Stem-End Rot and Gummosis

TWO FUNGOUS DISEASES OF CITRUS.

H. S. Fawcett.

Mr. President, Ladies and Gentlemen:

In addition to the many unfavorable conditions to which the fruit grower is liable, such as frost or scorching heat, floods or drought, or hurricanes, there are the ever-present insect and fungous enemies, new and destructive kinds of which are liable to get into his orchard at any moment without his notice.

It is with two fungous enemies of citrus trees, that have been known and studied during the past one or two years, that this paper proposes to deal. The two diseases associated with these two fungi, are Stem-End Rot and Gummosis. Stem-End Rot is a comparatively new disease. Gummosis has been known for many years, but the fungus associated with it has only recently been studied. To the practical orchardist, the minute details in regard to these fungi are of little interest. He is interested in them just in so far as a knowledge of the habits of growth and life history of the organisms enables him to intelligently control them. At the same time, he may realize the importance of careful and painstaking research by the Plant Pathologist into the minutest details of the organisms causing them, because of the fact that this knowledge often enables him to combat a disease at once, which has baffled him for a lifetime. It is so with these diseases of the orange. A knowledge of their cause is suggesting effective means of controlling them.

WHAT ARE FUNGI?

It is scarcely necessary to say that the fungi are plant growths of very low order and include such names as moulds, mildews, smuts, rusts, toadstools, mushrooms, puff balls, etc. The different kinds of fungi, as is so well known, are exceedingly variable in size, from those 1-1000 of an inch, to those a foot or more in greatest diameter, and in form they vary from those comparable in size to a hen's egg, to those that could be likened in form to a cabbage palmetto, an oak tree, a towering redwood tree, or an Indian mound. The two fungi which have to do with Stem-End Rot and Gummosis of citrus trees are both so small that they can rarely be seen on the trees even with the hand lens, and only the effects of their work appear. When growing in large quantities, however, they appear like differently colored moulds, which are seen
under a compound microscope to be composed of innumerable interwoven fungus threads. These fungi keep themselves alive from generation to generation and spread from place to place by means of seed-like bodies called spores.

CONTROL OF FUNGOUS ENEMIES.

Spraying is usually the first thing that is thought of in connection with a fungous disease. Spraying has been the great remedy in the past, and is still an efficient means of relief for many kinds of diseases of plants.

While we may never be able to get entirely away from the use of the spray pump and fungicides, I believe that for orange trees at least in the future, the pruning knife, the saw and axe and the burning brush heap, and the planting of resistant varieties, are going to be a far greater factor than the spray pump, in the control of fungous diseases. It is not the purpose of this paper to discourage spraying for orange diseases in its right place and at the right time. Spraying for certain insect and fungous diseases will no doubt always have to be resorted to for temporary relief, as the doctor uses medicine. A doctor will insist on your living and taking care of yourself in such a way that you will not need his services, and yet at the same time, he will prescribe medicine to break up some ailment which you have let go along until it is serious. It seems that the situation is sometimes somewhat analogous to this in an orange grove. I believe, however, that the ideal we should work toward is to do away as much as possible with the necessity for spraying, as the doctor would advise you to so live as to do away with his medicines.

It is the desire here to emphasize strongly the need for "the pound of prevention," grove sanitation, and care in keeping our trees resistant to an attack of the enemy, of propagating only good healthy nursery stock, and seeking for resistant varieties, and budding our trees to these; and sometime in the future, if possible, to throw away our spray pumps on the scrap heap, so far as fungus diseases are concerned. The danger that comes with spraying for fungi in orange trees, is that in many cases while you are killing one enemy, you may at the same time be killing half a dozen fungus friends. Therefore, one must know what he is doing. In using the pruning knife, the saw and the axe, we are not so apt to be killing so many of our friends. It is necessary not only to study each disease in itself, but to study it in relation to other diseases that may be present, and in relation to other factors, such as insects, weather, fertilization, etc. What may be of utmost value under one set of conditions may be all wrong under another different set.

STEM-END ROT OF CITRUS FRUITS.

