A COMPARISON OF A SCLEROTINA FOUND ATTACKING APRICOT FRUITS IN CALIFORNIA WITH VARIOUS AMERICAN AND EUROPEAN FRUIT SCLEROTINIAS

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painted 1/2/15
canker of Bartlett Pear
X 1
from material brought
into Lab. 12/19/14
& kept in water

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April, 1918
Berkeley, California

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I. The Problem.

During the past few years the brown rot fungus, a species of Sclerotinia, has grown increasingly important in the central coast regions of California largely because of its parasitic attacks upon apricot trees and blossoms. The ripening fruit is likewise often attacked. This fungus occurring in California is locally called Sclerotinia fructigena, but should it be called by this name or by a different name? It was to find definitely if possible the answer to the above question that I undertook the experimental work later described.

II. History of species and present status of the species question.

a. In Europe.

Persoon (1) in 1796 gives the following description of a fruit rot fungus:

Torula fructigena: cinero-albida, subrotunda, filorum articulis ovatis.

Hab. in variis fructibus putridis Pruni domesticae Amygd. Persicae, autumno praecipue frequens in piris putridis, cespitulos crassos subrotundus efficiens. Obs. Fila in novo hocce genere nec in capitula stipitata colliguntur, qualia exhibent Moniliae negue digitiformia trunco imposita, uti in genere Aspergillo locum obtinet, and articulata; articulis deciduis, and glabra simplicissima sunt, quae in Dematio non observantur.

The above may be translated:

Torula fructigena: grayish-white, nearly round, egg-shaped united in chains.

Habitat: in various fruits of the domestic plum when decaying, peach, in autumn especially frequent in decaying pears, producing nearly round thick knobs.

Observation. There are chains in this new kind and they are not collected into crowded heads in like manner to the Moniliae, and not like finger-like forms inposed on a trunk, as takes place in the Aspergillus form, and they are articulated: the articulations separate and are smooth and very simple, which are not observed in Dematium.

His color term cinero-albida seems to refer to the color of the spores under the microscope, and not to the color of the fungus on the fruit as seen by the unaided eye. "Nearly round thick knobs" is his most definite morphological description. When he says, "There are chains in this new kind and they are not collected into crowded heads, *etc.*" he seems to be referring again to the appearance of the fungus under the microscope. His description of his group Monilia is not very enlightening.

Monilia. Erecta, filis moniliformibus capitulum constituentibus.

His description of Torula is just as vague.

Torula. Acaulis, fila moniliformia intricata, indeterminata effusa.

Persoon changed the name of this fungus from Torula to Monilia and Monilia it remained for 100 years, or until the Monilia form was found to be an imperfect stage of a Sclerotinia.

Ehrenberg (2) in 1818 gives the following:

Moniliae

Oideum Lk.

laxum mihi 4) inpruno armeniaco putrido

4) OIDEUM laxum: floccis erectis divergentibus pallido cinereis; articulis rarius confluxis pellucidis magnis. Habitu et colore ab O. fructigena Schmidt valde differt, cujus specimina, in herbario nostro servata, ab ipso amico Dr. Schmidt examinata sunt. Noster fungus Sporotrichum fere refert

Ehrenberg's description may be translated:

Moniliae

Oideum Lk.

laxum mine 4, in decaying apricots

4) OIDEUM laxum: tufts erect diverging pale ashen; spores large, pellucid, rarely holding together. Habit and color which differs exceedingly from O. fructigena Schmidt, whose specimens, which have been preserved in our herbarium, have been examined by Dr. Schmidt himself. Our fungus is closely related to Sporotrichum.

The first part of this description seems to be the only part of much value. Ehrenberg seems to describe a fungus different from the one Persoon describes, the difference apparently lying in the morphological appearance of the conidial pustules.

According to Aderhold and Ruhland (3) the name Oideum laxum was changed to Oospora laxa by Wallroth in 1833, and was later determined by Saccardo and Voglina as Monilia.

Bonorden (4) in 1851 claims to have found another fruit rot fungus which he calls Monilia cinerea and describes it as follows:

Monilia cinerea M; Kommt auf faulenden Früchten vor und hat graue Hyphen und unregelmässig - elliptische Sporen. Bildet kleine graue, etwas bräunliche Büschel oder Häufchen deren Mycelium in den Fruchten (Kirschen) sehr leicht beobachtet werden Kann, wenn man seine perpendikuläre Schnitte davon unter das Mikroskop bringt. Das Mycelium besteht aus artikulirten Fäden, welche sich ästig in den Zellen der Frucht verbreiten und mit spitzen, nicht septirten, im Inneren Körnigen, frei in die Zellen hineinragenden Faden endigen.

The above may be translated as follows:

Monilia cinerea Mine; habitat on decaying fruits. Hyphae gray; spores irregularly elliptical; sporodochia small, gray, somewhat brownish; mycelium from which sporodochia are produced is readily seen in vertical sections of the fruit (cherries). Mycelium of septate filaments which spread, branching in the cells of the fruit, and end in free filaments containing granular contents within the cells.

Saccardo (5) in 1886 mentions the three species of Monilia, fructigena, laxa and cinerea and besides these gives two varieties of M. fructigena, var. syconophila and var. candida.

Monilia fructigena Pers. Oidium fructigenum Link, Torula fructigena Pers. caespitulis compactiusculis, pulvinatis, saepe circinantibus confluentibusque, tomentosis, albidis dein carneo-ochraceis, hyphis fasciculatis breve ramosis; conidiis longe ramoso-catenulatis, ovoideis v. oblongis 25 10-2 e hyalino carneolis.

Hab. in fructibus Piri, Mali, Persicae. Armeniacae in Germania, Gallia, Italia, Britannia, Belgio, Austria, America bor.

Var. syconophila. Cfs. Rabenh. Flora 1850 p. 632 conidiis acutionibus; caespitulis subaurantiacis. In fructibus Fici siccis Casamicciola Ital. austri.

Var. candida Walk (sub Oospora): caespitulis candidis. Ad poma sub dio putrescentia in Thuringia. An haec var. mera typi forma junior? Sporotrichum fructigenum Link. videtur quoque status infans.

Monilia cinerea Bon. caespitulis minutis, cinereis compactiusculis; hyphis cinereis ramulosis septatis; conidiis irregulare ellipsoideis v. saepius limoniiformibus, 15-17- 10-12, e concreo hyalinis, longe concatenatis.

Hab. in fructibus putrescentibus Pruni Cerasi in Germania et Italia.

Monilia laxa Walk Sacc. et Vogl., Oospora laxa Walk., Oidium laxum Ehrenb., Acrosporium laxum Pers.., conidiis catemilatis, erectinsculis, divergenti-ramosis, dense aggregatis, griseis in articulos (conidia) singulos, ovales secedentibus.

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

The foregoing descriptions by Saccardo may be translated thus:

Monilia fructigena Pers. Oidium fructigenum Link, Torula fructigena Pers. spore masses more or less compact, cushion-shaped, often rounding and confluent, hairy, whitish then flesh color with ochre yellow, hyphae bunched, with short branches; conidia in long branching chains, egg-shaped or oblong 25 x 10 -12 microns, from transparent to flesh color (carneolis).

Habitat. in the fruit of pears, apples, peaches and apricots in

Germany, France, Italy, England, Belgium, Austria and North America.

Var. syconophila. Cfr. Rabenh. Flora 1850 p. 632:

with rather pointed conidia; spore masses shading into orange. On the dried fruits of the fig in Casamicciola, southern Italy.

Var. candida Walk (sub Oospora): spore masses white. In fruit (apple) rotting in the open in Thuringia. "Is this variety an early form of the genus? - one will recall that Sporatrichum fructigenum Link seems also an undeveloped form."

Monilia cinerea Bon. minute tufts, ashy (colored) more or less compacted; hyphae ashy (colored), branching, septate; conidia irregularly ellipsoidal or more frequently lemon-shaped, 15-17 x 10-12 microns, from ashy to transparent, in long connected chains.
Hab. in rotting cherry fruits in Germany and Italy.

Monilia laxa (Walk) Sacc. et Vogl., Oospora laxa Walk. Oidium laxum Ehrenb. Acrosporium laxum Pers. with conidia in chains, more or less erect, branching divergently, thickly clustered, ashy (colored) separating into single oval spores.
Hab. in rotten fruit of the apricot in Germany (Ehrenberg) "Is this Monilia different from M. cinerea?"

In general Saccardo's descriptions, with their names, agree with the descriptions of the three forms already given.

Woronin (6) in 1900 definitely establishes two species of Sclerotinia, which he calls Sclerotinia fructigena and Sclerotinia cinerea. At that time none of the apothecia of any of the fruit rot Monilias had been found and described, but Woronin was so sure that the forms he was

working with were really the imperfect stages of a Sclerotinia that he called the two forms Sclerotinia fructigena and Sclerotinia cinerea instead of Monilia fructigena and Monilia cinerea.

He gives for the average size of the conidia of Sclerotinia fructigena taken from the surface of naturally infected pears and apples, which have fallen to the ground, as 20.9 x 12.1 microns. The maximum measurements for conidia produced in the open he gives as 24.5 x 13.2 microns. In cultures on different favorable media the size of the conidia increases still more, reaching 20.7 - 30.8 x 14.9 - 16.5 microns.

Spores of Sclerotinia cinerea taken from leafy shoots of cherry and peduncles of cherry blossoms and from the surfaces of different stone fruits average 12.1 x 8.8 microns. He says however, that the size is not constant. The largest spores of Sclerotinia cinerea collected by him in the open measure 13.2 x 9.9 microns. Spores in cultures on different favorable media are larger, and measure usually 17.5 x 11.2 microns. Single spores he adds in the favorable culture media may reach even 24.2 x 13.2 microns.

Woronin found the most striking difference between these two forms to lie in the general form and color of the conidial pustules. Sclerotinia fructigena produced the compact knob-like yellowish pustules, while Sclerotinia cinerea produced the grayish more powdery pustules. See Plate 28 for copies of the color blocks appearing with Woronin's work.

Aderhold and Ruhland (3) in 1905 claim the distinction of rediscovering the species laxa. In their work they compare the apothecial stage of the species they call laxa with the apothecial stage

of S. fructigena, and compare the conidial stage of their species with the conidial stage they call cinerea. The species they call laxa is quite distinct from S. fructigena, but in the final analysis about the only distinction between their S. cinerea and S. laxa is the fact that S. laxa occurs naturally on apricots, and S. cinerea on other stone fruits, especially cherries, although S. laxa is supposed to have somewhat larger conidia than their S. cinerea.

They also decide that the form attacking peaches and plums in North America is S. cinerea and not S. fructigena, as Norton calls it, for the following reasons:

1. Preserved asci and ascopores they obtained from Norton are somewhat smaller than the asci and ascospores of their above Sclerotinia laxa.

2. Because Smith, E.F. describes conidia occurring on the peach in the Eastern United States as ashen-gray.

The first reason they think bars Norton's species from laxa, the second reason from fructigena.

Following are the principal distinguishing characteristics of Sclerotinia fructigena as given by Aderhold and Ruhland (3):

Table I. Showing principal distinguishing characteristics of Sclerotinia fructigena, Sclerotinia laxa, and Sclerotinia cinerea as given by Aderhold and Ruhland.

Species	Ascospores (microns)	Conidial tufts	Asci (microns)	Habitat
S. fructigena	11-12.5 x 5.6 -6.8 pointed, without oil drops	yellow, larger	120-180 x 9x12	pomes
S. laxa	11.5-13.5 x 5.2-6.9 blunt, often with small oil drops	gray smaller	121.5-149.9x8.5-11.8	apricot
S. cinerea	6.2 -9.3 x 3.1 - 4.6 blunt	gray smaller	8.9-107.6 x 5.9- 6.8	stone fruits

The foregoing measurements for Sclerotinia cinerea were made from apothecia on a peach mummy sent to Aderhold and Ruhland by Norton, the measurements for Sclerotinia fructigenia and Sclerotinia laxa were made from material obtained in their own country.

Massee (7) 1910 gives only one name, and that Sclerotinia fructigena, to the form that attacks apples, cherries, plums and peaches in England. He says that the fungus fruits are grayish-white or whitish. He describes the Monilia stage as follows:

"tufts consisting of simple or branched chains of ovoid or lemon-shaped hyaline spores, 21-25 x 10-12 microns.

The sizes of the spores here given correspond more nearly to the

Table 1. Staining reactions of *Sclerotinia* species, varieties of *Sclerotinia trifoliorum*, *Sclerotinia libera*, and *Sclerotinia sclerotiorum* as given by Weimer and Harvard.

Species	Appearance (mature)	Conidial Data	Ascus (mature)	Ascospores
1. *Trifoliorum*	11-18.5 x 5.8 - 8.8 pedicel, elliptical to oval drops	yellow, large		12.5-15.0 x 7x12 spores
2. *Libera*	11.8-13.2 x 5.2-6.9 Short, ellipsoidal with small oil drops	gray ovoid	11.8	8.8-10.5 x 4.4-5.2 ellipsoidal
3. *sclerotiorum*	8.2-9.4 x 5.1 - 4.8 blunt	gray smaller	0.4-10.5 x 6.5- 8.8	ovoid irregular

The foregoing measurements for *Sclerotinia sclerotiorum* were made from specimens on a peach mummy sent to Weimer and Harvard by Norton, the measurements for *Sclerotinia trifoliorum* and *Sclerotinia libera* were made from material obtained in their own cultures.

Species (?) 1919 gives only one name, and that *Sclerotinia trifoliorum*, to the form that attacks apples, cherries, plums and peaches in England. He says that the longer fruits are greyish-buff or yellow. He describes the conidia shape as follows:

"Conia consisting of simple or lengthened strains of ovoid or lemon-shaped hyaline spores, 21-25 x 10-12 microns."

The sizes of the spores here given correspond more nearly to the

sizes given by Saccardo for fructigena than for cinerea, but the color of the spores corresponds more nearly to cinerea than fructigena.

Wormald (8) 1917 in studying the classification of Monilias distinguishes four types of Monilia as found on cultivated fruit trees of the genera Pyrus and Prunus. He used prune juice agar plate cultures, and cultures on steamed potato in Roux' tubes as a basis for his classification, which is given below.

	Prune juice agar plate cultures	Cultures on steamed potato in Roux tubes
(1) Monilia fructigena occurring commonly on apples and plums and frequently on sweet cherries	Margin almost entire or laciniate; no known coloration; conidia absent	Conidial tufts yellow, well-developed at upper end of potato, forming raised zones
(2) Blossom wilt Monilia of the apple, also occurring occasionally on plums	Margin with deltoid or flabelli form lobes, growth usually arrested about midway between center and side of plate, and new outgrowths as flabelli-form lobes develop usually from the sinuses; olive green to brown zones appear, the first usually at 0.5 to 1 cm. from the center; conidia absent	
(3) A grey Monilia frequent on plums and sweet cherries	As above but no brown zones appear	conidial tufts grey more numerous than in (2) often appearing in concentric circles around point of inoculation.
(4). American form of Monilia.	Margin entire or crenate; conidial tufts numerous, usually in concentric circles; brown coloration of the agar absent or appears as a peripheral band near the edge of the plate; growth generally more rapid than in (2) or (3) and more uniform	Conidial tufts grey, almost covering the whole surface in a continuous layer.

Sclerotina fructigena is the only form to which he gives a specific name. In his summary however he says in part:

"The causal organism is a grey Monilia easily distinguished from M. fructigena; at present it is to be referred to Monilia cinerea Bon.

On culture media the habit of the fungus is different from that of the grey Monilia (also referred to M. cinerea by American workers) which is commonly found in North America."

b. In the United States

Smith (9) in 1889 states that Monilia fructigena causes a destructive rot of peach fruit and blight of young peach branches in the orchards of Delaware and Maryland. He says,

"In the fungus the common mode of propagation from peach to peach, and the only known one, is by means of ash-gray conidia, which are produced in great numbers on the brown surface of the affected parts. These spores generally occur in little hemispherical tufts or confluent masses on bundles of hyphal threads which have burst through the skin of the peach."

Smith says that he first discovered the blight in the summer of 1887 in Delaware. He also says that this fungus occurs destructively on peaches, apricots, plums and cherries, and to some extent also on apples, pears, and quinces.

Cordley (10) in 1899 gives the name Monilia fructigena to the form occurring on prunes, cherries, peaches, apples, pears and quinces in Oregon. As to color he says:

"In passing through almost any of our prune orchards when the green fruit is being picked, or even earlier, one may see here and there a

prune that is partly or wholly covered with this ash-grey or blue-gray 'mold' ..... On cherries and peaches ..... As the disease spreads the surface of the diseased tissues becomes covered with the characteristic ash-grey conidial tufts. In apples, pears, and quinces the disease spreads in much the same way but more slowly, and usually with a less abundant spore formation."

He says that the name of this fungus was determined in 1895 by means of prune specimens.

Norton (11) in 1902 changes the name of the form found in Maryland peach and plum orchards from Monilia fructigena to Sclerotinia fructigena, after definitely connecting the Monilia stage with a perfect stage. Norton says that the asci and paraphyses are of the usual form of the Pezizaceae and of the genus, and that the asci are 45-60 microns long and 3-4 microns wide with 8 spores in the apical half. He also says that cultures obtained from the ascospores produced the characteristic yellowish gray conidia of Monilia fructigena.

The question of the identification of species has interested several workers in this country, they no doubt being stimulated by the work of Woronin, Aderhold and Ruhland and other European workers. But our workers seem to have given little consideration to the possible Sclerotinia laxa, or, disregarding the specific names, to the fact that there may be more than two specific, economic fruit rot Sclerotinias. It will be remembered that Norton called the form he studied fructigena.

Read (12) in 1908 calls the form he has collected on various hosts fructigena. The measurements of the asci he gives as 125-215 x 7-10 microns.

The spores he says are ellipsoid, ends round or less pointed, hyaline, often containing refractive granules, and measure 10-15 x 5-8 microns. The measurements of chlamydospores, conidia, he gives as 10-28 x 7-17 microns, mostly 7 x 11 microns. He gives the color of the pustules as at first cinereous, later on cherries and plums becoming ochraceous-buff to Isabella color (R), on peaches even drab to Isabella color (R), on pears and apples acquiring a blackish tinge. He says also they are lemon-shaped, continuous, hyaline, inarticulate di - or trichotomously branched chains without disjunctors.

Reade's description seems to fit better into Aderhold and Ruhland's description of S. laxa than their description of S. fructigena. S. fructigena is supposed to have ascospores pointed at both ends, which do not contain granules or oil drop.

Mathney (13) in 1913 decides that the American brown-rot fungus is Sclerotinia cinerea and not Sclerotinia fructigena. He knows of Aderhold and Ruhland's work dealing with the three species, fructigena, laxa and cinerea but he evidently does not consider laxa very seriously.

Mathney's general averages of ascospore measurements taken from Connecticut, Massachusetts, Maryland, New York, Indiana, and Wisconsin follow:

Host	Asci Microns	Ascospores Microns
Peach	135-190 x 6.9-10.5 mostly 163 x 8.9	10.5 -14.5 x 5.2-7.5 mostly 12.5 x 6
Plum	135-173 x 6.8-10.8 mostly 151x9.4	9.3-14.2 x 5-7.4 mostly 11.8 x 6.3

The average measurements for the American brown-rot conidia he hives as 14.7 x 9.9 microns. Conidia from California, Indiana, and New Hampshire and local conidia were used in getting these measurements. These measurements

might find a place either under Scleritinia cinerea or Sclerotinia laxa as given by Aderhold and Ruhland.

Mathney gives the color of the conidia of Sclerotinia fructigena as yellowish; of Sclerotinia cinerea as ash-gray.

c. In California

In California the brown rot fungus is called Sclerotinia fructigena. A strain, which is apparently typical of the California form is discussed more in detail under Experimental.

d. General Summary

I. There are three early virginal descriptions of fungi, all of which have finally been put into the genus Sclerotinia, which attack the common domesticated fruits. Vague though these descriptions be, Persoon, describing Torula fructigena in 1796, Ehrenberg describing Oideum laxum in 1818, and Bonorden describing Monilia cinerea in 1851 all seem to be describing different fungi.

II. That there are more than three forms of Sclerotinia, or Monilia as he calls them, that attack the common domesticated fruits is demonstrated by Wormald. He distinguishes four kinds. The only form he calls definitely by name is Sclerotinia fructigena.

III. There is great need for exact systematic work with standardized methods in order to determine the number of species of fruit rot Sclerotinias.

III. Experimental

a. Introductory - Obtaining of the various strains used in culture and inoculation work.

As apothecia[1] have never been reported in California and as they are often difficult to get in other places, the cultural work has been confined to the Monilia stage.

