Treatment of Grape Diseases: The Science and Successes of Frank Lamson-Scribner

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In 1886, the United States Department of Agriculture (USDA) inaugurated the Section of Mycology within the Division of Botany. The purpose was to investigate "the diseases of fruits and fruit trees, grains and other useful plants, caused by fungi" (12). Assistant botanist Frank Lamson-Scribner (Fig. 1), hired in 1885, was named the head and became the first scientist employed by the federal government with the specific duty to further the understanding and control of plant diseases (4). In the process, he brought the late nineteenth century's changing concepts of botany to bear. He knew that for disease control to become effective it would have to move from the hands of agricultural empiricists into the laboratories of plant pathologists who were studying the life histories of fungi and trying to understand the complex relationships between pathogens and hosts.

Scribner's task was a difficult one for a scientist in an institution inaugurated on the promise of practical service to American farmers, not on discoveries of fundamental scientific principles. Scribner needed immediate success to justify his attention to science despite calls for his Section to engage in practical work. He wisely decided, even though the plant disease problems in the United States were immense and varied, to improve his chances for a quick victory by focusing his attention primarily on the diseases of one plant, the grape.

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Grape diseases were among the most visible and injurious plant diseases in America during the second half of the nineteenth century. As grape production expanded in the United States, growers increasingly reported serious damage from these maladies. For example, one Missourian told fellow members of the American Pomological Society in 1879 that for four successive years black rot had "destroyed almost the entire crops of most vineyards in our region . . . planted at an expense of over a million dollars" (1). There were numerous other reports at the time of the destructive powers of black rot (*Guignardia bidwellii* (Ellis) Viala & Ravaz) (Fig. 2). Growers across the country also were confronted with losses due to downy mildew (*Plasmopara viticola* (Berk. & M.A. Curtis) Berl. & De Toni in Sacc.) and anthracnose (*Elsinoë ampelina* Shear).

By the 1880s, most informed observers blamed these rots and mildews on pathogenic fungi. Although some workers, like William Saunders at the USDA, may have emphasized the significance of predisposing factors such as weather and soil, most still readily accepted the idea of fungi as the cause of plant diseases (9). But simply knowing that a fungus caused a disease failed to satisfy farmers who were challenged by unprecedented plant disease outbreaks during the agricultural expansion and specialization in the second half of the nineteenth century. Undeniably, some successful cures and preventatives had been developed over the years, even centuries, through empirical observations and trial-and-error cultural practices. Knowledgeable growers removed dead limbs and burned dead leaves, twigs, and fruit to destroy inoculum.

Unlike the entomologists, who scored victories against the Colorado potato beetle and apple canker-worm in the 1870s and 1880s with liquid spray compounds such as Paris Green and London Purple (6), plant disease workers had few reliable chemical weapons in their arsenal. Most commonly, for example, many viticulturists dusted their vines with sulfur using hand-held bellows. Since the late 1840s, this had been a common and successful treatment for powdery mildew of grapes (*Uncinula necator* (Schwein.) Burrill), which occurred on the leaves, stems, and berries of grapevines. Yet the use of sulfur against the mildly harmful powdery mildew was one of the rare success stories, and it had only weak connections at best to an understanding of the biology of the pathogen. Other grape diseases, such as black rot and downy mildew, responded less favorably to sulfur treatment than did powdery mildew.

The reason, which mycologists and some perceptive agriculturists were discovering, was that not all pathogenic

