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THESIS

On

BROWN ROT OF FRUITS AND FRUIT TREES IN OREGON

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Gilbert Bradley Posey

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APPROVED:

Professor of Botany & Plant Pathology in Charge of Major

Head of Department of Botany and Plant Pathology

Dean of School of Agriculture

Chairman, Committee on Graduate Students and Advanced Degrees

BROWN ROT OF FRUITS AND FRUIT TREES IN OREGON.

Introduction

Brown Rot caused by Sclerotinia (monilia) species has long been known in North America as a disease of stone fruits. A few cases have been reported where pomaceous fruits were attacked by the disease.

In the state of Oregon during the past few years at least, the malady has not limited its attacks to fruits alone, but it appears to have been very active in causing blossom-blight, spur-blight, twig-blight, and branch cankers on cherry, plum, prune, apricot, peach, and pear trees. Furthermore, a monilia has been observed to over-winter in infected tissue of the above hosts and to produce an abundance of viable conidia during following winter and spring, as late at least as June.

The questions naturally arise: Has the brown rot fungus which causes the ordinary fruit rot of stone fruits been so favored by environmental conditions as to enable it to make vigorous attacks on blossoms, twigs, spurs, and branches of both stone and pome fruits, or is the blight trouble of the above host due to another fungus? If the latter supposition is true and we are dealing with two fungi, what is the proper classification of each form?

In view of the problems presented, the writer, acting upon the suggestion of Professor H. S. Jackson of the Oregon

Agricultural College, began in September, 1913, a study of the monilias of drupaceous and pomaceous hosts in Oregon. The purpose of his study was to establish an understanding of the inter-relationship of the monilia forms which are believed to cause fruit rot and those associated with blossom-blight, twig-blight, spur-blight, and branch cankers in Oregon, and to give experimental proof as to the extent of the injuries which they are capable of causing.

Status of the Problem in Oregon when the Present Investigation was Begun.

The first available record of the brown rot fungus in Oregon was made by U. P. Hedrick in 1895. He called the fungus monilia fructigena. Mr. Hedrick's first observations were made on specimens sent him for identification by growers. At this time, the disease was thought to have been recently introduced into the state, but, upon further inquiries among the growers, he was convinced that the monilia disease had existed in Oregon for a number of years, and had proved dangerous only under particularly favorable conditions. From the account given by Hedrick, leaves, twigs, and fruits were attacked, but most damage was done to the fruits. No account of the over-wintering or dissemination of the fungus was given.

In addition to Hedrick's statements, there appeared in 1912 in the First Biennial Crop Pest and Horticultural Report of the Oregon Experiment Station, pages 248-250, an article by H. S. Jackson on "Brown Rot of Stone Fruits" in which reference is made to both fruit rot and blossom-and twig-blight of stone fruits caused by Sclerotinia fructigina.

An examination of the correspondance files and laboratory records of the Department of Plant Pathology at the Oregon Agricultural College shows that the monilia fruit rot is common in practically all sections where stone fruits are grown. The same source of Information shows that up to the time when the present investigation was begun, a monilia blight of stone and pome fruit trees had been recorded as follows:

> On apricot branches, Albany, Ore., May 5, 1913; pear branches and spurs from Halsey, Ore., June 6, 1913; apricot twigs from Portland, Oregon, June 15, 1913.

Historical Sketch

Three sclerotinia diseases of fruits and fruit trees have been reported in Europe, namely: Sclerotinia fructigena (Pers.) Schr. Sclerotinia Cinere Bon., and Sclerotinia Laxa.

Sclerotinia fructigena has been known in literature since 1796, when Persoon gave the name Torula fructigena

to a fungus which he found on decayed fruits of Prunus domestica, Amygdalus persica and Pyrus. This name was accepted by other writers, notably, Albertini and Schweinitz, Saccardo, and Rabenhorst. In 1801 Persoon changed the name to monilia fructigena. This latter name was generally accepted by most writers and is the name by which the fungus is most commonly known today. Kunze and Schmidt a little later referred it to Oidium fructigena, under which name it received attention from such writers as Ehrenberg, Cooke, Duby and Fries.

In 1822 Persoon renamed the fungus and called it Acrosporium fructigena. This classification was never accepted by other writers. Wallroth later placed it in the genus Oospora, calling it both Oospora candida and Oospora fructigena. Von Thümen classified it as Oidium wallrothii, but later changed it to Oidium fructigenum.

The first writers to attach any economic importance to this fungus were Von Thümen and Hallier. Schröter in 1893, being confident of its ascomycetous nature, placed it in the genus Sclerotinia. This classification was confirmed in Europe by Aderhold in 1904.

Sclerotinia cinerea was first described as monilia cinerea by Bonarden in 1851. He had noted it forming small, gray, sometimes brownish, conidial tufts on rotted fruits. This species has many times been confused with Sclerotinia

fructigena, in fact, many of the descriptions given the one could apply equally well to either. Saccardo, in 1886, recognized monilia cinerea while Schröter transferred it to Sclerotinia along with Sclerotinia fructigena. Woronin, in his study published in 1900, established beyond a doubt that the two species are distinct. This opinion is held by Soraner. From 1889 until the present date many articles have appeared in American literature dealing with a fungus found throughout the fruit districts on stone fruits, and in a few cases on pome fruits. This fungus has been referred to in this country by most writers as Sclerotinia fructigena or monilia fructigena. Among the earlier of such writers may be mentioned: Smith, F.E; Goessman, C.A.; Holsted, B.D.; Chester, F.D.; Humphre; Underwood, L.M. and Earle F.S.; Quantance, H. L.; Clinton, C.P. and Norton, J.B.S. Norton was the first to find the ascogenous stage of the fungus. In 1902 he described Apothicia found on mummied peaches and plums as Sclerotinia fructigena. In a recent correspondence with Professor Norton, however, he has stated that the fungus referred to by him in 1902 was unquestionably Sclerotinia cinerea.

Among the more recent American writers may be mentioned: Gussow, H.T.; Jahle, R.A., and Matheny, W.A.

Jahle published in 1913 an extended study of peach cankers in New York, which cankers he proved to be caused by the common brown rot fungus. He called his fungus Sclerotinia

fructigena, but in the latter part of his paper he states that he has compared it with Sclerotinia cinerea and Sclerotinia fructigena from Europe and is of the opinion that the fungus which he has worked with is Sclerotinia cinerea.

Matheny, in a comparative study of the American Brown Rot Fungus, the European Sclerotinia cinerea, and S. fructigena, published in 1913, gave strong evidence that the Brown Rot fungus commonly referred to in America as Sclerotinia fructigena or monilia fructigena, agrees in general characteristics with Sclerotinia cinerea, and is markedly different from Sclerotinia fructigena.

The present writer has compared Matheny's description with those of European writers and is convinced that Matheny has made the proper classification of the common American Sclerotinia of stone fruits.

Sclerotinia Laxa (wallr.) Sacc.

Sources of Material for the Present Investigation.

Letters requesting pure cultures and infected host tissue of Sclerotinia fructigena, Sclerotinia cinerea, and Sclerotinia Laxa were sent to various parts of Europe. Requests were also sent to different State Experiment Stations in the United States for pure cultures and infected host tissue of their local species of monilia or Sclerotinia on drupaceous and pomaceous hosts.

Pure cultures and infected host tissues were received as follows:

E.A. Salmon, Wye, Eng.--Pure cultures of Sclerotinia fructigena isolated from rotted plum and cherry fruits; Sclerotinia fructigena mummied plums, cherries, apples, and pears; Sclerotinia fructigena blighted apple spur.

G.H. Godfrey, Dept. Ag., Washington, D. C.--pure cultures of monilia isolated from infected peach in Arkansas.

G.W. Keitt, University of Wisconsin, Madison, Wis.--pure cultures isolated from tufts of monilia spores on a Wolf River apple at Madison, Wisconsin; pure culture isolated from monilia spores on a rotted Montmorency cherry, Madison, Wisconsin; pure cultures isolated from Apothecia on a peach mummy at Hort, Mich.; pure culture isolated from apothicia on mummied plum at Madison, Wisconsin.

J.B.S. Norton, State Experiment Station, College Park, Maryland--Dried apothecia on peach mummy; blighted plum

blossoms and cankered branches of plum.

Pure cultures of monilias isolated at the Oregon Station were turned over to the present investigator as follows:

H.P.Barss, State Experiment Station, Corvallis, Oregon--November 11th, 1913, pure cultures of a monilia isolated from branch tissue of peach plum (B 558) from British Columbia June 14, 1913; a monilia isolated from twig and spur tissue of prune (B 559) from Estacada, Oregon, June 15, 1913. A monilia isolated from branch tissue of apricot from Albany, Oregon, May 5th, 1913.

F.D.Bailey, State Experiment Station, Corvallis, Oregon-a monilia isolated from pear branch and spur tissue from Halsey, Oregon, June 9th, 1913 (B 545); a monilia isolated from cherry fruit tissue from Corvallis, Oregon, June 26, 1913 (B 571); a sclerotinia isolated from apothecia on peach from vicinity of Corvallis, April 4, 1913 (B 496).

Since the beginning of the present investigation in September, 1913, material has been collected in Oregon as follows: In the fall of 1913 and winter of 1914 many orchards in the neighborhood of Corvallis were inspected and many monilia rotted prunes, peaches, and apples, and mummied prunes, peaches and cherries were collected by the writer. Professor H. S. Jackson also collected a monilia rotted pear at Halsey, Oregon, which he turned over to the present investigator.

During the spring of 1914 specimens collected on field trips by Mr. F.D. Bailey and the writer, as well as many specimens sent to the laboratory for identification, were fruitful in supplying for study monilia blighted blossoms, twigs and spurs of plum, prune, cherry, and pear, and apothecia on mummied prunes, peaches and cherries.

During the summer of 1914 the writer collected monilia fruit rot of plum, prune, cherry, and peach from various points in the state.

In the winter of 1915 monilia blighted twigs and spurs, and cankered branches of peach, plum, prune, and cherry, were collected near Granger, Oregon.

During the spring of 1915 material was collected by the writer as follows: twig and spur blight, and branch cankers on apricot, peach, plum, cherry and pear; mummied fruits hanging on trees of peach, prune, plum, cherry and quince; Apothecia on mummied prunes, plums, peaches, cherries, apricots, pears and apples; fresh blossom blight on apricot, peach, prune, plum, cherry and pear.

Preliminary Classification of Material

The various monilia specimens collected were recorded in the regular department accession list. Pure cultures were isolated in each case. All of the strains were first grown on potato dextrose. From a microscopic examination of the growths on this medium a temporary division into three groups

was made as follows:

Type I:--Aerial mycelium very fine, snow white, later collapsing and sometimes taking on a greenish tint; submerged growth (below the surface), usually muddy brown to greenish black; margin of the aerial and submerged growth irregularly fringed, conidia very few. Sclerotia when formed usually not in a solid sheet, but in separate black patches varying in size and shape.

Type II:--Aerial mycelium, thin, white, soon replaced by ash-gray or brown spores tufts; spore tufts produced in abundance in concentric zones. The conidial chains not densely packed together but present a loose granular appearance. Margin of growth very regular. Sclerotia black, regular, covering whole field.

Type III:--(Sclerotinia fructigena):--Aerial mycelium woolly, white at first, later ochraceous-yellow; conidia in most cases few, produced on tufts of upstanding yellowish hyphae. Margin of growth regular to irregular. Sclerotial layer very dense black, covering whole field, later taking on an unevenness of surface.

The following table is arranged to show the various strains collected, arranged in accordance, first--with their respective types, and second--with their respective primary hosts. The date and locality of collection and location of fungus on host are also included in this tabulation.

Table Showing Material Collected

Accession number	Date of collection	Locality	Host	Location on Host
Type I				
B545	6/9/13	Halsey, Ore.	Pear	Branches and spurs, tissue
B906	5/5/14	Salem, "	"	Branch tissue
C329	3/28/15	Halsey, "	"	Branch and spurs, spores
C356	4/5/15	Corvallis"	"	Same as Above
C416	4/27/15	Looking Glass"	"	"
C425	5/1/15	Corvallis"	"	Branch and spur and Bl. spores and tissue
C351	4/5/15	Corvallis"	Quince	Spores on mummy
B527	5/5/13	Albany, "	"	Branch tissue
C298	2/22/15	Granger, "	Apricot	Branches & spurs, spores
C308	3/21/15	" "	"	"
C350	4/6/15	Portland,"	"	"
C399	4/18/15	"	"	"
B839	3/26/14	Springbrook,	Cherry	Spores on dead branches
B899	5/10/14	" "	"	Branch tissue
B902C	"	" "	"	"
B930	"	Woodburn, "	"	"
C253	2/4/15	Corvallis"	"	Spores on dead spurs
C310	3/21/15	" "	"	Spores on dead leaf
C369	4/8/15	" "	"	Spores on dead blossoms
C393	4/16/15	" "	"	"
C401	4/21/15	" "	"	"
C407	4/23/15	" "	"	"
C414	4/27/15	" "	"	"
C426	5/2/15	" "	"	"
B558	6/6/13	Mission, B.C.	City Plum & Prune	Branch tissue
B559	"	Estacada, Ore.	"	"
B838	3/26/14	Springbrook"	"	Spores on branch
B894	3/8/14	B.C.	"	Branch tissue
B895	"	" "	"	"
B900	1/10/14	Springbrook"	"	"
B901	"	Dundee, "	"	"
B903	"	Newberg, "	"	"
C39	7/15/14	Myrtle Creek"	"	Fruit tissue
C252	2/14/15	Corvallis "	"	Spores on branch canker
C288	3/15/15	Springbrook"	"	"
C290	3/19/15	Albany, "	"	Spores on mummy
C299	"	Springbrook"	"	Spores on branch
C315	3/24/15	" "	"	"
C316	"	" "	"	"

Table Cont'd

C327A	3/28/15	Halsey, Ore.	Plum & Prune	Spores on surface mummy.
C330	"	" "	"	Spores on branch
C366	4/8/15	Corvallis,"	"	"
C394	4/27/15	Looking Glass"	"	Spores on blossoms
C394	6/16/15	Corvallis,"	"	"
C174	1/20/15	" "	Peach	Branch tissue
C178	1/26/15	Granger, "	"	Spores on branch
C301	3/21/15	" "	"	Spores on mummy
C302	"	" "	"	Spores on branch
C355	4/5/15	Corvallis "	"	"
C372	4/10/15	Springbrook	"	"
Type II				
B631	9/6/13	Corvallis,"	Apple	Fruit tissue
B797	2/9/14	" "	"	"
C332	3/28/15	Halsey, "	"	Apothecia
C346	4/2/15	Corvallis,"	"	"
C357	4/7/15	Madison, Wis.	"	Spores on fruit
B633	10/10/13	Halsey, Ore.	Pear	"
C331	3/28/15	" "	"	Apothecia
B798	2/9/14	Corvallis,"	Quince	Tissue of fruit
C299	3/21/15	Granger, "	Apricot	Apothecia
B640	10/17/13	Corvallis,"	Cherry	Spores on fruit
B831	3/15/14	" "	"	Apothecia
B877	4/4/14	Salem, "	Cherry	Spores on blossoms
B902C1	5/10/15	Springbrook"	"	"
B955	7/13/14	Vancouver, B.C.	"	Spores on fruit
C309	3/23/15	Corvallis, Ore	"	Apothecia
C317	3/24/15	Springbrook"	"	"
C319	3/23/15	Corvallis, "	"	"
C359	4/7/15	Madison, Wis.	"	Spores on fruit
C373	4/12/15	Salem, Ore.	"	Spores on blossoms
C405	4/23/15	Eugene, "	"	"
C407	"	Corvallis, "	"	"
C409	"	" "	"	"
B641	9/13/13	Portland market	Plum & Prune	Spores on fruit
B874	4/8/14	Corvallis, Ore.	"	Spores on blossoms
B876	3/30/14	Riddle,	"	"
B893	3/12/14	Corvallis	"	Apothecia
B918	6/9/14	Riddle	"	Spores on fruit
B919	"	" "	"	"
B920	"	Myrtle Creek"	"	"
B921	"	" "	"	"
B922	"	" "	"	"

Table cont'd

B931	5/22/14	Riddle, Ore.	Plum & Prune	Spores on fruit
B932	"	" "	"	"
B933	9/18/14	Corvallis,"	"	"
C35	9/20/15	Newberg "	"	Dried prune
C80	12/3/14	Mass.Agr.Col.	"	Prune fruit
C275	3/2/15	Corvallis,Ore.	"	Spores on mummy
C305	3/20/15	" "	"	Apothecia
C313	"	" "	"	"
C314	"	Salem "	"	"
C318	"	Corvallis,"	"	"
C394	4/16/15	" "	"	Spores on blossoms
C404	4/23/15	" "	"	"
C406	"	" "	"	"
C360	4/7/15	Wis.	"	Apothecia
C353	4/5/15	Corvallis,Ore	"	"
C327A	3/28/15	Halsey, "	"	Spores on mummy
B634	9/8/13	Corvallis,"	Peach	Spores on fruit
B973	3/12/14	" "	"	Apothecia
B923	6/10/14	Myrtle Creek	"	Spores on fruit
C187	9/15/14	Corvallis,"	"	"
C251	2/12/15	" "	"	Spores on mummy
C278	3/4/15	Bentonville,Ark.	"	Spores on fruit
C300	3/21/15	Granger, Ore.	"	Apothecia
C307	"	" "	"	Chlamydospores on mummy
C358	4/7/15	Madison,Wis.	"	Apothecia
C363	4/3/15	Corvallis,Ore.	"	"
Type III				
C149	7/5/14	Wye,Eng.	Apple	Rotten fruit tissue
C148	"	"	Pear	"
C150	"	"	Cherry	"
C151	"	"	Plum	"

Study of the Three Types

The preliminary working over of the strains of fungi at hand showed that there existed a wide difference in cultural appearance between the strains which were commonly found causing fruit rot of drupaceous hosts and those frequently found causing twig blight and branch canker of both pomaceous and drupaceous hosts.