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1. I searched in the spring of 1917 during the blossoming period of the apricot trees for apothecia of our fruit rot, Sclerotinia, and for apothecia of Sclerotinia libertiana. I brought to the laboratory from one orchard several of what I supposed to be Sclerotinia libertiana apothecia. These were all taken from the soil and none had any evident connection with a "mummy". Miss Smith (assistant professor of Plant Pathology at the University of California) placed these apothecia in a moist chamber with the adhering soil and considerable water. In a short time three apothecia showed to be slightly different from the typical Sclerotinia libertiana apothecia. They were somewhat darker and redder, a little coarser and tougher and more cup-shaped. Miss Smith used two of these apothecia to make rough cultures, first rinsing off the apothecium with distilled water and then planting a piece of it in a flask of bread and prune juice. From four flasks three apparently pure cultures of Monilia were obtained. Examination of the asci and ascospores of the other apothecium revealed a great ~~a great~~ similarity to Sclerotinia libertiana asci and ascospores. The spores were somewhat larger than the spores of Sclerotinia libertiana and were inclined to be egg shaped, and possessed a ready ability to form a cross wall, and produce sterigmata and gonidia without first producing mycelium. Gonidia were sometimes produced directly by an ascospore without the interposition of a typical sterigma. The spores of Sclerotinia libertiana do not act this way, as far as I know. The above facts are extremely suggestive.

Other persons have searched for the apothecia of our fruit rot, Sclerotinia, but have not found them to their knowledge, apparently three of those mentioned above were apothecia of our fruit rot Sclerotinia. There seems to be some chance of confusing them with the often abundant apothecia of Sclerotinia libertiana.

In all I possessed sixteen strains of Sclerotinias. The word "strain" is here used for want of a better word.

In no case am I responsible for any of the following specific names. The cultures were so labeled before they were sent to me. Where a strain is not given a specific name, no name came with the culture. In the case of strains 1,7 and 8, the California strains, the specific names are not known.

Sclerotinia sp. designated as strain 1 was obtained in the following manner:

A ripe but undried French prune was inoculated without sterilizing with spores and probably mycelium from the surface of a naturally infected apricot. The spores which formed on the French prune were used to make three poured plates of standard nutrient agar. From one of these plates a pure single spore culture was obtained by constant watching under the microscope and transferring to fresh culture medium. This is the strain the name of which I desire to determine.

Westerdijk's Sclerotinia cinerea designated as strain 2 was obtained either from cherry or plum in Hollard and forwarded to me by Dr. Johanna Westerdijk. In her letter accompanying this culture she says that this form was obtained from cherry, but the label on the culture says it was obtained from plum.

Westerdijk's Sclerotinia fructigena designated as strain 3 was obtained from apple in Holland and forwarded by Dr. Westerdijk along with strain 2.

English Sclerotinia fructigena designated as strain 4 was obtained at the Oregon Agricultural Experiment Station from a pear fruit sent to them by Dr. Salmon from Kent in England, and forwarded from Oregon here.

Oregon Sclerotinia cinerea designated as strain 5 was isolated at Corvallis, Oregon from an apple fruit.

Michigan Sclerotinia cinerea designated as strain 6 was obtained from an apothecium on a peach "mummy" Hart, Michigan. It was received through the Wisconsin Agricultural Experiment Station.

Apricot twig Sclerotinia designated as strain 7 was obtained in California during May from a small twig that had evidently been killed back during the previous blossoming period of the tree. It was not a single spore strain.

Apricot leaf Sclerotinia designated as strain 8 was obtained from a dead leaf at the time strain 7 was obtained. It was not a single spore strain.

Westerdijk's apricot Sclerotinia designated as strain 9 was isolated from conidia on apricot obtained in Germany, and sent here by Dr. Westerdijk.

Westerdijk's plum Sclerotinia designated as strain 10 was isolated from conidia on plum obtained in Holland and sent here by Dr. Westerdijk.

Westerdijk's cherry Sclerotinia designated as strain 11 was isolated and sent here by Dr. Westerdijk.

Westerdijk's apple Sclerotinia designated as strain 12 was isolated from conidia on apple obtained in Holland and sent him by Dr. Westerdijk.

Strains 9, 10, 11, 12 were not given a specific name by Dr. Westerdijk.

Washington prune blossom Sclerotinia designated as strain 13 was isolated from prune blossoms obtained in Clarke County, Washington and forwarded here by Dr. F. D. Heald.

Washington prune Sclerotinia designated as strain 14 was isolated from prune mummies obtained in Clarke County, Washington and forwarded here by Dr. F. D. Heald.

Prunus demissa Sclerotinia designated as strain 15 was obtained from Washington through Dr. Heald, where it causes a common blight and rot of the fruit of Prunus demissa.

Amelanchier Sclerotinia designated as strain 16 is a Sclerotinia that is found on the Amelanchier in the Palouse Country, Washington. It was sent here by Dr. Heald.

The best plan for studying these different strains and for arriving at some solution of the problem, namely the identification of our species, seemed to be to grow the strains on fresh fruits, as well as on prepared media, and to observe the type and color of growth, size and shape of spores, and other noticeable features. In the first series of inoculations ripe apricots were used.

b. Apricot inoculations to obtain rate of growth, type of growth, color of conidia, and approximate sizes of conidia.

The first twelve strains were used to inoculate fresh ripe apricots. Attempts to sterilize the apricots before inoculating injured the fruit so much, that the apricots were finally inoculated just as they were

picked from the tree after being placed in covered glass dishes. Two fruits were inoculated with each strain and two fruits were used as checks for each strain. All strains had been growing the same length of time on identical media at the time they were used for inoculating the apricots. The fruits were picked July 19, 1916 and were inoculated July 21, 1916. Table 2 gives rate of growth, type of growth, and color of conidia.

Table 2. Giving rate of growth, type of growth and color of conidia of the first twelve strains on ripe apricots

Strain	Rate of Growth 5 days old	Type of growth	Color	Remarks 5 days old
1	1st 1/3 brown 2nd brown 3 cm. diameter	Profuse spore production typical	A little lighter than Saccardo's[1]	Cks. normal Growth and color typical for strain
2	1st normal 2nd brown 1.5 cm. diam. to one side of pt.	Scant spore production Tendency of fruit to wrinkle as fungus advances decided	Seems to be like a very few spores for determining	Cks. normal
3	1st-3/4 brown 2nd brown 3 cm. diam.	Profuse spore production Similar to 1	See 1	Cks. normal
4	1st normal 2nd 1/3 brown	Profuse spore production Compact felty looking pustules	Cartridge buff (R)[2]	cks. normal
5	Very much advanced in decay Skins blackening progressively	Profuse low growing spores similar to 1	See 1	Cks. normal
6	Both 1/2 brown	See 1	See 1	Cks. normal
7	1st 1/2 brown 2nd brown 3 cm. diam.	Well developed Barely showing	Grayish olive (R)	Cks. normal
	1st normal 2nd 1/3 brown	In one week first growth overgrown with secondary whitish mycelium	do.?	Cks. normal

Table 2, continued

Strain	Rate of growth 5 days old	Type of growth	Color	Remarks 5 days old
9	1st normal 2nd nearly 1/2 brown	Spores barely showing on brown fruit	Grayish olive (R)	1 ck. normal other contaminated in 3 days
10	1st normal 2nd brown 1½-2 cm. diam.		See 1	Cks. normal
11	1st normal 2nd 1/3 brown	Similar to 1	Grayish olive (R)	1 ck. normal other contaminated in 4 days.
12	1st normal 2nd 1/3 brown	Similar to 4	Cartridge buff (R)	cks. normal

1. Saccardo, P.A. Chromotaxia seu Nomenclator Colorum 1894
2. Ridgeway, Robert Color standards and Nomenclature 1912

To obtain the color of the spore masses, a small mass of them was placed in the bottom of the dish, so that the spores could be placed over and near the color blocks to get the colors. Thus the light was partially transmitted, partially reflected.

All the strains were similar in that they readily induced a rotten condition of the apricot fruits. Some however did this much more rapidly than others. Strain 2, Westerdijk's Sclerotinia cinerea, progressed very slowly, in fact it was the slowest growing of all. Strain 5, Oregon Sclerotinia cinerea, became established first and grew most rapidly of all the strains. The other strains lay between these two extremes with a tendency to approach 5 rather than 2, 2 remaining distinctly in a class by itself as regarded the rate of growth.

In the matter of type of growth there seemed to be four different forms.

(1) Profuse somewhat loose spore pustules. Strain 1 typical.

(2) Profuse, compact, felty-looking spore pustules. Strain 4 typical.

(3) Abundant surface mycelium with very few spores. Strain 8 the only strain with this characteristic.

(4) Scant surface mycelium with very few spores. Strain 2 the only strain with this characteristic.

Nearly all the forms resembled the first above. The second had only two representatives, the third and fourth one representative each.

There seemed to be three different spore colors:

(1) Cartridge buff (R)
(2) Grayish olive (R)
(3) Drab - a little lighter than Saccardo's drab.

The two strains, 4 and 12, that had the profuse, compact, felty-looking spore pustules were the two that had the cartridge buff spores. The strain that had abundant surface mycelium with very few spores, strain 8, seemed to have grayish olive (R) spores, while the strain that had scant surface Mycelium with few spores, strain 2, seemed to have the drab-colored spores. All the other forms had either the drab-colored or grayish-olive spores.

If color must be considered as an important factor we would have five different types.

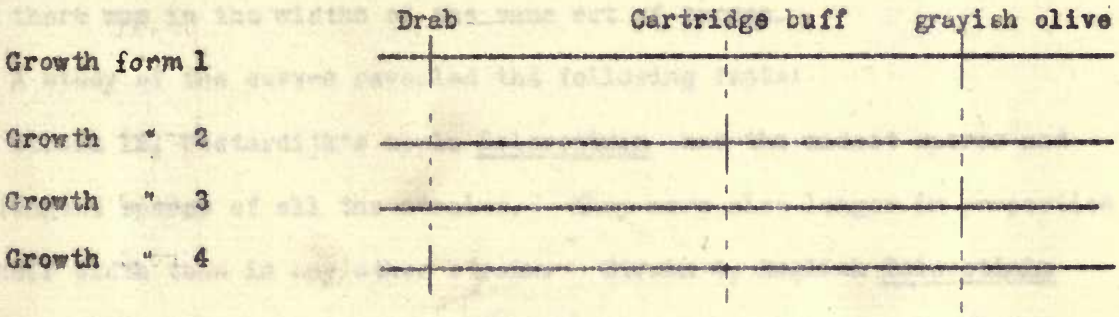

Diagram 1, showing possible types if color must be considered an important factor. Combination shown where solid lines cross.

The colors of all these forms did not remain constant as will be brought out later.

In getting the dimensions of the conidia they were mounted in ethyl alcohol (about 50%). The oil immersion lens was used. The values of the spaces of the ocular micrometer were calculated by means of comparing with a corrected stage micrometer. The value of the smallest spaces of the ocular micrometer was 1.9 microns, and, in measuring the spores, only the lines and an imaginary line half way between the lines were considered. That is if a spore, in length, covered 9 spaces and a

little over ~~over~~ but was nearer 9 than 9.5 spaces it was considered as 9 spaces, or 17.1 microns long. Unconscious selection was eliminated as far as possible by taking the spores as they came in crossing the field, but often masses of spores had to be skipped. 100 spores of each strain, as grown on the apricot fruits, were measured in this way. Plates 1-12 show graphical representations of the results.

The curves for spore width, with one notable and one minor exception, have a single peak. The curves for spore length all have more than one peak. That is there was more variation in the lengths of a set of spores than there was in the widths of the same set of spores.

A study of the curves revealed the following facts:

Strain 12, Westerdijk's apple Sclerotinia had the widest spores and the longest spores of all the strains. They were also longer in proportion to their width than in any other strain. Strain 4, English Sclerotinia fructigena had the next widest and longest spores, and the spores that stood next in their excess of length over width.

Aside from these general conclusions nothing more definite could be hazarded. Thus spore size differences, in this case at least, did not offer a very hopeful basis for differentiation. For this reason no more measurements were taken. Other workers have laid considerable stress on conidia dimensions.

The next series of cultures was grown on steamed rice.[1]

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1. 10 grams of rice and 50 cc of water placed in a flask and sterilized in the autoclave for 30 minutes at about 15 pounds pressure.

c. Steamed rice cultures to obtain the color of the conidia of the first twelve strains.

Flasks of steamed rice were inoculated with the first twelve strains, the ones used in the apricot inoculations. These cultures, as before, had been grown on the same medium the same length of time before using for inoculating. The colors were obtained by viewing the less dense masses of conidia through the flasks. All these cultures were planted November 23, 1916. Table 3 gives the colors on rice and the date the colors were determined, together with the colors as found on the apricot fruits.

Table 3. Giving colors of conidia of the first twelve strains when grown on steamed rice as compared with the colors of the conidia on apricot fruits.

Strain	Color of Conidia on rice	Color of Conidia on apricot	Date Color on Rice
1	Light grayish olive (R)	A little lighter than Saccardo's drab	12/1/16
2	Do.	Seems to be like 1 on apricot	12/2/16
3	Do.	See 1 on apricot	12/2/16
4	Cartridge buff (R)	Cartridge buff (R)	12/1/16
5	Light grayish olive (R)	See 1 on apricot	12/2/16
6	Do.	See 1 on apricot	12/2/16
7	Do.	Grayish olive (R)	12/2/16
8	Light mineral gray (R)	Do?	12/2/16
9.	Light grayish olive (R)	Grayish olive (R)	12/2/16
10.	Do.	See 1 on apricot	12/2/16
11.	Do.	Grayish olive (R)	12/2/16
12	Cartridge buff (R)	Cartridge buff (R)	12/2/16

On examining mounts from the culture of strain 8 no typical conidia could be found, only a mass of mycelium, irregular and spore-like at times.

Comparing Table 3 with Table 2, it was found that strains 4 and 12 were the only strains that had the same color of conidia when grown on rice that they had when grown on the apricot fruits. Three of the strains, 7,9 and 11 were very nearly the same color on rice that they were on the apricot fruits, all of these being light grayish olive (R) on rice and grayish olive (R) on apricot.

These rice cultures apparently offered little as a basis for differentiating the strains.

The next set of cultures was made on ripe Royal Anne cherries, all sixteen strains being used this time.

d. Cherry inoculations to obtain color of conidia and general appearance of fungi on the fruits for all of the sixteen strains.

Ripe Royal Anne cherries were picked from one tree June 29, 1917. June 30th the cherries were inoculated. Five cherries were used for each strain. The cherries were placed on 5 x 7 inch glass plates in position for photographing, with their appropriate numbers. The three outside cherries of each lot were used for inoculating, the two inside cherries being saved for checks. Two strains were present on each plate. plates 13-20. Glass dishes were placed on the fruit, which was kept on top of a laboratory table where there was a strong north light. Some temperatures secured by means of a thermometer which lay on the table with the cultures were as follows:

Date	Hour P.M.	Temp.°C
June 30	5:30	23.5
July 2	6:00	20.5
" 3	5:00	20.5
" 5	5:00	21.4
" 6	4:00	20.6
" 7	1:00	22.6
" 9	5:00	20.7
" 11	1:00	21.0

The photographs, taken July 7, 1917, show the results of inoculating the cherries with the different strains. Strains 2,15 and 16 failed absolutely to develop. The other strains showed varying degrees of development. The colors were taken by approaching the fruits as closely as possible with the color chart without touching them. Masses of the pores were not removed to the glasses as was done when getting the color of the spores on the apricots. The fruit was inoculated on the 30th of June and the colors were obtained on the 14th of July or two weeks after inoculating. Following is the list of colors obtained.

Strain	Color
1	Drab(S)
2	No fungus developed
3	Very slightly grayer than drab (S), but so close to it that the difference would ordinarily be overlooked.
4	Drab (S)
5	"
6	"

7	Drab (S)
8	Whitish mycelium but there seem to be no spores
9	Drab (S)
10	"
11	"
12	Cream (S)
13	Drab (S)
14	"
15	No fungus developed
16	"

Strain 1 showed itself in a typical manner on the cherry fruit. Strain 2 failed to develop. Strain 3 was typical. But what happened to strain 4? Instead of appearing as formerly with the smooth, felty-looking, cartridge buff pustules, it appeared in a form so closely resembling strains 1 and 3 that the three strains could not be distinguished. Up to this time strains 4 and 12 were alike as far as external appearances were concerned. There was a slight indication of a difference between 4 and 12 when the different strains were grown on the apricot fruits the previous year. When grown on the apricot fruits the spores of 12 were the longest of any with no exception. See graphs, plates 1-12. The easiest way to explain the situation would be to say that the cultures were probably mixed. I will not agree to such an explanation. We must leave the problem without a solution remembering the following:

Strain 4 which originally had the smooth, felty-looking, cartridge buff pustules, and which was called Sclerotinia fructigena, at the Oregon

Agricultural Experiment Station, resembled strain 3, which strain typically has had, ever since I have possessed it, dusty-looking drab-colored pustules, and which was called by Dr. Westerdijk Sclerotinia fructigena and that this strain 3 so closely resembled strain 1, or the California fruit rot form, that they could not be distinguished. These three strains were similar to several others, namely 5, Oregon Sclerotinia cinerea, 6, Michigan Sclerotinia cinerea, 7, Apricot twig Sclerotinia (California), 9, Westerdijk's apricot Sclerotinia, 10, Westerdijk's plum Sclerotinia, 11, Westerdijk's cherry Sclerotinia, 13, Washington prune blossom Sclerotinia, and 14, Washington prune Sclerotinia.

Strain 5 as it appeared on the cherries was characteristic for this strain, that is it was similar to strain 1, Strains 6 and 7 acted in a typical manner. Strain 8 which habitually produced abundant mycelium acted in a characteristic manner. No spores could be detected on the fruit. Strains 9, 10 and 11 were all characteristic and similar to strain 1. Strain 12 appeared as formerly with compact, felty-looking cream colored pustules. Strains 13 and 14 showed to be similar to strain 1, while strains 15 and 16 failed to develop.

As far as macroscopic characteristics go there were three different types that developed on the cherries.

(1) Profuse somewhat loose spore pustules drab (S) in color. Strain 1 typical.

(2) Profuse, compact, felty-looking spore pustules cream (S) in color. Strain 12 the only strain.

(3) Abundant surface mycelium with apparently no spores.

Strain 8 the only strain.

Strain 2, which had always remained in a class by itself, failed to develop.

All the forms, that developed, with the exception of 8 and 12 resembled strain 1, or the California fruit rot strain.

In this lot of inoculations there were only two colors represented, drab(S) and cream(S). Strain 12 had the cream-colored pustules, and all the others had drab-colored pustules with the exception of 8 which apparently had no spores.

After the experimental work which has been described above had been completed it was decided that there were four possible forms among the cultures, 1, 2, 8 and 12 being the typical forms. Strain 8, the California strain obtained from an apricot leaf, was discarded at this stage of the work. Single spore strains of 2 and 12 were obtained in the conventional manner. Strain 1 was already a single spore strain. Because of the peculiar behavior of strain 4 a single spore culture of it was also obtained, and likewise a single spore strain of 3. These single spore strains were used to make planted plate cultures on Czapeck's agar.[1]

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1. Czapeck's agar

Distilled water	1000.00	cc
Magnesium sulfate	.50	grams
Dipotassium hydrogen phosphate	1.00	"
Potassium chloride	.50	"
Ferrous sulphate	.01	"
Sodium nitrate	2.00	"
Cane sugar	30.00	"
Agar agar	15.00	"

e. Czapeck's agar cultures to obtain general types of growth of strains 1, 2, 3, 5 and 12.

This formula was chosen because it was a complete nutrient medium, because it could be readily duplicated by other workers, and because due to its lack of color, and because of its transparent qualities it was considered a desirable medium to use in photographing the cultures.

Poured plates were made in the usual way and were inoculated with the five strains, 1, 2, 3, 4 and 12, August 16, 1917. The photographs of these five strains were taken August 28, 1918 or twelve days after the plates were inoculated. Plates 21-25. These are typical photographs of the different cultures.

Strain 1 produced spores abundantly. In obtaining the color of the pustules the petri dish was placed over the color chart, the lid of the dish having first been removed. The spore pustules of this strain were very close in color to pale olive-buff (R). The general outline and appearance of the culture may be seen from the photograph of this strain. Plate 21.

Strain 2 produced a compact, somewhat moist looking culture that was barely raised above the surface of the agar, and to the unaided eye there seemed to be no spores present. An examination of material from the culture under the microscope revealed some spore-like pieces of mycelium, but no typical spores. Plate 22.

Strain 3, called by Dr. Westerdijk Sclerotinia fructigena produced spores abundantly and was so similar to strain 1 that the two could not be distinguished. Plate 23.