The fungous enemy causing stem-end rot is a comparatively new one. The oval spore of this fungus, about 1-4000 of an inch long gives rise to a filament that enters at the stem end of the fruit while it is still hanging to the tree, or after it has been picked. If it enters while on the tree the fruit drops and the fungus by means of innumerable branching and interwoven microscopic threads, causes it to
pass through the stages of decay, from slight softening at the stem end, to brown mushiness and finally to a hard, dark-brown or black mummy. The spurs from which the fruit has dropped, die back from 3 to 12 inches or more and often show drops of gum near the border between the dead and live wood of these twigs. Spores of the fungus have been found in great numbers on these dead branches and on the mummified fruits, and pure cultures have been obtained from the interior of these twigs as well as from the interior of softened fruit.

A year ago I gave you my first report on this disease and gave out the information that had been obtained up to that time. The information then at hand was that stem-end rot was a serious decay of sound fruit as well as injured fruit; that this decay developed often on sound oranges in transit; that it was caused by a fungus growth which usually entered at the stem end; that it might be transmitted from diseased oranges to healthy ones by contact or by soaking them in water; that it might be transmitted also by means of pure cultures of the fungus placed on the fruit, or placed in water in which the fruit was soaked; that the fungus could infect the fruit through a stem left on an orange at least 3 inches long; that fruits could be infected by placing them in water with soil from under infected trees; that it took from one to three weeks after infection, for symptoms of the decay to appear.

During the past year additional information and facts in regard to the disease have been obtained by observation and spraying experiments in various orange groves in the state, and by experiment and study in the laboratory. I will not give you the tiresome details of these, but speak of the facts brought out.

First of all there is one correction to make. I said last year that the fungus was a species of Achlya belonging to the water moulds. Further study has shown that it is not a water mould, but probably some higher form.

**INOCULATION EXPERIMENTS.**

In my paper last year I showed some charts containing the tabulated results of the work to that time. In order to definitely establish these results and find out further in regard to the fungus, some additional experiments were carried out last November and December. We wished to find out (1) the influence that injury to the rind would have on making the fruit subject to stem-end rot decay. For this purpose the rinds of some oranges were slightly cut near the stem end like a bad clipper cut, while others were left uninjured and comparison sets were made, placing on these both fungus filaments and the fungus spores. A comparison was also made as between the effect of stem end rot fungus, and the known citrus disease fungi, when placed on the surface of the fruit. Both sound and clipper-cut fruit were used as before. The results are shown in Table I.
Table I.

STEM-END ROT INFECTION ON ORANGES.

<table>
<thead>
<tr>
<th>Experiment No.</th>
<th>Total Stem End Decay in 5 Days.</th>
<th>18 Days.</th>
<th>23 Days.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fungus filaments put on stem end.</td>
<td>22</td>
<td>66</td>
<td>100</td>
</tr>
<tr>
<td>2. Fungus filaments put on clipper-cut rind</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3. Spores of fungus put on stem end</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>4. Spores of fungus put on clipper-cut rind</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>5. No fungus put on stem end</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>6. No fungus put on clipper-cut rind</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>7. Withertip fungus put on stem end</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>8. Withertip fungus put on clipper cuts</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>9. Scaly bark fungus put on stem end</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>10. Scaly bark fungus put on clipper cuts</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>11. Gummosis (Diplodia) fungus put on stem end</td>
<td>.00</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>12. Gummosis (Diplodia) fungus put on clipper cuts</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

(2) We wished to find out how readily fruit, lying on the soil in which there was stem-end rot fungus, would be infected. For this purpose 5 wooden boxes containing soil were prepared as follows: (a) Soil from under an infected tree, (b) soil from Experiment Station grounds in which no citrus trees had been growing, the same source sterilized and treated by mixing in cultures of stem-end rot fungus. Sound fruits were then placed stems down in the soil, and it was kept moist. (See Table II.)