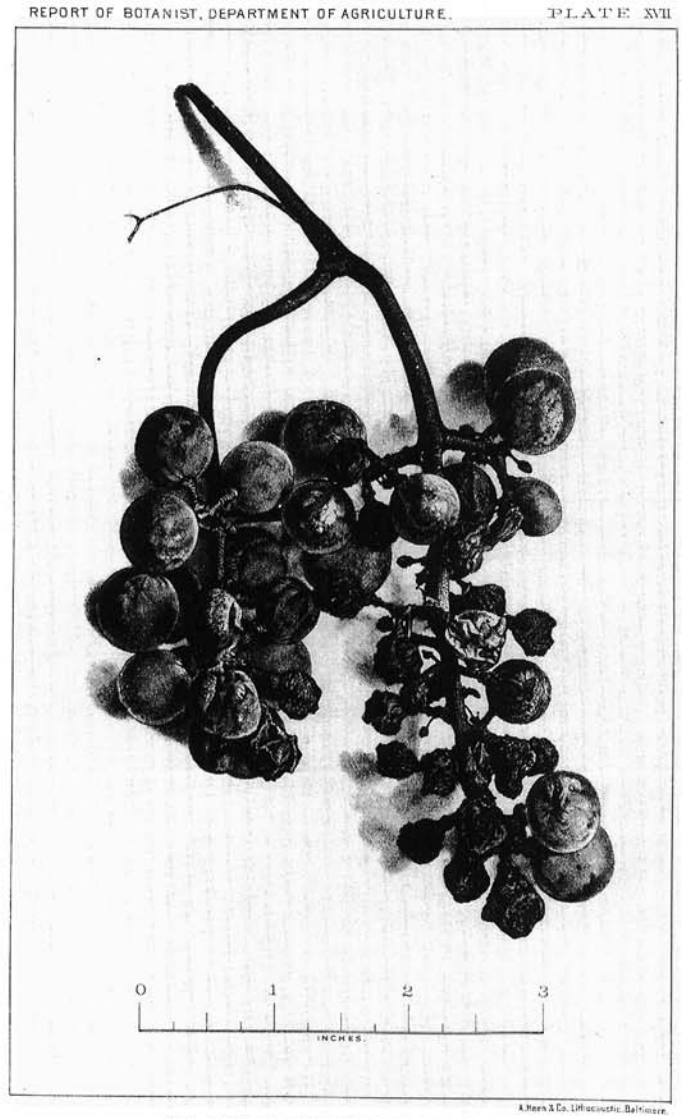
fungi, and thus not all diseases, were alike. There were significant variations in how fungi survived, in their life cycles, and in how they did their damage. In the case of the two fungi associated with the grape mildews, scientists were accumulating evidence that powdery and downy mildew, terms coined by USDA entomologist Charles V. Riley in 1885, prevailed under different climatic conditions (8). Moreover, not only were these two fungi morphologically distinct, but their disease cycles on the host plant also differed markedly. Whereas the fungus that caused powdery mildew grew mostly on the outside of the leaf tissue and was found on upper and lower leaf surfaces, the downy mildew fungus established itself mostly on the underside of the leaves and grew extensively within the tissues of the host plant. Because of the difficulty in reaching the mycelia of the downy mildew fungus with applications of sulfur, as Scribner noted in 1885, "little can be done to check" its "ravages" (10).

The requirement for more scientific work to uncover the nature of fungal life cycles was one of Scribner's central messages as assistant botanist in his first USDA report on "Fungous Diseases of Plants" in 1885. Just knowing "that a disease . . . is due to a species of fungus," he insisted, was hardly enough information "to advise remedies or preventives." Scribner stated that dependable treatments would follow careful studies of "the life history of the parasite, its method of nutrition, growth and propagation, and the varied forms or conditions under which it perfects its spores or fruit; the manner of distribution, exactly how it comes upon or enters the affected plant, and its means of continuing its existence from year to year" (10). Clearly, what Scribner described involved lengthy, painstaking, and perhaps expensive research. There was no doubt in his mind, however, that the rewards to agriculture would be more than worth the effort.

Scribner noted pointedly that America's "crops . . . are damaged to the extent of many millions of dollars annually by the attacks of fungi." Facing such a dire threat, he felt that the time was ripe for accelerating and extending plant disease investigations in the United States (10). Fortunately, America's small circle of plant disease workers was prepared to move forward with the kind of scientific work that Scribner envisioned. In the mid-1880s, the United States could claim a group of well-qualified professionals who were already concentrating on disease-causing fungi and bacteria, and contributing to a more complete understanding of these pathogens and the diseases they caused. Additionally, American scientists now had a body of scientific literature from which they could proceed with more detailed studies on the organisms that caused plant diseases. Not only did they benefit from the published work from Europe, but American plant disease workers possessed their own growing bibliography.

As encouraging as the scientific environment was, however, it was actually a grape disease ravaging Europe and the control breakthrough that followed, that gave Scribner and the Americans an important boost at a critical time. Downy mildew had plagued French vineyards since its introduction from North America in 1878 (8). The French were searching for solutions; however, most purported cures were concoctions based on

Fig. 1. Frank Lamson-Scribner, about 1889. He initiated experiments with chemical fungicides in the USDA and shifted important work in applied plant pathology from Europe to America in the 1880s. The medal on his coat, the decoration of Chevalier du Merite Agricole, was awarded by the French government in 1889 for his work on grape diseases. Courtesy of Special Collections, University of Maine, Orono.



BLACK ROT OF THE GRAPE.

(From an original photograph.)