The same was true of strain 4, which to begin with had the felty-looking, cartridge Buff pustules. Plate 24.

Strain 12 remained distinct. On this agar it was the most rapid grower of any of the strains. Pustules were not produced, and a microscopic examination was necessary to find if there were any spores present. A few typical conidia were found. Plate 25.

These cultures were kept on the same table as the cherry cultures where some of the temperatures were:

Date	Hour P.M.	Temp. ° C.
August 16	3:30	18.5
" 17	3:30	18.5
" 18	1:00	18.4
" 20	4:30	20.5
" 21	3:00	18.5
" 22	4:30	19.5
" 23	1:30	18.5
" 24	12:30	20:0
" 25	4:30	21.7
" 27	4:00	21:3

To further test the individualities of these five selected strains it was decided to grow them all together on one medium. A Seek-no-further apple was chosen for this inoculation work.

f. Inoculations of the five strains, 1, 2, 3, 4 and 12 into one apple to further test their individuality.

For this experiment a nearly ripe Seek-no-further apple was carefully picked from the tree, placed in a moist chamber and inoculated

with the five strains used for the Czapeck's agar cultures, 1, 2, 3, 4 and 12. This was done on August 17, 1917. Five check punctures were made, one below each inoculation point, and these remained unchanged until overgrown by the fungus from above. The photograph was taken August 27th, 1917, or ten days after inoculation. Plate 26. In it the five letters, A, B, C. D, E represent the strains 1, 2, 3, 12 and 4 respectively.

A, C, E or strains 1, 3, 4 again could not be distinguished. They produced spores abundantly, especially A and E. The pustules were a little lighter than drab (S). B, or strain 2, grew so slowly that it was soon surrounded by A and C. Strain 2 produced a circular brown decayed spot, with a crack in the epidermis of the apple running through the point of inoculation. Microscopic examination revealed the fact that there were typical conidia present in the crack.

D, or strain 12, produced its most characteristic pustules. immediately around the letter. These were typically compact, felty-looking, and were cartridge buff(R) in color.

Thus again there were what seemed to be three distinct strains.

The inoculation of this apple terminated the experimental work.

C. Summary and conclusions.

I. The Sclerotinia found attacking apricot fruits in California (strain 1 is typical) produces conidia abundantly on many artificial and natural media. The pustules are rather loose and powdery, the color of these pustules being typically a drab, a little lighter than Saccardo's drab. These pustules may appear scattered or in more or less concentric zones.

II. This strain is similar to, and seems to be identical with, the following forms.

A strain attacking apple in Hollard and called by Dr. Westerdijk Sclerotinia fructigena. This strain never has produced, while in my possession, the yellowish pustules supposed to be typical for Sclerotinia fructigena.

A strain attacking apples in Oregon, and called Sclerotinia cinerea at the Oregon Agricultural Experiment Station.

A strain attacking peaches in Michigan and called by the Wisconsin Agricultural Experiment Station Sclerotinia cinerea

A strain attacking apricot twigs in California.

A strain attacking apricot fruits in Germany.

A strain attacking plum in Holland

A strain attacking cherry in Holland

A strain attacking prune blossoms in Clarke County, Washington.

A strain attacking prune fruits in Clarke County, Washington.

III. The strain mentioned under I of this summary is distinct from two other Sclerotinias which produce fruit rots, and which in turn are distinct from one another.

One is typically slow growing and produces very few conidia, which seem to be typically the same color as the conidia of the California fruit rot Sclerontina, that is a light drab, and sometimes more grayish. This form, called Sclerotinia cinerea by Dr. Westerdijk, was obtained from cherry or plum in Holland.

The other form produces typically felty-looking cartridge-buff (R) pustules. It was isolated from conidia on apple in Holland.

IV. These three distinct forms seem to correspond to the three original descriptions of Persoon, Ehrenberg and Bonorden.

The commonest form, of which the California apricot rot Sclerotinia is typical, seems to correspond in general to Ehrenberg's description. I suggest that it be called Sclerotinia laxa.

The form with the cartridge-buff pustules seems to correspond to Persoon's description. I think it should be called Sclerotinia fructigena.

The third form, called by Dr. Westerdijk Sclerotinia cinerea I think should retain that name.

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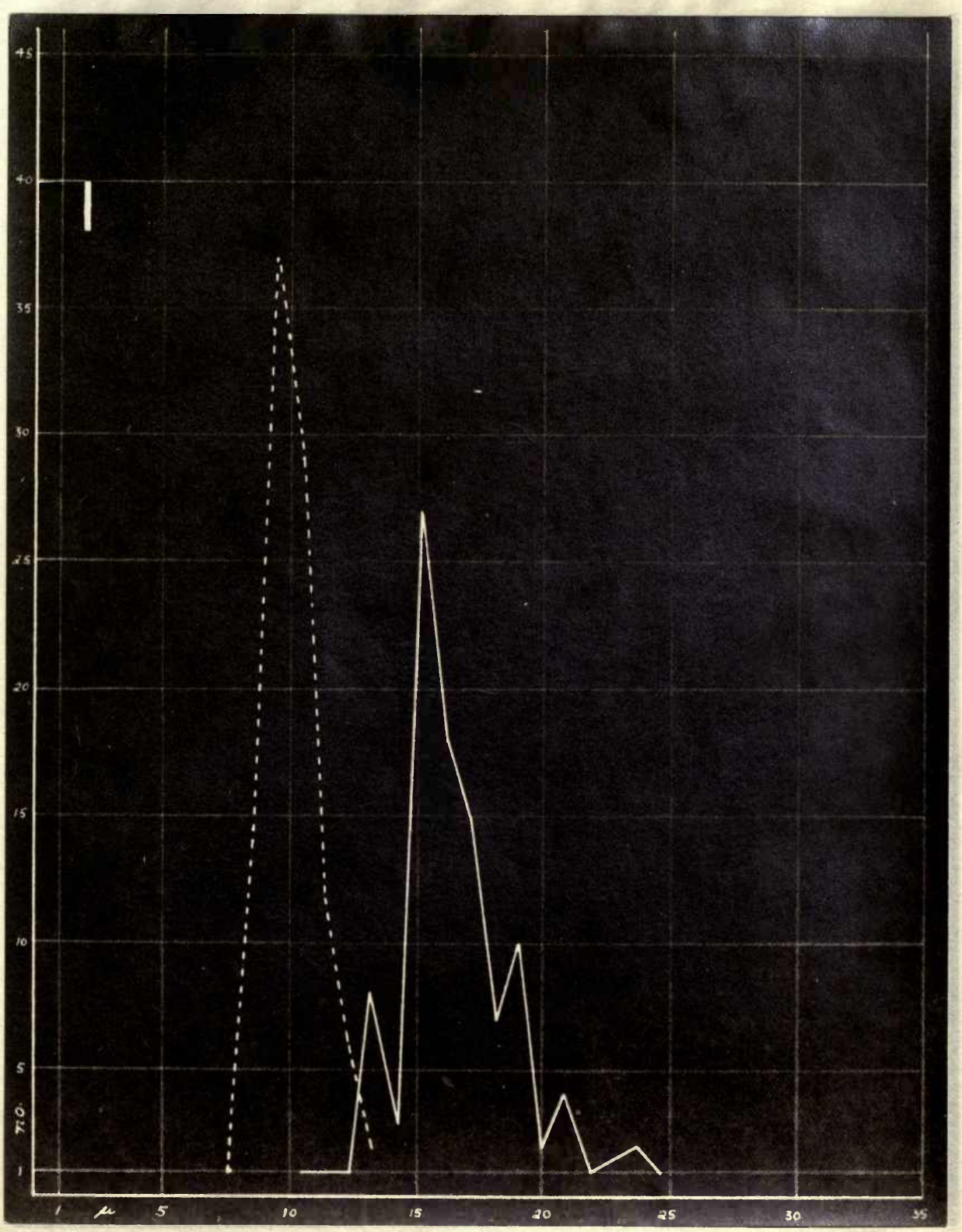
ILLUSTRATIONS

Plates 1-22. Graphical representations of the lengths and widths of 100 spores of each strain from strains 1-12 inclusive as grown on ripe apricot fruits. The dotted line representing widths and the solid line lengths.

Plates 1-12. Graphical representations of the lengths and widths of 100 spores of each strain from strains 1-12 inclusive as grown on ripe apricot fruits. The dotted line representing widths and the solid line lengths.