The results of these experiments show that this fungus unlike the blue mold can enter without injury, but is favored by injury; that the time for decay, from the introduction of spores is greater than when filaments of the fungus are introduced, and that withertip and scaly bark fungus cannot produce stem end decay.

<table>
<thead>
<tr>
<th>Experiment No.</th>
<th>Total Stem End Decay After 5 Days.</th>
<th>13 Days.</th>
<th>22 Days.</th>
<th>31 Days.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. From under infected trees, Ormond, Fla.</td>
<td>.00</td>
<td>.00</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>2. From Florida Experiment Station Grounds</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>3. From Florida Experiment Station Grounds, plus fungus</td>
<td>.00</td>
<td>.00</td>
<td>2.5</td>
<td>5</td>
</tr>
<tr>
<td>4. From Florida Experiment Station Grounds, sterilized</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>5. From Fla. Exp. Sta. Grounds, sterilized, plus fungus</td>
<td>.00</td>
<td>5</td>
<td>26</td>
<td>42</td>
</tr>
<tr>
<td>6. Check, fruit protected from soil</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
</tbody>
</table>

(c) soil from Experiment Station grounds in which cultures of fungus had been mixed, (d) soil from the same source sterilized, and (e) soil from the
but that the gummosis fungus (*Diplodia*) of which more will be said later is also able to produce a kind of stem end decay.

Other new facts brought out by our study since last year are these: That the fungus lives and produces spores in the dead twigs and in and on the decayed fruit, that it is more widely distributed than it was first thought to be.

We also tried out some spraying experiments beginning in October in five different parts of the state. In the first plot Bordeaux mixture was used; in the second ammoniacal copper carbonate; in the third self-boiled lime sulphur and in the fourth the commercial lime sulphur. The reports of shipping experiments have just come in, and it seems that the spraying had very little effect upon the amount of stem end decay on fruit held at Washington for as long as three weeks. The checks were nearly as good as any of the others. This shows that spraying with fungicide for stem end rot decay is no good whatsoever, especially if begun as late as October. The checks were 21% after three weeks at Washington, Bordeaux was 32% (11% more), ammoniacal copper carbonate was 21%, just the same as the check; self-boiled lime sulphur, 23%; commercial lime sulphur, 17%, somewhat less, but not greatly less than the check.

These shipping tests were made by H. J. Ramsey of the Bureau of Plant Industry.

**CONTROL.**

The results of this study and experiments with this fungus indicate rather definite lines of control. Since the spores of the fungus are abundant upon the killed twigs and mummified fruit upon the ground, the importance of a thorough pruning out of these dead branches and a thorough cleaning up and burning of diseased fruit that have dropped the previous year is suggested as a means towards preventing new infection of the next crop.

The result of the inoculation experiments last year suggested the probability of fruit becoming infected when being washed, and the advisability of trying experiments in treating the wash water and also in spraying the oranges with a fungicide just as they came out of the tank. In cooperation with Mr. Ramsey of the Bureau of Plant Industry, Washington, we carried on some experiments in this line at two different packing houses. It may be said as a general statement that these experiments did not indicate that any new infection took place in the short time that the fruit was in the wash water. Our experiments at least, did not show any consistent difference in amount of stem end decay between the treated and the untreated fruits. Some of the chemicals we used appeared to increase the amount of blue mould decay due probably to injury to the rind.

**GUMMOSIS.**

A second fungus enemy has been found guilty only during the last ten months in connection with the gummimg of both orange and peach trees. The gummimg of orange and peach trees in various forms has been known for a good many years. There are several diseases in which gummimg occurs, but the word "gummosis" in Florida has been applied to the particular disease of citrus trees in which the first stages are characterized by copious
flow of gum from breaks in the bark on the trunk or large limbs some distance from the ground, and in the later stages by a shagginess of the bark. Only recently has it been known that there was any fungus in connection with this trouble and it has been attributed to various causes, such as cold, the wrong kind of fertilizers, borers and the like. And while one or more of these factors may weaken or injure the tree so that the fungus may more easily enter, it now seems probable that this organism is one of the agents in causing one form of disease known as gummosis.