A series of experiments were outlined to compare these two apparently different types of monilia with each other and with various monilia fungi secured from other parts of the world.

Comparative studies were made of these types by growing them on: green apples, plums and pears; on ripe plums and apples; on fruit tree blossoms in the orchard; on tree tissue in the orchard, and on artificially prepared sterile media.

Study of Growth on Fruit

"Green Apples"

Green apples, one-third grown, were gathered from Yellow Newtown trees in the college orchard. Care was taken to keep the fruits as free from blemishes as possible. They were brought into the laboratory, washed in $HgCl_2$ solution (1-1000), placed on a table which had been scrubbed with the same solution, and allowed to dry.

On one cheek a circle was made with a blue wax pencil, and on the other a cross was made. A glover's needle was flamed, allowed to cool, and then a puncture was made with it in the center of the circle and at the intersection of the lines of the cross. In the former there were placed, by means of sterile platinum needles, small bits of mycelium or spores from pure cultures of the fungus which was to be studied. The puncture in the cross was left as a check. There were as many checks as inoculations. Therefore, it was not deemed necessary to seal the wounds in order to assure a correct knowledge of the probability of other organisms entering.

After an inoculation had been made, as just described, the fruit was placed into a box which had been subjected to fumes of formaldehyde for several hours and had afterwards been well aired. Moist fiber paper was placed over the fruits, the box cover placed on, and the boxes placed under out-of-door conditions. The papers were kept moist until decay had begun to spread about the points of inoculation.

At the time these inoculations were made it was not possible to obtain individual boxes for each set of inoculations. The boxes at hand were card-board boxes about 15 x 10 x 3 inches in dimensions. These were divided into four compartments by placing card-board strips crosswise at uniform

intervals.

Twenty strains of monilia were used in this test--Eight representing Type I and twelve representing Type II.

Eighteen fruits were inoculated with each strain. They were placed in the boxes in accordance with the "2-1 offset" style of packing apples. In all cases they were so arranged as to have the inoculated sides facing each other and the checks likewise. A sample box of inoculated fruits in this test is shown in Fig. 1, Plate I.

Ten days after the inoculations were made on the fruits the following readings were made: Type I rotted and turned the fruit brown and a thick white mycelial mat developed on the surface. Type II rotted and turned the fruits a darker brown and produced an abundance of light brown spore tufts all over the surfaces.

These decayed fruits, after remaining in the laboratory for several months, turned dark brown to black. Type I became very hard and much wrinkled. The white mat had changed into a hard brown mass of resting spores. There was a thin, black, scleratial layer just beneath the epidermis. The fruit tissue inside of this layer was not entirely destroyed but remained as dry corky, brown mass, making the whole mummy hard and solid.

The surface of Type II was not finely wrinkled as above. It was of a deeper black color and the wrinkles

were fewer and larger. The fruit tissue inside was entirely destroyed. A black sclerotial layer was formed just beneath the epidermis. Inside of this layer was an empty space, while enclosing the core was a thick, irregular, sclerotial mass which did not, however, enter the seed cavities. Fig. 1, Plate I, shows a much reduced photograph of apples inoculated with (B 902 C) and (B 902 C 1), cherry monitors of type I and II respectively. This growth is ten days old--note the white rust on Type I and the scattered sporodoclina on Type II.

The fungi used in this experiment were as follows: Type I--B 906 (pear), B 527 (apricot, B 902 C, B 899, B 839 (cherry), B 838, B 559, B 558 (prune). Type II--B 797 (apple), B 633 (Pear), B 798 (quince), B 640, B 877, B 902 C i (cherry), B 641, B 876, B 893, B 931 (prune), B 634, B 873 (peach).

"Green Pear"

Green pears about one-third grown were gathered from trees in the Meeker orchard. They were brought into the laboratory, washed in a 1-1000 % solution of $HgCl_2$, and allowed to dry on a table which had also been washed with the $HgCl_2$ solution. Inoculations were made with the organisms mentioned below after the same manner as used in inoculating the green apples.

The inoculated fruits were placed in wooden propogating trays, such as are used for starting seedlings in green-houses.

These trays were about 18 x 11 x 3 inches in dimentions. They were divided into four equal compartments by placing boards in crosswise of the trays. Cotton was placed on the bottom to hold the fruits in place. The whole tray and contents was sprayed with formaldehyde solution and allowed to dry before putting the fruits in. From twelve to thirty fruits were inoculated with each strain of fungus used. They were placed in the trays like the bottom layer of a 2-1 offset apple pack with the calyx ends down and they received the same subsequent treatment as was given the apples, as described in previous pages.

The following fungi were used for these inoculations: Type I-B 906 (Pear), B 527 (apricot), B 839, B 899 (cherry) B 558, B 559, B 838, prune. Type II-B 797, (apple), B 633 (pear), B 798 (quince), B 640, B 831, B 877, B 902 C1 (cherry), B 641, B 876, B 893, B 931 (prune), B 634, B 873 (peach).

Ten days after inoculations were made the fruits were decayed. Both types turned brown. Type II became darker brown than Type I. Type I produced a vigorous growth of white mycelium on the surface. This growth first appeared in large pustules and later the pustules spread into a solid white mat of mycelium. Type II produced ash-gray to brown sporodoclia on the surface. Figs. 1, Pl. I, and Pl. II, show natural size pictures of pears inoculated with the separate types ten days after the inoculations were made.

After the infected fruits had remained in the laboratory for several months the following readings were made:

Type I: There was very little or no sclerotium formation. When there was any noticable sclerotium it was a thin layer just under the surface. The interior of the mummy was very corky, breaking up into a dry chaffy substance when cut with a knife. Type II: The whole fruit was transformed into a hard, black, sclerotial mass. The epidermis was not attached firmly to this fungus mass and peeled off very easily, having a solid mass of fungus. The seeds remained unattached on the inside of these mummies.

"Green Plums"

Green plums were gathered from trees in the college orchard. They were brought into the laboratory, washed in a 1-1000 solution of $HgCl_2$, and placed on a table, the surface of which had been scrubbed with some of the same solution of mercury. Subsequent inoculations were made exactly after the methods used with the apples as given previously. Conditions were kept as near like those used in test with green apples as possible.

The following fungi were used for these inoculations: Type I-B 906 (pear), B 527 (apricot), B 839, B 902 C (cherry), B 558, B 559, B 838 (plum and prune). Type II--B 797 (apple), B 633 (pear), B 798 (quince), B 640, B 831, B 902 C 1 (cherry), B 641, B 893

(prune), B 634, B 873 (peach).

Ten days after inoculations were made the following readings were taken: Type I--entire fruits badly decayed. A thick, white mat was developed on surface, much like that on the pears caused by the same type. Type II--entire fruits had decayed and ash-gray to brown sporodochia were produced on the surfaces.

After the fruits had remained in the laboratory for several months, the following readings were taken:

Type I--Infected fruits were changed into dark blue mummies with a hard, whitish-yellow to mouse-gray mat composed mostly of resting spores. Under this was an irregular sclerotial formation. The tissue of the fruits had entirely collapsed and when the sclerotial mass hardened it adhered closely to the pit. These mummies presented a finely wrinkled surface. Type II presented a surface less wrinkled than that of Type I. A few brown tufts of resting spores were scattered over the surfaces. The entire fruit tissues were transformed into thick, hard layers of sclerotium. This layer appeared black on the surface and dark brown in cross-section. Unlike the sclerotia in type in that they do not adhere tightly to the pit.

"Ripe Bradshaw Plums"

The fruits were brought into the laboratory and handled in the same manner as were the green plums. One hundred fifty-nine fruits were inoculated with the following fungi of Type I: B 906

(pear), B 839, B 899, B 902 (cherry), B 558, B 559, B 838, B 894, B 895 (plum and prune). Ninety-seven fruits were inoculated with the following fungi of Type II: B 633 (pear), B 640, B 831, B 902 C 1 (cherry), B 641, B 893 (prune).

The characters of growth during the various stages, so far as noted, were identical with those on the green fruits.

"Ripe Apples"

In the spring of 1915 inoculations were made with pure cultures of representatives of each of the two types used before, as well as with strains of Sclerotinia fructigena (Type III) on ripe Yellow Newtown apples. At this time the organisms had been studied extensively on agar media, corn meal, sterile carrot plugs, and sterile pear stems. It had been observed that many points of differences between the types had remained distinct. Both Sclerotinia fructigena and Sclerotinia cinerea were studied on apple fruits by Matheny. It was, therefore, thought advisable to grow all three types of the fungi under observation on this medium and compare growths with results obtained by former investigator.

A box of Yellow Newtown apples were purchased from a retail dealer in Corvallis, Oregon. The apples were examined separately and all bruised ones were discarded. The sound fruits were then washed in a 1-1000 solution of $HgCl_2$, placed on a clean table and allowed to dry. Inoculations were made

by the same method used for the green apples described previously. Nine fruits were inoculated with each strain of fungus used. The inoculated fruits were placed in clean, wooden trays which had been subjected to fumes of formaldehyde for several hours and then had been thoroughly aired. Each tray was divided into two compartments by placing in cross partitions at the center.

Moist paper was placed over the tops of the trays and they were then placed on a platform outside of a second story window on the north side of the laboratory. Daily observations were made on the fruits and the progress and appearance of the fungi noted.

Fifty-four fruits were inoculated with the following strains of Type I: B 545, B 906, (Pear), B 902 c (cherry), B 838 (prune), C 178 (peach).

Eighteen fruits were inoculated with the following strains of Type II: B 633 (pear, B 641 (prune).

Thirty-six fruits were inoculated with the following strains of Type III: C 149 (apple), C 148 (pear), C 150 (cherry), C 151 (plum).

When the final notes were taken on these fruits the fruits were not mummified. Observations, so far as have been made, are summarized as follows: Type I--A very light brown decay developed about the point of inoculation. The margin of discoloration was

not marked by a definite line as was the case in Type II. The fruits remained light brown, tough and leathery. In some cases there was a blackening of the skin about the point of inoculation. Very small mouse-gray sporodochia appeared scatteringly on the surfaces. In several cases the surfaces were much sunken in places.

Type II--A light brown decay spread symmetrically about the point of inoculation. The margin of decay was marked by a distinct line. The brown color gradually darkened until it became black. Brown sporodochia were sparingly scattered over the surface. The texture was very soft and the surface was becoming finely wrinkled.

Type III--A brown decay developed about the point of inoculation until the whole fruit was rotted. The margin of decay was more regular than in Type I, but not as regular as that of Type II. The brown color became reddish in places. The inner part of the fruit became soft and then the surface became finely wrinkled. Some fruits were shrunken to one-third their normal size. Large, ochraceous sporodochia were developed on the surfaces from thick mats of mycelium which formed under the skin.

"Blossom Inoculation"

By Spraying Blossoms with Water Suspension of Spore, 1914.

March 26, 1914: Blossom infection was attempted by spraying peach and cherry blossoms with water containing a suspension

of spores of the several organisms given below. The organisms B 496, B 634, B 640, and B 831 (of Type II) produced an abundance of conidia spores when pure cultures were grown on potato Dex Agar. This was a convenient method of securing spores at this particular time of the year, therefore, spores from such pure cultures were used in making spores suspensions for spraying. B 838 and B 839 (of Type I) do not produce spores very abundantly on potato dextrose agar, and no other artificial substratum had been used for growing pure cultures of these organisms as at that time spores were taken from sporodochia on the surface of blighted branches.

In each case spores from cultures to be used were also placed in hanging drops in Von Tügharn cells and observed to determine their relative viability. Spores were noted to give a high per cent of germination in every case.

Thirty-cubic-centimeter vials were filled with tap water, sterilized in an autoclave for twenty minutes under fifteen pounds pressure, allowed to cool and spores of the several organizms were transferred to separate vials by means of sterile platinum needles.

A drop of the water containing the spore was examined under microscope. More spores were added in each case until such a microscopic examination showed a field thickly dotted with spores.

The solution was then poured into a sterile atomizer and sprayed on blossom clusters. After spraying the blossom clusters a paper bag was placed over the small branch to prevent other organisms from attacking the blossoms. None of the inoculations on peach blossoms seemed to give positive results.

Both types of organisms on cherry produced blighted blossoms. Re-isolations from such blighted blossoms gave the same organisms as were inoculated within each. The fungus did not apparently extend into the wood tissue of the tree.

"Blossom Inoculated in Orchard"

By Spraying Blossoms with Water Suspension of Spores, 1915.

In the spring of 1915 blossoms of pears and cherries were inoculated by spraying blossoms in the orchard with a water suspension of viable spores. The work was done just as the blossom inoculation work described for 1914. The following organisms of Type I were used: C 329, C 348 (pear), C 298 (apricot), C 343 (cherry), C 330 (plum), C 301 (peach). From three to eight inoculations were made on large limbs of both pear and cherry trees with each of the above organisms. C 329 produced one infection on cherry blossoms. The organism was re-isolated and found to agree with an original pure culture. None of the inoculations on pear appeared to produce infections. (NOTE: A severe attack of blister mite and venturia scab were made on most of the pear

trees and they did not set fruit on the un-inoculated branches. The cherries used were of the sweet varieties.)

Blossoms Inoculated by Placing Viable Spored on Stigmas and Nectaries, 1915.

In the spring of 1915 blossom inoculations were made by placing spores from sporodochia found on the surface of branches of both drupaceous and pomaceous on the stigmas of pear and cherry blossoms, and also at the base of the styles. The object in view was to determine the point of attack on the blossoms.

Germination tests were also conducted by placing spores in hanging drops in Von Tüghem cells. In each case high percents of germination were noted with organisms used in these inoculations. The following table is arranged to show: the primary hosts, the laboratory accession numbers of the fungi used, date of inoculation, number of inoculations, number of checks used, the host upon which inoculated, point of host where inoculation is made and results of inoculations.

The following fungi were in this test: Type I--C 356 (pear), C 178, C 301 (peach). Type II--B 831, B 955 (cherry), B 641 (prune), B 634 (peach).

Type I (C 178) produced blighted blossoms and produced cankers on three small branches.

Type II (B 831, B 955) produced blossom blight. One small canker was produced.

The cankered branches and blighted blossoms apparently resulting from blossom inoculations were brought in to the laboratory. Attempts were made to re-isolate the respective organisms from the dead tissue apparently resulting from blossom infection.

B 831: May 10, 1915. Plates were poured with potato dextrose agar. Seven plantings of the spores from the surface of the blossoms of B 831 were made. At the same time a plate of the same medium was planted with the original culture of B 831. After four days' growth the plates were examined. All plantings grew vigorously. The seven plantings from spores on the B 831 blighted blossoms were identical in appearance with the seven plantings of the original strain of B 831.