Plates 1-12. Graphical representations of the lengths and widths of 100 spores of each strain from strains 1-12 inclusive as grown on ripe apricot fruits. The dotted line representing widths and the solid line lengths.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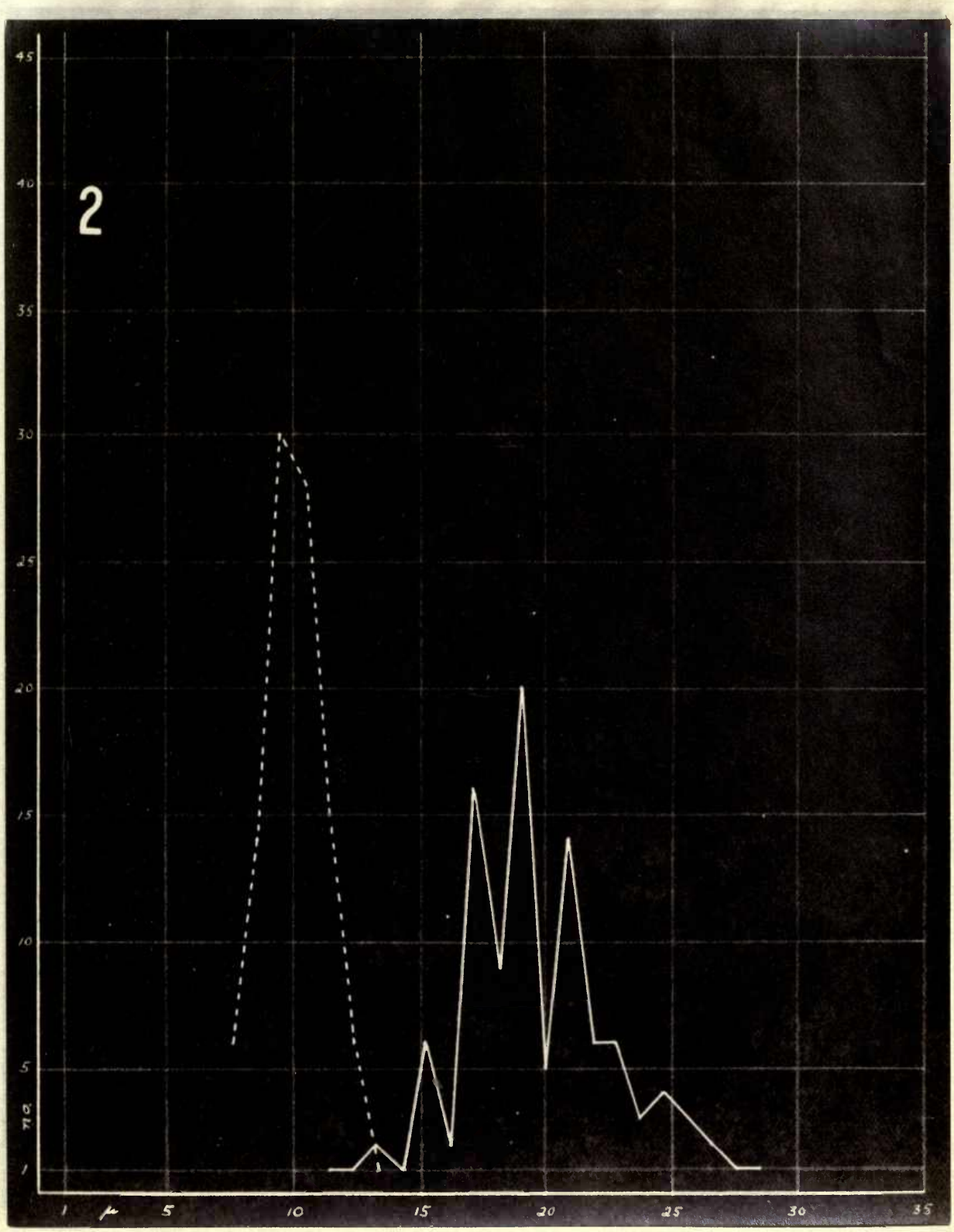
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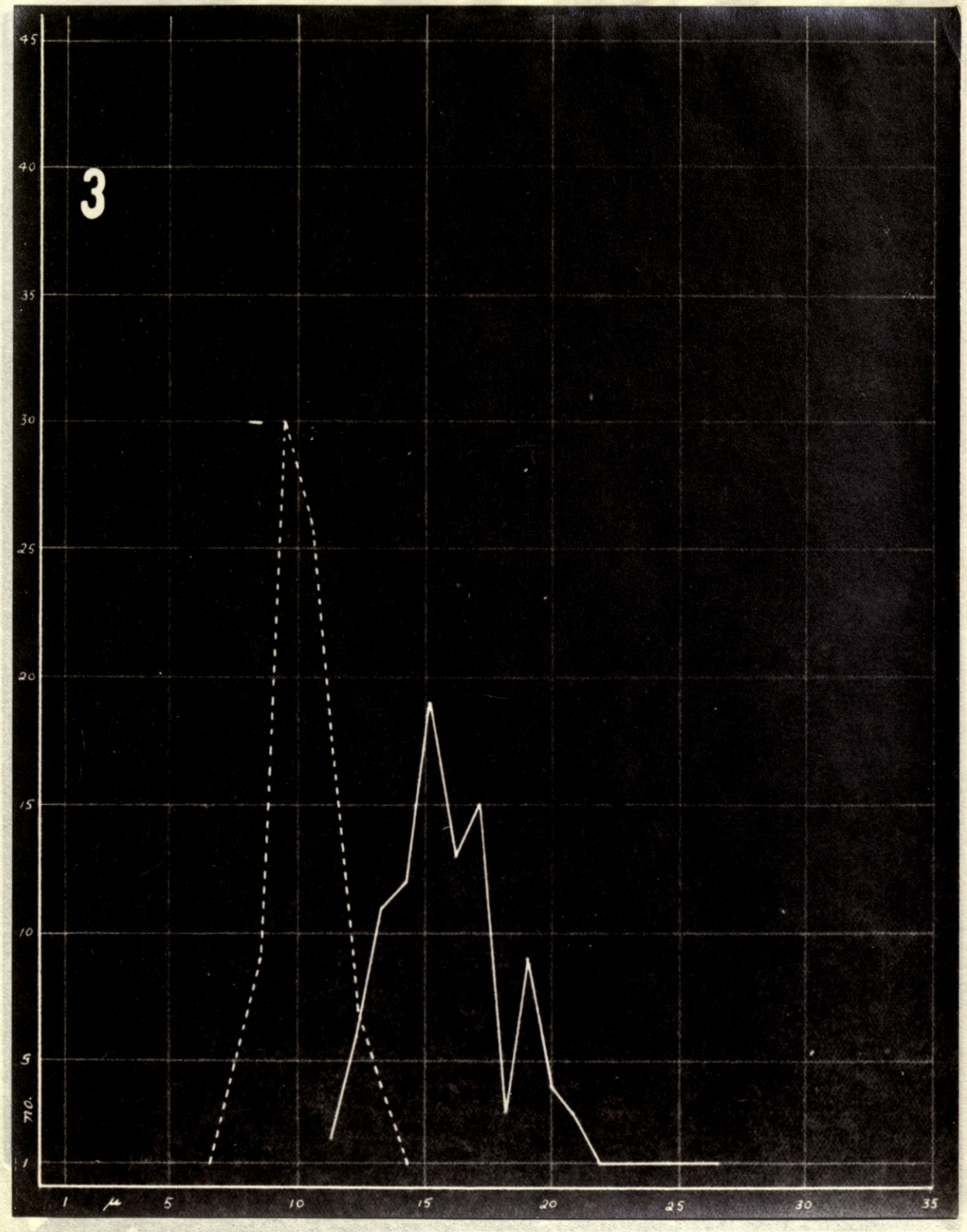
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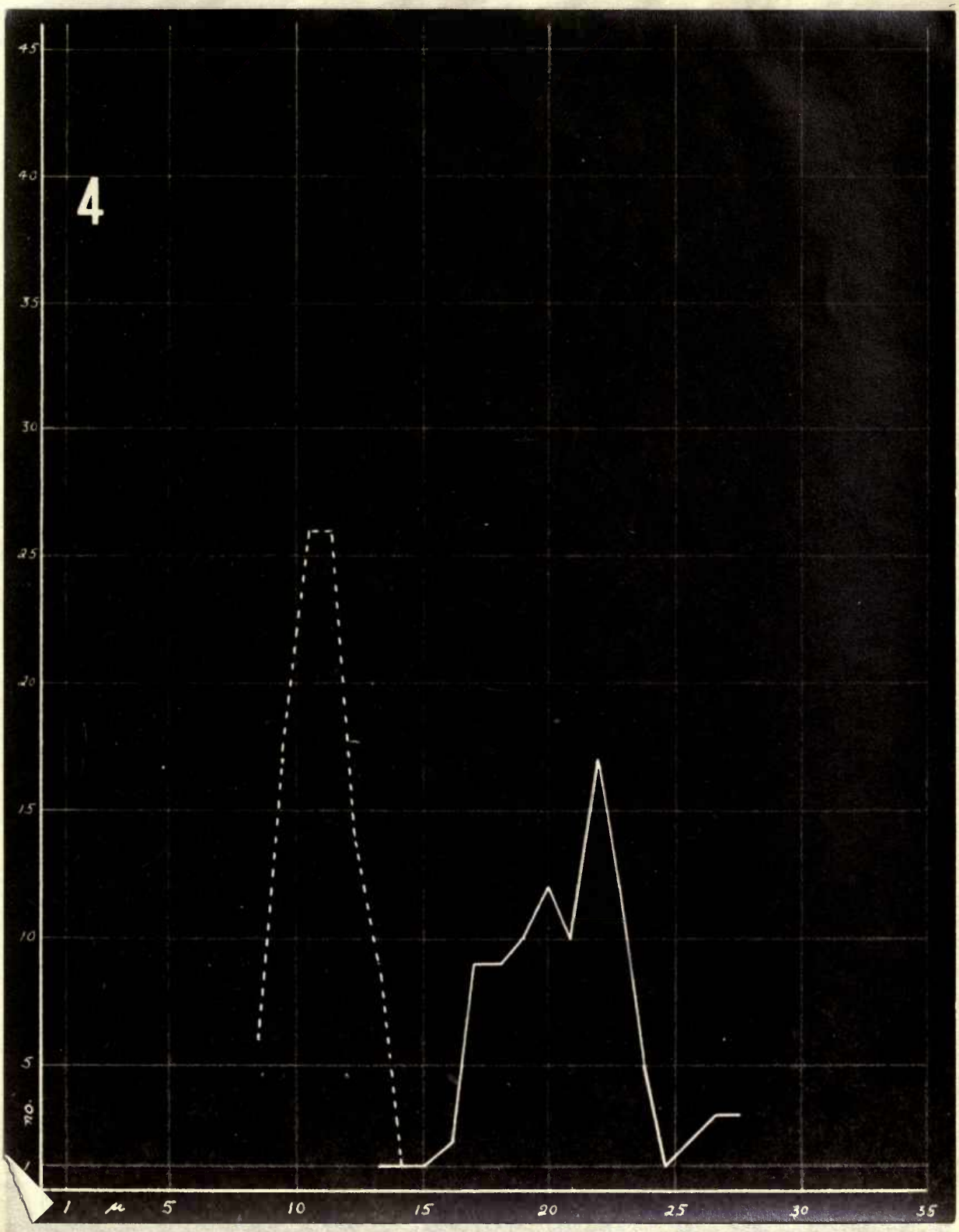
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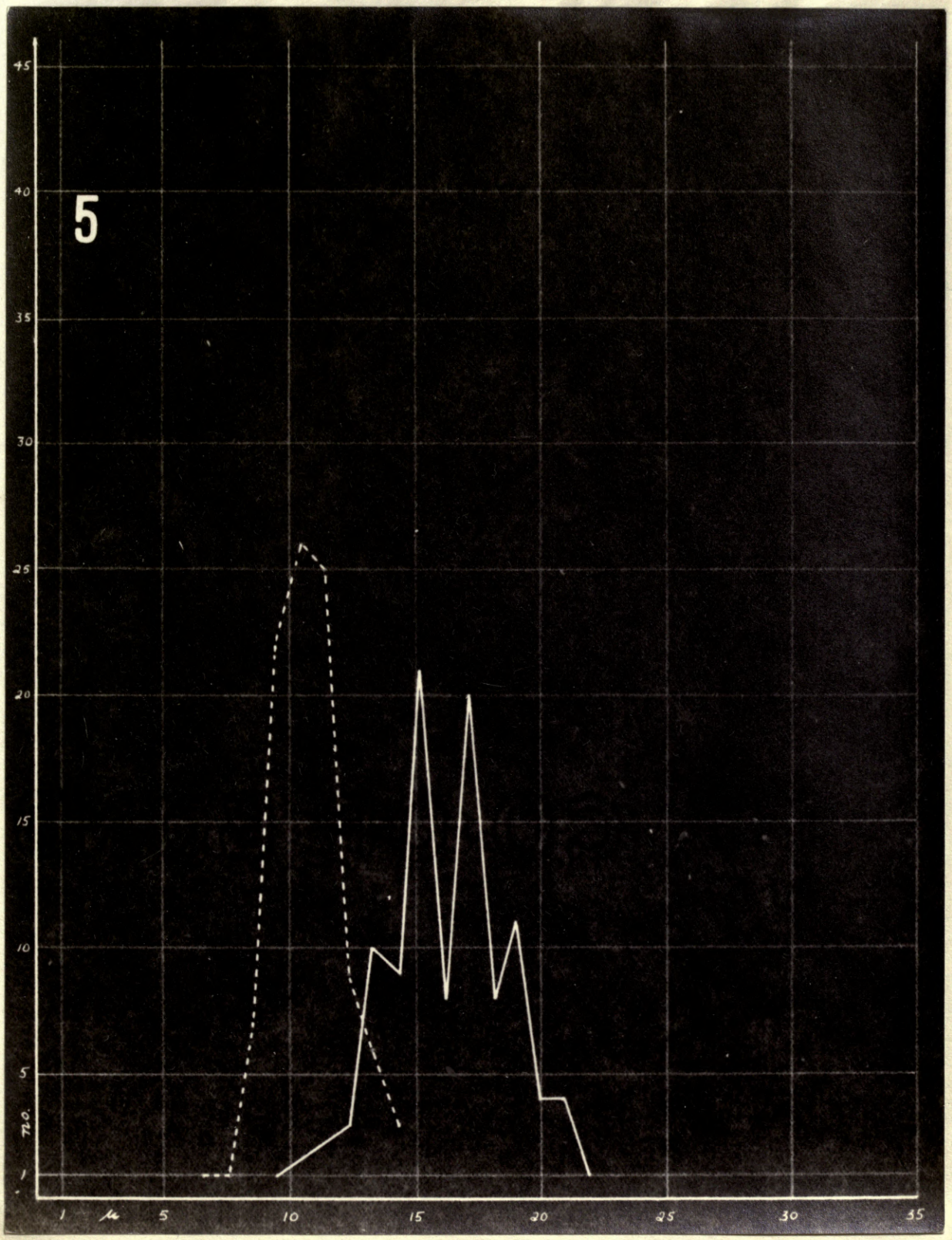
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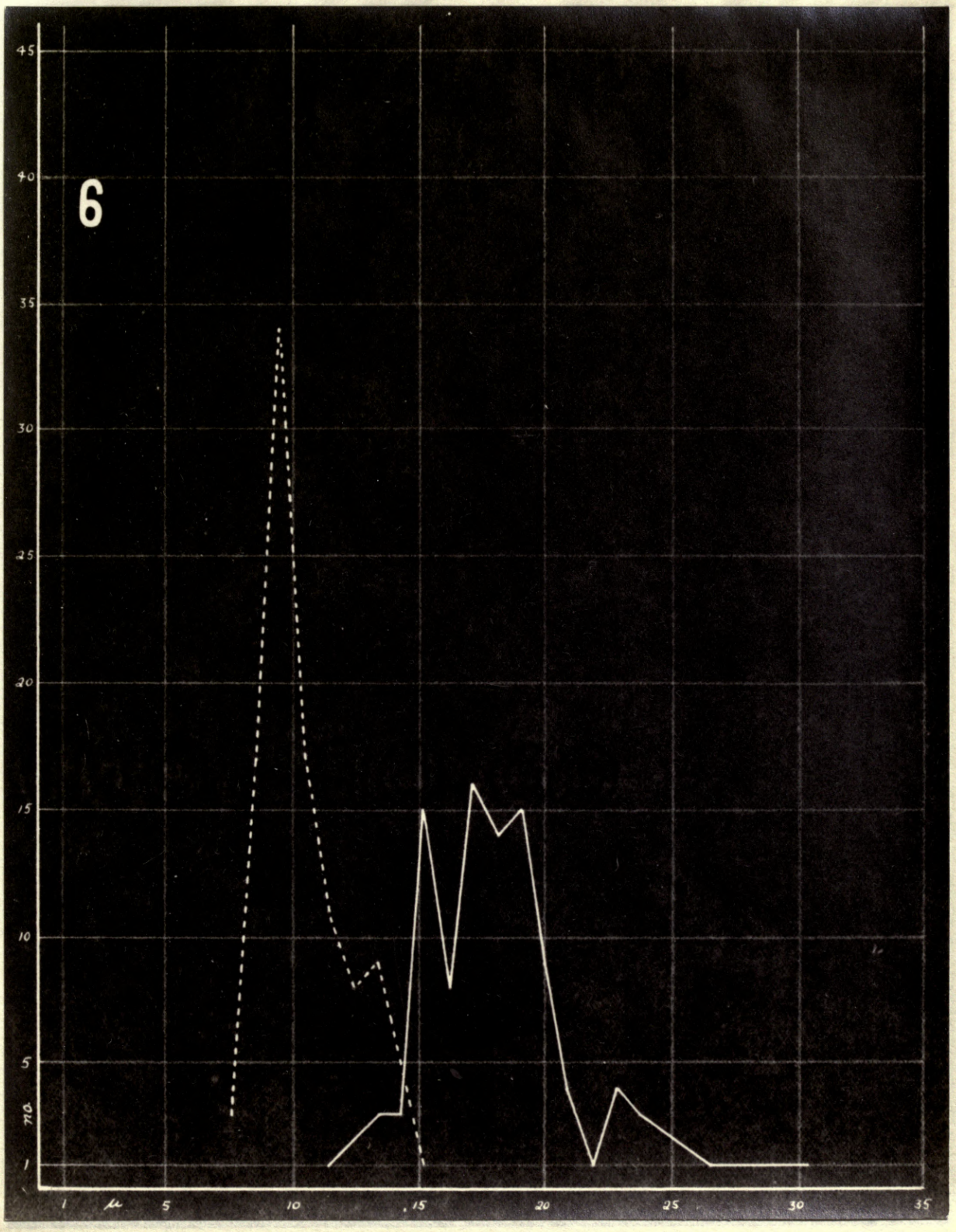
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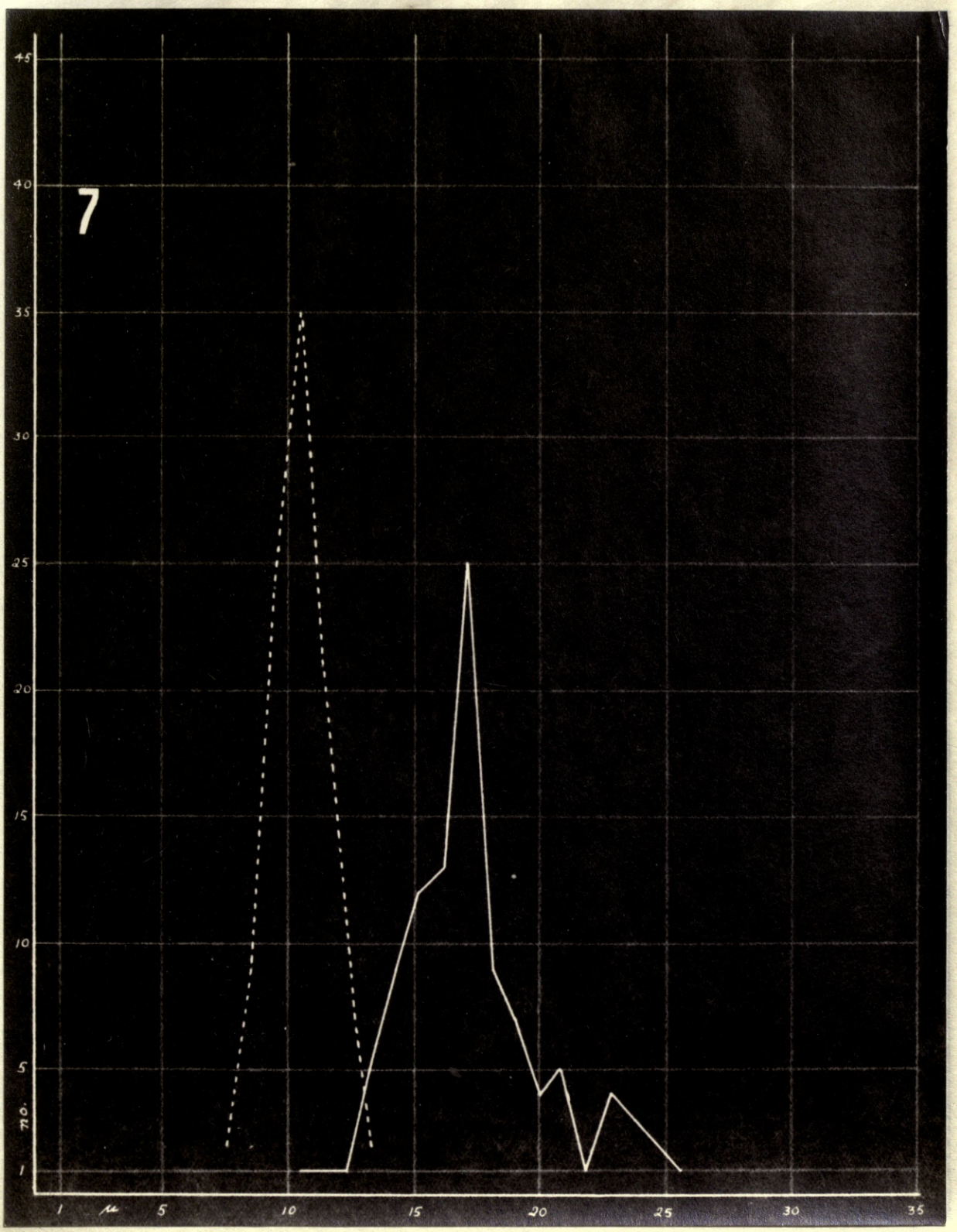
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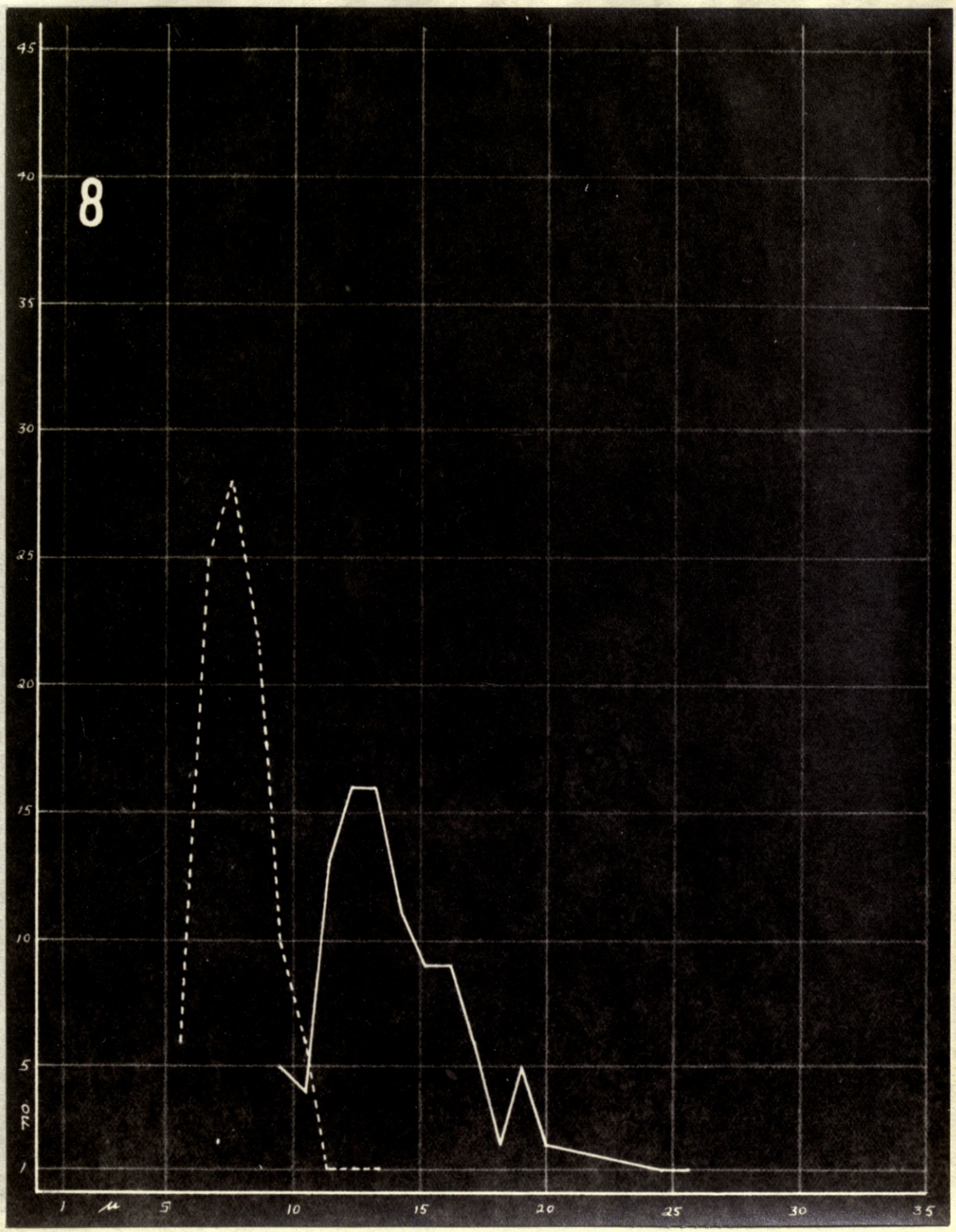
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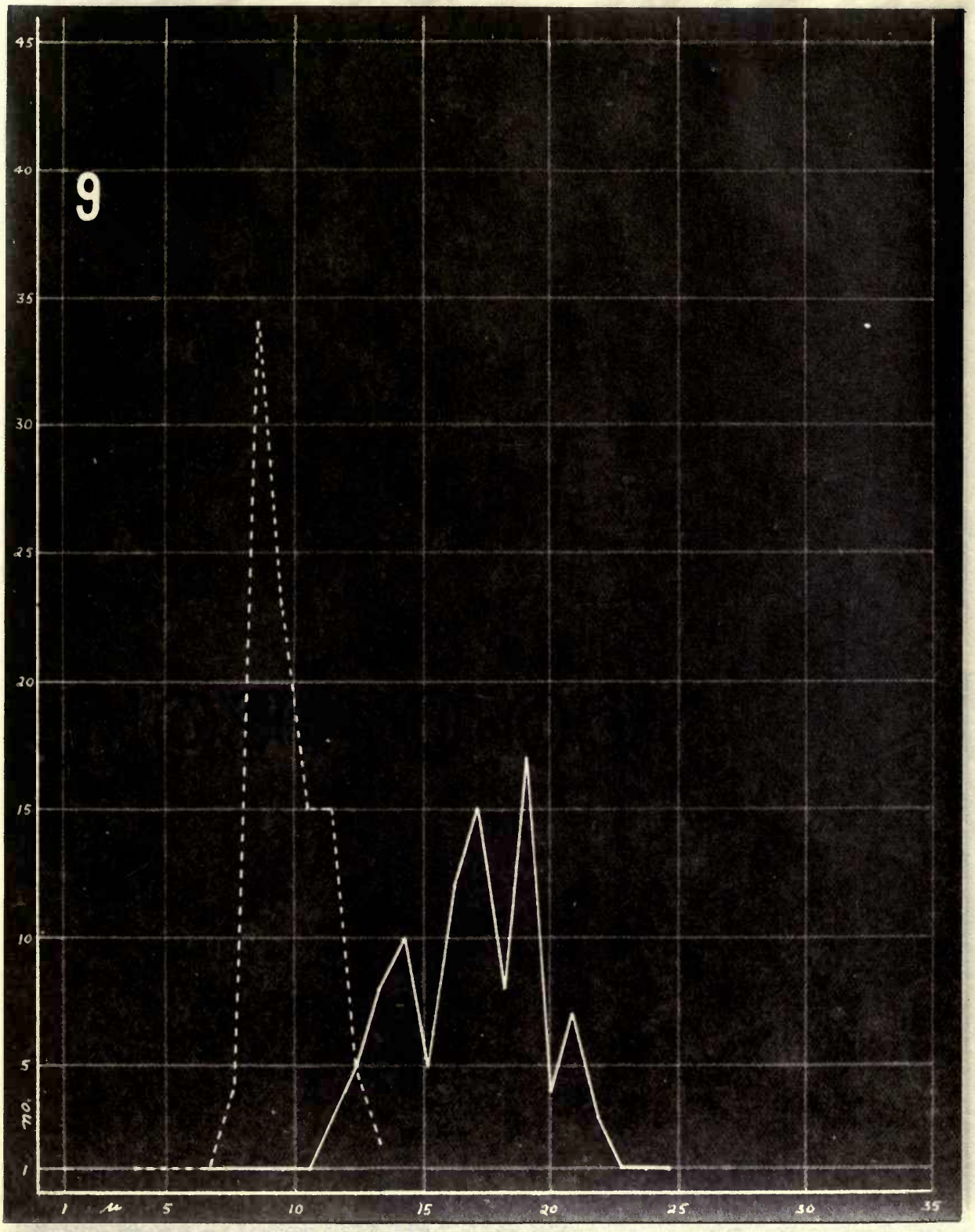
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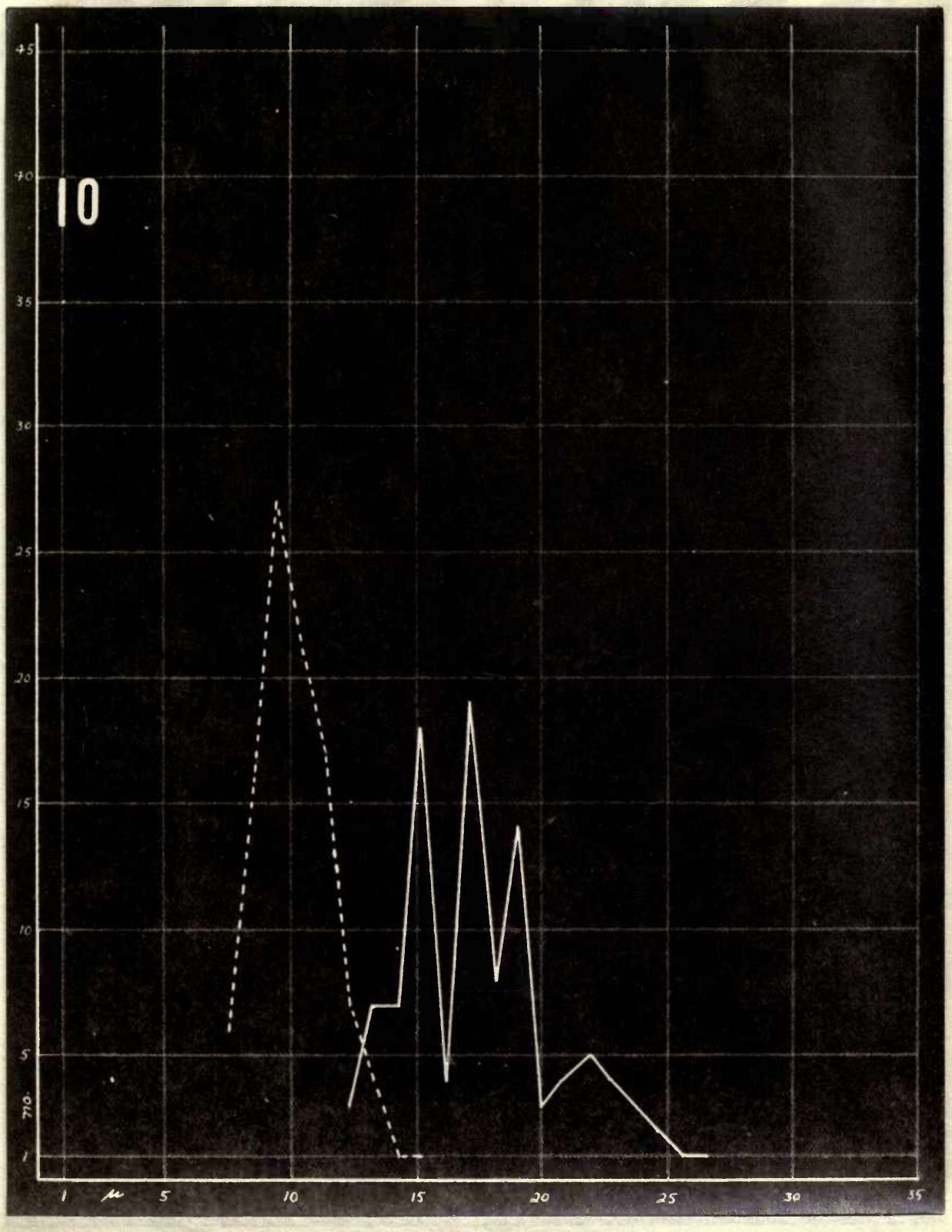
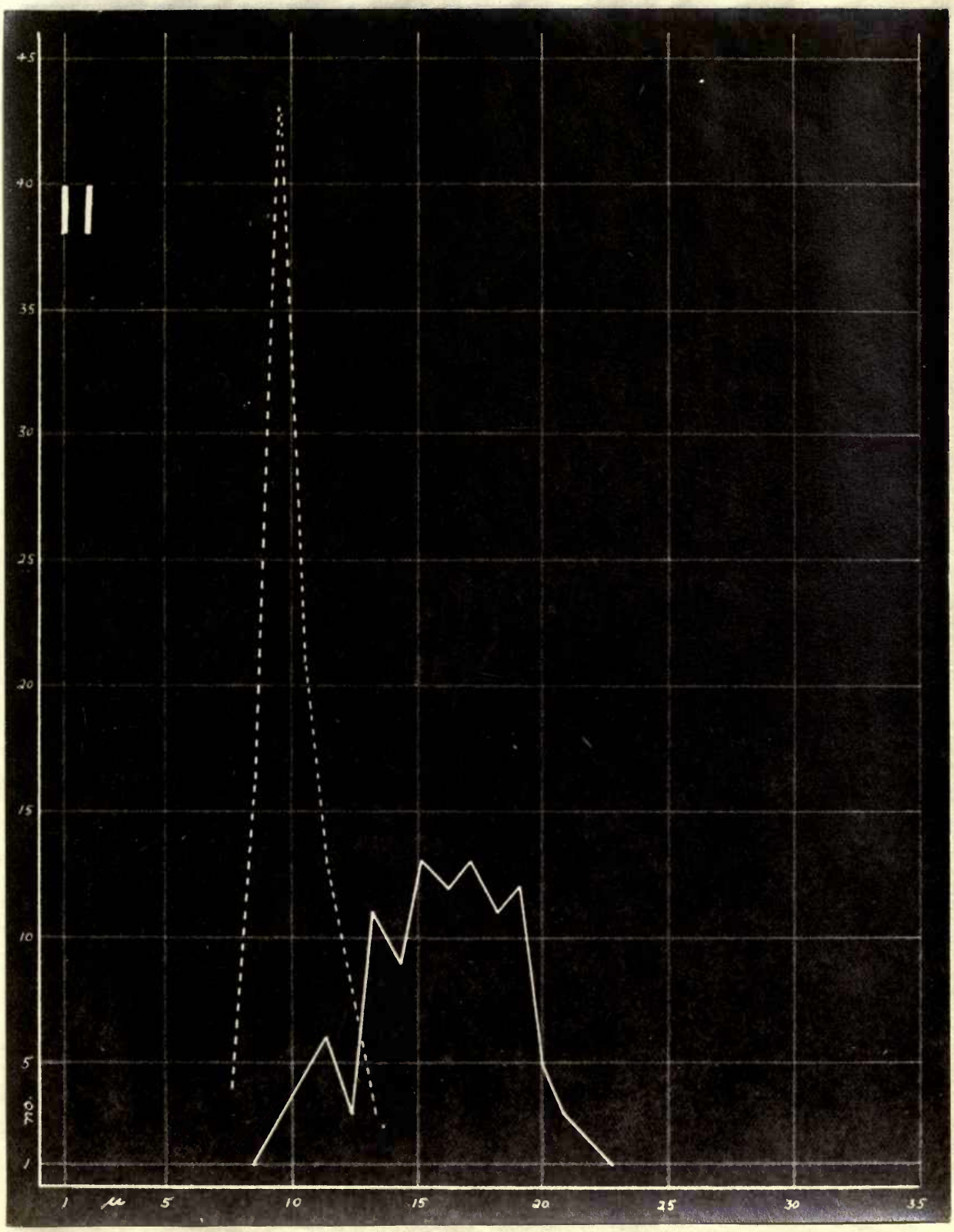
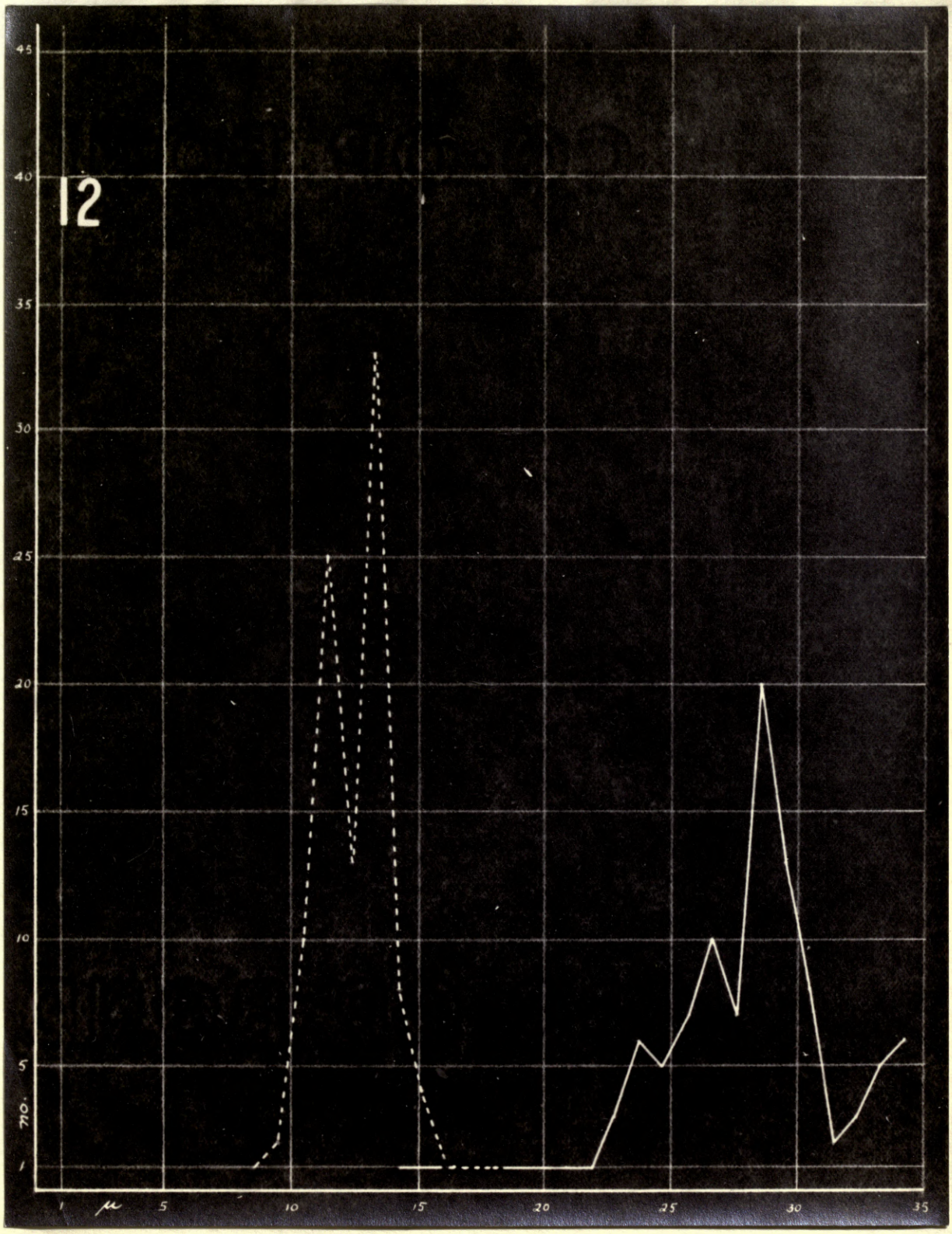
35
30
25
20
15
10
5
1
no.
1
5
10
15
20
25
30
35