DESCRIPTION.

The disease first makes itself apparent on citrus trees by the oozing out of a thin watery gum, which sometimes runs down the bark in lines, forming what is known as "tears." Later the gum thickens and collects in large quantities at the cracked places in the bark. As the disease progresses, the bark cracks still more and assumes a shaggy ulcerated appearance over patches three inches to a foot or more in length. The diseased patches may extend entirely around the limb or may be confined to one side of the branch. The gum seems to exude most during the growing period in the spring and summer, and sometimes entirely ceases in the fall and winter. In cases where the gummosis is not too severe, new bark is formed under the old and the surface becomes marked by ridges, warts and resinous-looking deposits and at the edge of the diseased area are large bits of bark which have been pushed up and are hanging by one edge. When the disease is of some age, it may easily be mistaken for the true scaly bark.

A species of fungus belonging to the genus Diplodia (Diplodia natalensis) has been found under the bark of diseased patches on citrus trees and the same fungus has been found in connection with diseased limbs on gumming peach trees. It was first obtained from the interior of gumming peach branches by E. W. Berger of the experiment station in July of last year and was afterwards isolated by him from gumming peach branches from five different counties in the state. The two most widely separated localities were West Tampa and Pensacola.

In September of the same year, what appeared to be the same fungus was obtained from the gumming orange limbs and afterwards obtained from six different counties of the state. Both peach and orange trees in the greenhouse were inoculated by taking bits of this fungus which had been grown in the laboratory and inserting it under the bark. In each case, the bark of healthy trees was cut in exactly the same way. These peach and orange trees in which the fungus had been inserted under the bark gummed copiously, very much in the same manner as they do when infected in the orchard; while those which had been cut in the same way but no fungus inserted, healed up without gumming in any case. This seems to show that this particular fungus may be one of the agents at least in inducing the gum and it is probable that in many cases some slight injury allows the fungus to get in. This is not thought to be true in all cases, as the following will indicate:

Some inoculations were made by placing the fungus on the surface of the bark
of peach trees without cutting or injuring it in any way. Where the bark was young and green, gumming took place, while in cases where the bark was thicker and harder, no gumming was seen.

Another interesting discovery was made while working with this fungus. It was found as stated before, that this fungus could also cause stem end decay of being inserted into the bark of healthy orange and peach trees will cause copious gumming; and that the same fungus when placed on oranges is able to cause a form of decay resembling stem-end rot.

CONTROL.

The line of treatment for gummosis at once suggested by this discovery is to

Table III.

<table>
<thead>
<tr>
<th>GUMMOSIS FUNGUS INFECTION ON ORANGES.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experiment No.</strong></td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td>1. Soaked in water with fungus 24 hours</td>
</tr>
<tr>
<td>2. Soaked in water without fungus 24 hours</td>
</tr>
<tr>
<td>3. Fungus filaments put on stem end</td>
</tr>
<tr>
<td>4. Fungus filaments put on clipper cuts</td>
</tr>
<tr>
<td>5. Check. No fungus put on stem end</td>
</tr>
</tbody>
</table>

fruits. The decay is so similar to the true stem-end rot decay, that even an expert could not tell it at its early stages. As the decay from the gummosis fungus proceeds, however, the fruit becomes light in weight, with black streaks and is not so soft and mushy as in the other decay. Table III. shows the results of experiments with the gummosis fungus.

These results seem to show that sound oranges are not so readily attacked by the *Diplodia* fungus as by the true stem-end rot fungus, but that injured oranges are just as readily attacked and more quickly destroyed. I do not think this fungus could enter a sound orange while still on the tree.