B 955: May 10, 1915. Plates were poured with the same medium used above. Seven plantings from spores on the surface of the blossoms apparently blighted by B 955, and seven plantings from the tissue in the canker area, were made. At the same time seven plantings were made on the same medium with spores in a pure culture of the original strain of B 955. After four days' growth the plates were examined. All plantings grew vigorously. The growths from both the tissue planting and the spore plantings gave growth identical with the original strain B 955.

C 178: May 10, 1915. Plates were poured with the same medium used above. Seven plantings from spores on the surface of the blossoms apparently blighted by C 178, and seven plantings from the tissue in the cankered area, were made. At the same time, seven plantings were made on the same medium with spores from a pure culture of the original strain of C 178. After four days' growth the plates were examined. All plantings grew vigorously. The growths from both the tissue and spore plantings were identical with each other and with the growth from the pure culture of the original strain of C 178.

This blossom inoculation test may be summarized as follows: Blossom infection does occur by spores coming in contact with the floral parts. Type I and Type II are capable of producing blossom blight on peach, and branch infection develops from infected blossoms.

Growth on Sterile Artificial Culture.

Representative strains of the three types of fungi were grown on sterile artificial substrata under laboratory conditions. Observations were made at different periods of growth on these media, and from a comparison of such observations a summary of the results on the several media is made.

The artificial substrata employed were prepared as follows:

Potato dextrose agar (M 166): Potatoes were peeled, six hundred grams weighed out, sliced very thin, washed in tap water, put in aluminium kettle with fifteen hundred cubic centimeters of tap water, allowed to cook slowly for fifteen minutes, and the juice decanted off. Sixty grams of string agar agar (purchased of Brush & Tomb.) were melted in thirteen hundred cubic centimeters of tap water. Sixty grams of dextrose (pure) was dissolved in two hundred cubic centimeters of tap water. All three of the solutions were poured together and boiled on hot plate fifteen minutes. They were kept stirred while boiling, made up to three liters by adding hot tap water, strained through cotton twice, poured--one hundred cubic centimeters in each of a number of two-hundred-fifty-cubic-centimeter glass flasks. Cotton stoppers were then placed in the flasks and the flasks placed in the autoclave and kept under steam pressure of fifteen pounds for fifteen minutes. Mixture was then removed from autoclave and slanted.

Oat agar (M 167): Two hundred grams of oat grains were crushed by rubbing between two pig-iron bricks. The crushed grain was placed in a double boiler, two liters of tap water added and allowed to boil slowly for one hour. The dicoction was strained through a coarse wire net. Forty grams of powdered agar (purchased of Baush and Lomb.) was added. It was then cooked in a double boiler for one hour and afterward poured into a number of 250 cc. glass flasks, 100 cc. into each. Cotton stoppers were placed

in the flasks and they were sterilized in autoclave for thirty minutes under a pressure of fifteen pounds.

Prune agar (M 174): Twenty dried Italian Prunes were boiled for thirty minutes in two liters of tap water, the juice decanted off and added to forty grams of string agar agar (purchased of Baush & Lomb.). This was boiled on hot plate forty minutes, strained twice through cotton and then one hundred cubic centimeters of it was poured into each of a number of 250 cc. flasks. The flasks were plugged with cotton stoppers, placed in the autoclave under a pressure of fifteen pounds for twenty minutes. It was then removed from sutoclave, slanted, and allowed to cool.

Corn meal (M 175): Sixty grams of corn meal were placed in each of many 500 cc. flasks, one hundred sixty centimeters of tap water added to each and each plugged with cotton and placed in autoclave for thirty minutes under a pressure of fifteen pounds.

Carrot plugs (M 186): Carrots were peeled, cut into rod shaped strips two and one-half by one-quarter inches, and placed in test tubes. A small piece of cotton was placed in the bottom of the tube before putting the plug in, and enough tap water was added to saturate it well. The tubes were plugged with cotton sterilized in an Arnold Sterilizer intermittently for three days.

Apple plugs (M 187): Cylindrical strips, two inches by one-fourth of an inch, were cut from ripe Yellow Newtown apples,

placed in test-tubes on small balls of cotton, enough tap water added to saturate cotton, tubes plugged with dry cotton, sterilized in Arnold Sterilizer for three days.

Pear stems (M 188): Healthy pear branches of last year's growth were brought in, cut in pieces two and one-half inches long, placed in test-tubes on small balls of cotton, enough water added to saturate cotton. Tubes were then plugged with dry cotton, placed in Arnold Sterilizer and subjected intermittently to sterilization for three days.

Apple agar (M 185): Two well ripened Baldwin apples were mashed up in one liter of tap water, cooked on hot plate slowly for one hour, melted sixty grams string agar (purchased from Baush and Lomb.) in two liters of tap water. Poured both together, cooked thirty minutes on hot plate, poured one hundred cubic centimeters in each of a number of 250 cc. flasks and then corked flask with cotton. Then sterilized for twenty minutes at fifteen pounds pressure in autoclave, slanted and allowed to cool.

Potato Dextrose Agar

Pure cultures were grown on potato dextrose agar (M 163). Transfers were made from this medium to M 166 on December 29, 1914. The following table is arranged to show: Type of fungus, its primary host, its laboratory accession number, the medium trans-

ferred from, the medium transferred to, the age of growth where final reading is made, and notes on growth.

Primary host	Accession number	Age of growth	Notes on Growth
		days	
Type I			
Pear	B 906	135	13 days gave a woolly whitish mat composed of fine white mycelial threads. 135 days' growth gave a thick, collapsed cottony mat on surface with black sclerotia 1 mm. to 3 cm. in diameter showing through.
Cherry	B 902 C	"	Same as above but mycelium not as abundant and presented a greenish tint; a few green conidia tufts were dotted over the surface. Sclerotia smaller and less definite.
Prune	B 838	"	Sclerotia smaller and less definite
Type II			
Pear	B 633	"	13 days growth gave a series of zones of grayish-brown conidia. These were very thick and produced a loose granular appearance on the surface. In some cases the zones appeared slightly greenish. 135 days' growth gave a thick mat of sclerotia from 1-3 mm. thick. The top surface was irregularly marked with a few large wrinkles. There was a soft greenish covering where there were no conidia. On this felty surface globules of amber-brown gonidia were present. Most of the surface was covered with brown conidial masses which had at this time become flattened down.
Cherry	640	"	All same as B 633. Some varied as to zonation of spores and production of gonidia.
"	B 902c1	"	
Prune	B 641	"	
"	B 893	"	
Type III			
Pear	C 148		13 days' growth gave a very thick white mat with a greenish tint. There were a few acherous-yellow upstanding conidial tufts with rounded top. 135 days' growth gave a thick sclerotial mat 1-3 mm. in diameter with a
Plum	C 151		

Potato Dextrose Agar Table cont'd.

	with a thickly wrinkled surface. There was a thin film of somewhat collapsed yellowish mycelium on the surface.

Oat Agar

Pure cultures were grown on potato dextrose agar (M 163). Transfers were made from this medium to M 167 on December 29, 1914. The following table is arranged to show: Type of fungus, its primary host, its laboratory accession number, the medium from which transferred, the medium to which transferred, the age of growth when final reading is made, and notes on growth.

Primary host	Accession number	Age of growth	Notes on Growth
		Days	
Type I			
Pear	B 906	135	(13 days' growth gave an irregular growth. (There were three colors of growth on the surface, namely: thick greenish tufts of conidia; (brownish-green erect conidiaphores, and white (mycelia growth. 135 days' growth gave a field (rather thickly set with sclerotial masses 2-4 (mm. thick and 5-35 mm. in diameter. These (sclerotia were very irregular in shape. From (the surface of some of the sclerotia drops of (gonidia ooze were present and in some cases (these were confluent. Some gonidial ooze (was present on the surface of the agar where (there were no sclerotia. The ooze was of a (light brown color. (Ridgway).
Cherry	B 902	"	
Prune	B 838	"	
Type II			
Pear	B 633	"	(13 days' growth gave a field completely covered with brown to ash-gray sporodochia. (These were much the same as on potato dextrose (agar. Zones were present in part of the field. (Substratum under fungus growth showed greenish (dark discoloration. 135 days' growth gave a (field covered almost entirely with gonidial (ooze. Most of the thick masses of conidia (had disappeared at this time. There were distinct sclerotia formed in the greater portion (of the field. Sclerotia, where formed, not (dense, thin--about 1 mm. thick.

Oat Agar Table cont'd.

Cherry	B 640	135)	(Same as B 633. The sclerotium formation
Cherry	B 902 C 1	")	(varied from no definite layer to well-formed
Prune	B 641	")	(thin sclerotial layers. In one case there
Prune	B 893	")	(were very few gonidia produced, but the (surface was colored with white mycelium.
Type III			
Pear	C 148	")	C 148, 13 days' growth gave a field cov-
Plum	C 151	")	ered a radiate growth from the central planting. There were several concentric convex rings formed on the surface of the substratum and composed of closely compacted conidiophores and conidia having in mass a warm-buff (Ridgway) to ochraceous yellow color. The portion between these zones was almost destitute of aerial mycelium. 135 days' growth gave the same general appearance except that the rings had flattened or collapsed somewhat and gonidial ooze was present in irregular droplets on part of the surface,--The whole surface underlayed with a greenish to dark brown sclerotial layer which extends just beneath the whole surface. C 151 is same as 148.

Prune Agar

Pure cultures of the organisms to be tested were grown on oat agar No.167. Transfers were made to prune agar M 174 on January 1st, 1915. The following table is arranged to show: Type of fungus, its primary host, its laboratory accession number, the medium from which transferred, the medium to which transferred, the age of growth when final reading is made, and notes on growth.

Primary host	Accession number	Age of growth	Notes on Growth
		days	
Type I			
Pear	B 906	135	(13 days' growth gave a field covered with (irregular mycelium growths. The growth in the (center was white while that along outer (margin was more or less translucent. 135 (days' growth gave a thick irregular mat (varying from black to gray in color. The (growth was set deep into the substratum, (5 mm. in places. In some portions of the (field a black sclerotial layer was formed (1-2 mm. thick. In other portions of the field (the submerged mycelium did not darken up but (remained translucent to muddy with brown to (blackish splotches.
Cherry	B 902C	"	(Same as B 906 but not as regular in appear-
Prune	B 838	"	(ance of surface. Gonidia present in drop- (lets about on the surface.
Type II			
Pear	B 633		(13 days' growth gave a field with its sur- (face scatteringly set with brown sporodochia. (The substratum was discolored black to dark (brown. 135 days' growth gave a field covered (with small drops of ooze. The substratum was (colored dark brown to black 1-4 mm. deep. (This discoloration was not a dense sclerotial (layer but seemed to be composed of roundish (brown specks about size of a pin head.
Cherry	B 640	"	(All were like B 633, except conidial tufts
Cherry	B902C1	"	(were present in greater abundance and in
Prune	B 641	"	(B902C1 the whole field was distinctly zoned.
Prune	B 893	"	(
Type III			
Pear	C 148	"	(C 148. 13 days' growth presented a field
Plum	C 151	"	(covered with whitish mycelium. This mycelial (layer was very fine and thin. 135 days' (growth the field was covered with a layer (1-4mm. thick of black sclerotia. This scler- (otial layer was much wrinkled and covered with (thin weft of mycelium which gave the surface a (grayish cast. C 151 was same but was uniformally (covered with a fine reddish-brown to greenish (mycelial weft.

Apple Agar

Pure cultures were grown on corn meal medium (M 175). Transfers were made to sterile apple plugs (M 185) on Jan. 1, 1915. The following table is arranged to show: Type of fungus, its primary host, its laboratory accession number, the medium from which transferred, the medium to which transferred, age of growth when last reading is made, and notes on growth.

Primary host	Accession number	Age of growth	Notes on Growth
		days	
Type I			
Pear	B 906	135	(13 days' growth same as on prune agar (M 174).
Cherry	B902C	"	(135 days' growth same as on prune agar
Prune	B 838	"	((M 175) except B 906 is much denser and (shows more discoloration in substratum.
Type II			
Pear	B 633	"	(Practically same as on M 174 prune agar.
Cherry	B 640	"	(None showed any zonation. Substratum
Cherry	B902C1	"	(with black specks darkened.
Prune	B 641	"	
Prune	B 893	"	
Type III			
Pear	C 148	-------	(Very similar to growth on M 174.
Plum	C 151	-------	(Did not show any tendency towards a dense (sclerotial layer. Substratum discolored (reddish brown 4 mm. deep. Dark growth in (substratum composed of a layer of brown (mycelium which is not dense or uniform.

Corn Meal

Pure cultures of the organisms to be tested were grown on oat agar (M 167). Transfers were made to corn meal media (M 175)

on January 18, 1915. The following table is arranged to show: Type of fungus, its primary host, its laboratory accession number, the medium from which transferred, the medium to which transferred, the age of the growth when final readings are made, and notes on growth.

Primary host	Accession Number	Age of Growth	Notes on Growth
		Days	
Type I			
Pear	B 906	135	13 days' growth gave a field covered with a very thin white mycelial growth. There were a few scattering greenish sporodochia. 135 days' growth gave thick white to brownish yellow mycelial mat on top surface. Thick irregular sclerotial masses were formed between the medium and the sides of the flask, interspersed, in placed, with cottony mycelial growths.
Cherry	B902C	"	Same as B 906 but there was less aerial mycelium and a more vigorous sclerotium formation.
Prune	B 838	"	
Type II			
Pear	B 633	"	15 days' growth gave a field entirely covered with a very thick mat of whitish mycelium which was covered in irregular splotches with ash-gray to brownish layers of conidia. These splotches showed at the center a white mat without conidia. 135 days' growth gave a solid mass of very thick irregular sclerotia formed between the corn meal mass and the sides and part of the bottom of the flask. The top was covered with a white cottony mat in the center and a dense ring from ash-gray to yellowish-brown conidia around the edge.
Cherry	B 640	"	All same as B 633 only varying in color of spore mass slightly.
Cherry	B902C1		
Prune	B 641		
Prune	B 893		

Corn Meal Table cont'd.

Type III			
Pear	C148)	135	(13 days' growth gave a thick whitish lumpy (mycelial mat. In some cases there was (slight blackish decoloration in the sub- (stratum. 135 days' growth gave mass with a (solid layer of fungus about it. On top (this was translucent brown to yellowish. (The sides were covered with thick masses (of yellowish to blackish brown sclerotia. (The bottom was covered with a thick mat of (whitish mycelium.
Plum	C151)		

Carrot Plug

Pure cultures were grown on corn meal medium (M 175). Transfers were made to apple agar (M 186) on January 1, 1915. The following table is arranged to show: Type of fungus, its primary host, its laboratory accession number, the medium from which transferred, the medium to which transferred, the age of the growth when final reading is made, notes on growth.

Primary host	Accession number	Age of growth	Notes on Growth
Type I			
Pear	B 906		(20 days' growth gave a white cottony my- (celium growth with greenish tint covering the (plug. At the bottom of the plug and along (the edge where the plug lay against the tube (a dirty greenish brown to black indefinite (sclerotial-like mass was forming. 135 days' (growth gave a shrunken plug covered with an (irregular sclerotial mass a few conidia being (produced at the top. Droplets of gonidia were

Carrot Plug Table cont'd.

		(scattered over the surface. Most of the (sclerotial layer was covered with a weft (of mycelium which ranged in color from white (to greenish yellow.
Cherry	B902C	(Similar to the above:
Prune	B 838	(_ B 906.
Type II		
Pear	B 633	(20 days' growth gave a plug covered with a well (formed black sclerotial layer. In some (few cases light brown conidial tufts were (present. 135 days' growth gave a black shrunken (mass of sclerotia peppered all over with (brown conidial tufts.
Cherry	B 640	)
Cherry	B902C1	)
Prune	B 641	)---- All identical with B 633.
Prune	B 893	)
Type III		
Pear	C 148	(20 days' growth gave plugs entirely covered
Plum	C 151	(with a thick growth varying in color from (ash-gray to ocher yellow. On the top surface (it was mostly of the latter. Irregular (sclerotial lumps appeared on the surface under (the mycelium growth. These were ash-gray (on top and gave rise to many watery droplets of (ooze. Where the plug lay against the side of (the tube the sclerotia were seen to be thick (and well formed. None of the American Sclerotin-(ias of stone or pome fruits have been noted to (form such sclerotia on carrot plugs. (135 days' growth gave a plug of the above (characteristics which had dried up into a hard (grayish-black sclerotial mass.