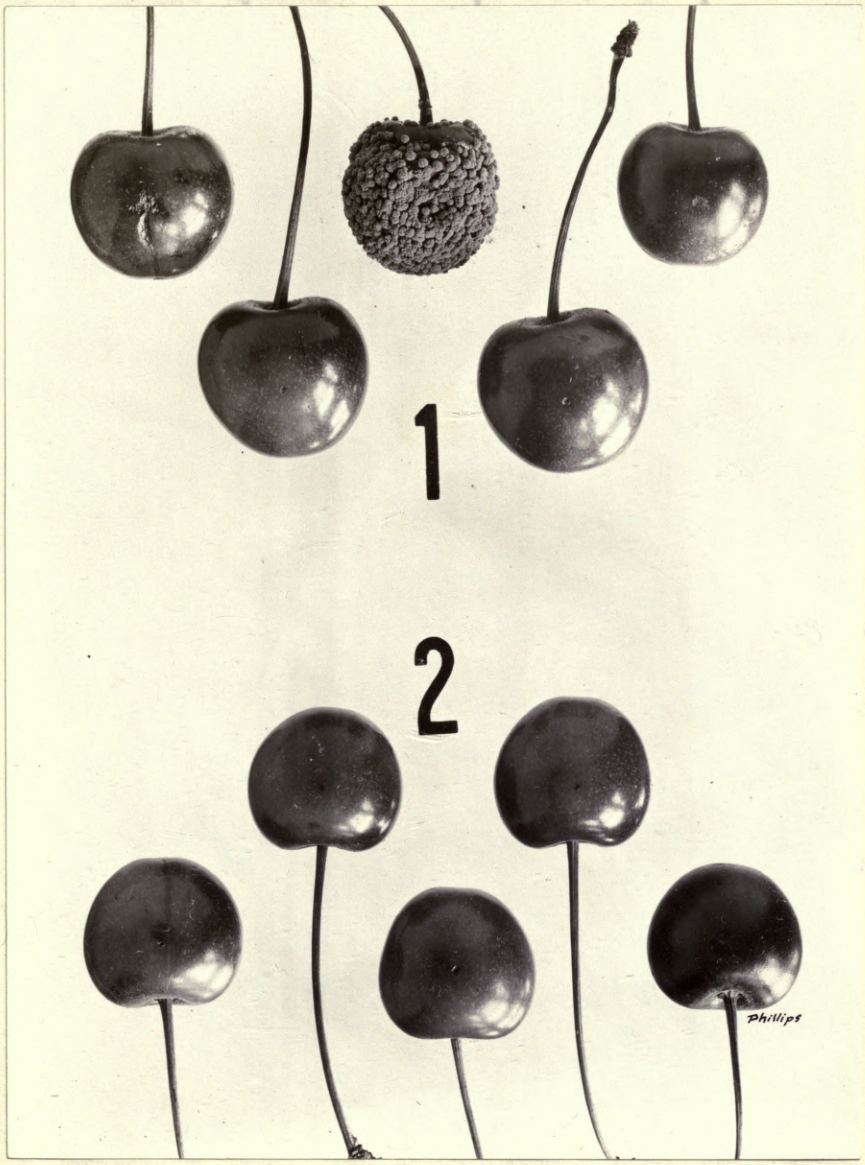

10
45
40
35
30
25
20
15
10
5
1
710
1
5
10
15
20
25
30
35

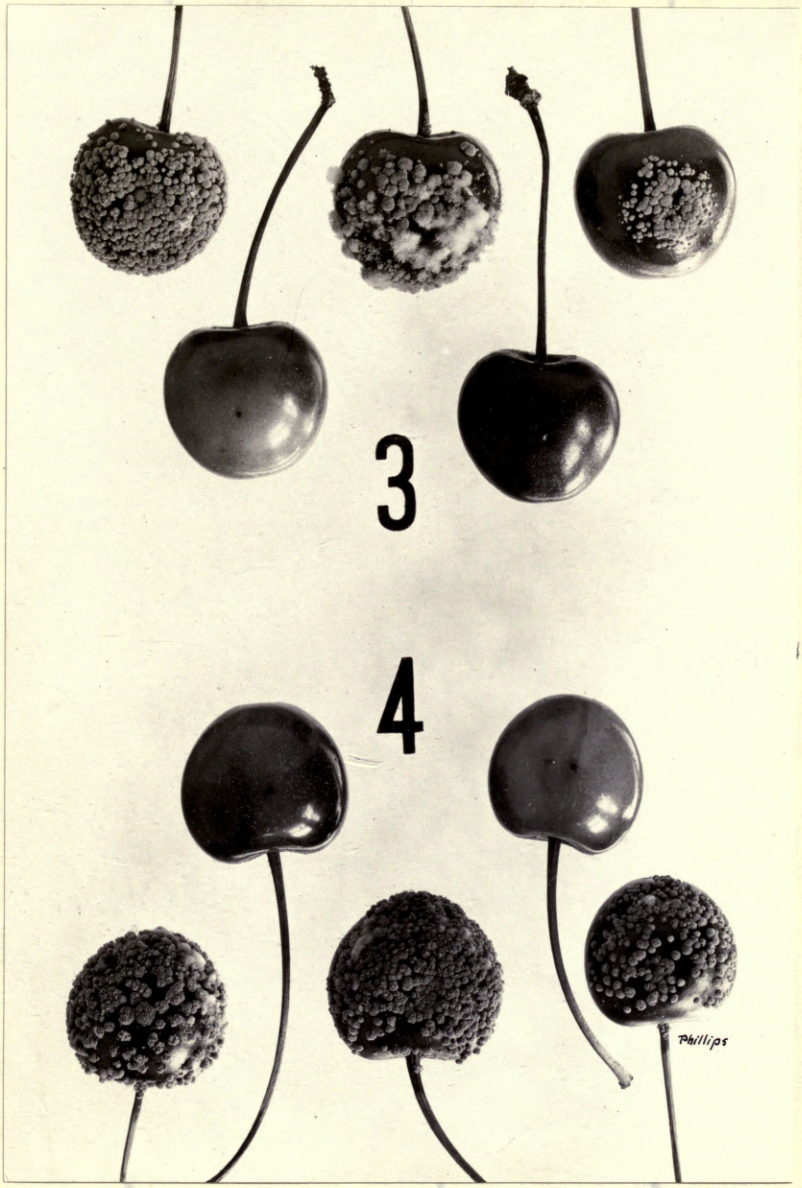

II
45
40
35
30
25
20
15
10
5
1
OR
1
μ
5
10
15
20
25
30
35

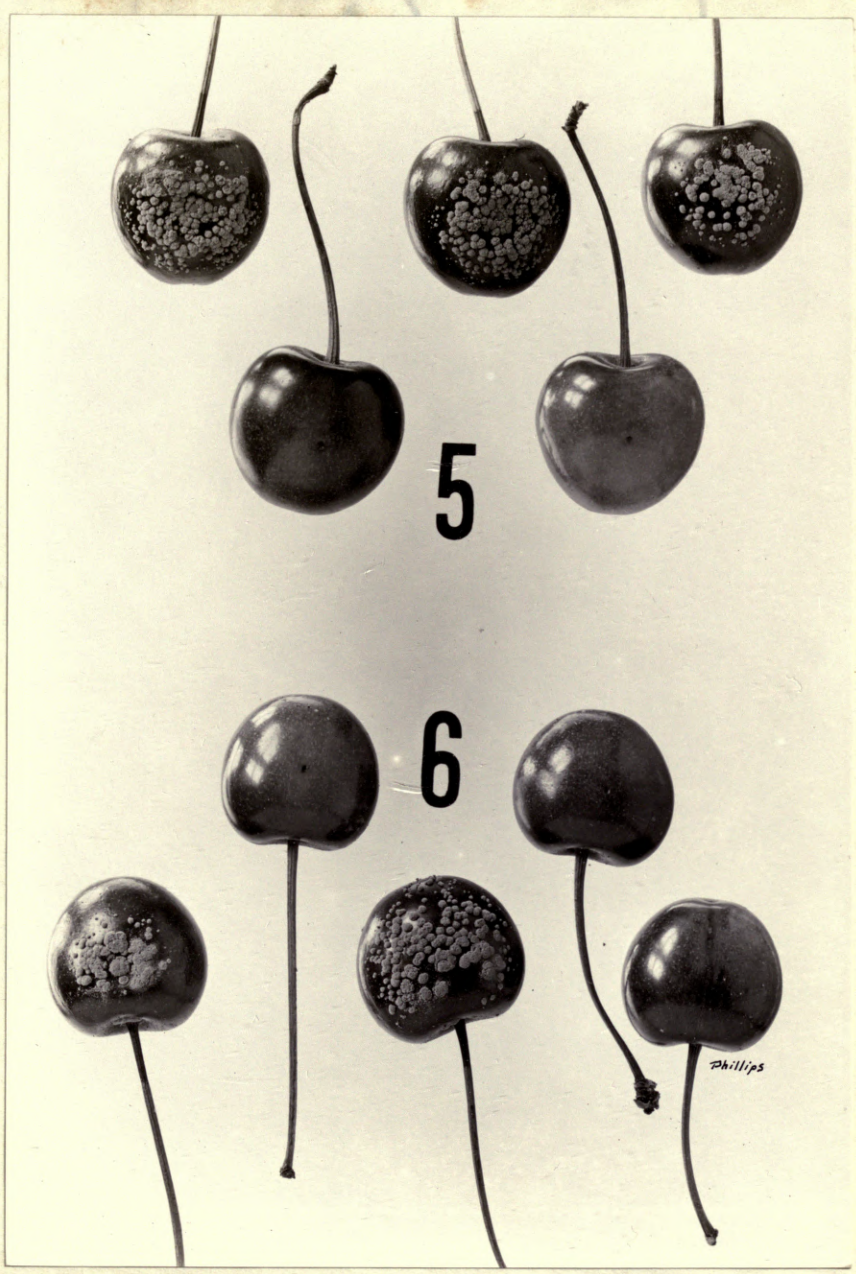

12
45
40
35
30
25
20
15
10
5
1
No.
1 μ
5
10
15
20
25
30
35

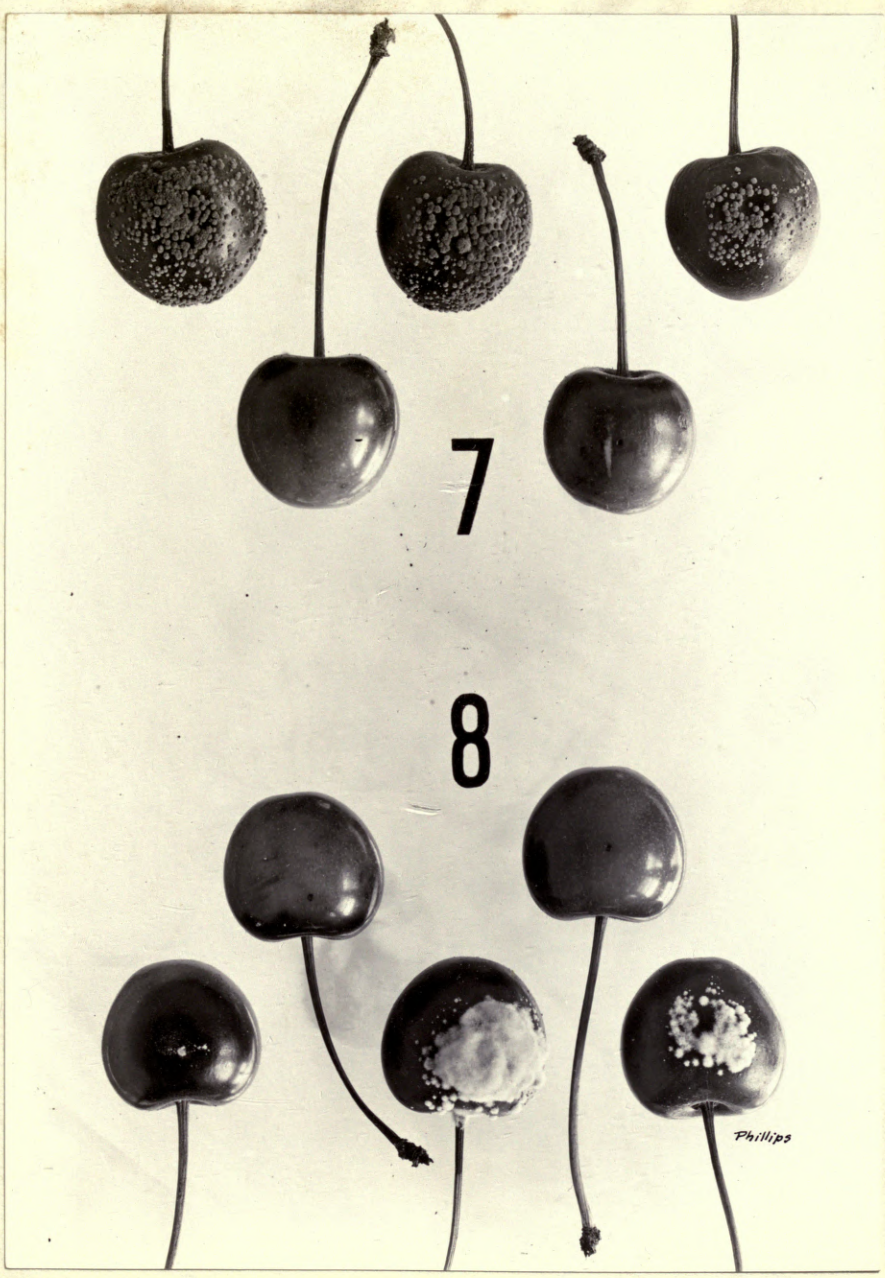
Plates 13-20. Photographs showing the results of inoculating ripe Royal Anne cherries with strains 1-16 inc. respectively.