The facts brought out in relation to gummosis are that there is a species of fungus connected with it; that this fungus can be grown on pure culture and on get rid of the organism in the infected tissue. If the disease has progressed until a good portion of the bark around a tree is involved, it might as well be cut out and burned. If it is not far advanced, the tree or limb affected can probably be saved by the following treatment. The finding of this fungus growing in the diseased places would indicate that the severe cutting away of all diseased tissue should be employed in order to get rid entirely of this fungus. Some growers have been using with apparent success the method of cutting away quite severely, and where there are decayed places cutting these out further with a sharp knife or chisel. These cut surfaces are then disinfected, and the whole surface covered with a kind of grafting wax. A very good wax for this purpose, which has been used with good success by Mr. Hart
of Hawks Park for cut surfaces, is made as follows: 6 ounces alcohol, 1 pound rosin, 2 ounces tallow, 1 ounce spirits of turpentine. Mix the tallow and rosin and heat together. Take off and cool and turn alcohol in slowly. Last put in the turpentine.

In conclusion it may be said that prevention rather than cure is what we should strive for in the future, and even after the disease is present, the pruning knife and the saw are of first importance and the once “cure all” method of spraying should be used with care. For orange trees at least, it seems to me that spraying with fungicides in our present state of information should not be depended upon and should be looked on rather as a temporary means of relief in some severe cases of disease. In the treatment of these troubles, it is necessary, as has been stated before, to know all the different agents both fungous and insect that are working in an orange tree; and to adopt the method that will be best fitted when one considers the effect of this treatment on all of them taken together.

**DISCUSSION.**

Prof. Hume: In connection with this report we have two other speakers, but I believe it would be a good idea to have at least part of the discussion now.

I might say in this discussion that Prof. Fawcett is a very modest man. He has worked out and put before you today, a problem which has puzzled the best investigators in this country, both in the peach growing districts and in California, and it has come off just as plain as the rule of two and two are four. But I think you ought to know the study and observation and investigation which has made his talk possible.

Mr. Gillette: Prof. Fawcett stated to us that he thought in the early stages of this disease (gummosis), it might be controlled. I would like to ask him by what method or what means it can be controlled, and what he has found most successful.

Prof. Fawcett: I have had very little experience myself in treating it the way I would treat it since this recent discovery. The method as employed was to take off the loose bark and paint with Carbolineum. The results were not as satisfactory as we wished; although it seemed to help it, it did not cure the trouble. Mr. Stevens of DeLand, has cured a number of cases by cutting back, in the early stages, into the live wood both ways from the point of infection and, in some cases, putting grafting wax over it.

Mr. Gillette: What was the disinfectant used?

Prof. Fawcett: I think he used Carbolineum. But some caution must be used in using Carbolineum, because if you get it too strong, it might do much harm. I advocate a more mild disinfectant, such as Bordeaux, or a paste of lime and sulphur. Of course, you can weaken Carbolineum with soap and water.

Mr. Gillette: The Professor’s experience coincides with mine, exactly. I presume I have had more experience with gummosis than almost anyone here, for the reason that I had charge of a large grove in Cuba. You never have seen gummosis in Florida that compares with that they have in Cuba. In a grove of
probably 150,000 trees in Cuba, I pro-

sume 60 or 70 per cent of them have

been attacked with gummosis. At the
time I saw it, it resembled foot rot, al-

though in the wrong place. I thought it
was foot rot. The trees were infected
just a little above the ground. I soon
found that I knew nothing about it. They
thought that my coming from Florida, of
course I would know just how to cure it,
but I had to confess that it was some-
thing new to me. In one of the groves
they had a good deal of trouble with
lemon trees largely on account of this
trouble with gummosis. Several experts
visited Cuba, and some of them claimed
that the trouble was with the roots. I
did not believe that.

When the disease started, we cut it
back just as the Professor says, into the
clean wood. We scraped it, and treated it
with Carbolineum, but soon found that
it burned the trees. We weakened it, and
found it worked better. Some of the
trees, however, died, and we concluded
to burn them. We had the trees cut off,
and new shoots came up, and some of the
finest trees grew from those old roots.

The disease never started on those trees
until about the second or third year; that
seems to be the time when the disease be-
gins to develop. At first, I thought it
was brought about by something the trees
had taken up from the soil.