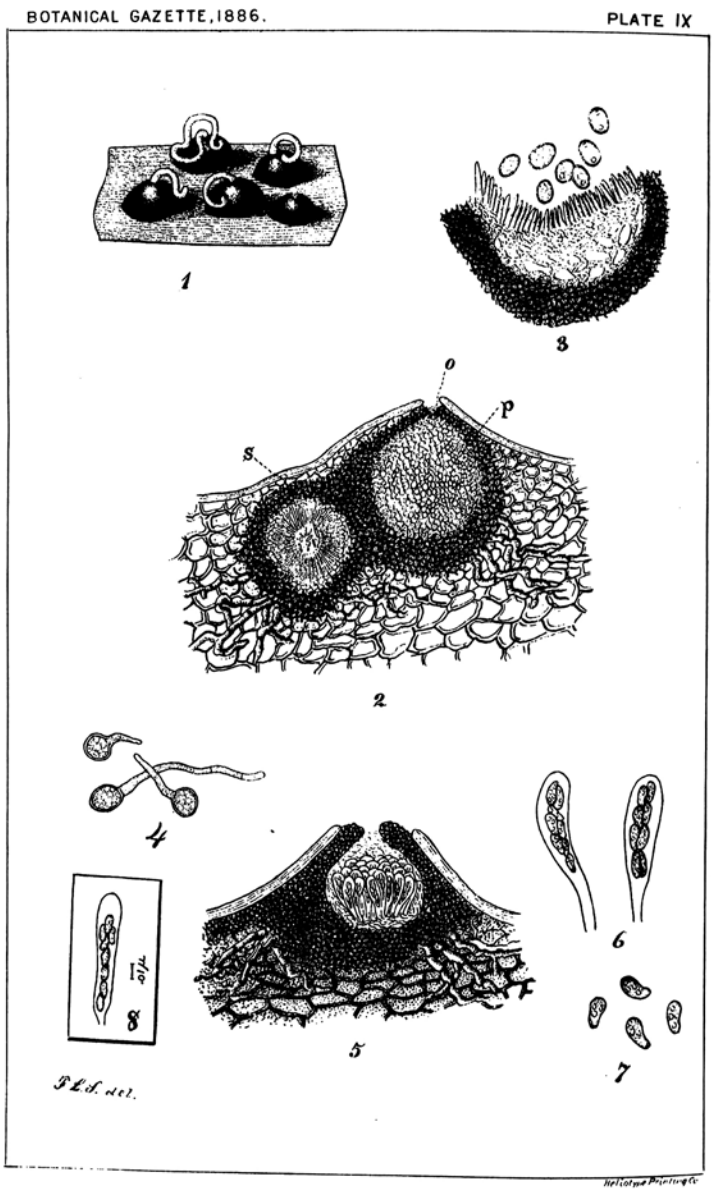
(The article of Mr. A. W. Pearson, which this plate illustrates, will be published in a special bulletin.)

Fig. 2. Black rot of grape. Caused by *Guignardia bidwellii,* this highly destructive disease was a major threat to America's viticultural industry in the 1880s. Under the direction of F. L. Scribner, the USDA achieved success in its understanding and control between 1885 and 1888. From the *Report of the Commissioner of Agriculture,* 1885.

the traditional belief that the most noxious substances would prevent even the most destructive diseases. Yet scientists with a better understanding of the mycological world than previous generations were putting their minds to the problem. For example, Pierre Marie Alexis Millardet, a student of Anton De Bary and a professor of botany at Bordeaux, France, had worked on the life cycle of *Plasmopara viticola* since he and J. É. Planchon had discovered it in France in 1878. By 1880, he had found the resting spores of the fungus and understood how it spread. Millardet realized that the zoospores of the fungus might be vulnerable to attack if caught before their germ tubes penetrated the leaf tissue (5). Legend has it that in 1882, Millardet noticed that grapevines in the Médoc that had been sprinkled with a mixture of copper sulfate and lime to prevent pilferage were free of downy mildew, whereas untreated vines in the same vineyards were diseased. He began to investigate the efficacy of combinations of copper salts and lime. Millardet knew, as did many of his contemporaries, that copper sulfate had proved effective against fungal sporulation, particularly in wheat smut. Adding the lime reduced the danger of injury to the foliage. Over the next 2 yr after this initial observation in 1882, his results were nothing short of stunning.

News of the French success with a chemical remedy for downy mildew arrived in America at a fortuitous time—just as Scribner was launching his plant disease work at the USDA. The departmental entomologist, C. V. Riley, who had gone to France to help viticulturists combat the dreaded insect phylloxera, made one of the earliest American references to Millardet's "Bordeaux mixture" in his paper "The Mildews of the Grape-Vine," presented to the American Pomological Society in September 1885. He reported that "the experience of the past year in France has furnished a remedy which, from all accounts, . . . is in every way satisfactory because it not only destroys direct, but acts as a prophylactic." Furthermore, according to Riley, the mixture adhered well to the leaves and proved effective after only a single application (8).