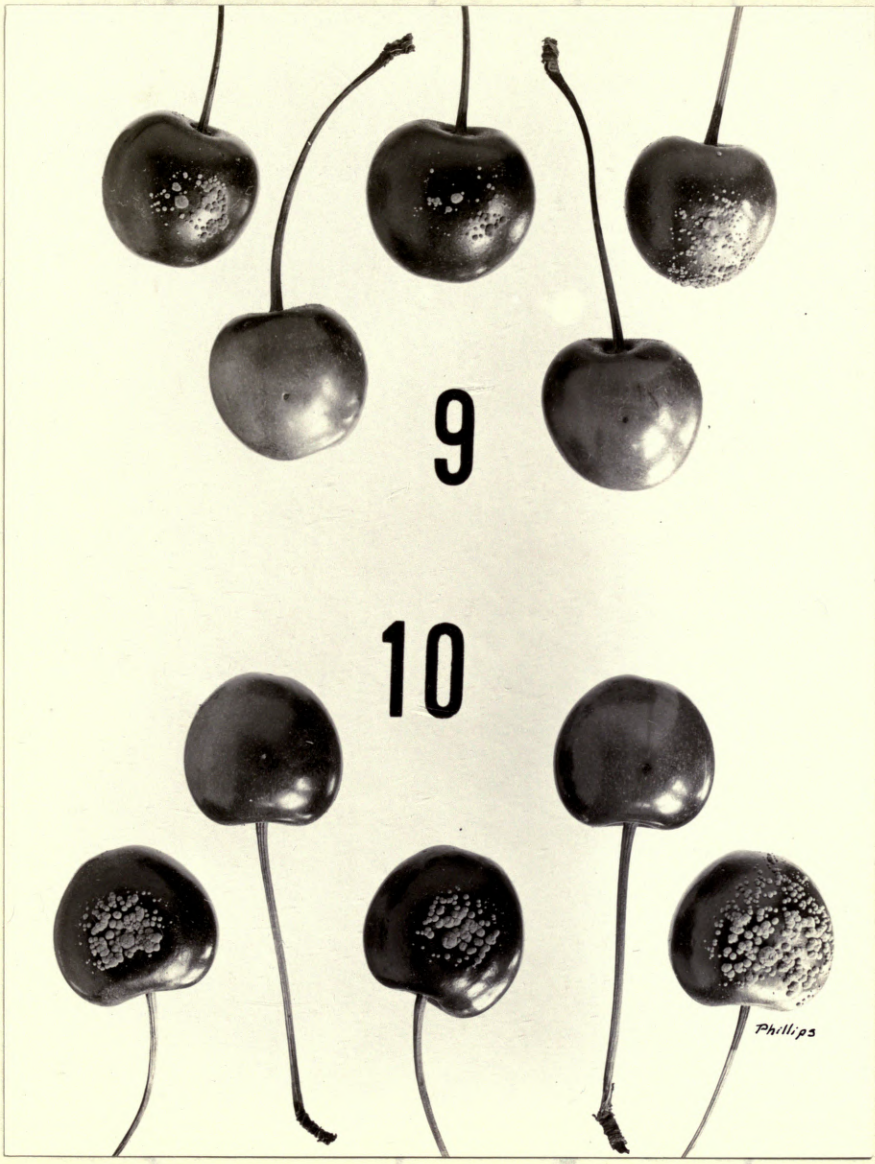
Fruit inoculated June 30, 1917
Photographed July 7, 1917
Cherries are natural size.

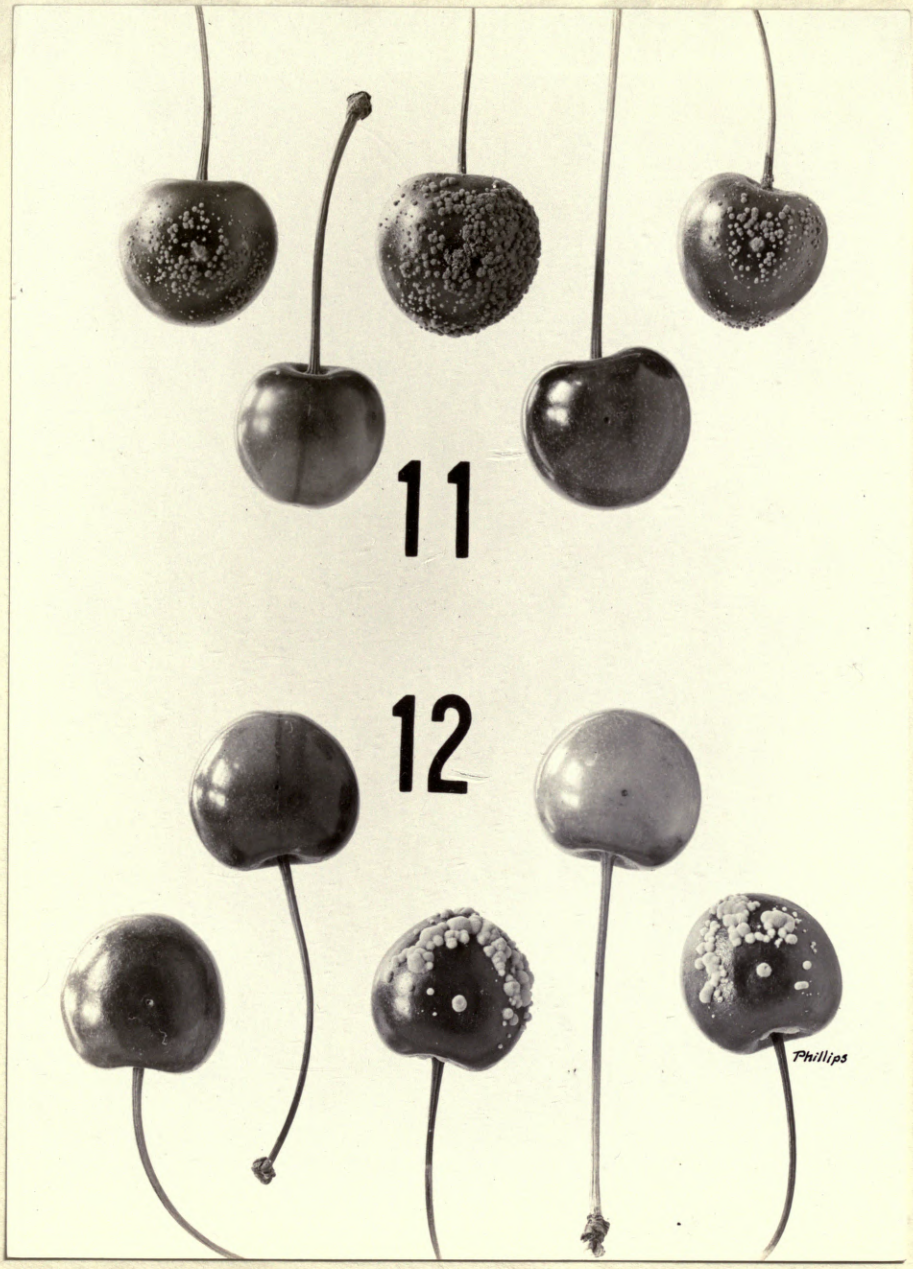

1
2
Phillips

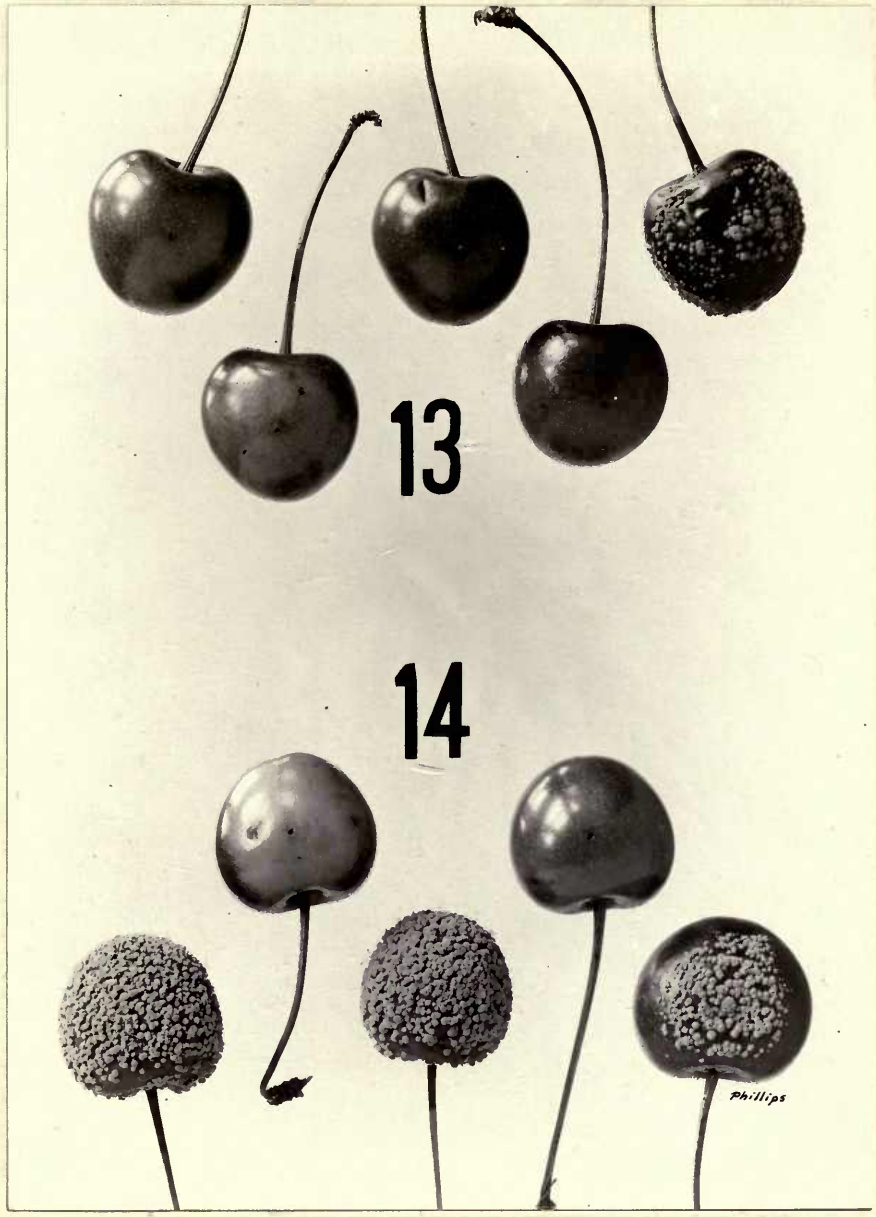

3
4
Phillips

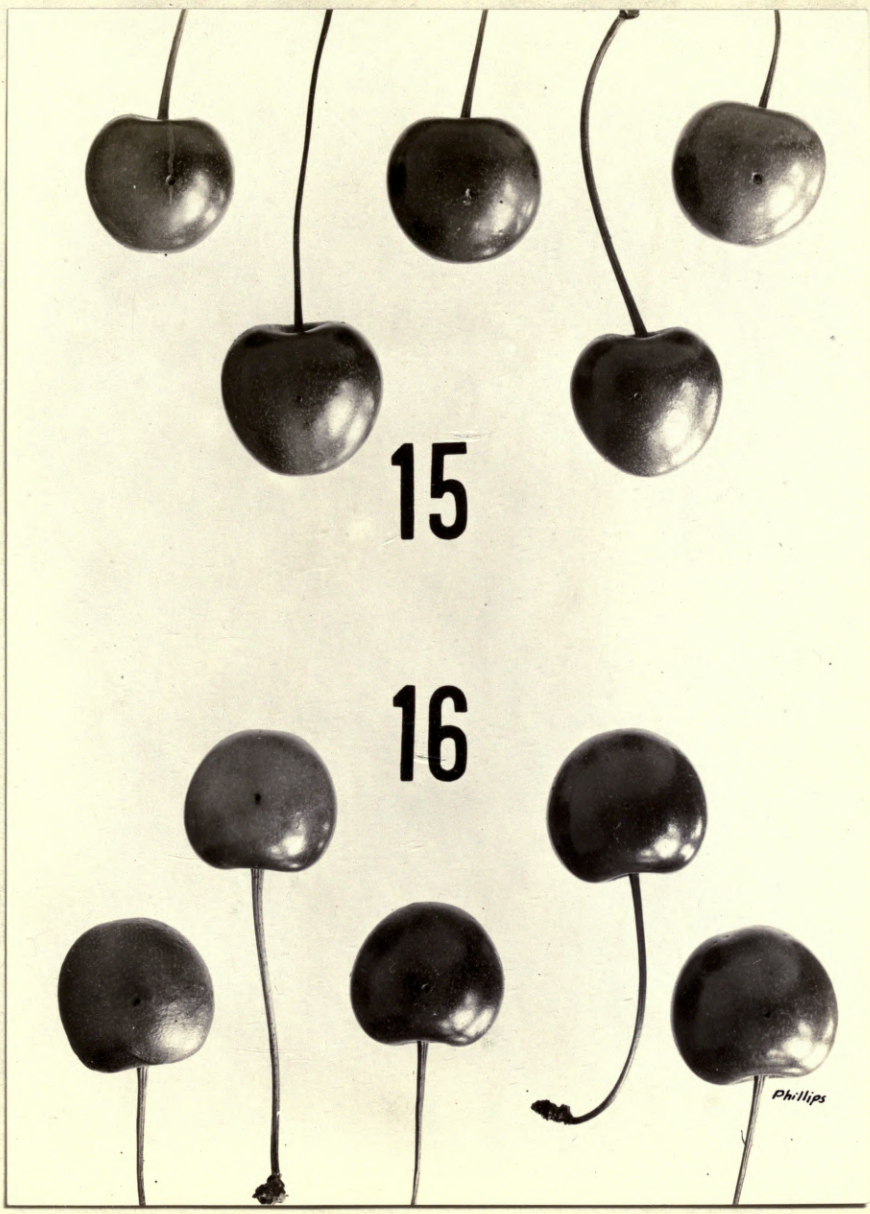

5
6
Phillips

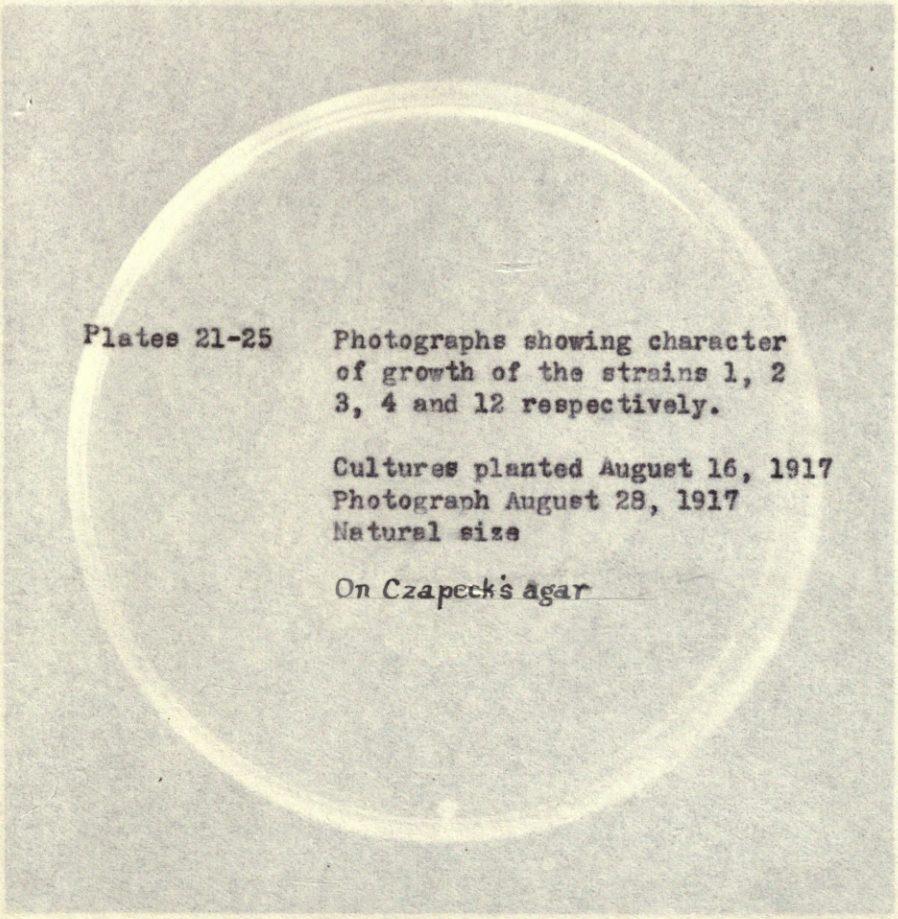

7
8
Phillips


9
10
Phillips


11
12
Phillips


13
14
Phillips


15
16
Phillips



Plates 21-25 Photographs showing character of growth of the strains 1, 2 3, 4 and 12 respectively.

Cultures planted August 16, 1917
Photograph August 28, 1917
Natural size

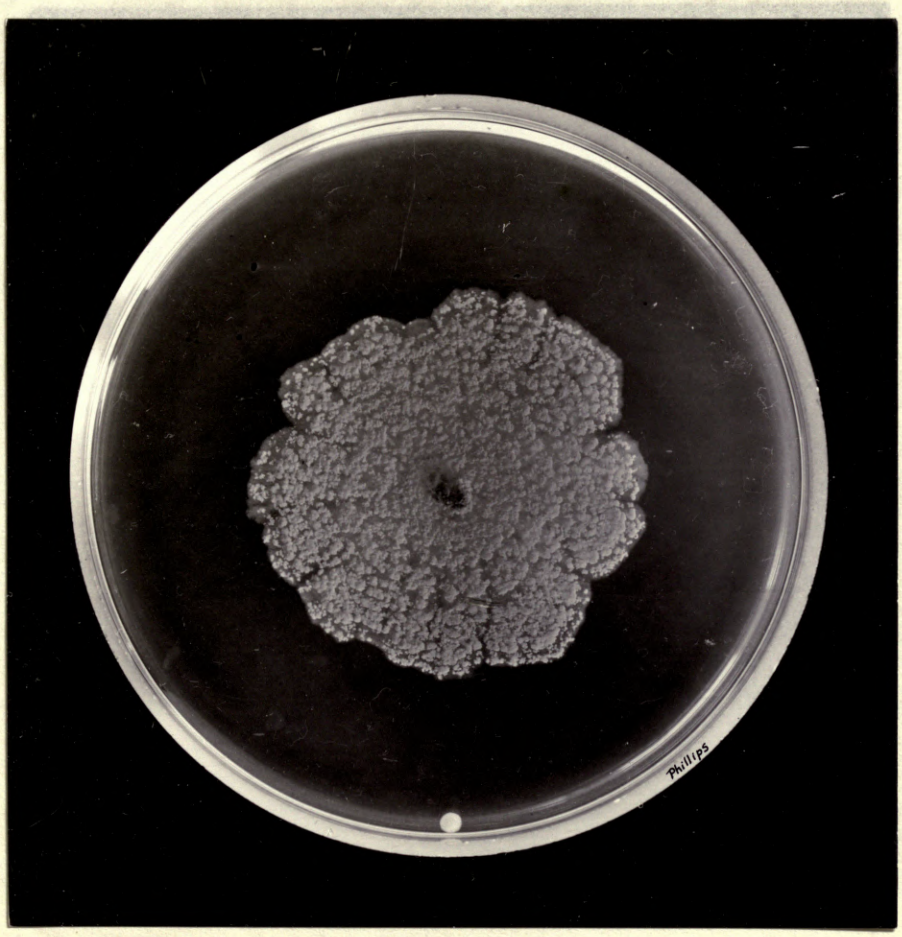
On Czapeck's agar

Strain "1"

Plates 21-25 Photographs showing character of growth of the strains 1, 2 3, 4 and 12 respectively.