Apple Plugs

Pure cultures of the organisms to be tested were grown on corn meal medium (M 175). Transfers were made to sterile carrot plugs

(M 186) on January 30, 1915. The following table is arranged to show: Type of fungus, its primary host, its laboratory accession number, the medium from which transferred, the medium to which transferred, the age of growth when last reading is made, notes on growth.

Primary host	Accession number	Age of growth	Notes on Growth
		days	
Type I			
Pear	B906	135	(20 days' growth gave a plug covered with a thinly formed sclerotial layer which was covered with fine mycelium. 135 days' growth showed the entire tissue to be covered with a thin, not very dense, sclerotial layer. This was covered with very fine whitish to yellowish tinted mycelium. A few scattering conidia are noted.
Cherry	B902C	"	
Prune	B 838	"	
Type II			
Pear	B 633	"	(20 days' growth gave a plug entirely covered with a thick, well formed black sclerotial layer. In some places light brown conidia were present. 135 days' growth gave hard black sclerotial masses with a few conidia on the top.
Cherry	B 640	"	
Cherry	B902C1	"	
Prune	B 641	"	
Prune	B 893	"	
Type III			
Pear	C 148	"	(20 days' growth gave a plug covered with thin sclerotial layers something like Type I but not so dark. The surface growth was greenish gray to ochraceous yellow in color. The sclerotia were formed in long lumps, somewhat raised and covered with fine ash-green growth. 135 days' growth--Sclerotia covered with a soft grayish-brown mycelial layer.
Plum	C 151	"	

Pear Stems

Pure cultures of the organisms to be tested were grown on corn meal medium (M 175). Transfers were made to sterile pear stems on January 1st, 1915. The following table is arranged to show: The type of fungus, its primary host, its laboratory accession number, the medium from which transferred, the age of growth when final readings are made, and notes on growth.

Primary host	Accession number	Age of growth	Notes on Growth
		days	
Type I			
Pear	B906	135	(20 days' growth gave fine whitish woolly (coating on lower portion of stem. At the (top end there was a thick mat of whitish (conidial layer with erect conidophores. (135 days growth did not change the general (appearance.
Cherry	B902C		(Same as
Prune	B 838		(B 906
Type II			
Pear	B 633		(20 days' growth gave a thick white mycelial
Cherry	B 640		(growth at the base along the sides of the stem
Cherry	B902C1		(where the epidermis is ruptured and at the
Prune	B 641		(top. On the tip of the top slant there are
Prune	B 893		(concentric zonations of spores yellowish brown (in mass. These spores are of a denser brown (than those of Type I above. 135 days' growth (did not change the appearance of the growth.
Type III			
Pear	C 148		(13 days' growth gave abundance of thick white (mycelial growth, ochreous-yellow conidial (layer borne sparingly on the top surface. (135 days' growth gave no change.

Pear Stems Table cont'd.

Plum	C 151	135	(13 days' growth gave same growth (as C 148 but less vigorous. (135 days' growth gave no change.

"Summary of Results of Growth on Sterile Media"

Three types of organisms always showed differences at some stage of growth on every substratum upon which grown.

Fig. 1, Plate 16, shows a natural size picture of pure cultures on potato agar (M 170). The cultures are thirty-five days old. The one on the left is B 906, a pear monilia of Type I. The one on the right is C 148, a pear monilia, of Type III.

Fig. 2, on the same plate, shows natural size pictures of pure cultures on prune agar (M 174). The cultures are thirty-five days old. The one on the left is B 902C1, a cherry monilia of Type II. The one on the right is B 902 C, a cherry monilia of Type I.

In general, Type I tends to produce abundant, white, aerial growth in the earlier stage of a more or less irregular outline. Concentric zonation is rarely present. Conidium formation is meager, but when spore tufts do occur they are usually mouse-gray in color. Gonidia are produced in abundance in old cultures but not as abundantly as Type II.

Type II tends to produce a white aerial growth which soon becomes changed into brown sporogenous hyphae. There is most always an abundance of conidia produced. A more uniform sclerotium layer is developed than in Type I. Great abundance of gonidial ooze is produced, especially on oat agar.

Type III tends to produce a very abundant white aerial mycelial growth which later bears ocherous tufts of aerial mycelium and conidia. The tendency towards thick sclerotium formation seems to be greater than in either of the other types. On oat agar very distinct broad ocherous zones of upstanding conidium bearing mycelium are formed.

"Tree Inoculations."

During the summer and winter of 1914, and the spring of 1915, many inoculations were made on trunks, limbs and branches of apples, pears, cherries, prunes and peaches. All of these inoculations were made in the same manner. The spot chosen for an inoculation was washed off with a cloth saturated with a 1-1000 solution of $HgCl_2$. A circle was made on the bark with a blue wax pencil. When the bark had become nearly dry the point of a sharp sterile scalpel was inserted in the center and run in under the bark. When the scalpel was removed there appeared only a slit in the center of the circle. Such punctures are called "slit punctures" in this paper.

Inoculations were made by inserting a small bit of the fungus tissue in under the bark with a sterile needle while the slit was held slightly open by raising the scalpel handle. The wound was left unsealed after the fungus was inserted. Two parallel lines were used to mark a check puncture. The puncture was made the same as for inoculations.

The following abbreviations and signs will have the following meaning throughout the explanation of this experiment:

T--Tree trunk
Br.--Branch
Yr.--Year or years old
Bl.Cl.--Blossom cluster
O--Inoculation
=--Check

The following tables are arranged to show the primary host of the fungus used; the laboratory accession number of the fungus; the age of culture and kind of medium growing upon; location of inoculations; number and locations of checks; number of inoculations; and results of inoculations.

Table X--Tree Inoculations on Apple

Table X.

Primary Host	Accession number	Age of culture and kind of medium grown on	Number & location of inoculations	Number & location of checks	Number of inoculations	Results after days.
		March 12, 1915.				
Type I						
Pear	B906	12 days Carrot plugs	4 T 4Br. 2Yr. 8Br. 4 Yr.	Same as inoculation	16	Negative Results
Cherry	B902C	"	"	"	16	" "
Prune	B838	"	"	"	16	" "
Type II						
Cherry	B902C1	"	"	"	16	" "
Prune	B893	"	"	"	16	" "
Type III						
Pear	C148	"	"	"	16	" "
Plum	C151	"	"	"	16	" "

"Discussion of results of inoculations on apple trees": One hundred twelve inoculations were made on the trunks, limbs and branches of two-year-old apple trees. This was before the trees had started a vigorous growth in the spring. None of the inoculations were fruitful in producing infection.

Table XI

Tree Inoculations on Pear

Primary host	Accession number	Age of culture and medium growing on	Location of inoculations	Location of checks	Number of inoculations	Results of Inoculations
		July 8, 1914				Last observations made May 10, 1915.
Type I						
Pear	B906		4 T 4 Br.Yr.	Same as inoculation	8	Negative results
Cherry	B839		2 T 2 Br.Yr	"	4	" "
Prune	B838		"	"	4	" "
		March 5, 1915.				
Pear	B545	12 days growth on carrot plugs	6 T 6Br.2Yr. 6Br.Yr.	"	18	1 32 yr.produced canker 8 in. long.
Pear	906	"	"	"	18	2 Br.yr. were girdled and dried up.
Apricot	B527	"	4 T 4Br.2Yr. 4Br.Yr.	"	12	Negative results.
Cherry	C253	"	2 T 2Br.2Yr. 3Br.Yr.	"	7	1 Br.Yr. was girdled and dried up.
Plum	C252	"	"	"	7	Negative Results.
Peach	C178	"	"	"	7	" "
		March 27, 1915.				
Pear	B545	"	7 Br.3Yr.	"	7	" "
Pear	B906	"	5 Br.6Yr. 2 Br.3Yr. 4 Br.2Yr. 2 Br.Yr.	"	13	" " (5 Br.3Yr.produced canker (3 x 6 in. long. 2 Bl.Cl.
Peach	C178	"	5Br.3Yr. 3Bl.Cl.	"	8	----(wilted and turned brown, (cankers 3 in. long were (produced at their bases.
Type II		July 8,1914				
Pear	B633	M137 Potato dex.ag.	2 T 4Br.2Yr.	"	6	((2 T produced cankers 2" long
Pear	B633	March 12, '15. 12 days carrot plug	6T 6Br.2Yr. 6Br.Yr.	"	18	(1 Br.2Yr.produced blighted (branch. 3 Br.Yr.wilted (and dried up.
Cherry	B831	March 27, '15				
		"	2Br.3Yr. 2Br.2Yr. 1Bl.Cl.		7	(2 Br.3Yr.produced cankers (2 to 6 inches long. (2 Br.2Yr.produced cankers (2 to 6 in.long. 2 Br.Yr. (produced cankers 2-4" long (Branch dried, 1 Bl.Cl. (wilted.

Table XI cont'd.

Primary Host	Accession number	Age of culture and medium growing on	Location of inoculations	Location of checks	Number of inoculations	Results of Inoculations
		March 5, 1915.		Same as inoculation		
Type III						
Pear	C148	12 days carrot plug	2Br.4Yr. 2Br.2Yr. 2Br.Yr.		6	Negative Results
Plum	C151	"	"	"	6	" "
		March 27, 1915.				
Pear	C148	"	2Br.3Yr. 5Br.2Yr.	"	7	(2 Br.3Yr.produced cankers (3-10 in.long. Abundance of (Monilia sporodochia were (produced on under surface. (5Br.Yr. produced cankers (3-8 in. long.
Pear	C151	"	"	"		"

"Discussion of Results of Inoculations on Pear Trees."

There has been a total of one hundred seventy-four trunk, branch and limb inoculations made on pear trees varying in age from two to fifteen years.

Twenty inoculations made on two-year-old trees July 8, 1914, with strains of Type I, isolated respectively from Pear (B906), Cherry (B839), Prune (B838), and Plum (B894), gave no infection.

Sixty-nine inoculations made on two-year-old trees March 5, 1915, with strains of Type I isolated respectively

from Pear (B545 & B906), Apricot (B527), Cherry (C253), Plum (C252), and Peach (C178), gave a total infection of one two-year-old branch and four year-old branches. The infection on two-year-old wood was caused by a pear monilia (B545). Three of the infections on one-year-old wood were caused by another pear monilia (B906). One infection on one-year-old wood was caused by a cherry monilia (C253).

Twenty-eight inoculations made on fifteen-year-old trees March 27, 1915, with strains of Type I, isolated respectively from Pear (B545 and B906) and Peach (C178), gave a total infection of five three-year-old branches and two small side branches bearing blossom clusters. All of these infections were caused by the Peach monilia. Large cankers from three to six inches long were produced on the three-year-old wood. In no cases were the limbs entirely girdled, but in most cases the lisions had extended almost around the limbs. Fig. 1, Plate III, shows natural sized photograph of these cankered limbs.

Where inoculations on the small side branches caused infection the branch was soon girdled at the point of inoculation, and the fungus spread down the branch tissue and entered the limb. Cankers from two to three inches long were produced about the base of these blighted branches. Fig. 2, Plate III, shows a natural sized photograph of a limb bearing two blighted branches with cankers at their bases.

Six inoculations made on two-year-old trees, July 8, 1914, with a strain of Type II, isolated from Pear fruit (B633), gave no infection.

Eighteen inoculations made March 12, 1915, on two-year-old trees with a strain of Type II, isolated from Pear fruit (B633) gave a total of six infections. Two inoculations produced cankers two inches long and one inch broad on the trunk. One inoculation produced a blighted condition of one two-year-old side branch, and three inoculations caused year-old side branches to wilt and dry up.

Seven inoculations made March 27, 1915, on a fifteen-year-old tree with a strain of Type II, isolated from the apothecia on a cherry mummy, gave a total of seven infections. Two of the inoculations on a three-year-old limb produced cankers from three to six inches long. The appearance of these cankers was very similar to those formed by fungus C178 of Type I. Fig. 1, Plate V, shows a natural sized photograph of such cankers. Two inoculations on two-year-old branches produced cankers about the points of inoculations which soon girdled the branches and caused them to blight. Figs. 2 & 3, Plate IV, show these blighted branches. Similar conditions were produced by two inoculations on one-year-old branches. One inoculation on a blossom cluster caused it to blight.

Twelve inoculations made March 5, 1915, on two-year-old

trees with strains of Type III, gave no infections.

Fourteen inoculations made March 27, 1915, on fifteen-year-old trees with strains of Type III, isolated respectively from pear fruit (C148) and plum fruit (C151), gave a total of fourteen infections. Infections took place within a few days after the inoculations were made. The canker produced spread very rapidly and soon girdled the branches in each case. Forty-five days after the inoculations were made, large ocherous-yellow sporodochia were produced along the under sides of the affected branches. In this case the limbs and branches were blighted before very distinct cankers could be formed. Plate V shows a natural sized photograph of the blighted branches. The one on the right shows distinctly the large sporodochia.

Table XII

Tree Inoculations on Peach

Primary Host	Accession number	Age of culture & kind of media	Location of inoculations	Number of Location of checks	Number of inoculations	Notes on Results
		Feb.21, 1915.				Last reading taken May 14, '15.
Type I						
Pear	B906	12 days' growth on carrot agar	4T 4Br.Yr.	Same as inoculation	8	3T produced cankers 3-5" long, nearly girdled branch, 1 Br.Yr. produced cankers 1-4" long girdled branch.
Cherry	B902C	"	"	"	8	1Br.Yr. produced canker 3" long almost girdled.
Prune	B838	"	4T 2Br.2Yr." 3Br.Yr.		9	1T produced canker 1 1/2" long. 2Br.Yr. produced can- 2 and 3" long, girdled branch

Table XII cont'd.

Prune	(Type II C80)	12 days' growth on carrot agar	3T 5Br.Yr.	Same as inoc.	8	Negative results.
		March 6, 1915				
Cherry C253		"	10 Br.Yr.	"	10	5Br.Yr.produced cankers 2-4" long, 3 girdled br.
Plum C252A1		"	15 Br.Yr.	"	15	10Br.Yr.produced cankers 2-4" long, 6 girdled br.
Peach C178		"	8Br.Yr.		8	1Br.Yr. produced cankers 3" long girdled.
		March 26, 1915				
Peach C178		"	3 T. 7Br.Yr.	"	10	3 T produced cankers 2-3" long nearly girdled, 5 Br.Yr. produced cankers 2-4" long, girdled br.
Type II						
		Feb.21,1915				
Prune B893		12 days' growth on carrot plug	3T 4 Br.Yr.	"	7	3 T produced cankers 3-7" long about girdled, 3 Br.Yr.produced cankers 4-5" long, girdled, producing spores.
		Feb.26,1915				
Peach C251		"	3 T 5 Br.Yr.	"	8	3 T produced cankers 3-6" long 1/2 girdled, 4 Br.Yr.produced cankers, 2-4" long girdled.
		March 6, 1915.				
Pear B633		"	2 T 14 Br.Yr.	"	16	2 T produced cankers 3 & 4" long, 1/2 girdled, 12 Br.Yr. produced cankers, branches died and produced spores on surface.
Cherry B902C1		"	3 T 2Br.Yr.		5	3 T produced cankers 2-6" long, 1/2 girdled, producing spores, 2 Br.Yr.produced cankers-branches girdled, producing spores.
Prune B893		"	2 T 13 Br.Yr.		15	2 T produced cankers 3 & 8" long, 1/2 girdled, producing spores, 13 Br.Yr.produced cankers 2-6" long, girdled, producing spores.
		March 26, 1915				
Cherry B831		"	6 Br.Yr.	"	6	6 Br.Yr.produced cankers 2-4" long, 3 girdled, 3 half-girdled zones produced.
Cherry B955		"	1 T 6Br.Yr.	"	7	1 T produced canker 3" long, spores produced. 6Br.Yr.produced cankers 2-4" long, spores produced.
Prune B641		"	5Br.Yr.	"	5	5 Br.Yr.produced canker 3-4" long spores produced.
Peach B634		"	8Br.Yr.	"	8	8 Br.Yr.produced canker 3-5" long spores produced.

Table XII cont'd.

		April 2, 1915				
Peach	B873	"	5Br.Yr.	"	5	5 Br.Yr.produced canker 3-5" long spores produced.
Type III		Feb.21,1915				
Pear	C148	"	3 T 2Br.2Yr. 5Br.Yr.	"	10	Negative results.
Plum	C151	" 3 T	7Br.Yr.	"	10	" "
		March 6, 1915				
Pear	C148	"	8Br.Yr.	"	8	1Br.Yr.produced canker 1 1/2" long, 1/3 girdled.
Plum	C151	"	8Br.Yr.	"	8	1 Br.Yr.produced canker 1" long, 1/3 girdled, spores produced.