In the first grove of one hundred acres,
I never saw trees grow more beautifully
than they did for two years. Then, after
a wet season, the disease broke out all
through the grove. Out of 8,000 trees,
about 7,000 were affected. It seems as
though the extreme moisture had made
soluble in the soil something which the
tree had taken up to excess. The tree
was just like a person whose blood is bad
and boils had broken out. We began
treating them just as the Professor stated,
by cutting out, cleaning away and using
several insecticides. Some trees were
healed up in a short time, and some of
them seemed to entirely recover. But we
soon found out that if the knife used in
scraping the trees was not absolutely
clean, it would inoculate another tree, so
we had to put the blade into the fire and
burn it after treating every diseased tree,
to keep from carrying the disease all
through the grove.

I was on the Isle of Pines about three
weeks ago. I went into one of the larg-
est groves on the Island. It is a hand-
some grove, but all through it I noticed
vacant spots, and in walking through I
noticed trees with great sores on the side,
some of them healed and some of them
bleeding badly from the disease. It
seems to me that unless they do some-
thing very soon, they are going to lose
a very valuable piece of property. As I
stated before, the disease is much more
prevalent there, and works much more
rapidly.

This disease seems to be more prevalent
in the hammocks and in the lower lands,
like those on the Manatee River. They
seem to have considerable trouble there.
I know several people in that section who
are troubled with it, and they are going
to lose their groves if drastic measures
are not taken.

In nursery work, we very frequently
begin budding, say in July or August.
This is something we ought not to do.
Very frequently you will find a whole lot
of those trees will gum, in a manner very
similar to gummosis, although I do not think it is the same thing. I was once very much alarmed, for the reason that gummosis seemed to have gotten my nursery, but it soon healed over and there was no harm done.

Prof. Rolfs: I know there is no one here who can appreciate the amount of work Prof. Fawcett had to do to come to this scientific conclusion. However, there is no one here who undervalues the conclusion he has come to. He has proved it is due to a specific agent he has discovered. I think Prof. Fawcett is on good, solid ground to getting a practical and profitable remedy which heretofore we could not have gotten without great expenditures of money, and then only in an approximate way. The knowledge of this disease has been carried to this point; now he is ready to go ahead with the practical side of it and find out what is the best remedy.

I merely wished to call attention to this, Mr. Chairman, that the talk consumed only a few minutes, while it took nearly twelve months to give him the knowledge to make that talk. In a few minutes he told you what he had discovered about gummosis of the peach, but he did not tell you that it has baffled the scientists from California to New York and south to Florida, and this is the first time it has been definitely proven what the agent is.

Dr. Richardson: A line of thought has been suggested to me by a remark dropped by Mr. Gillette. You remember that he said that it was something like a man with impure blood that broke out in boils. Having practiced medicine for thirty years, and having treated people for boils, I want to say that we know, now, that impure blood is not the cause of boils. We know that boils are caused by microbes that come from without.

It occurs to me that this is true in every one of these diseases we have been discussing, of citrus and other fruit trees. They have not come up from the soil. The disease has come into the tree from other sources; in Mr. Gillette's experience, the inoculated knife. The old-time surgeon used to introduce more diseases than he cured by the use of his infected hands and unclean instruments.

A short time ago, I was advised by self-proclaimed experts to treat my trees with remedies applied to the soil. I know better, now. If you stop to think a moment, you will know that these things do not go that way. The best of all germicides, the most potent, and the cheapest, is God's sunlight. Sunlight destroys more germs than anything else. Next comes water. Water, and then the best known germicide is pure, dry earth. These three are the strongest combination of germ-killers known.

One of the first things a grower should do, is to protect his trees by means of proper cultivation of the soil. Keep it clean. Keep the soil stirred up so that the other two agents may get at it. Let the sun and the water and the dry earth come to the relief of the diseased tree, and they will do more than anything else I know of. The sanitarian today is a successful practitioner, and the sanitary grower is the most successful in treating the diseases we have been discussing. Prevention is better than cure, any time. Keep the germs away from your fruit and it will carry to market without rotting. If you can keep away from your
pruning shears and budding knife, the germs that are teeming in millions, you will have cleaner and better stock. Don't look in the wrong place. Keep things clean, keep your soil stirred, and give Nature a chance to do better work.