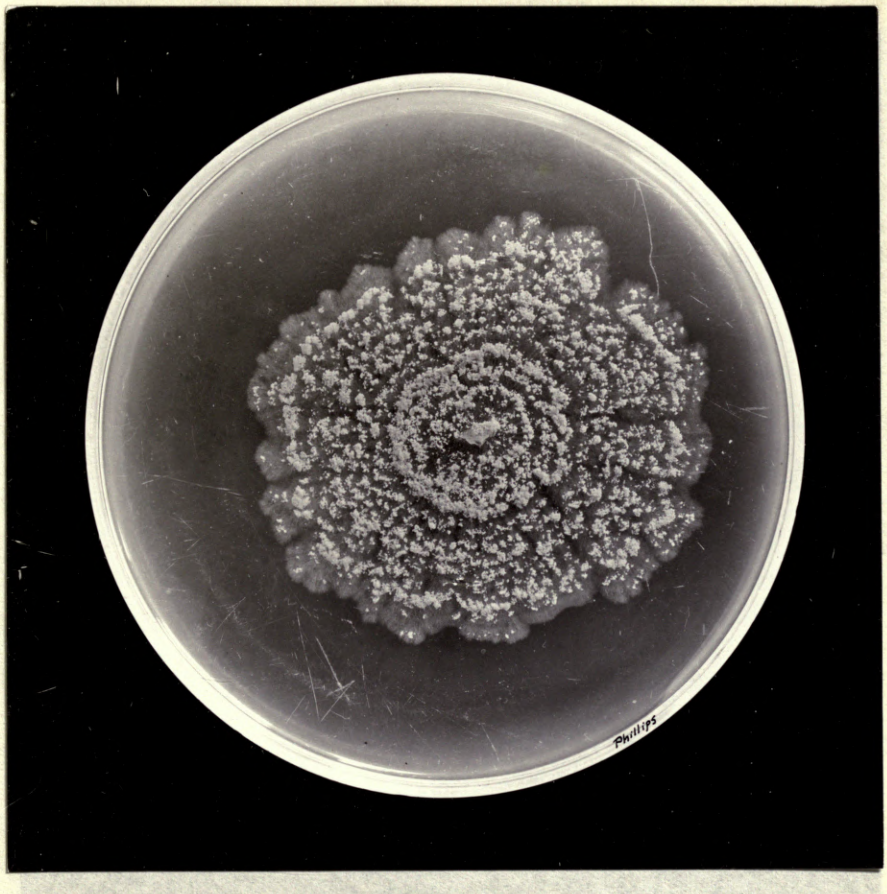
Cultures planted August 16, 1917
Photograph August 28, 1917
Natural size

On Czapeck's agar

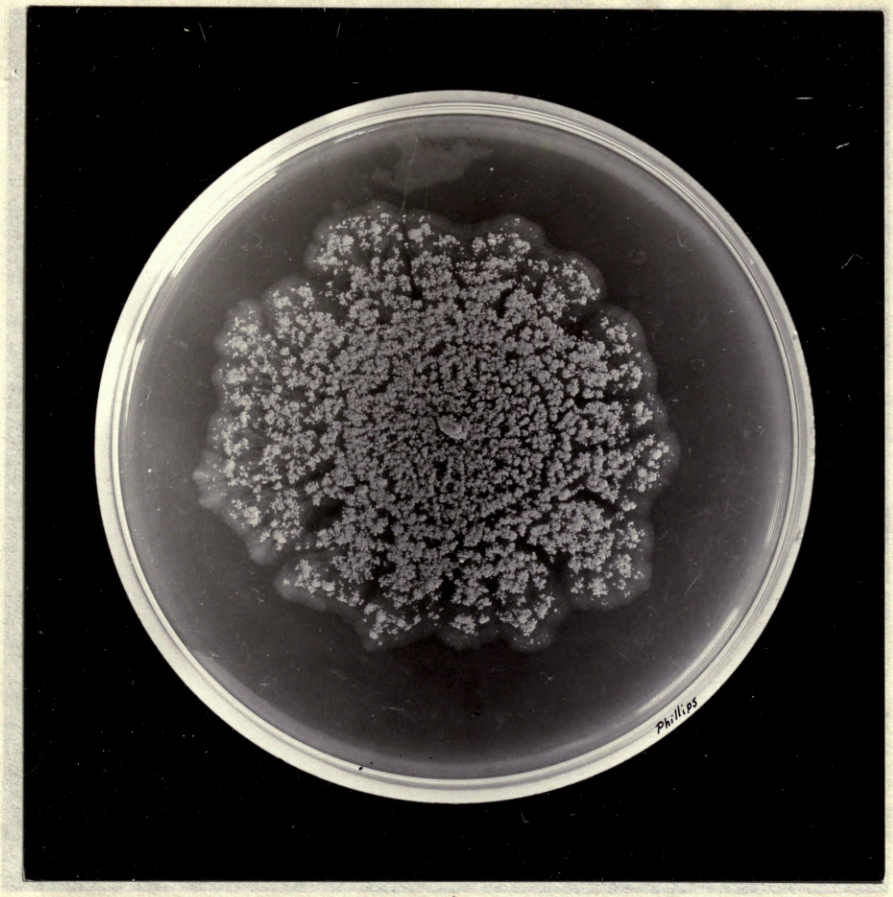


Strain #1

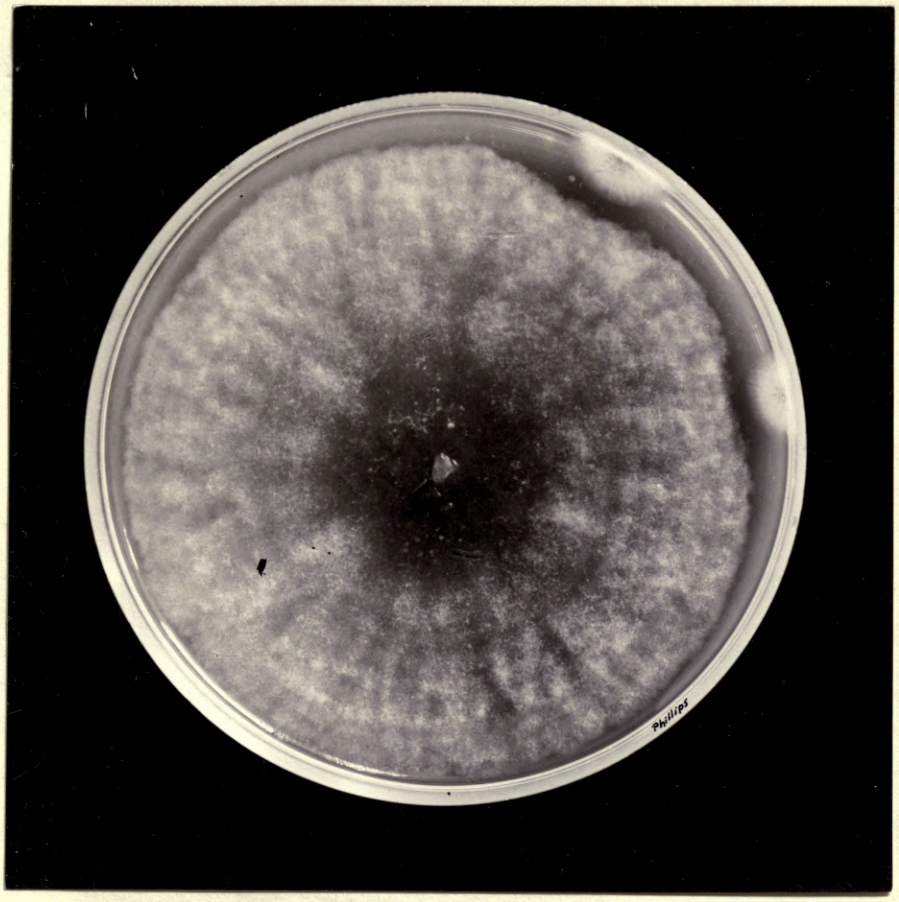
Strain 2



Strain *3



Strain *4



Strain #12

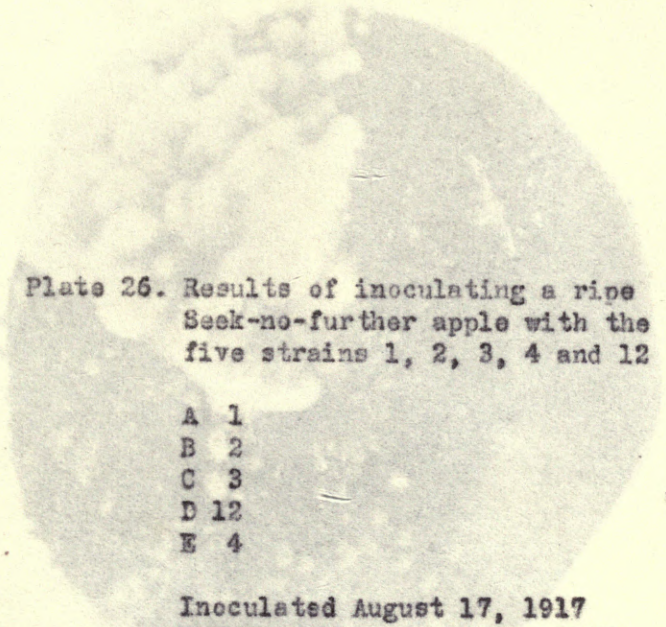


Plate 26. Results of inoculating a ripe Seek-no-further apple with the five strains 1, 2, 3, 4 and 12

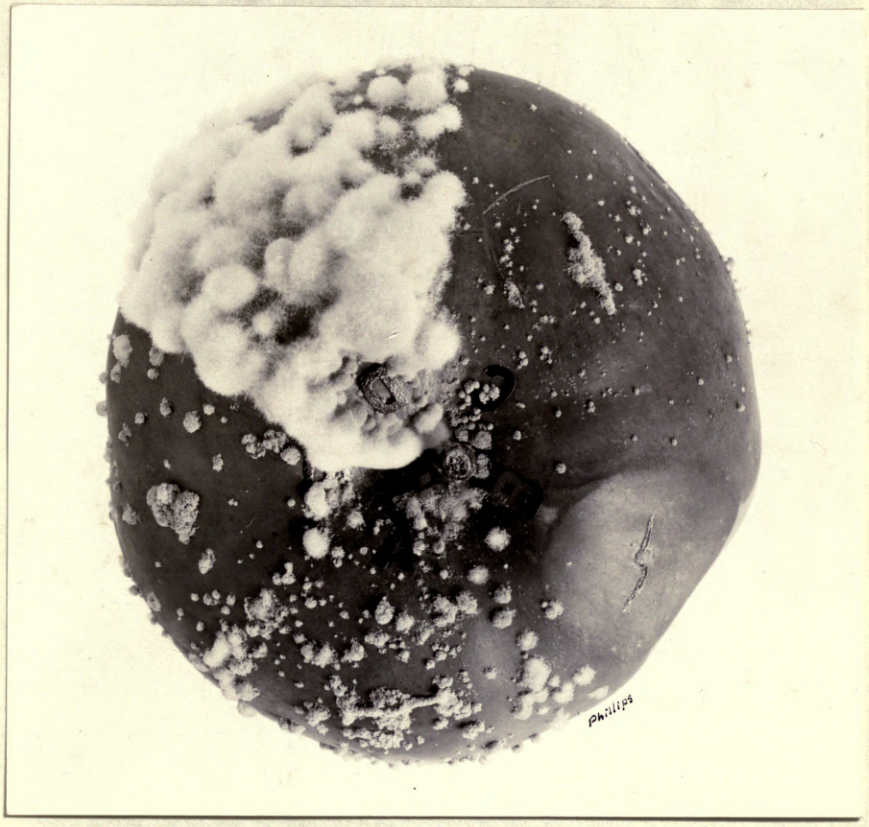
A 1
B 2
C 3
D 12
E 4

Inoculated August 17, 1917
Photographed August 27, 1917
Natural size

Plate 26. Results of inoculating a ripe
Bean-no-further apple with the
five strains 1, 2, 3, 4 and 12

A 1
B 2
C 3
D 12
E 4

Inoculated August 17, 1917
Photographed August 27, 1917
Natural size


Phillips

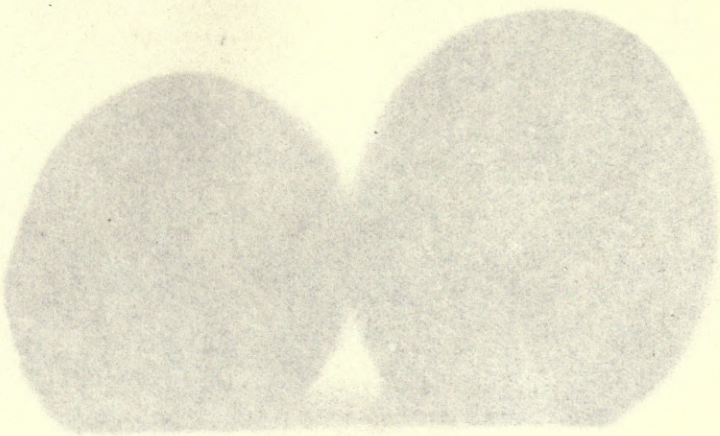


Plate 27. Upper. Diamond plums inoculated with spore material from a naturally infected apricot

Inoculated Sept. 5, 1914
Photographed Sept. 11, 1914

Lower. Pond Seedling plums inoculated with spore material from a naturally affected apricot.

Inoculated Sept. 5, 1914
Photographed Sept. 11, 1914

These pictures are typical of the California apricot fruit rot.

Plate 27. Upper. Diamond plums inoculated with spore material from a naturally infected apricot

Inoculated Sept. 5, 1914
Photographed Sept. 11, 1914

Lower. Pond bearing plums inoculated with spore material from a naturally affected apricot.

Inoculated Sept. 5, 1914
Photographed Sept. 11, 1914

These pictures are typical of the California apricot fruit rot.

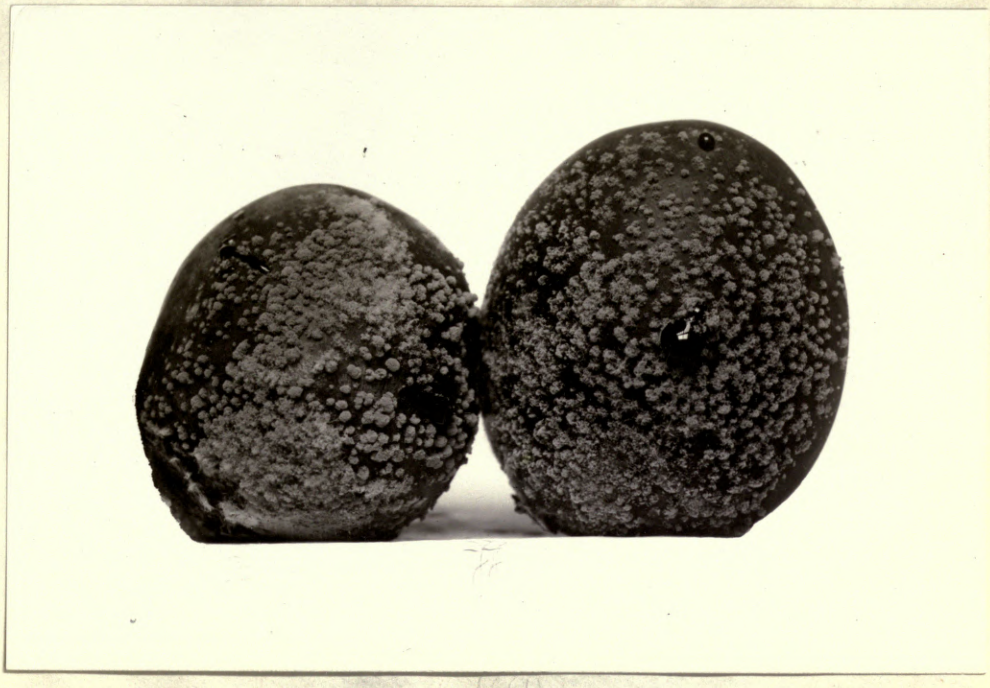


Plate 28. Upper. Photograph showing result of inoculating a quince with spore material from a naturally infected apricot.

Inoculated Sept. 28, 1914
Photographed about October 21, 1914

Lower. A. Sclerotinia cinerea, color of pustules. Copied from Woronin's work in St. Petersbourg Academie Memoires Ser. Viii, V. 10, pl. IV, 1900.

B. Sclerotinia fructigena, color of pustules. Same source as A.

C. California Apricot rot, Sclerotinia, strain 1, Showing color of pustules on prune juice and bread culture in a flask.. 23 days old. This color is typical.

D. Color of gonidial mass of strain 1 when grown on sterilized green beans in a test tube. Culture 2 months old.

Plate 28. Upper. Photograph showing result of inoculating a quince with spore material from a naturally infected apricot.

Inoculated Sept. 28, 1914
Photographed about October 21, 1914

Lower. A. Sclerotinia cinerea, color of pustules. Copied from Woronin's work in St. Petersburg Academie Memoires Ser. VIII, V. 10, pl. IV, 1900.

B. Sclerotinia fructigena, color of pustules. Same source as A.

C. California Apricot rot, Sclerotinia, strain 1, showing color of pustules on prune juice and bread culture in a flask.. 28 days old. This color is typical.

D. Color of gonidial mass of strain 1 when grown on sterilized green beans in a test tube. Culture 2 months old.

Photographed September 11, 1914

A B C D

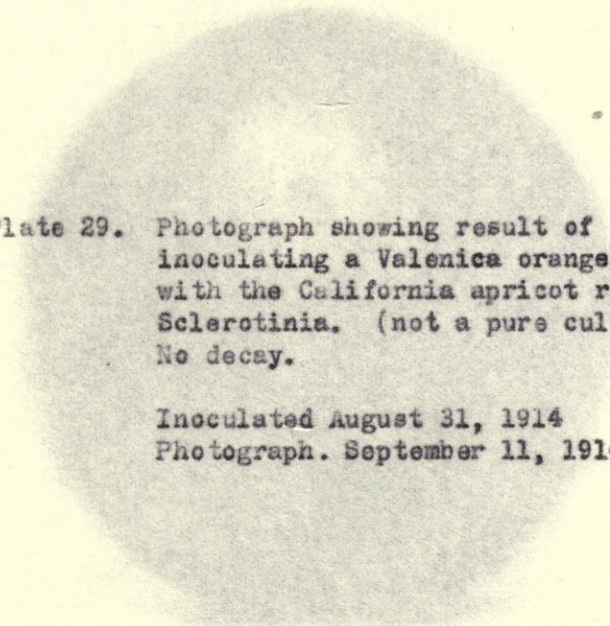


Plate 29. Photograph showing result of inoculating a Valenica orange with the California apricot rot Sclerotinia. (not a pure culture) No decay.

Inoculated August 31, 1914
Photograph. September 11, 1914

Plate 29. Photograph showing result of inoculating a Valencia orange with the California apricot rot Sclerotinia. (not a pure culture) No decay.