Discussion of Results of Inoculations on Peach Trees.

Two hundred and six inoculations have been made on limbs and branches of two-year-old peach trees with representatives of the three types of fungi under consideration.

On February 21, 1915, thirty-three inoculations were made with strains of Type I, isolated respectively from pear (B906), cherry (B902C), prune (B838). On May 14, 1915, there was a total of ten infections. B906 produced cankers 3-5 inches long on the trunks from three inoculations, and cankers 1-4 inches long, girdling the branches, from three inoculations on the year-old-branches.

B902C produced one canker three inches long on the trunk. B838 produced one canker one and one-half inches long on the trunk and two cankers two and three inches long girdling the branches on branches one-year-old.

On March 6, 1915, thirty-three inoculations were made on two-year-old peach trees with strains of Type I, isolated respectively from cherry (C253), plum (C252A1), peach (C178). C253 produced five cankers from two to four inches long, three of which girdled the branches, on branches one-year-old. C252A1 produced ten cankers from two to four inches long, six of which girdled the branches, on branches one-year-old. C 178 produced one canker three inches long, which girdled the branch, on a branch one-year-old.

March 26th, 1915, ten inoculations were made on two-year-old trees, with a strain of Type I, isolated from peach (C178). Three cankers from two to three inches long were produced on the trunk. Five cankers from two to four inches long, which girdled the branches, were produced on branches one-year-old.

February 21st, 1915, seven inoculations were made on two-year-old tree with a representative of Type II, isolated from apothecia on prunes (B893). Six infections took place. Three inoculations on the trunk produced cankers from three to seven inches long which almost girdled the tree. Three inoculations on year-old branches produced cankers from four to five inches long. The latter were girdled and many brown powdery tufts of spores were produced on the surface of the canker.

February 26th, 1915, eight inoculations were made on a two-year-old tree, with a strain of Type II, isolated from peach (C251). Seven infections took place. Three inoculations on the trunk produced cankers from three to six inches long, about half way girdling the tree. Four inoculations on one-year-old branches produced cankers from two to four inches long. The branches were blighted and numerous brown sporodochia were produced in the cankered area.

March 6, 1915, thirty-six inoculations were made on two-year-old trees with strains of Type II, isolated respectively

from pear (B633), cherry (B902C1) and prune (B893). B633 produced two cankers, three and four inches long, from inoculations on the trunk, and twelve cankers on year-old-branches which girdled the branches and produced an abundance of sporodochia on the surface of the cankered area. B902C1 produced three cankers from two to six inches long on the trunk, and two cankers which girdled the branches and produced brown spores on the cankered area on branches one-year-old. B893 produced two cankers three and six inches long on the trunk. Spores were produced on the surfaces of these much sunken cankers. The same organism produced thirteen cankers from two to six inches long which girdled the branches and produced brown spores on the surface of the cankered area on one-year-old branches.

March 26, 1915, twenty-six inoculations were made on two-year-old peach trees, with strains of Type II, isolated respectively from cherry (B831 and B955), prune (B641) and peach (B634). B831 produced six cankers from two to four inches long on branches one-year-old. The branches blighted and brown spores were produced on the cankered area. B955 produced one canker three inches long on the trunk, and five cankers on the one-year-old branches which appeared identical with those produced by B831. B641 and B634 produced results identical in appearance with B831. The former producing five infections while the latter produced eight.

On April 2nd, 1915, five inoculations were made on a two-year-old peach tree with a strain of Type II, isolated from apothecia on peach. Five cankers from three to five inches long were produced. The branches were blighted and brown spores were produced on the surfaces of the cankered areas.

February 21, 1915, twenty inoculations were made on two-year-old trees with strains of Type III, isolated from pear (C148) and plum (C151). No infections took place.

March 6, 1915, sixteen inoculations were made on two-year-old peach trees with strains of Type III, isolated from pear (C148) and plum (C151).

C148 produced one canker, one-half inch long, on a branch one-year-old. The branch was about one-third girdled. C151 produced one canker one inch long on a branch one-year-old. The branch was about one-third girdled. There was a large ocherous-yellow sporodochia in the center of the canker.

Plate VI shows a natural size photograph of cankers produced by B906 of Type I. The two objects on the right represent one-year-old branches which were girdled and blighted by the fungus. The center of the cankered areas show up lighter than the unaffected tissue. The larger object on the left represents an inoculation with the same organism on the trunk of a two-year-old tree. Note the large drop of gum on the surface of the cankered area.

Plate VII shows a much reduced photograph of two-year-old peach trees inoculated with Type I. The object on the left represents a tree with two large gummy cankers on the trunk and a blighted side branch at the top, produced by C178 (peach monilia). The object on the right shows a large shoot with blighted side branches caused by C252 (plum monilia). Note the lighter color of the cankered areas at "x" and "y".

Fig. 2, Plate VIII, shows cankers produced on year-old peach branches by C148 and C151 organisms of Type III. Note the large sporodochia at the center of the canker on C151. Fig. 2, Plate VIII, represents long, gummy cankers produced on the trunk of a two-year-old peach tree by C178, a peach monilia of Type I.

Plate IX shows natural sized photographs of cankers produced by B893, a representative of Type II, isolated from apothecia on prune, on peach branches. Note the light colored areas dotted with sporodochia on the small branches in Fig. 1. Fig. 2 shows rather indistinctly cankers on larger branches caused by the same organism.

Plate X shows a much-reduced photograph of small peach trees with cankers on the side branches, caused by B893 and B633. Note the light areas where inoculations were made on the blighted branches. The check branches remain in a vigorous condition.

Table XIII

The Inoculations on Italian Prune

Primary Host	Accession Number	Age of culture and kind of medium growing on	Location of Inoculations	Number and location of checks	Number of Inoculations	
		Feb.19,1915				
Type I						
Pear	B906	12 days' growth on carrot plug	4 T 2Br.2Yr. 3Br.Yr.	Same as inoc.	9	Negative results
Cherry	B902C	"	4 T 3Br.2Yr. 3Br.Yr.	"	10	
Prune	B838	"	4 T 6Br.Yr.	"	10	
		April 3, 1915				
Pear	B545	"	2Br.2Yr. 6Br.Yr.	"	8	1 Br.2Yr.girdled with canker 2-1/3" long. 5 Br.Yr.girdled with canker 2-3" long 3 girdled.
Pear	B906	"	1 T 6 Br.Yr.	"	7	2 Br.Yr.girdled by canker 1 1/2"long 1 T produced canker 1" long
Cherry	B902C	"	"	"	7	1Br.Yr.girdled by canker
Cherry	C253	"	2Br.2Yr. 5 Br.Yr.	"	7	2 Br.2Yr.produced cankers 1" long almost girdled. 5 Br.Yr.girdled, ends dried up.
Prune	B838	"	1 T 6 Br.Yr.	"	7	1 T produced canker 1" gumming 6 Br.Yr.girdled by canker, ends dried up.
Prune	B838	"	1 T 2 Br.2Yr. 6 Br.Yr.	"	9	1 T produced canker 1" long. 2 Br.2 Yr.canker 2" long.6Br.Yr. girdled by canker, top dried up.
Peach	C178	"	3Br.2Yr. 5Br.Yr.	"	8	3Br.2Yr.produced cankers 1 1/2"long 5Br.Yr.girdled by canker, top dried up.
Type II		Feb.19,1915				
Cherry	B831	"	3 T 1Br.2Yr. 2Br.Yr.	"	6	1 T produced canker
Prune	C80	"	3Br.Yr.	"	3	Negative results
		April 3,1915				
Pear	B633	"	1 T 6Br.Yr.	"	7	1 T produced canker 6 Br.Yr.produced cankers, girdled br.
Cherry	B831	"	"	"	7	1 T produced canker 6Br.Yr.produced canker

Table XIII cont'd.

Cherry	B955	"	8 Br.Yr.	"	8 8Br.Yr.girdled by canker, top dead
Prune	B641	"	6 Br.Yr.	"	6 6 Br.Yr.girdled by canker, top dead.
Prune	B893	"	2 T 4Br.Yr."		6 2 T cankered 1" long spores produced, 4 Br.Yr. girdled by canker, top dead, spores produced.

Table XIII cont'd.

Prune	C80	12 days' growth on carrot plug	5 Br.Yr.	Same as inoc.	5	Negative results
Peach	B634	"	8 Br.Yr.	"	8	8 Br.Yr.girdled by canker, top dead.
Peach	B873	"	1 T 6Br.Yr.	"	7	1 T canker, 2" long, spores produced. 6 Br.Yr.girdled, 2-3" long spores produced, top dead.
Type III		Feb.19,1915				
Pear	C148	"	3 T 1Br.2Yr. 2Br.Yr.	"	6	Negative results.
Plum	C151	"	"	"	6	" "
		April 3, 1915				
Pear	C148	"	"	"	6	1 T produced canker 1/2" long 1Yr.Yr. 2" long, half girdled.
Plum	C151	"	"	"	6	1 T produced canker 1/2" long 1 Br.Yr. produced canker 1/2" long.

Discussion Tree Inoculations on Italian Prunes.

One hundred and ninety inoculations were made on two-year-old Italian prune trees with representatives of the three types under consideration. An examination of the above table will show a total of one hundred five infections. From these infections cankers from one-half to three inches in length were formed. Many of the small branches were girdled and subsequently dried up. Brown sporodochia were noted to develop in the cankered areas of Type II. No sporodochia were produced on Types I and III. All infections on large branches or trunks produced large drop of gum on the surface.

Twenty-nine inoculations with Type I, nine with Type II and twelve with Type III, on February 19, 1915. All gave negative

results.

Fifty-three inoculations with Type I on April 3rd, 1915, produced a total of forty-three infections, or about eighty-one per cent.

Fifty-four inoculations with Type II on the same date gave a total of forty-nine infections, or about ninety per cent.

Twelve inoculations with Type III on the same date gave a total of four infections, or about thirty-three per cent.

Cankers caused by the various types were similar in appearance. Type II produced an abundance of spores on the surface of the cankers, while Types I and III did not produce any spores.

Fig. 1, Plate XI, shows natural size photograph of a canker caused by C151 of Type III on prune. Fig. 2, on the same plate, shows a similar canker caused by B545 of Type I.

Plate XII shows cankered trunk and blighted branches of prune caused by B838 of Type I.

Plate XIII shows much reduced photograph of small prune tree with blighted side branches caused by inoculations with B873 and B893 of Type II.

Plate XIV shows natural size photographs of the blighted branches and a canker further down on the trunk. Fig. 1 represents blighted branches caused by B873. Fig. 2 represents blighted branches and cankered trunks, caused by B893.

Table XIV

Tree Inoculations on Cherry

Primary Host	Accession number	Location of Inoculations	Number and location of checks		Notes on Results
June 25, 1914					
Type I					
Pear	B906	6 T	same as inocu.	10	Negative result
Cherry	B839	2 T 4Br.2Yr. 4Yr.Yr.	"	10	" "
"	B899	"	"	10	" "
"	B902C	"	"	10	" "
"	B904	"	"	10	" "
"	B930	"	"	10	" "
Prune	B558	"	"	10	" "
"	B903	"	"	10	" "
Dec.6,1914					
Pear	B906	5 T 5Br.2Yr. 10 Br.Yr.	"	20	" "
Apricot	B527	"	"	20	" "
Cherry	B902C	"	"	20	" "
March 12, 1915					
Prune	B838 (10 days growth carrot plug)	"	(2Br.4Yr.12 1Br.3Yr. 7Br.2Yr. 2Br.Yr.)		" "
April 10, 1915					
Pear	B545	"	" 2Br.4Yr. 2Br.2Yr. 2Br.Yr. 4Bl.Cl.	10	2 O on branches 4 yr.old produced cankers 2" long.
"	B906	"	" "	10	2 Br.4Yr.produced cankers 2 1/2" long 2 Br.2Yr. " " 3 1/2" long
Cherry	C253	"	" "	10	2 Br.4Yr.produced cankers 3"long-gummy-very 2 Br.2Yr. " " 1 1/2" long very gummy 1 Bl.Cl.wilted
Prune	B838	"	" "	10	2Br.4Yr.produced cankers 2 1/2" long-gummy 2 Br.2Yr. " " 1" long-gummy 1 Br.Yr. " " 2" "
Peach	C178	"	" "	10	2 Br.4Yr. " " 1-2" " 2 Br.2Yr. " " 1" " 1 Br.1Yr. " " 1/2" " 3 Bl.Cl.wilted.

Table XIV cont'd.

		Dec.12,1914 (10 days' growth on carrot plugs)				
Type II						
Pear	B633		5 T 5Br.2Yr. 10Br.Yr.	20	(Checked on all results May 10, 1915. Negative Results.	
			same as inoc.		Total No.trees	
		March 12,1915				
Cherry	B831	10 days' growth on carrot plug	2Br.4Yr. 1Br.3Yr. 4Br.2Yr. 3Br.Yr.	Same as inoculations.	10	2Br.4Yr.produced sunken cankers 1 1/2" long. 1 Br. 3Yr.produced sunken cankers 1 1/2" long.4 Br.2Yr.produced sunken cankers 2½" long. 3Br.Yr. produced sunken cankers 1" long.
Prune	B893	"	5Br.2Yr.	"	9	3Br.2Yr.produced sunken cankers 1" long. 2Br.Yr.produced sunken cankers 1" long.
Plum	C80	"	2Br.4Yr. 1Br.3Yr. 3Br.2Yr. 2Br.Yr.	"	8	Negative Results
		April 10,1915.				
Pear	B633	"	2Br.4Yr. 2Br.2Yr. 2Br.Yr. 4Bl.Cl.	"	10	2Br.4Yr.produced cankers 1½" long 2Br.2Yr. " " 1"long 2Br.Yr. " " 1-2" " 2Bl.Cl.wilted.
Cherry	B902Cl	"	"	"	10	2Br.4Yr.produced cankers 3" long 2Br.2Yr. " " 1½"long 2Br.2Yr. " " 1-2" " 2Bl.Cl.wilted.
"	B955		"	"	10	2Br.4Yr.produced " 1-2" " 2Br.2Yr. " " 1-2" " 2Br.Yr. " " 1" " 3Bl.Cl.wilted
Prune	B641	"	"	"	10	2Br.4Yr.produced " ½" " 2Br.2Yr. " " 1-2" " 2Br.Yr. " " 1-2" " 4Bl.Cl.wilted
"	B893	"	"	"	10	2Br.4Yr.produced " 1½" " 2Br.2Yr. " " 1½" " 2Br.Yr. " " 3/4" "
Peach	B634	"	"	"	10	2Br.4Yr. " " ½" " 2Br.2Yr. " " ½-1" " 1" Yr. " " 1½" "
"	B873	"	"	"	10	2Br.4Yr. " " 1" " 1Br.2Yr. " " ¼" "
Type III						
Pear	C148	"	"	"	10	1Br.4Yr.produced small canker ¼" long 1Br.Yr.produced small canker 1"long
Plum	C151	"	"	"	10	2Br.4Yr. " canker ½" long.

Discussion of Results of Inoculation on Cherry Tree

Three hundred and forty inoculations were made on two-year-old and six-year-old cherry trees. Table XIV shows that ninety-two infections were produced from these inoculations.

Eighty inoculations made June 25, 1914, on two-year-old trees, did not produce any infections. Eighty inoculations made December 6, 1915, on two-year-old trees, did not produce any infections.

Thirty-nine inoculations made March 12, 1915, on six-year-old trees with strains of Types I & II, gave a total of fifteen infections. All of these infections were caused by representatives of Type II, isolated from apothecia on cherry (B831) and from apothecia on prune (B893).

One hundred and forty inoculations made April 10, 1915, with representatives of all three types gave a total of seventy-eight infections. Type I produced twenty-seven infections out of fifty inoculations, or about fifty-four per cent.

Type II produced forty-eight infections out of seventy inoculations, or about sixty-eight per cent.

Type III produced three cankers out of twenty inoculations, or about one and five-tenths per cent.

In general appearance the cankers produced by the three types of fungi were similar. Types I and II produced cankers considerable larger than did type III.

NOTE: Final observations have not been made at this time. Further notes and examinations will be made, photographs will be taken, and a note covering the rest of this experiment will be issued as a supplement to this paper.

Summary of Results from Tree Inoculations.