Scribner tentatively endorsed copper sulfate and lime treatments for downy mildew in his 1885 report (10). The French success boosted the efforts of the members of the botanical and horticultural communities, as well as those of USDA Commissioner Norman J. Colman, to press urgently for expanded plant disease investigations in Washington, D.C. Not only was there a prospect of eradicating downy mildew specifically, but mycologists realized that with nearly 40 species of *Peronospora* in the United States, the possibility of arresting the spread of other pathogenic fungi looked



SCRIBNER ON BLACK ROT.

EXPLANATION OF PLATE IX. Fig. 1. A fragment of epidermis of a diseased berry, showing five of the black "pustules" formed by the development of the pycnidia. From four of these slender, contorted, worm-like filaments are being extruded; these are the stylospores held together by a kind of mucilage.

Fig. 2. A section through a bit of the berry, including a pycnidium (P) and a spermagonium (S). At O is the osteolum of the pycnidium through which the spores escape at maturity.

Fig. 3. A section of a portion of a pycnidium, more highly magnified, showing the basidia.

Fig. 4. Three stylospores germinating.

Fig. 5. A section through the perithecium or conceptacle of the ascosporous form, showing the asci, etc.

Fig. 6. Two separate asci, showing the 8 sporidia in each.

Fig. 7. Four of the sporidia that have escaped from an ascus.

Fig. 8. An ascus, enclosing 8 sporidia, found June 2, 1886, in grape (destroyed in 1885 by "Black Rot") kept for a week in moist air. From camera lucida sketch made by Erwin F. Smith in the laboratory of the University of Michigan. Mr. Smith notes that the "receptacles containing the asci are numerous, and the asci themselves abundant."

Fig. 3. F. L. Scribner's mycological illustrations of the black rot fungus. In addition to directing important field experiments with copper fungicides, Scribner conducted vital microscopic investigations while at the USDA laboratory between 1885 and 1888. From the *Botanical Gazette,* 1886.

promising (8,10). Americans may not have been the first to make the scientific links between Bordeaux mixture and downy mildew, but they were the earliest to recognize "the full significance of the discovery, and set about with the greatest energy to adapt and employ copper-containing sprays for the defence of every kind of crop" (5).

However, much remained to be learned about the investigations in Europe, as well as about the nature of grape diseases in the United States, before the USDA could offer much useful knowledge to the American grower. To assemble this information, Scribner followed two main paths of inquiry. First, he continued to rely on existing research and published material from Europe and the United States. He cultivated a closer correspondence with European plant disease workers, particularly in France and Italy. He also continued to make use of the studies of American scientists such as William G. Farlow of Harvard and William Trelease of the Shaw Botanical Garden in St. Louis as he had for his report in 1885.

In 1886, in addition to eliciting wider support from the American botanical community, Scribner decided to initiate his own original investigations. He and his small staff concentrated on life history studies of the fungi that attacked grapes (Fig. 3). However, lacking extensive laboratory facilities in-house, the USDA needed American growers and their vineyards to bolster experimental efforts. Scribner hoped not only to gain the cooperation of growers so he could test the different chemicals being promoted for control of grape diseases, but also to obtain important statistical data on the range and extent of diseases of grapes and other plants in the United States.

In May 1886, the USDA sent two circulars on grape diseases to 3,000 American viticulturists. The first—*Treatment of the Downy Mildew (*Peronospora viticola*) and the Black-Rot (*Phoma uvicola*)*—gave five different formulas for control, either liquid or powder mixtures containing some variation of copper sulfate and/or lime in addition to a milk-kerosene emulsion first proposed in France by USDA entomologist C. V. Riley. Bordeaux mixture, or as it was popularly referred to, "the copper mixture of Gironde," was "highly recommended" (23). The second circular was designed to obtain "a more definite knowledge as to the distribution of and the losses occasioned by Grape-vine Mildew and Black Rot of the Grape." It gave a short description of the diseases and asked growers whether they had observed either of the diseases, and if so, what losses they had incurred. The USDA also wanted to know under what climatic circumstances these diseases appeared, what grape cultivars seemed more susceptible, and finally, what remedies had been tried and with what degree of success (24).