Inoculated August 31, 1914
Photograph. September 11, 1914

Plate 30. Upper Photograph showing fresh conidia being produced on an apricot that was attacked the previous year and which remained hanging in the tree through the winter. These fresh

. Thomas

Plate 30. Upper Photograph showing fresh conidia being produced on an apricot that was attacked the previous year and which remained hanging in the tree through the winter. These fresh conidia serve as a source of infection to the blossoms, as well as fresh conidia produced on twigs killed the previous season with the fungus.
Photograph during the blossoming period Spring, 1917

Lower. Photograph showing result of inoculating Spitzenberg apple with the California apricot rot Sclerotinia (not a pure culture)
Inoculated November 7, 1914
Photograph by W. W. Thomas

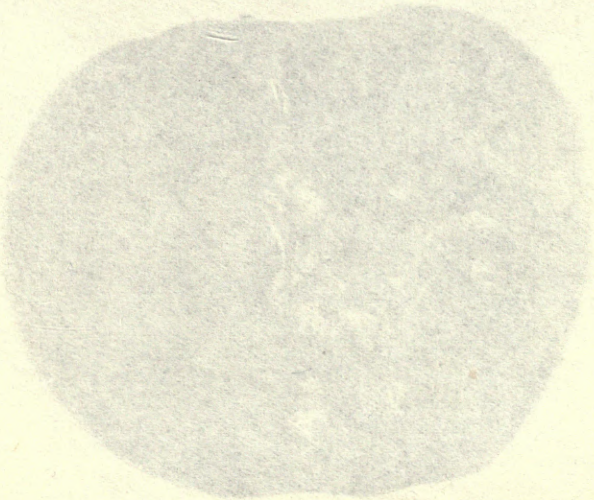


Plate 30. Upper Photograph showing fresh conidia being produced on an apricot that was attacked the previous year and which remained hanging in the tree through the winter. These fresh conidia serve as a source of infection to the blossoms, as well as fresh conidia produced on twigs killed the previous season with the fungus.
Photograph during the blossoming period Spring, 1917

Lower. Photograph showing result of inoculating Spitzenberg apple with the California apricot rot Sclerotinia (not a pure culture) Inoculated November 7, 1914
Photograph by E. M. Thomas

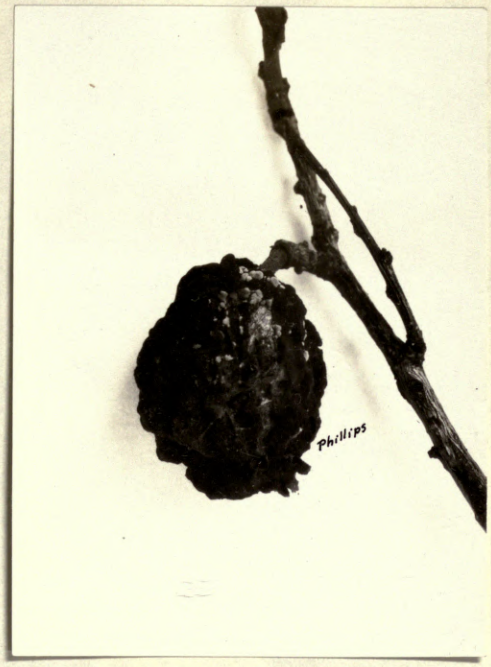


Plate 21. Photograph showing results of inoculating a seedling apricot branch

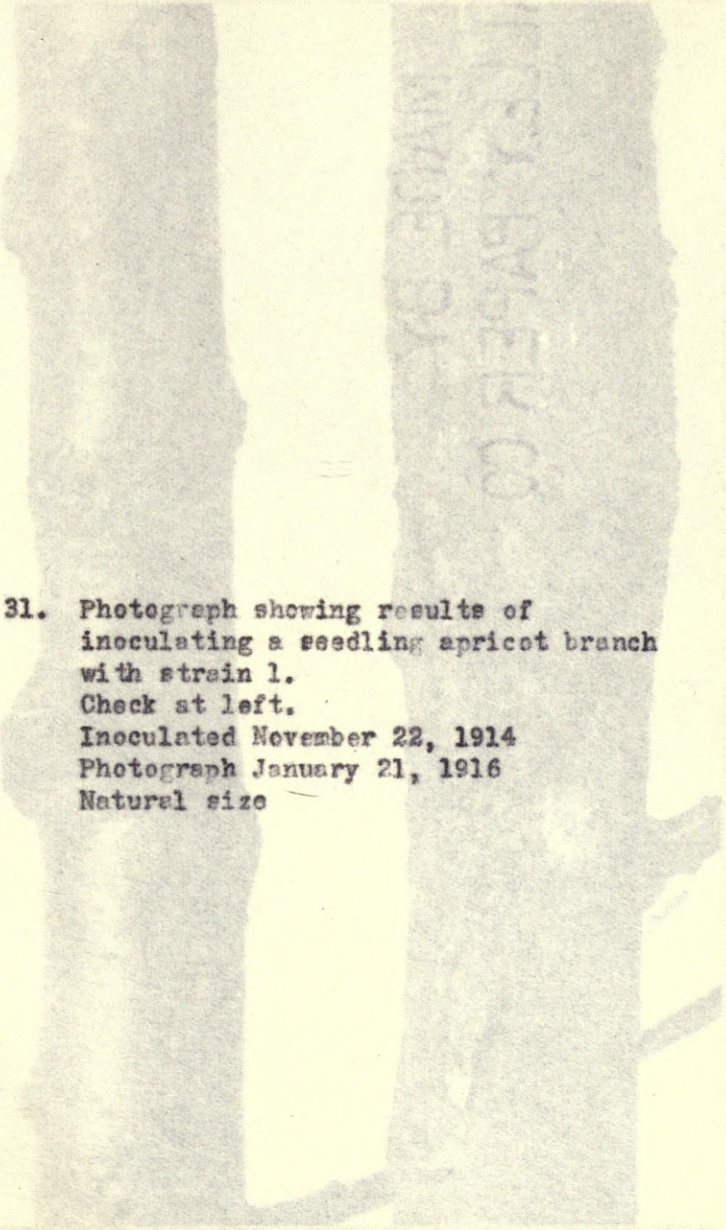


Plate 31. Photograph showing results of inoculating a seedling apricot branch with strain 1.
Check at left.
Inoculated November 22, 1914
Photograph January 21, 1916
Natural size

Plate 31. Photograph showing results of
inoculating a seedling apricot branch
with strain 1.
Check at left.
Inoculated November 29, 1914
Photograph January 21, 1915
Natural size


Phillips

Plate 32. Photograph showing results of inoculating a seedling peach branch with strain 1.
Check at lower right
Inoculated November 22, 1914
Photograph January 21, 1916
Slightly reduced.

Plate 32. Photograph showing results of
inoculating a seedling peach branch
with stocia I.
Check at lower right
Inoculated November 23, 1914
Photograph January 21, 1915
Slightly reduced.


Phillips

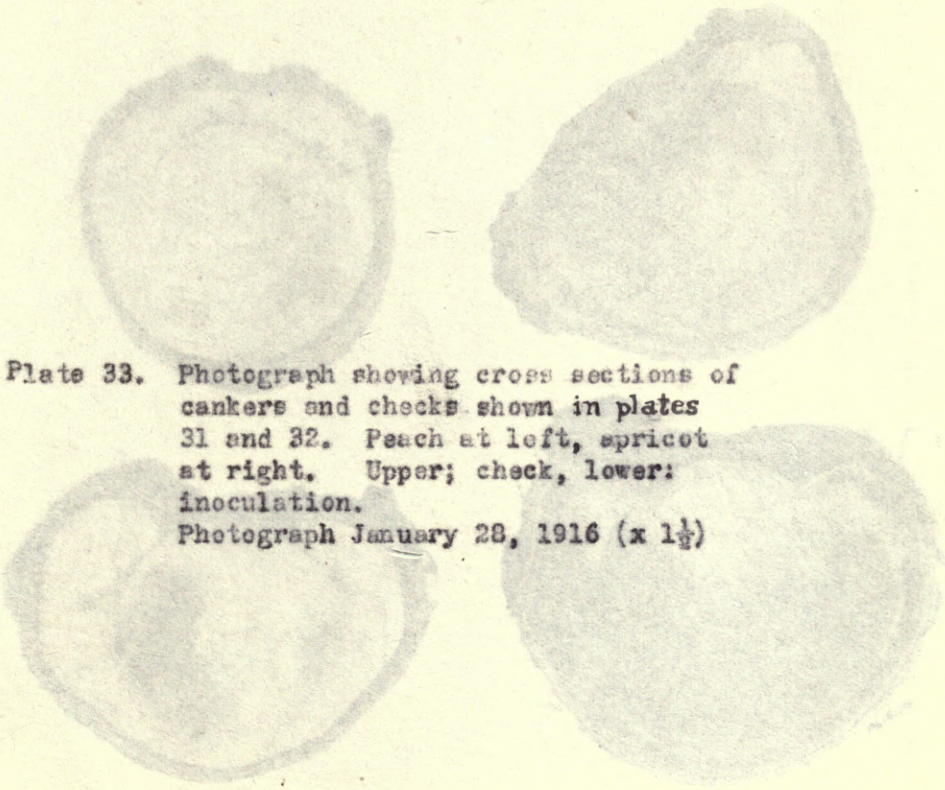


Plate 33. Photograph showing cross sections of cankers and checks shown in plates 31 and 32. Peach at left, apricot at right. Upper; check, lower: inoculation.
Photograph January 28, 1916 (x 1½)

Plate 33. Photograph showing cross sections of cankers and checks shown in plates 31 and 32. Peach at left, apricot at right. Upper; check, Lower: inoculation.
Photograph January 28, 1916 (x 1½)

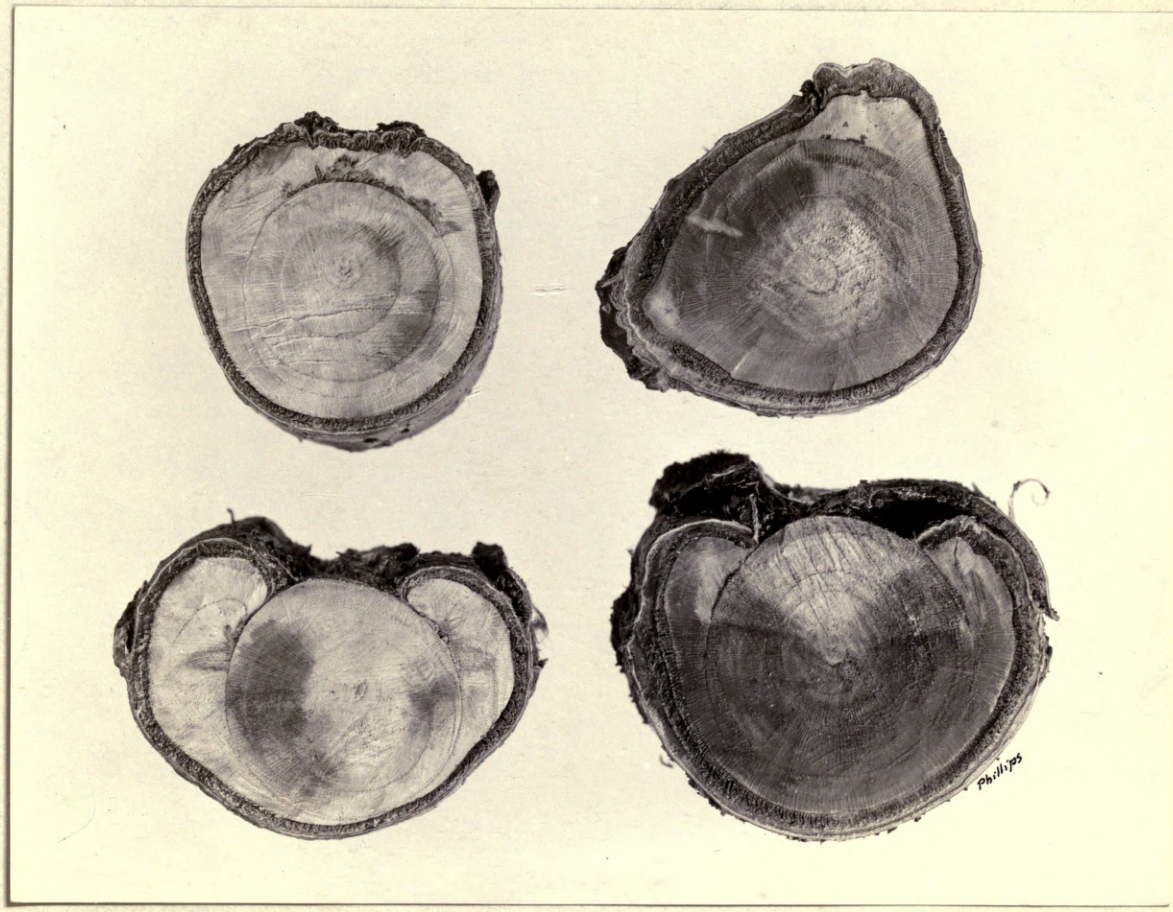

Phillips

Plate 34.

A. Showing variation in size and shape of conidia of strain 1 when grown on sterilized plum wood in a test tube. Culture 15 days old. (x1000)

B. Showing variation in size and shape of conidia of strain 1 when grown on standard nutrient gelatine in a test tube. Culture 15 days old. (X 1000)

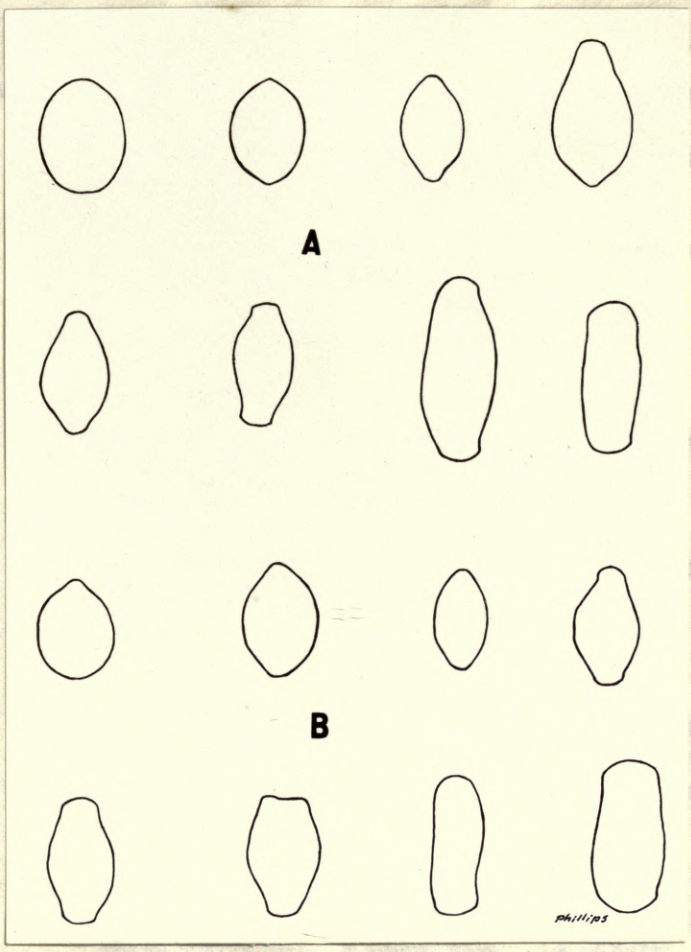
C. 1) These numbers 1, 3, 4, 12
3) correspond to the strains of
4) the same number, and show the
12) appearance of separating conidia. Taken from Royal Anne cherries July, 1917. (x 1000)

Plate 34.

A. Showing variation in size and shape of conidia of strain 1 when grown on sterilized plum wood in a test tube. Culture 15 days old. (X1000)

B. Showing variation in size and shape of conidia of strain 1 when grown on sterilized cultivated potatoes in a test tube. Culture 15 days old. (X 1000)

C. 1) Three numbers 1, 3, 4, 12
3) correspond to the strains of
4) the same number, and show the
12) appearance of segmenting conidia.
Taken from Royal Mass observed in
July, 1917. (X 1000)


A
B
Phillips

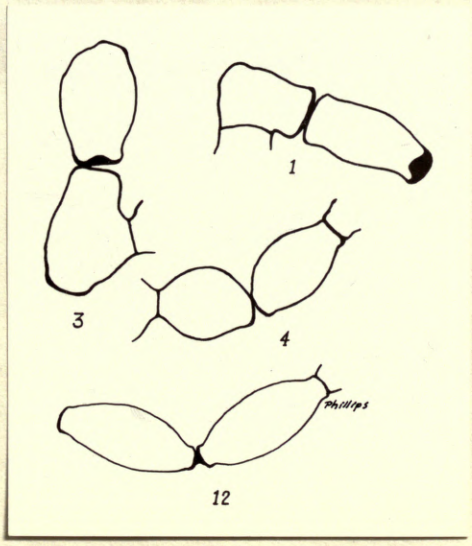

1
3
4
Phillips
12

Plate 35. A) Conidia from the surface of an apricot
B) naturally infected with the California apricot rot Sclerotinia (x 1000)

C. 3 mature conidia from a culture of strain 1 on Solanum tuberosum 14 days old (x 1000) and germinating conidium of California apricot rot Sclerotinia (2 days in tap water) (X 1000)

D. Spore-like bodies from culture on Diamond plum (x 1000) September 19, 1914. See plate 27, upper photograph.

E. Germinating conidium of the California apricot rot Sclerotinia in 100% peach juice, the acidity of which was +10.4. Drop culture 8 days old. (x 2000).

F. Conidia of the California apricot rot Sclerotinia produced in a tap water drop culture of conidia from a naturally infected apricot. 49 days old. (x 1000).

G. 3 germinating conidia of the California apricot rot Sclerotinia in distilled water drop culture. 3 days old. (x 2000)

Plate 35. A) Conidia from the surface of an apricot naturally infected with the California apricot rot Sclerotinia (x 1000)

B)

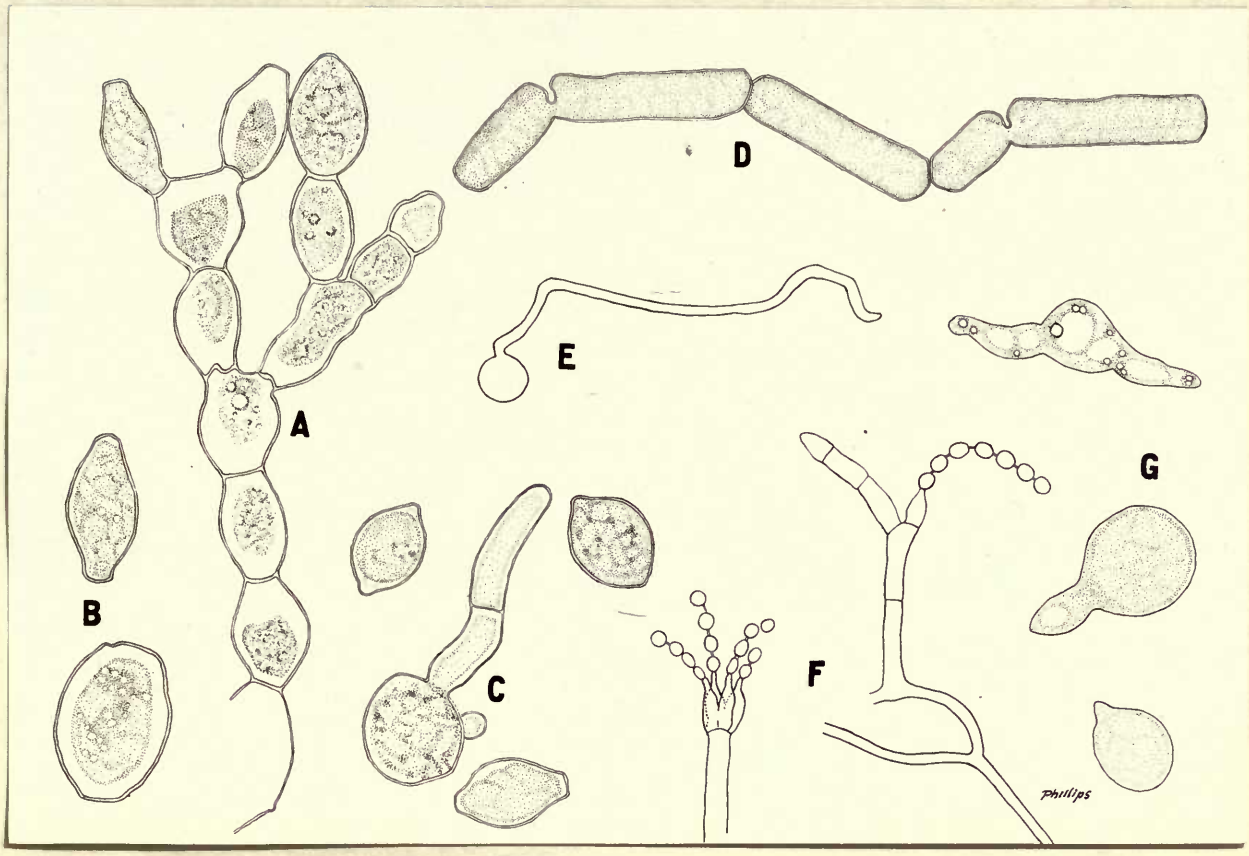
C. 3 mature conidia from a culture of stria I on Solanum tuberosum 14 days old (x 1000) and germinating conidium of California apricot rot Sclerotinia (2 days in tap water) (X 1000)

D. Spore-like bodies from culture on Diamond plum (x 1000) September 19, 1914. See plate 27, upper photograph.

E. Germinating conidium of the California apricot rot Sclerotinia in 100% peach juice, the acidity of which was 10.6. Drop culture 8 days old. (x 2000).

F. Conidia of the California apricot rot Sclerotinia produced in a tap water drop culture of conidia from a naturally infected apricot. 45 days old. (x 1000).

G. 3 germinating conidia of the California apricot rot Sclerotinia in distilled water drop culture. 3 days old. (x 2000)


A
B
C
D
E
F
G
Phillips