From the results obtained from inoculations on stone and pome fruit trees, the following conclusions appear to be logically arrived at:

1st. Strains of all three types of monilia fungi worked with are capable of producing serious injury to pear, peach, prune, and cherry trees, when the fungi are brought in contact with vigorously growing bark tissue.

2nd. Trees which are dorment, or are not producing vigorous growth, are not readily attacked by these fungi.

3rd. The early stages of canker development are similar in appearance on all of the hosts which were infected.

4th. Type III distinguishes itself from Types I and II when inoculated on pear limbs and branches by producing large ocheraceous sporodochia on the cankered areas within forty-five days after inoculations were made, while Types I and II did not produce any sporodochia on this host within the period of observation.

5th. Type II distinguished itself from Types I and

III by producing an abundance of brown sporodochia on the cankered areas of twigs and branches of peach and Italian prune, while Type I produced only a few greenish sporodochia in the slit of the inoculation, and Type III produced an occasional acherous sporodochia on the surface of the cankers on these hosts.

-----ooOoo-----

Descriptions of, and Some Remarks by, Other Authors on S. fructigena, S. cinerea, and S. Laxa.

The following descriptions are given by Stevens, 1913, for the European Sclerotinia fructigena and Sclerotinia cinerea:

"SCLEROTINIA FRUCTIGENA (Pers.) Schr.

Apothecia from sclerotia produced either in or on mummied fruits, o.5-3 cm. high, stem dark brown, disk lighter, 5-8 or even 15 mm. in diameter; asci 125-215 x 7-10 u; spores ellipsoidal 10-15 x 5.8 u.

Conidia (=Monilia fructigena Pers.) conidiophores covering the fruits of the host with a dense mold-like growth of light brownish-yellow or ocherous color; spores averaging 20.9 x 12.1 u. on stone and pome fruits, especially the latter.

"SCLEROTINIA CINEREA (Bon.) Wor.

Apothecia and asci similar to those of S. fructigena.

Conidia (Monilia cinerea Bon.) conidiophores covering the fruits with a dense grayish mold-like growth; spores averaging 12.1 x 8.8 u. on stone and pome fruits, especially the former."

The following description is given by Saccardo for Sclerotinia laxa:

"MONILIA LAXA (Wallr.)

Sacc. et Vogl., Oospora laxa Wallr. Flor. Crypt. n. 1574, Oidium laxum Ehrenb. sylv. p. 10. 22, Link Sp. I, p. 323, Acrosporium laxum Pers. myc. I, p.25.--Conidiis catenulatis, erectiusculis, divergenti-ramosis, dense aggregatis, griseis in articulos (conidia), singulos, ovules secedentibus.

Hab. in fructibus putridis Pruni Armeniacae, in Germania (Ehrenberg).--"An diversa a M. cinerea Bon.?""

The following discussion and comparisons of European S. fructigena and S. cinerea are cited by W.A.Matheny:

"Several points of difference between these two species have been cited by Aderhold, Woronen and others. Of these the most striking are as follows:

(1) Conidia of S.f. are always larger than those of S.c.

(2) There is a difference in shape of the conidia, those of the former having an elongate ellepsoidal form, while those of the latter are more rounded.

(3) The conidial tufts of S.f. are light brownish-yellow or ocher, and are always larger, while those of S.c. are ash-gray and always smaller. It is noted that the conidial tufts of the former often grow together, exhibiting a smooth upper surface. This does not occur with the latter species.

(4) S.f. occurs on pome fruits while S.c. occurs on stone fruits.

(5) The ascospores of S.f. are sharply pointed at the ends, while those of S.c. are rounded on the ends. The former are without oil droplets. The latter possess them."

The following are the conclusions drawn by W.A.Matheny, 1914, after making his comparative study:

"The 300 experiments on different fruits show in every instance a wide difference between the S.fructigena of Europe and the local brown rot. First: They differ in the rate of growth, the former being much slower than the latter. Second: The conidia tufts do not agree in size, shape, or color. The S.cinerea, when grown on plums, pear, apples and quinces, agrees in practically every instance with the local Sclerotinia. When grown in pure culture the European S.fructigena never agreed with the local form; 300 cultures of each were made. The conidia of the former are larger than those of the latter. Those of the latter, however, agree in size with the conidia of S. cinerea.

While the asci and ascospores of the European S.fructigena and the American form apparently correspond in size, there are differences that remain distinct. The ascospores of the former are sharply pointed at each end and are free from oil droplets, while the ascospores of the latter are rounded at the ends and

possess oil droplets. No exception was found to this rule.

The American brown rot of stone fruits is not identical with S. fructigena occurring in Europe on some fruits. It agrees more nearly with S. cinerea and should be referred to that species."

-----ooOoo-----

Discussion of Types on Their Known Hosts.

Type I. Apple.

Sclerotinia type I has not been found thus far on apple. Many inoculations with this type however on green and ripe apple fruits produced infections. These results are given in tables and accompanying data Fig.1 Pl. 1 shows a much reduced photograph of apples inoculated with type I contrasted with growths of the same age of type II.

Pear

Sclerotinia Type I has been collected by the writer on pear only on the blossoms and cankered and blighted branches. Many inoculations on pear fruit produced infection. Fig. 2. Pl. 1 shows natural size photograph of pear fruits inoculated with type I. The fruits on the right side of this cut were inoculated with type II. Plate 2 shows type I and type II on pear fruits. The white wooly growth on type I easily distinguishes it from the small brown tufted growth on type II. Note the check in the center not infected.

Inoculations on living pear branches shows the fungus to be capable of producing serious lisions on limbs and entirely girdle small branches.

The results of these inoculations are included under "Fruit Inoculations".

Plate 32 shows pear branch with 100% of natural infection

of type I. Figs. 1 & 2, Plate show natural size photographs of branches bearing cankers produced by artificial inoculations. Note that in fig. 2 infection took place on the side branches and the cankers on the limb were produced by the fungus growing down the branch and entering the limb. Reisolotions were made from the tissue along the margin of one of these cankers and pure culture resulted of apparantly the same organism which had been inoculated on the small branches.

Not more than six cases of natural infection on trees has been noted by the writer and those were during the spring of 1915. In three cases 100% infection was noted on the blossoms, and as a result not a single fruit set on these trees during that season. Professor Jackson made the first collection of type I on pear trees at Halsey, Oregon, 1913. Upon two occasions blighted blossoms and cankered limbs have been sent to the laboratory for identification. One from Salem, Oregon, by E. A. Armstrong, May 10, 1915, the other from Looking Glass R. April 27, 1915, by Geo.

Measurements of one hundred conidia from sporodochia on the surface of pear branches gave dimensions ranging from 15 x 13 to 10 x 5 micromes with an average 13.4 x 8.5. Spores very seldom show scars on the buds, less lemon shaped, and more rounded than spores of Type II.

Quince

Sclerotinia Type I has been collected by the writer, infecting quince fruits and the small branches bearing such fruits. Only one collection of such material has been made. April 5, 1915, mummied quinces were collected from a quince tree near Corvallis, Oregon. Similar mummies were found upon the ground under the same tree. These mummies were brown to dark brown in appearance.

The surfaces were finely wrinkled. From the shaded sides of these wrinkles, thick smooth surfaced tufts of conidia were produced in great abundance. The cushions of spores in mass presented a grayish olive color (Ridgway). There was a thick hard reddish brown layer just under the surface. This layer appeared to be made up of fungus threads and broken down fruit tissue. Fig. 2. Plate 19 shows a natural size picture of such mummies. Note the abundance of sporodochia on the surface. Note also that sporodochia are produced in one case on the small branch bearing the mummy.

One hundred conidia were measured in a mount taken from surface of mummied fruits C 351. These measurements ranged from 16 x 12 to 9 x 6 with an average of 12 x 8 micronia S. Form of spore seem same as on pear Type I.

Apricot

Sclerotinia Type I has been found by the writer on Apricot infecting the blossoms and branches. Severe cases of infection were observed in Mr. Raber's orchard near Granger, Oregon. Blossoms were blighted by this organism as early as March 21 in 1915. Small branches bearing blighted blossoms were also blighted. Where infected blossoms were born on short spurs on larger limbs, cankers two to six inches long were produced. Branches and limbs which had been infected the year previous bore an abundance of greenish to brownish sporodochia. The infected area of small branches turned a very light color.

No artificial inoculations were made on the Apricot with this type of organism. The first infection of Type I on apricot was noted by Mr. H. P. Barrs in the spring of 1913 when he made an examination of material sent to the laboratory by a grower in Albany, Oregon.

Upon several occasions infect branches have been sent in from Portland, Oregon. One hundred spores were measured in mounts made from spores in sporodochia on dead branches (C 298). These measurements gave dimentions ranging from 18 x 13 to 9 x 6 with an average of 13 x 9 mircrons. Form of spore same as on pear Type I.

Cherry

Sclerotinia Type I has been collected by the writer infecting blossoms, leaves, fruits and branches. The fungus attacks the blossoms just about the time they open. It is not definately known where the point of infection is. Observations show that branches are sometimes infected by the fungus spreading back through the pedicel. Plate 28 shows a natural size photograph of a sour cherry branch bearing many blighted blossoms and a few sound fruits.

Note the long lateral branch is entirely killed.

Leaves are attacked in moist weather. The infected area takes on a translucent appearance and finally drys up, turns brown and produces sporodochia on the surface.

In the only case of fruit infection notes blackish mummies with large brown sporodochia were observed.

Many cases of branch infection have been noted. The natural attacks on sweet cherries have been noted to kill the blossoms and spurs only. On sour cherries the wood tissue is seriously attacked. Small branches are blighted, and large cankers produced on limbs. The cankers produced resemble those produced on plum. See plate 30.

Irtificia inoculations show that serious bisims are caused on branches from one to four years old. Table XIV and accompanying data shows the results of many such inoculations.

One hundred spores were measured in mounts made from sporadochia on the surface of cherry branches. These measurements ranged from 16 x 13.5 to 10 x 6 with an average of 13 x 9. Form of spore same as Type I on pear.

Plum and Prune.

Sclerotinia Type I has been collected by the writer on plum and prune infecting blossoms, fruits and branches.

Blossom infection so far as observed takes place just as it does on cherry and apricot. Blossoms of Petite prunes and sugar plums seem more susceptable than the blossoms of Italian prunes. Plate 29 shows a natural size picture of branches from sugar plum, bearing blighted blossoms and healthy blossoms. The object on the left represents a blighted branch of the same host.

Many mummied fruits hanging in trees have been collected. These mummies are covered with crowded cushions of spores mouse-gray to dark olive gray (Ridgway) in mass. Fig. 2 Plate 26 shows a natural size photograph of such a mummied fruit. No black sclerotiod tissues were found in these fruits.

Many fruits were artificially inoculated in the laboratory. Uniform infections were produced. The results of these inoculotia are given in tables IV & V and accompanying data.

Cankers are produced on plum and prune by type I very

similar to the cankers produced by the same type on pear, apricot, and cherry. Plate 30 shows photographs of natural infections on sugar plum. Fig. I is identical with the left object in fig. 2 enlarged 2.4 diameters. Note the large sporodochia on the spur in the center of the canker.

Many artificial inoculations were made on trunks and branches of two-year-old Italian prune trees. A high per cent infection was noted. Fig 2 Pl 11 shows a natural size photograph of a canker produced by these inoculation. Plate 12 shows another set of cankers produced by artificial inoculations with type 11 Table XI shows the results of these inoculations.

One hundred spores were measured in mounts made from sporodochia on the surface of prune branches (C 288). These measurements gave dimentions ranging from 17.5 x 12.5 with an average of 13-9.5. Form of spore same as type I on pear.

Peach

Sclerotinia Type I has been collected by the writer infecting fruits and branches. Blossom inoculation was produced by placing viable spores on the stigmas of blossoms. Small cankers were produced on the branches at the bases of these blighted blossoms.

Many hanging peach mummies have been collected during the winter and spring of 1915 which show an abundance of mouse-gray (Ridgway) sporodochia on the surfaces. There seems to be no sclerotioid bodies formed in these mummies. Fig 3 Pl 31, shows a natural size photograph of such mummies. The mummies in the picture were collected Feb. 22, 1915, and photographed at once. March 22, another collection of mummy peaches bearing type I sporodochia was made. At this time the mummies were still covered with mouse-gray sporodochia containing countless viable spores.

In every case where such mummies as described were found there was also found dead branches bearing on the under side numerous mouse-gray colored sporodochia. These were very similar to those on the mummies, and where cultures were made they made identical growth.

Fig 1 Pl 31 shows a photograph of a branch bearing sporodocia enlarged 2.4 diameter. Fig 2 on the same plate shows several such branches taken natural size.

Many inoculations made on trunks and branches of two-year-old peach trees produced infection. Serious cankers were produced from such inoculations. Table XII and accompanying data show results of these inoculations in detail.

One hundred spores from sporodochia on the surfaces of dead branches and mummied fruits were measured. These measurements have

a range of dimensions from 18 x 12.5 to 10.5 x 7 with an average of 12.5 x 8.9. Form of spore same as Type I on pear.

Economic Importance.

So far the problem has not been handled from this point of view. A few striking observations have been made however which are thought worthy of mention here. In the spring of 1915, three pear trees in an orchard near Corvallis were attacked by the disease at blooming season with the result that 100% blossoms blight ensued on these trees. Many small branches were killed and cankers produced on the larger limbs also. During the same season counts of blighted blossom clusters on sour cherries were made. It was found that the per cent of blight on these trees ranged from 30-70. A sugar plum tree was noted where on there was 90% blossom blight caused by both Type I and II. Peach trees in the orchards where this disease has been found were apparently so badly attacked during the last few years that lack of vigor made it a difficult matter to determine the amount of damage being done during the current season when such observations were being made. One apricot has been observed that was practically killed by the disease. In this case the fungus had attacked the tree the year before also and at blooming season, there was an abundance of viable spores on dead branches scattered through the tree top. From these sporodochia apparantly every

blossom on the tree was blighted. Apricots, peaches and sour cherries are especially susceptable.

Summary of Type I.

Measurements, microscopic and macroscopic examinations of sporodochia and spores of S Type I occuring the surface of cankered branches or twigs or mummied fruits of pear, quince, apricot, cherry, plum and prune and peach proved them to be identical.

Strains of S. Type I isolated from the various pomaceous and drupoceous hosts resemble each other closely when grown artificially on green apples, pears and plums; agar media; Sterile carrot, and apple plugs; and sterile pear stems.

S. Type I shows marked differences from Type II and III on such of the above media which were used for growing each. S. Type I is capable of causing decay of apples, pears and plums by artificial inoculation. S. Type I is capable of production, in the orchard, blossom blight, and twig and branch cankers of pear, apricot, cherry, plum, prune and peach.

S. Type I produces in nature mouse-gray to dark-brownish sporodochia on blighted and cankered branches of drupoceous and pomaceous fruits. This character has not been noted in Type II.

Small light-brown sporodochia have developed on the surface of

branches of pomaceous hosts which were previously inoculated with Type II. Sporodochia have not been produced from artificial inoculations so abundantly by Type I and when sporodochia were produced they were mouse-gray in color and produced only in the slits of punctures. In nature conidia of S.Type I are usually rounded at the ends and do not show a distinct scar as is generally noted in Type II. (See page...)

S. Type I is not identical with either Types I or II.

Apple

Type II has thus far been found in Oregon infecting the fruit only of apples. This fungus has not been found to be a common parasite of apple fruits, but frequently attacks the fruits through wounds made by codling moth lavae. Observations indicate that infection occurs at ripening season of the variety of apple attacked. Occasionally an apple is rotted while hanging on the tree, but in the majority of cases observed the decay took place after the fruit fell to the ground.

The first symptom of the fungous decay is light-brown discoloration of the epidermis about a wound. This brown area spreads gradually and symmetrically about the point of infection until the whole surface is discolored. In all cases observed the growing margin of the fungous decay was regular. The rapidity with which

the fungus spreads in a fruit apparently depends upon environmental conditions. In nature warm, cloudy, moist weather seems to afford ideal cultural conditions for the organism. The light brown discoloration gradually becomes darkened, often in irregular patches, until eventually the whole fruit is black. The surface usually remains unwrinkled until the black color begins to appear in the epidermis, then a gradual drying out of the decayed tissue causes the surface to become shrunken into large or small wrinkles and eventually hardening into a black shriveled mummy.