Although the response was smaller than Scribner had anticipated (less than 400 for Circular No. 2—384 replies, 366 localities, 41 states or territories; no figures available for Circular No. 1), the circulars nevertheless symbolized a landmark by the USDA to gather and coordinate information on a major plant disease problem in the United States. The correspondence returned from growers, along with other published sources, provided additional evidence that black rot, anthracnose, and the mildews (downy and powdery) were "widespread and devastating" to American viticulturists. According to the reports received, USDA officials estimated that collectively "for the United States east of the Rocky Mountains, the entire loss from mildews and black-rot cannot, on an average, be much less than 40 per cent annually" (11).

The returns from Circular No. 1 regarding the different chemical remedies for black rot and downy mildew proved less valuable to Scribner. Although he maintained that he had every "reason to believe that many made a trial of one or more of the remedies proposed," he nonetheless admitted "that few responded to the request that the results . . . be reported to the Department." Scribner blamed this poor response on three factors. First, grape growers had little experience with systematic experiments. Second, he claimed that American viticulturists were reluctant to use anything besides sulfur, which was widely regarded as a "cure-all." Third, Scribner found "a certain feeling of indifference on the part of farmers and fruit-growers . . . due to the greatness of our country and the variety of our resources, but more especially to the almost entire absence of information respecting the nature and habits of the fungi themselves" (12).

Scribner combined the results of his two circulars with the studies published by W. G. Farlow and the French authors M. Cornu, P. Viala, M. L. Ravaz, and M. G. Foëx to assemble several important publications on grape diseases in the last 6 mo of 1886. The most significant was USDA Bulletin No. 2 (11) entitled *Report of the Fungous Diseases of the Grape Vine.* It was a milestone in plant disease studies: the first scientific, book-length treatment of its kind in America dealing with the major known diseases affecting a single host.

By the end of 1886, even though Scribner had written several important papers on grape diseases, much of the valuable information contained in these reports was based on European research rather than on experimental work in the United States. The control of plant diseases in America would require the systematic testing of fungicides under the distinctive conditions of soil, climate, plants, and microorganisms in this country. The USDA had yet to acquire the equipment, personnel, and facilities to do this level of scientific inquiry, and the use of growers for experimentation was a partial success at best. Commissioner Colman acknowledged these limitations (2), but the work done by Scribner was already bearing political fruit. Colman won approval from Congress to enlarge the Section of Mycology into the Section of Vegetable Pathology in 1887, with a larger budget and more assistants. Scribner took over as chief (3).

Scribner set to work in the new Section, still believing that the future lay with copper compounds. He was already pondering questions on the most suitable time in the growing season for spraying, the possibility that diluted mixtures could be just as effective as full-strength mixtures (and cheaper for growers), and the benefits of improved spraying equipment. But he needed more data from the field to provide conclusive evidence for these tentative aspects of disease control. Another USDA circular (Fig. 4) went out in April 1887 regarding the *Treatment of the Downy Mildew and Black-Rot of the Grape* (25). Unfortunately, except for a more "generous response," especially regarding Bordeaux mixture, the USDA found most viticulturists ill-prepared to conduct the kinds of rigorous tests needed (14).

To acquire more reliable results, the USDA established several special stations in 1887 for the purpose of more controlled experimentation during the summer of that year. Scribner chose vineyards in Charlottesville, Virginia; Vineland, New Jersey; Neosho, Missouri; and Denison, Texas—regions hard hit by both black rot and downy mildew—and designated their owners USDA special agents with the duty of testing copper salts as remedies (16). To guarantee consistency, the Department supplied the special agents with the chemicals and equipment for conducting the field tests.

The results of these experiment stations were mixed. Reports affirmed "the efficacy of the Bordeaux Mixture and Eau Celeste as a remedy for Downy Mildew and anthracnose, and in some cases . . . positively stated that their use had a restraining influence over Black-rot" (13). After the 1887 growing season, however, Scribner still found it difficult to make scientific pronouncements on fungicides with confidence. Growers and agents in "almost all cases" had begun making applications of copper salts only after the grape diseases had become well-established (13,14). Scribner was well aware that the action of these copper fungicides was preventative, and therefore, that successful control depended on early and repeated applications before

germination of the fungal spores and in the event of wet weather conditions. Consequently, the Section had to wait for the next growing season to continue testing.

While struggling to get practical fungicide experiments off the ground, Scribner himself turned to the life-history research that he knew was the key to effective disease control. He was to make discoveries on the nature of the black rot fungus that were to have profound implications for applied plant pathology. For years, botanists had associated black rot on the fruit (*Phoma uvicola*) and the leaf spot disease of grape (*Phyllosticta labruscae, Phyllosticta viticola,* etc.) with two separate fungi (15). Scribner himself had made this distinction in early publications (11). However, his view of black rot began to change during the summer of 1887 when Professor Pierre Viala (Fig. 5) of the Ecole Nationale D'Agriculture at Montpellier, France, arrived in the United States on a special mission from the French Ministry of Agriculture.

