing sections of the State.

While the bulletin above mentioned gives the results of two years' work with the fungus, it is incomplete; since many questions arose that could not be answered. The work was continued through the season of 1900 and a few more facts were established which add to our knowledge of the disease.

EFFECTS OF THE DISEASE AND APPEARANCE OF AFFECTED PARTS.

A brief discussion of the work of the fungus and the appearance of cankered limbs will not be out of place at this time; but for a fuller discussion of the subject the reader is referred to the former bulletin.

Any part of the tree above ground, with the possible exception of the leaves, may be attacked by the canker fungus which has been proven to be *Sphaeropsis malorum* Pk. When the larger limbs, or in rarer instances, the trunks, are attacked, the injuries are known as cankers. Such injuries are often quite conspicuous since the bark becomes thick and rough, and saprophytic fungi soon gain a foothold causing the parts to turn black. (See Plate I.) The injuries are often several feet in length; and because of these striking characters, cankered limbs may be recognized at a considerable distance.

The fungus may live in the outer bark but here it does little harm and true cankers are formed only when it gains entrance
to the cambium layer. Under favorable conditions the fungus spreads until a considerable area of bark is destroyed. The limb may be girdled by the fungus but borers and saprophytic fungi often complete the work of destruction. An affected branch may live for a number of years and bear fruit but if the wound is large the normal activity of the branch is seriously interrupted. The swelling of the bark is probably caused by an excess of food being deposited, as a result of the partial girdling of the limb.

When the twigs are attacked a portion of the new growth may be killed in much the same manner as when attacked by pear blight. Much damage may result from such attacks and the fungus may occur in orchards where there is no evidence of cankers on the larger limbs.

Black rot of apples was first brought to the attention of the public by Dr. Chas. H. Peck in 1881. Since then the disease has been found also on pear and quince fruit; and at the present time black rot is a common orchard disease. Several experimenters have proven the identity of the fungus as it occurs on the three hosts. Our experiments prove that the black-rot fungus and the canker fungus are identical.

The leaves of apple trees are occasionally attacked by a *Sphaeropsis*, when injuries appear in the form of round brown dead spots somewhat like those from burning by improper spraying with Paris green. This form of *Sphaeropsis* has not been definitely proven to be identical with *S. malorum*, but the indications are that it is the same.

EXPERIMENTS IN 1900.

The inoculation experiments with cultures of the canker fungus were continued, for the purpose of confirming former results and to determine, if possible, the relationship between the *Sphaeropsis* that occur on various plants. Cultures were made from cankered apple-tree limbs and from decaying apples. Trees of various kinds were inoculated with these cultures, as given in the table below. A flamed scalpel was used in making incisions in the bark, then some of the fungus as it had developed

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in the cultures was inserted in the wounds. Check wounds were made in the same manner but not inoculated and all wounds were protected with grafting wax. (See Plate III.)

Table I gives the plan and results of the experiments, and includes: Hosts from which cultures were obtained; kinds of trees inoculated; number of inoculations made; growth of fungus where inoculated.

**Table I.—Growth of Sphaeropsis from Different Sources on Different Hosts.**

<table>
<thead>
<tr>
<th>Hosts from which cultures of <em>Sphaeropsis</em> were obtained</th>
<th>Kind of tree inoculated</th>
<th>Number of inoculations made in each tree</th>
<th>Growth of fungus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Apple tree, Apple fruit, Check</td>
<td>Apple tree</td>
<td>4</td>
<td>Very good</td>
</tr>
<tr>
<td>2 Apple tree, Apple fruit, Check</td>
<td>Pear tree</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>3 Apple tree, Apple fruit, Check</td>
<td>Hawthorn, <em>Crataegus oxyacantha</em></td>
<td>4</td>
<td>Very good</td>
</tr>
<tr>
<td>4 Apple tree, Apple fruit, Check</td>
<td>Apricot (Russian)</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5 Apple tree, Apple fruit, Check</td>
<td>Peach tree</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>6 Apple tree, Apple fruit, Check</td>
<td>Sumach</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>7 Apple fruit, Check</td>
<td>Persimmon</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>8 Apple fruit, Check</td>
<td>Hop hornbeam</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Cultures of *Sphaeropsis* as obtained from all of the hosts given in the table, save from the peach, were experimented with the previous season and all were found to produce black rot of apple fruits readily and all made some growth when inoculated into apple and pear nursery trees. Table I shows that, on the other hand, the canker fungus refused to grow when inoculated into apricot, peach, sumach, persimmon or hop hornbeam trees.
PLATE I.—SPAEROPSIS ON APPLE: 1, BRANCH GIRDLED AT a AND INJURED AT b BY CANKERS; SAPROPHYTIC FUNGI AT a ALSO; 2, SAME WITH DEAD BARK REMOVED; 3, TYPICAL CANKER; 4, BARK SHOWING PYCNDIA NATURAL SIZE.
Plate II—Body Blight on Pear: 1, Diseased Trunk and Branches; 2, Patch of Body Blight Surrounding Living Spur; 3, Trunk Scraped and Washed as a Cure for the Disease.