Microscopic examination shows that the mummy is composed almost entirely of fungous cells. During the process of decay the negative mycelium of the fungus replaces most of the fruit tissue. In the latter stage of decay the mycelial threads become densely interwoven into a hard leathery or horney mass, the sclerotium. The outer surface of this fungus mass is black. A cross-section shows the inner portion to be lighter colored. Examinations of many sclerotinia apple mummies shows that in each mummy there is a scleratial layer covering the entire fruit one-eighth to one-half mm thick and lying just beneath the cuticle. A sclerotial mass often develops in the inner region of the fruit about the core. These inner sclerotial masses may be of various shapes and thicknesses.

With the firm fleshed, thick skinned varieties of apples it has been observed that the two regions of sclerotium formation are sometimes separated by a layer of broken down fruit tissue, or,

when this tissue is disintergrated, an empty space may be left instead. Soft fleshed, thin skinned varieties often collapse when the fungus attack has reached light-brown and sclerotia formed subsequently vary widely as to shape, form, and Mycelium: mycelium within the tissue is light-brown in color, rarely closely septate, much branched, unequal in diameter, and occasionally cellulor in appearance.

Gonidia or micro-conidia are formed in monilia like chains arising from very small mycelial threads. They are very small, spherical, and may produce a muddy brown appearance.

Conidia are variable in shape, ellipsoid to lemon-shaped (mostly lemon-shaped, subhyaline to hyaline, contents granduler. Conidia are borne in chains on branched hyhae. The spores are formed by the laying down of septia at constrictions in the hyhal threads. The formation of uniformally shaped conidia has been noted when the spore formation takes place at the ends of hyhae. The ends of the spores are at first truncate with distinct scars. The celulor contents later bulge the scar wall into a papillate protrusion. In many conidia observed the scar-mark appeared as a circular mark around the spores one to two u from the ends. Conidia shaped as described above present the appearance of a minute lemon. These conidia have been noted to be cut off from the ends of hyphae and they are therefore, called "normal conidia."

Hyphal or mycelial cells may be cut off from any portion of the vegetative growth. Such cells usually do not take on the form of normal conidia but remain as cells of various shapes and forms, depending upon the size of the gungous thread from which they were formed.

To determine the relative sizes of conidia of apple monilias and sclerotinia from various localities in the United States the following table of spore measurements is given.

Spores from eleven day old growth on potato dextrose agar of monitia isolatis from apathicre on apple (C 346)

No of spores measured										
				Width						
	11	13	13.5	16	17	17.5	18.5			Mean
	1	1	1	13	1	6	2			16.4
25					Length					
	8	9	10	10.5	11	11.5	12	12.2	13	
	1	1	2	1	3	5	6	3	3	11.4

Spores from eleven day old growth on potato dextrose agar of momlia isolated from apothicia on apple (C 332)

	11	12	12.2	13	14	15	16	17.5	21	mean
	1	1	1	2	3	10	4	2	1	15.3
25	8.5	9	10	11	11.5	12.2	14			
	2	1	10	5	3	3	1			10.5

Spores from surface of ripe yellow Newtown apple April 29, which had been inoculated with pure culture of momila from Pear fruit (B 6330 March 19.

No Spores measured				Length						Mean
	12	14	15	16	17.5	18	18.5	19	20	
	1	2	4	4	4	2	2	2	4	16.2
25					Width					
	,8	9.5	10	11	11.5	12.2	13	14.5		
	1	1	4	2	3	10	2	2		11.6

Spores from eleven day old growth on potato dextrose agar of isolated from spores on surface of apple Wis (C357)

No spores measured					Length			Mean
	11.5	12.5	14	17.5	19	21		
	2	2	2	12	4	1		16.4
25					Width			
	8.5	10	11.5	12.5				
	1	1	15	4				11

Spores from surface of ripe yellow Newton apple May 14, which had been inoculated with pure culture of monilia from Prune point (B 641) May 19.

No. spores measured					Length				Mean
	12	14	16	17.5	18	18.5	19	20	
	1	1	3	4	6	6	2	2	16.1
25					Width				
	8	9.5	10	11	11.5	12.2	13	14.5	
	1	2	2	3	6	8	2	1	11.5

Apothecia were found attacked to sclerotia in mummied apples during the Spring of 1915. Two collections of such materials were made as follows: Halsey, Oregon, March 28th, 1915; Corvallis, Oregon, April 2nd, 1915. In gross appearance the apothecia looked very much like the apothecia of Sclerotinia Type I found locally on mummy prunes. Microscopic examination of the asci and ascospous give the following measurements:

Measurement of Asci

(Note-Top figure equals value, and the bottom figure equals number).

No Asci measured												
	Length											Mean
	130	135	138	142	143	145	150	155	163	173	175	
	1	3	5	4	4	1	2	1	2	1	1	146.3
25	Width											
	7	8.8	9	10	11.7	12.2						
	2	7	7	7	1	1						9.3

Ascospores

No Spores measured						
	10	11	11.5	12.2	13	
	4	3	4	13	1	12.1
25						
	4.5	5	5.5	6.5		
	3	13	5	4		5.3

Early in this paper it was stated that the present author has accepted Matheny's work (1913) as conclusive proof that Scleratinia cinerea is the Sclerotinia affecting stone fruits in the eastern and central United States. The general averages of Matheny's measurements of asci and ascospores of S cinerea on Plum and peach are here given in comparison with the general average of the measurements taken by writer of the apothocia on apples in Oregon.

The given measurements would seem to indicate that the apothicia involved were stages of the same organism.

Fig. 2 plate 18 shows natural size pictures of apothicia and the S cleroticoid fruits to which they are attached. Fig 1 Pl 20 shows a photomicrograph of asci and ascospores. Fig 1 Pl 19 shows natural size pictures of buried apple mummies.

Author	Host	Fungus	Asci	Ascospores
W.A. Matheny	Peach	S. Cinerea	135-190x6.9-10.5 Mostly 163x8.9	10.5-14.5x5.2-7.5 Mostly 12.5x6
W.A. Matheny	Plum	S. Cinerea	135-173x6.8-10.8 Mostly 151x9.4	9.3-14.2x5-7.4 Mostly 11.8x6.3
Present Writer	Apple	Oregon Type II	130-175x7-12.2 Average 146.3x9.3	10-13x4.5-6.5 Average 12.1x5.3.

Pear

Sclerotinia Type II has been found in nature in Oregon on pear infecting only the fruit. Artificial inoculation on pear branches prove it to be capable of producing severe cankers when it is brought in contact with living waste tissue under favorable environmental conditions.

As a disease of pear fruit the fungus causes a brown rot, the latter stage of which turns the fruit black. This fungus is not of common occurance on pear fruits in this state but occasionally attacks fallen fruits through wounds. There has only been one instance observed by the writer where a fruit was attacked by the disease while still remaining on the tree. Prof. Jackson collected this fruit at Halsey, Oregon, Oct. 8th, 1915. There was apparently no injury on the fruit other than the fungus rot. Pure cultures were made from this organism and is referred to throughout this paper as B 633.

So far as observations have been made the pear fruit rot appears at the different stages of decay very similar to apple fruit rot caused by Type II.

The sclerotium formation in cases observed is similar to that of apple except with small green pears, where the whole structure under the epidermis is transformed into a thick sclerotium. Conidia and gonidia are produced identically as they are on the apple. The following conidia measurements have been taken.

Spores from surface of ripe yellow Newton apple April 29, 1915 which had been inoculated with pure cultures of monilia from pear fruit (B 633) Mar. 19.

No spores measured					Length				Mean
12	14	15	16	17.5	18	18.5	19	20	
1	2	4	4	4	2	2	2	4	16.2
25					Width				
8	9.5	10	11	11.5	12.2	13	14.5		
1	1	4	2	3	10	2	2		11.6

Spores from twenty day old growth on potato dextrose agar of type II isolated from apothecia on pear mummies

No spores measured					Length	Mean
12	14	15	16.5	16	17.5	
1	5	10	4	4	1	15.1
25					Width	
10	11	12	12.5	13	14	
2	3	5	8	5	2	13.9

Spores from twenty day old growth on potato dextrose agar of type II isolated from spothicia on prune.

No spores measured					Length		Mean
12	13.5	14	15	16	18	21	
1	1	3	10	4	3	3	15.3
25					Width		
8	10	11	12	13	14		
2	8	6	4	3	2		11.1
					Length		
12	13	14	15	17	18	22	
1	1	4	10	3	3	3	16.1
25					Width		
8	10	11	12	13	14		
2	8	7	4	2	2		11

Apothicia were found attacked to sclerotia in mummied pears in the spring of 1915. Only one collection of such material was made.

This was collected at Halsey, Oregon, March 28th, 1915. In gross appearance the apothecia looked identical with apothecia of Sclerotinia Type II found attached to sclerotia on mummied prunes and apples. Pure cultures were isolated from such apothecia and compared with pure cultures isolated from apothecia on prunes, peaches, and apples, and found tc be identical with each. Spore measurements of the above cultures are contained in the preceeding table of spore measurements.

Microscopic examinations of the asci and ascospores were made. The following table is arranged to show measurements of asci and ascospores.

Asci

No of Asci				Length		Mean
Measured	130	135	137	140		
	3	5	15	2		136
25				Width		
	8.5	9.5	10	11	11.5	
	2	5	10	5	3	10.3

Ascospores

No of ascospores Measured.				Length	Mean
	9	10	11	11.5	
	2	11	9	3	10
25				Width	
	6	6.5	7	7.5	
	5	8	7	5	6.7

The following table is arranged to show a comparison of the means of the above measurements with the mean of those for Type II on apple, and with means given by Matheny of Sclerotinia cinerea of the Eastern and central United States.

Author	Host	Fungus	Asci	Ascospores
W. A. Matheny	Peach	S. Cinerea	135-190x6.9-10.5 Mostly 163 x 8.9	10.5-14.5x5.2-7.5 Mostly 12.5 x 6
W. A. Matheny	Plum	S. Cinerea	135-173x6.8-10.8 Mostly 151 x 9.4	9.3-14.2x5-7.4 Mostly 11.8 x 6.3
Present Writer	Apple	Oregon Type II	130-175x7-12.2 Average 146.3x9.3	10-13x4.5-6.5
Present Writer	Pear	Oregon Type II	130-130x8.5x11.5 Average 136x10.3	9-11.5x5-7.5 Average 6.7

Fig. 1 Pl 18 shows natural sized photographs of sclerotioid pears bearing apothecia.

Plate 21 shows photomicrographs of asci bearing ascospores.

Fig 2 Plate 1 shows pear fruits inoculated with type II. Plate 2 shows fruits inoculated with type II.

Plate 4 shows pear branches cankered and blighted with type II.

Quince

Sclerotinia Type II has thus far been found in Oregon infecting the fruits only of quinces.

The writer has seldom found under field conditions in the orchard, quinces attacked by this fungus. It is very common on fruits in retail markets. All infections on fruits observed seemed to be associated with wounds.

Decay takes place much like it does in the cases of apples and pears. The fruits do not collapse, but shrivel into a large black, rather finely roughened surface mummy. Sclerotia in cross-section look like those of pear and apple mummies.

Conidia are produced on the surface of the rotted fruits before the black discoloration appears in the epidermis. Plate 23 shows mummies resulting from infected fruits secured in a local retail market.

Apricot

Sclerotinia Type II has been found by the writer on apricot in Oregon, only in the form of apothecia on mummied fruits. There was only one collection of such material made, and that was collected in Mr. Raber's orchard near Granger, Oregon, March21, 1915. In gross appearance the apothecia looked to be identical with apothicia of Sclerotinia Type II on mummied cherries. Pure cultures were isolated from these apothecia (C 299) on potato ager. The ensuing growth appeared to identical with the monilia commonly isolated from rotted cherries, prunes and peaches. It seemed also to be the same as the growth isolated from apothecia, on cherry, prune, peach, apple and pear. The following table is arranged to show measurement of the Asci and ascospores.

No of Asci measured			Length		Mean
130	135	140	145		
5	10	8	2		136.4
25			Width		
9	9.5	10	10.5	11	
3	5	10	6	3	10.8

No of Ascospores measured			Length		
8	9	10	11	11.5	
2	3	12	6	2	10.1
25			Width		
5.5	6	6.5	7		
5	10	6	4		6.1

The following table is arranged to show a comparison of means of measurements of asci and ascospores of apothecia on apricots

Author	Host	Fungus	Asci	Ascospores
W. A. Matheny	Peach	S. Cinerea	135-190x6.9-10.5 Mostly 163 x 8.9	10.5-14.5x5.2-7.3 Mostly 12.5x6
W. A. Matheny	Plum	S. Cinerea	135-173x6.8-10.8 Mostly 151 x 9.4	9.3-14.2x5-7.4 Mostly 11.8 x 6.3
Present Writer	Apricot	Oregon Type II	130-145x9-11 Average 136.4 x 10.8	8-11.5x5-7 Average 10.1 x 6.1
Present Writer	Cherry	Oregon Type II	135-175x8-12 Average 142.2 x 9.6	9-13.5x5-7 Average 11.5 x 6

with those local cherry apothecia, and with Matheny's measurements of Sclerotinia cinerea on peach and plum.

Cherry

Sclerotinia Type II has been collected by the writer in Oregon on fruits and blossoms. Artificial inoculations on cherry limbs and branches produced serious bisions, which in many cases almost or entirely girdled the branch.

In field conditions fruits are attacked most severely at ripening season, a few instances have been observed where green fruits are attacked. The fungus seems to enter most frequently through the blossom end and spread in the appearance of a brown rot until the whole fruit is decayed. From one to several days after the decayed spot appears ash-gray or brownish conidial tufts may be produced on the surface. The entire fruit tissue is finally replaced by a rather thick irrigular sclerotium. These sclerotia have not been examined under the microscope.

Blossoms become infected just about the time of fertilization. Petals, pistils and stamens have been noted to be infected. The fungus appears to spread back from these parts and cause the blossom stem to wilt. Small ash-gray sporodochia are produced on the infected blossoms Fig. 1 Plate 25 shows a natural size picture

of a branch of sweet cherry bearing infected blossoms, uneffected fruits from the same branch, and a cluster of blighted blossoms and small fruits.

Fig. 2 Plate 25 shows natural size picture of blighted blossoms bearing an abundance of spore masses. These blossoms had been kept over night in a moist chamber.

Apothecia were collected from many localities in Oregon during the springs of 1914 and 1915. The apothecia in gross appearance looked very much like those on mummied prunes except they were on the average much smaller. They were about the size of those found on apricot. Fig. 2 Pl. 24 shows natural size pictures of mummies bearing apothecia. Fig. 1 Plate 22 shows a photomicrograph of asci bearing ascospores. The following table is arranged to show measurements of asci and ascospores.

Asci

No of asci and ascospores			Length			Mean
	135	140	145	152	160	175	
	2	3	5	10	3	2	142.2
25				Width			
	8	9	10	11.5	12		
	4	10	6	3	2		9.6

Ascospores

	9	10	11	12	13	13.5	
	2	3	5	10	3	2	11.5
25							
	5	5.5	6	6.5	7		
	3	4	10	6	2		6

The following table is arranged to show a comparison of the

Author	Host	Fungus	Asci	Ascospores
W. A. Matheny	Peach	S. Cinerea	135-190x6.9-10.5 Mostly 163 x 8.9	10.5-14.5x5.2-7.3 Mostly 12.5 x 6
W. A. Matheny	Plum	S. Cinerea	135-173x6.8-10.8 Mostly 151 x 9.4	9.3-14.2x5-7.4 Mostly 11.8 x 6.3
Present Writer	Cherry	Oregon Sclerotinia Type II	135-175x8-12 Average 142.2 x 9.6	9-13.5x5-7 Average 11.5 x6
Present Writer	Prune	Oregon Sclerotinia Type II	136-170x8-9.5 Average 142 x 8.7	8-13x5-7 Average 9.2 x 6.1

cherry mean measurements of asci and ascospores with those of Type II on local prunes and with the means given by Matheny for Sclerotinia cinerea on plum and peach.

The damage caused by this disease on cherries will vary according to the weather conditions. Rainy weather during picking season may induce the fungus to cause a height per cent of loss. Counts have been made by the writer of per cent of blossom infection and found to range on sweet cherries from 0 - 90% of total blossoms.

Plum and Prune

Sclerotinia Type II has been collected by the writer on fruits and blossoms of plum and prune. Artificial inoculations on the trunks and branches of Italian prunes produced serious bisions which almost or entirely girdled the branches. An abundance of spores were produced on the under side of the infected branches.