Professor Viala, an authority on viticulture and vine diseases, came to the United States with a primary mission of searching for American grape stock varieties that would grow well in France and offer resistance to phylloxera. Commissioner Colman directed Scribner to accompany Viala on his field excursions and to furnish whatever facilities the Department could provide. Between June and September, Viala and Scribner visited vineyards in New Jersey, Maryland, Virginia, North Carolina, New York, Ohio, Texas, and California (21). Scribner used this time to compile a comprehensive picture of American grape diseases, including black rot and leaf spot.

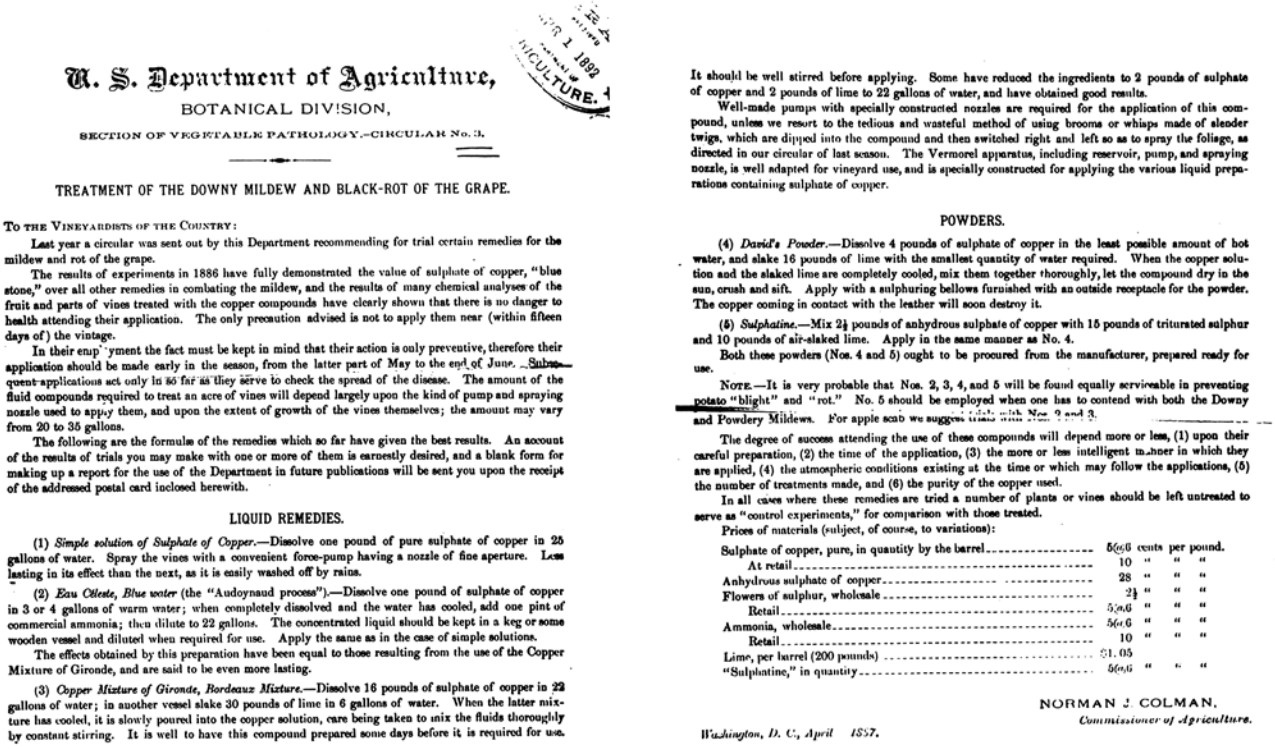
Scribner was at first reluctant to accept the hypothesis that both black rot of the fruit and leaf spot of the grape were caused by the same fungus, an idea Viala himself had speculated on in earlier mycological studies in France. However, his travels with Viala and additional research in Washington soon convinced him that this was indeed the case. In fact, his own life-history studies at the USDA laboratories went further, indicating that the leaves were the initial point of infection for black rot, often showing symptoms several weeks before the fruit (7,13,15).

This discovery had profound significance for the success of control measures. Scribner explained that the "confusion has been unfortunate from a viticultural point of view," because growers considered that they were dealing with two different fungal diseases and they had "not troubled themselves at all about the form on the leaves" in their efforts to control black rot with copper fungicides (21). In retrospect, it was not surprising that growers had reported poor results in 1887. By the time they applied copper sulfate to their grapevines, the fungus was already well-established on the fruit; it was simply too late to prevent the spread of black rot.