Plate appears in this bulletin by mistake.
Plate III.—Sphaeropsis Inoculations on Pear: 1, From Apple Fruit; 2, Check; 3, From Apple Tree.
Plate IV.—European Canker, Recent Infection; 2 and 3, Old Cankers.
Further experimenting will be necessary before the full significance of these negative results will be understood, but two ways of accounting for them come to mind. The first being that these hosts are, as has been supposed, attacked by different species of *Sphaeropsis*. In this case, apple fruits must be regarded as a very favorable medium for the growth of these different species and to a lesser extent the same will be true of apple and pear trees. The second explanation is that *Sphaeropsis* is not parasitic on these trees.

The statement was made in Bulletin 163 that the so-called species of *Sphaeropsis* occurring on apple bark and on decorticated apple wood are identical and that they are also identical with the black rot fungus of apple, pear and quince fruits, *Sphaeropsis malorum* Pk. It can now be stated that as a result of experiments extending through three seasons we have positive evidence that this *Sphaeropsis* occurs on apple trees, pear trees and hawthorn trees and on apple, pear and quince fruits and will grow as well on one host as on another. There is then, no reason for maintaining separate species for the fungus as it occurs on these hosts.

The results also indicate that there are still other hosts for the fungus but further experimentation will be necessary before they will be definitely determined.

**SUN SCALD, SUNBURN AND CANKER.**

On page 188 of Bulletin 163 reference is made to the occurrence of sun-scald, or winter injury, and its connection with the canker fungus. After becoming somewhat familiar with orchards in a state where sun-scald is a menace to all kinds of fruit trees, the writer is convinced that this condition is much more common in New York orchards than is commonly supposed. The longitudinal areas of reddish bark often seen on the south and southwest sides of trunk or limb are an indication of sun-scald. The tissues of this discolored bark have been killed by sun and frost. At the approach of warm weather, fermentation may set in and a sour odor be given off from the affected parts. A number of trees of the more tender varieties
in the Experiment Station orchards have been ruined by sun-
scald and at the present time the orchards contain several trees
that are seriously injured. Such injuries may be looked for in
any part of the State.

No variety of apple is more susceptible to canker than the
Esopus (Spitzenburg) although a few New York orchardists are
growing this variety to perfection. After an inspection of the
trees, we are inclined to the opinion that the Esopus trees, as
well as some other kinds, are easily injured by the sun's ray's
in summer. Such injury is also common to various cultivated
trees in many parts of the west, where it is known as sun-burn.

The canker fungus finds access to the living tissue through
such injuries and though the injured area itself is small it may
soon be greatly extended by the growth of the fungus.

In some parts of the west, orchardists spray their trees during
the winter with a whitewash as a protection against sun-scalld.
Whitewash has been used to some extent to prevent the pre-
mature swelling of fruit buds in spring and it has been found
to be some protection against winter injury as well. That the
action of the lime may also have a beneficial effect on the trees
is shown by instances in which a healthy condition of the bark
has followed its use. Plate II, Fig. 3, shows a scraped and
whitewashed pear tree.

The formula given below is recommended by the best author-
ities for a winter wash. The tallow and salt render the mixture
very adhesive so that it is not readily washed off by winter rains.

Lime (unslaked) .......... 30 pounds.
Tallow .................. 4 "
Salt ....................... 5 "

Dilute with enough water to make it spray easily through a
moderately fine nozzle.

Heading the trees low so as to protect the trunk from the sun
and forming a thick head for the purpose of shading the
branches, help to prevent sunburn.

THE TREATMENT OF APPLE-TREE CANKER.

The experiments in treating a canker infested orchard were
continued through the season just closed and again we must
report that no definite results were obtained. However, it is too much to expect that flattering results will attend a spraying experiment of this kind, since old infections cannot be cured and new ones are not rapidly formed.

Another year's observation confirms the recommendations made last year in regard to spraying with Bordeaux mixture, with good orchard sanitation, as a preventive of apple-tree canker. The presence of this disease in neglected orchards and its absence in orchards that have been well sprayed and well cared for in general, is strong evidence that with most varieties the disease may be easily controlled; but with some of the more susceptible kinds as the Esopus and the Twenty Ounce it is quite probable that the conditions known as sun-scald and sun-burn must be overcome before the canker fungus will be successfully combated.