Mr. Gillette: These discussions are always productive of results. We have found out something about boils. It has always been a question, it seems to me, since the dark ages, where is the best place to have boils. We have found out that we can pick the place, and all we have to do is to light on the right spot and make them come there.

Now, there is no question but that sanitation, applied by a physician, is a wonderful cure for diseases that flesh is heir to, but I am not so sure about it when applied to an orange tree. This question of orange growing is one which stumps us all. The Doctor has advised us to open up the soil and let in the air and water and sunshine. On the other hand, go into the dense hammocks where the orange trees grow naturally and you will find no sunshine, and it seems to me the trees are in a more perfect condition than where they are cultivated.

I have found in every neighborhood, at least one man who insists on clean cultivation. He grows oranges, too, and fine ones. His next door neighbor believes in cover crops and keeps the ground well protected from the sun, and he grows oranges, just as fine as the clean cultivation man. Another man goes still further and believes in letting the weeds have entire possession of his grove, and he succeeds, too. How these different methods all succeed stumps us, but they do.

Mr. Connor: In Professor Fawcett's paper he has a statement in relation to pruning the trees for stem-end rot. It seems to me this is a matter of rather grave importance to the growers who have stem-end rot in their groves, to know at what time the trees should be pruned with good results. Now, pruning out the dead wood when the tree is full of fruit would not be a good thing for the tree. I would like to have the Professor state, for the information of all of us, what he thinks to be the best time of the year to prune for stem end rot. I am looking for all the help I can get from people who know more about it than I do.

Prof. Fawcett: The wither-tip fungus is in almost every grove in the state. Prof. Rolfs' experiments some years ago, showed very plainly that there were two periods of the year when pruning can be most safely carried on. Those two times are in the dormant season in December and January and again in July, when the first growth of wood has somewhat hardened; and so I would say that for stem-end rot, also, we should, if possible, choose those periods so that we will not have a possibility of withertip infection. If you prune for wither-tip when the new growth is putting out vigorously, you are liable to have some trouble with infection in this new growth.

I would say right here that December and January for some of you who hold your fruit on the trees, would be a bad time. July would be a better time.

Professor Rolfs can probably tell us more about it than anybody here.

Prof. Rolfs: While I was carrying on the work on wither-tip, we found that
January was the most effective and advantageous time. Next to that, July. When we pruned in the early part of the year, and after the tender growth had hardened, it frequently occurred that it did more harm than good. Pruning was carried on successively through the entire twelve months to establish the fact as to when we should prune for wither-tip, and the effect on the trees was much better when they were pruned in January and July than at any other time. Just why that should occur, we did not attempt to answer, as we were after results at that time, not after the theoretical information.

As to whether we shall prune at the same time for stem-end rot will depend upon further investigations that Prof. Fawcett is making of the life history of this fungus. If infection of the fruit takes place at a different time of the year than when these prunings occur, it may be necessary to prune a little earlier or a little later, according as to what the further line of investigation may develop.

I think we are particularly fortunate in having Prof. Fawcett report these things to us year after year, to keep us in close touch and observation. You will see from the information you get on stem-end rot and on this gummosis, that Professor Fawcett has given us all he has in his shop, and we will have to be satisfied with that. During this coming year, he will accumulate some information and give it to us then if we want it, and I think we all want it.

Mr. Thompson: Professor Fawcett spoke of sterilizing the soil under the tree for stem-end rot. How is it done?

Prof. Fawcett: That was a small amount of soil for the experiment, and it was done by heating it up to 350 degrees. Of course, that was a small amount of soil and this method would be impracticable for general use.

Mr. Gillette: Have you discovered stem-end rot in green oranges.

Prof. Fawcett: Yes, it occurs when the oranges or grapefruit are just beginning to color and once in a while, before then. But it takes a different form. It discolors it when the oranges are green, but when the oranges are mature, it infects with scarcely a discoloration at first.