Scribner wasted no time in getting this information into the field during the 1888 growing season. He focused experiments that year at the Vineland, New Jersey, research station under the direction of Colonel Alexander W. Pearson, the skilled viticulturist and superintendent of the Vineland Wine Company. Conditions were especially favorable for black rot at Vineland in 1888. Pearson was instructed to apply different copper sulfate compounds to grapevine foliage, shoots, and berries early and repeatedly during the growing season (18). The emphasis was on the application of these chemicals to the foliage before the first appearance of the disease. Special care also was taken to leave some vines untreated for comparison (17,21).

The results of the experiments at Vineland during the spring and summer of 1888 were in marked contrast to those of the year before. Not only did the treatments prove highly effective against the black rot fungus, but the Bordeaux mixture clearly outperformed Eau Céleste and the other copper compounds. Scribner proclaimed success at last. In August, he wrote to Hermann Jaeger, special agent at Neosho, Missouri, declaring that "the treatment made at Vineland . . . with the Bordeaux mixture renders it no longer doubtful that by proper application . . . we can subdue or even entirely prevent the black rot" (19). That autumn, Scribner made a public announcement at a meeting of the Society for the Promotion of Agricultural Science. He announced that the field tests at Vineland gave the USDA assurance that the time had come when "we may successfully combat the Black Rot" (17).

The experiments in the spring and



U. S. Department of Agriculture,
BOTANICAL DIVISION,
SECTION OF VEGETABLE PATHOLOGY.—CIRCULAR No. 3.

TREATMENT OF THE DOWNY MILDEW AND BLACK-ROT OF THE GRAPE.

TO THE VINEYARDISTS OF THE COUNTRY:

Last year a circular was sent out by this Department recommending for trial certain remedies for the mildew and rot of the grape.

The results of experiments in 1886 have fully demonstrated the value of sulphate of copper, "blue stone," over all other remedies in combating the mildew, and the results of many chemical analyses of the fruit and parts of vines treated with the copper compounds have clearly shown that there is no danger to health attending their application. The only precaution advised is not to apply them near (within fifteen days of) the vintage.

In their employment the fact must be kept in mind that their action is only preventive, therefore their application should be made early in the season, from the latter part of May to the end of June. Subsequent applications act only in so far as they serve to check the spread of the disease. The amount of the fluid compounds required to treat an acre of vines will depend largely upon the kind of pump and spraying nozzle used to apply them, and upon the extent of growth of the vines themselves; the amount may vary from 20 to 35 gallons.

The following are the formulæ of the remedies which so far have given the best results. An account of the results of trials you may make with one or more of them is earnestly desired, and a blank form for making up a report for the use of the Department in future publications will be sent you upon the receipt of the addressed postal card inclosed herewith.

LIQUID REMEDIES.

(1) *Simple solution of Sulphate of Copper.*—Dissolve one pound of pure sulphate of copper in 25 gallons of water. Spray the vines with a convenient force-pump having a nozzle of fine aperture. Less lasting in its effect than the next, as it is easily washed off by rains.

(2) *Eau Céleste, Blue water* (the "Audoynaud process").—Dissolve one pound of sulphate of copper in 3 or 4 gallons of warm water; when completely dissolved and the water has cooled, add one pint of commercial ammonia; then dilute to 22 gallons. The concentrated liquid should be kept in a keg or some wooden vessel and diluted when required for use. Apply the same as in the case of simple solutions.

The effects obtained by this preparation have been equal to those resulting from the use of the Copper Mixture of Gironde, and are said to be even more lasting.

(3) *Copper Mixture of Gironde, Bordeaux Mixture.*—Dissolve 16 pounds of sulphate of copper in 22 gallons of water; in another vessel slake 30 pounds of lime in 6 gallons of water. When the latter mixture has cooled, it is slowly poured into the copper solution, care being taken to mix the fluids thoroughly by constant stirring. It is well to have this compound prepared some days before it is required for use. It should be well stirred before applying. Some have reduced the ingredients to 2 pounds of sulphate of copper and 2 pounds of lime to 22 gallons of water, and have obtained good results.

Well-made pumps with specially constructed nozzles are required for the application of this compound, unless we resort to the tedious and wasteful method of using brooms or whisps made of slender twigs, which are dipped into the compound and then switched right and left so as to spray the foliage, as directed in our circular of last season. The Vermorel apparatus, including reservoir, pump, and spraying nozzle, is well adapted for vineyard use, and is specially constructed for applying the various liquid preparations containing sulphate of copper.