Another point of practical importance not mentioned in the former bulletin is the method that some orchardists have adopted for saving the larger diseased limbs. This is done by sawing the limb off just back of the diseased area and then inserting cions of the same variety.

MACROPHOMA AND APPLE TREE CANKER.

In Bulletin 163, page 203, Macrophoma malorum (Berk.) Berl. et Vogl., is mentioned in connection with the body blight of the pear. This fungus is very common on both apple and pear trees and during the past season a number of cankered apple-tree limbs were found on which the injuries were evidently due to its attack.

After repeated trials the fungus was finally induced to grow luxuriantly in test tube cultures where it fruited abundantly. The spores germinate readily in potato agar but make very little growth. When transferred to sugar beet plugs they made better growth but produced no spores. The method finally adopted was to make plate cultures of the spores when they were located under the microscope, then transfer to sterilized bean stems in test tubes.

This Macrophoma resembles Sphaeropsis malorum Pk., closely in all respects except that the spores are hyaline, the spores of Sphaeropsis being dark. Saccardo even suggests that it may be
an immature stage of that fungus. But since the spores are still hyaline when germination takes place and, after sufficient growth, they in turn produce hyaline spores, there is no doubt as to the distinction between the two species.

Numerous inoculations were made in both apple and pear trees with cultures of the *Macrophoma* from both of these hosts but in no instance were positive results secured. These experiments should be repeated, however, before deciding that the fungus is not parasitic.

**THE EUROPEAN CANKER.**

Mention is made in Bulletin 163 of the canker fungus, *Nectria ditissima*, which is a common and serious orchard disease in many parts of Europe. *N. cinnabarina* is also mentioned as having been found on quince trees in an orchard near Geneva and an illustration is given of the injury that is produced. This species is quite common in America but is not regarded as being particularly injurious. Up to this time the former species had not been recorded as occurring on apple trees in America but during the past season specimens of apple limbs were received at the Experiment Station which proved to be infected with this fungus.

The following account of this disease is quoted from *Science*. ²


"Shortly after Bulletin No. 163 of this Station, entitled 'A New York Apple Tree Canker', was distributed, the writer received specimens of diseased apple limbs from various parts of the United States and Canada. Among the rest was a specimen from Nova Scotia which was noticeably different from any that I had yet seen. The injury was about six inches long on a limb two inches in diameter. Within the diseased area was a series of six ridges or convolutions in the wood surrounding a central starting point, each one of which evidently marked a year's growth of a parasitic fungus. The fungus, *Sphaeropsis malorum* Pk., which has been shown to be the cause of the common New York apple-tree canker, is more active in its growth. With this disease large areas of bark may be destroyed and the wood laid bare, or in other instances the bark may be much swollen and roughened, but the form of injury described above does not occur.

The appearance of the diseased limb, which was similar to that shown in [Plate IV] at 3, strikingly resembled the work of *Nectria ditissima* as illustrated and described by European writers. However there was no fungus
fruit in evidence, and as I was unsuccessful in obtaining more specimens the matter was dropped for a time.

In the latter part of May several specimens of diseased apple limbs were received from East Homer, Cortland County, N. Y., that were similar in appearance to the one from Nova Scotia, but in addition many portions of the dead bark and wood were thickly studded with the minute, deep red perithecia of a *Nectria*. Among the specimens were examples of recent infections as is shown at 1, in the [plate], as well as cankers of several years standing. The perithecia were abundant on all these specimens, so there seemed little doubt but that the *Nectria* was the cause of the diseased condition.

On visiting the locality it was found that the fungus was evidently confined to a small area and but few additional specimens were secured.

Through the kindness of Professor F. C. Sears, Wolfville, N. S., more specimens of the diseased apple limbs were obtained from that locality in June and the perithecia of the *Nectria* were found to be abundant on them. Professor Sears writes that this form of canker is doing serious damage in some of the orchards of the Annapolis Valley.

Specimens of the diseased branches were sent to Dr. R. Hartig, Munich, Germany, for identification, who writes that the cankers are caused by the fungus *Nectria ditissima*.

So far as I know this fungus has not as yet been recorded as occurring on apple trees in America, and its appearance in our orchards is of great practical importance since it is a serious pest to European fruit growers."

Since the above article was written, I have had an opportunity of comparing the fungus with specimens of *N. ditissima* on cankered apple trees which were collected for me in England by Mr. H. Hadlow of this Station. There is no doubt as to its identity.