Fruits are attacked while hanging on the trees. Most damage is done to fruits at harvesting time, but many green fruits are attacked during rainy summers. Infection in most cases observed takes place at the blossom end. The tissue is discolored brown symmetrically about the point of infection until the whole fruit is decayed. Ash-gray tufts of spores are produced on the surface from one to several days after infection takes place.

The entire fruit tissue is eventually changed into a thick

irregular sclerotioid layer about the pit. Mummies which hang on the trees a long time produce large chlanydospores in the sporodochia after the production of normal conidia has stopped.

Blossom infection has not been noted to be very abundant. The blossoms are attacked and distroyed in the same way as are the cherry blossoms. No counts have been made to ascertain the relative per cent of infections or various trees.

Many apothecia attached to mummy prunes have been collected during the springs of 1914 and 1915. Collections have been made from March 12 to April 8th during these two seasons. Apothicia vary in size. The length of the stype seems to vary according to the depth the mummy is buried from i - 6 Cm. in length. Fig. 1. Plate 24 shows a picture enlarged 2.4 diameters.

Fig 3 Plate 26 shows natural size pictures of mummied Italian prunes found hanging on trees in mid winter. Cultures were made from the sporodochia on the surface and growth of type II was produced. The sporodochia which show so abundantly on the surface are made up of large resting cells (chlamydospores).

The following table is arranged to show measurements of asci and oscospores.

No of asci measured	Length							Mean
	136	140	144	150	155	160	170	
	1	3	8	5	5	2	1	149

No of asci Measured.						Mean
25					Width	
	8	8.5	9	9.5		
	4	10	8	3		8.7

No of oscospores measured.							Mean
					Width		
	5	5.5	6	6.5	7		
	2	4	6	10	3		6.1
25					Length		
	8	8.5	9	10	11.5	13	
	2	10	6	4	2	1	9.2

Peach

Sclerotinia Type II has been collected on peach, by the writer, only on fruits.

Blossoms have been blighted by placing spores on the blossoms. Small cankers were produced on the branches bearing such blighted blossoms. Inoculation on two-year-old peach trees have produced serious injuries, in many cases girdling the branch. An abundance of ash-gray to brownish sporodochia were produced on the surfaces of cankers produced by inoculations.

Fruits are infected and rotted after the same manner as are the prune fruits. A heavier sclerotial layer is formed in the mummied, conidia and chlomydospores are produced so far as observed like those on prune. Fig 1 Plate 27 shows a photograph of a peach mummy bearing apothecia magnified 2.4 diameters. Fig 2 on same plate shows natural size photograph of apothecia while in the yound cup stage. Fig 2 shows the same object after having

been kept in moist chambers three days. Note the cups opening up.

Fig 2 Pl. 2 shows a photomicrograph of the asci bearing spores.

The following table is arranged to show measurements of asci and ascospores

					Length		Mean
	138	140	150	155	160	175	
	1	3	6	8	4	3	150.5
25					Width		
	8	8.5	9	9.5	11	14	
	6	10	5	2	1	1	8.8
					Length		
	8	9	9.5	10	13		
	8	12	4	2	1		9.3
25					Width		
	5	5.5	6	6.5	7	7.5	
	2	5	10	4	2	2	6.1

The following table is arranged to compare the mean measurements of asci and ascospores of type II on peach with those on prune and with measurements given by Matheny of Sclerotinia cinerea on Peach and plum.

Economic Importance

The problem has not been handled from this point of view, but some observations have been made which are deemed worthy or mention here. During the spring of 1915 counts on sweet cherry trees were made where blighted blossoms were noted to occur and where Type II alone was present on such blighted blossoms. The blossoms on three trees were counted. The per cent of blight

Author	Host	Fungus	Asci	Ascospores
W. A. Matheny	Peach	S. Cinerea	135-190x6.9-105 Mostly 163 x 8.9	10.5-14.5x5.2-7.2 Mostly 12.5 x 6
W. A. Matheny	Plum	S. Cinerea	135-173x6.8-10.8 Mostly 151 x9.4	9.3-14.2x5-7.4 Mostly 11.8 x 6.3
	Peach	Oregon Sclerotinia Type II	138-175x8-14 Average 150.5x8.8	8-13x5-7.5 Average 9.3 x 6.1
	Prune	Oregon Sclerotinia Type II	136-170x8-9.5 Average 149x8.7	8-13x5-7 Average 9.2 x 6.1

ranged from forty-five to eighty-five on these trees.

The disease is a serious pest in Oregon to prunes at picking time. It is said by many growers that the fruit rot of prunes caused by this disease is the worst prune disease that they have to contend with. By chance, if a few infected prunes are put into picking boxes with many sound ones and left over a night or so the fungus will make vigorous attacks on the sound fruits also. When the temperature in the dryer is run up slowly the fungus grows very rapidly and before the temperature is high enough to kill the disease it has spread to many fruits on the tray.

Summary of Sclerotinia Type II

Measurements and microscopic and macroscopic examinations of conidialspores of Sclerotinia Type II on apple, pear, quince, apricot, cherry, plum and prune and peach show them to be identical measurements and microscopic and macroscopic examinations of ascospores, asci and apothecia of Sclerotinia Type II on apple, pear, apricot, cherry, plum and prune and peach showed them to be identical.

The above measurements of ascospore and asci were compared in each case with respectial measurements given by W. A. Matheny for the Brown Rot fungus, on peach and plum of the Eastern and Central United States and found to agree very closely.

Strains of Sclerotinia Type II isolated from the various stone and pome fruits agree with each other when grown artificially on green apples, pears, and plums; ripe apples and plums; agar media; Sterile carrot, and apple plugs; and Sterile pear stems.

There is a wide difference between Sclerotinia Type II and S. Type I when grown separately on the above media. In cases where Type II[I] (Sclerotinia functigera) was grown on the same media as S. Type II there were always distinct differences.

Sclerotinia Type II is capable of producing fruit rot on apple, pear, quince, cherry, prune and plum, and peach; blossom blight on cherry, peach and plum and prune; twig and branch cankers on pear, prune and peach.

Sclerotinia Type II agrees in all points with S. Cinerea of the Eastern and Central United States and is certainly not identical with S. fructigeria of Europe. It is therefore undoubtedly the same species as described by Matheny as S. cinerea Bon.

Type III.

Sclerotinia Type III has not been found in Oregon on any host. The four strains isolated respectively from apple, pear, cherry, and plum received from E. A. Salmon as authoritic strains of S. fructigeria and collected in England, were grown on the same media as Type I and II. This Type did not show close

resemblance to either of the other types. It agrees perfectly with the monilial growth of S. fructigeria as described by European writers and confirmed by Mathery 1913. The writer was not acquainted with this fungus so he has studied it in comparison with Type I and II which are found abundantly in Oregon. This fungus grows more vigorously on artificially inoculated pear trees than does either of the Oregon types. It produces the large ochroceous sporodochia on the bark which are very different from sporodochia formed by Type I on pear bark. Type II has not been noted to produce spores on pear branches in the orchard.

It is certain, therefore, that Type III, S. fructigeria of Europe, is entirely distinct from either of the two strains of Sclerotinia found in Oregon.

"Attempts to Produce the Perfect Stages of Sclerotinia Types I and II, From Artificial Inoculations."

During the past two seasons attempts have been made to induce apothecia to form on sclerotia resulting from artificial inoculations as follows:

EXPERIMENT NO.I

Mummies resulting from the inoculations made on fruits for a comparative study of Types I and II, as described previously in this paper, were planted out-of-doors September 15th, 1914.

A case was made eight feet by three feet by four inches in dimensions, and divided into one hundred compartments with equal capacity. A wire screen was placed over the top and bottom of the whole case, and it was then taken to the O.A.C. Pathologium and placed in a protected location. The location chosen was deemed to be the best obtainable in the Pathologium, but it does not seem to be an ideal one in that natural shade is not sufficiently provided. The sod was removed to a depth of four inches from a rectangular plot just large enough to accomodate the case. The case was then placed therein and the bottoms of the compartments were covered with soil. The mummied fruits were placed in the compartments and covered with soil. A label was placed on the cross-partition at the lower end of each

compartment. The compartments of the case were in five rows of twenty each. Mummies resulting from each of the various lots of fruits were placed in one of these rows with each strain in a separate compartment. The top screen was then nailed over the top.

EXPERIMENT NO.II.

On June 11th, 1915, oat agar slants in tubes were planted with pure cultures of the following fungi: B839 (a strain of Type I, isolated from cherry), and B838, (a strain of Type I, isolated from prune).

Several irregularly shaped sclerotia were formed in each tube. On December 8th, 1915, these sclerotia were removed from the tubes and placed on sterile sand in a flask. The flask was placed in a cabinet under the sink in the laboratory and allowed to remain there until the last reading was made--May 26th, 1915.

Results of Experiments Nos. I and II.

The planted material was observed closely in both experiments until May 26th, 1915, when the last readings were taken. No evidence of apothecial development were noted.

The material is apparently in excellent condition at present, in both experiments. Full directions will be left with the head of the department of Plant Pathology concerning the purpose

and arrangements of these experiments, and it is hoped that further readings will be made in the spring of 1915.

In the beginning of this experiment the writer had little hope of producing positive results in the course of a single year, as the length of life cycle is given by other investigators as being much longer. However, the work now under progress in this direction is expected to produce positive results in the spring of 1916.

Explanation of Plates.

PLATE 1.

Fig.1: (much reduced), apples rotted with Types I and II. 1st and 2nd compartments from the left are Type I, and 2nd and 4th are Type II.

Fig2: (natural size), green pears by inoculations with Type I and II, Type I on left, Type II on right.

PLATE 2.

(Natural size), green pears inoculated ten days previously with two strains of Type I and Type II.

PLATE 3.

Fig.1: (natural size), cankers produced on pear limbs by inoculations on three-year-old limbs with a strain of Type I (C178) isolated from peach.

Fig2: (Natural size), cankers on the same age wood produced by the fungus (C178), spreading back from inoculations on the small side branches.

PLATE 4.

Fig.1: (Natural size), cankers produced by inoculations on two-year-old branches with a strain of Type II (B831) isolated from apothecia on cherry.

Figs.1 & 3: (Much reduced), a limb bearing blighted branches and cankers resulting from inoculations with B831. Note the blossom clusters killed by spread of a large canker on the main branch.

PLATE 5.

(Natural size); Blighted branches killed by inoculations with a strain of Type III (C151), isolated from plum fruits. Note the large sporodochia on the object on right.

PLATE 6.

(Natural size), cankers produced on two-year-old peach tree trunk and small branches, by inoculations with a strain of Type I isolated from pear.

PLATE 7.

(Much reduced), small peach trees with blighted limbs and cankered trunks caused by inoculations of strains of Type I

(C178) from peach and (C252) from sugar plum.

PLATE 8.

Fig.1: (Natural size), peach branches with cankers produced by inoculations with strains of Type III: (C151 plum and C149, pear). Note the large sporodochium in the center of the canker caused by C151.

Fig.2: (Natural size), gummy cankers caused on trunks of two-year-old peach trees by inoculations with C178 of Type I.

PLATE 9.

Fig.1: (Natural size), small branches blighted by inoculations with B893, a strain of Type II, isolated from apothecia on prune. Note light area of bark bearing abundance of sporodochia.

Fig.2: (Natural size), cankers produced on larger peach branches by B893 of Type II.

PLATE 10.

(Natural size), large peach shoots, showing blighted branches and cankered areas produced by B893 from prune and B633 from pear of Type II.

PLATE 11.

Fig.1: (Natural size), small canker with large gum drop on surface on two-year-old prune branch, caused by C151 of Type III.

Fig.2: (Natural size), small cankers produced on two-year-old prune branch by B545 from pear of Type I.

PLATE 12.

(Natural size), cankers on trunk and blighted branches of two-year-old prune tree, caused by B838, a strain of Type I, isolated from prune.

PLATE 13.

(Much reduced), two-year-old prune tree with canker and blighted branches, caused by two strains of Type II, (B873 from peach and B893 from prune.)

PLATE 14.

Fig.1: Young branches of two-year-old prune tree blighted by inoculations with a strain of Type II (B873) from peach. Note sporodochia.

Fig.2: Young branches and trunk of two-year-old pear tree. Branches have been blighted and the trunk cankered by inoculations with B893. Note many sporodochia on the small branches.

PLATE 15.

(Natural size).

Fig.1: Small peach branches bearing cankers with many sporodochia on the surface, produced by inoculations with B831, a strain of Type II, isolated from peach apothecia.

Fig.2: Small peach branches bearing cankers with many sporodochia on the surface, produced by inoculations with B634, a strain of Type II, isolated from rotted peach.

PLATE 16.

(Natural size).

Fig.1: Thirty-five days old growth of B906, a strain of Type I, isolated from pear and C148, a strain of Type III, isolated from pear on potato-dextrose-agar.

Fig.2: Thirty-five days old growth of B902C1 and B902C, strains of Types II and I respectively. Prune agar.

PLATE 17.

(All much reduced).

Fig.1: Thirty-five days old growth on potato dextrose agar of B906, a strain of Type I, isolated from pear.

Fig.2: Same age growth on same medium as Fig.1, strain of Type III isolated from pear.

Fig.3: Same age growth on same medium as above, of a strain of Type II, isolated from pear.

PLATE 18.

(Natural size).

Fig.1: Sclerotia and apothecia of Type II on pear (C331).

Fig.2: Sclerotia and apothecia of Type II on apple (C332).

PLATE 19.

(Natural size).

Fig.1: Sclerotioid apples resulting from natural infections with Type II.

Fig.2: Quince mummies resulting from natural infections with Type I. Note numerous sporodochia.

PLATE 20.

(Much enlarged), Asci from apothecium of Type II (C332) on apple.

PLATE 21.

(Much enlarged), Asci from apothecium of Type II, on pear (C331).

PLATE 22.

(Much enlarged), Asci from apothecia of Type II on apricot, (C299).--Figl.

Fig.2: Asci from apothecia on Type II on peach.

PLATE 23.

(Much enlarged).

Fig.1: Asci from apothecium of Type II on prune.

Fig.2: Asci from apothecium of Type II on cherry.

PLATE 24.

(Enlarged 2.4 diameters).

Fig.1: Mummy Italian prune bearing apothecia of Type II.

Fig.2: mummy cherries bearing apothecia of Type II.

PLATE 25.

(Natural size).

Fig.1: Sweet cherry branch bearing blighted blossoms. To the left is a blighted blossom cluster and two sound fruits.

Fig.2: Blighted blossoms of sweet cherry after having remained in moist chamber over right. Note the abundance of spores on the pedicels.

PLATE 26.

(Natural size).

Fig.1: Peach mummied with Type I; note sporodochia.

Fig.2: Plum " " " "; " " .

Fig.3: Prune " " " II; " " .

PLATE 27.

Fig.1: (Enlarged 2.4 diameters). Peach mummy bearing apothecia of Type II.

Fig.2: (Natural size). Peach mummy bearing apothecia of Type II.

Fig.3: (Natural size). The same as Fig.2, but taken before the cups had opened very much.

PLATE 28.

(Natural size). Limbs of sour cherry bearing blighted blossoms and sound fruits. This is natural infection with Type I.

PLATE 29.

(Natural size). Branches of sugar plum bearing blighted blossoms and young sand fruits. This is natural infection of Type I.

Note top of the left branch is dead.

PLATE 30.

Fig.1: (Enlarged 2.4 diameters). Branch of sugar plum bearing large canker caused by natural infection of Type I. Note the large sporodochia about the spur in the center of the canker.

Fig.2: (Natural size). Same as Fig.1. The object on left is the same object as is in Fig.1.

PLATE 31.

Fig.1: (Enlarged 2.4 diameters). Blighted peach branch bearing sporodochia of Type I, caused by natural infection.

Fig.2: (Natural size). Peach mummies bearing an abundance of sporodochia of Type I, caused by natural infection.

PLATE 32.

(Much reduced). Pear branch with one hundred per cent natural infection of Type I.

PLATE 33.

(Natural size). Mummied quinces resulting from natural infections with Type II in local market.

PLATE 34.

(Natural size).

Fig. 1: (B831), a strain of Type II, grown on a thin plate of potato dextrose agar--four days' growth.

Fig.2: (C148), a strain of Type III, grown on potato agar--four days' growth.

Fig.3: (C178), a strain of Type I, grown on potato agar--four days' growth.

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