POWDERS.

(4) *David's Powder.*—Dissolve 4 pounds of sulphate of copper in the least possible amount of hot water, and slake 16 pounds of lime with the smallest quantity of water required. When the copper solution and the slaked lime are completely cooled, mix them together thoroughly, let the compound dry in the sun, crush and sift. Apply with a sulphuring bellows furnished with an outside receptacle for the powder. The copper coming in contact with the leather will soon destroy it.

(5) *Sulphatine.*—Mix 2½ pounds of anhydrous sulphate of copper with 15 pounds of triturated sulphur and 10 pounds of air-slaked lime. Apply in the same manner as No. 4.

Both these powders (Nos. 4 and 5) ought to be procured from the manufacturer, prepared ready for use.

NOTE.—It is very probable that Nos. 2, 3, 4, and 5 will be found equally serviceable in preventing potato "blight" and "rot." No. 5 should be employed when one has to contend with both the Downy and Powdery Mildews. For apple scab we suggest trials with Nos. 2 and 3.

The degree of success attending the use of these compounds will depend more or less, (1) upon their careful preparation, (2) the time of the application, (3) the more or less intelligent manner in which they are applied, (4) the atmospheric conditions existing at the time or which may follow the applications, (5) the number of treatments made, and (6) the purity of the copper used.

In all cases where these remedies are tried a number of plants or vines should be left untreated to serve as "control experiments," for comparison with those treated.

Prices of materials (subject, of course, to variations):

Sulphate of copper, pure, in quantity by the barrel	5@6 cents per pound.
At retail	10 " " "
Anhydrous sulphate of copper	28 " " "
Flowers of sulphur, wholesale	2½ " " "
Retail	5@6 " " "
Ammonia, wholesale	5@6 " " "
Retail	10 " " "
Lime, per barrel (200 pounds)	$1.05
"Sulphatine," in quantity	5@6 " " "

NORMAN J. COLMAN,
Commissioner of Agriculture.

Washington, D. C., April 1887.

Fig. 4. USDA, Section of Vegetable Pathology Circular No. 3, April 1887. The third circular issued by the department since 1886 on grape diseases. From the original.

Fig. 5. Pierre Viala, professor at the Ecole Nationale D'Agriculture, Montpellier, France. A French specialist on viticulture and grape diseases, he visited principal vineyard regions in the United States with F. L. Scribner of the USDA in the summer of 1887. Courtesy of the National Archives.

summer of 1888 were a major victory for the USDA and American plant disease workers. Shortly thereafter, M. Prillieux, Inspector-General of Agricultural Education in France and Professor at the Institut Agronomique, corroborated the results obtained at the Vineland, New Jersey, station. Field tests at the other research stations in the United States also supported the original investigations at the New Jersey vineyard. Scribner had shown the value of combining careful research in the laboratory with practical disease control experiments in the field. Moreover, his collaboration with Viala demonstrated the value of international cooperation. By the end of 1888, the prospects of chemically controlling two major grape diseases were encouraging. The Americans had not only verified and extended important European work on the treatment of downy mildew, but also contributed substantially to the understanding and prevention of black rot. Viala, in recognition of Scribner's achievement, wrote late in 1888 that "the discovery of an efficacious course of treatment for Black Rot will permit, perhaps, . . . the development of American viticulture on a new basis" (21).

Scribner would remark much later in life that his work with Bordeaux on the control of black rot and downy mildew was his most important contribution to plant pathology (20). Ralph E. Smith, a prominent American phytopathologist of the twentieth century, characterized Scribner's role in chemical controls accurately when he reflected that Scribner "immediately saw the significance . . . and vigorously pushed the development" (22). Scribner's foresight defined and entrenched applied plant pathology in the United States. But his influence did not end there.

Scribner's experience with black rot became a model for plant pathology in the USDA. Workers began with a thorough examination of disease conditions in the field, followed by laboratory studies to unlock the life history of the causal agent. They then conducted field tests of control measures, hopefully with success, before concluding with publication of the results for scientists and agriculturists to review. This system returned practical results quickly on many troubling fungal disease problems and kept research pressure on the study of bacterial and then viral diseases that would not respond to copper fungicides. By putting a system in place for doing fundamental and applied plant disease research and by bringing in a number of qualified scientists like Erwin F. Smith, Beverly T. Galloway, and Effie A. Southworth to continue and expand this work after his departure, Scribner charted the path for an outstanding future for plant pathology in the USDA.

ACKNOWLEDGMENTS

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