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Verrucaria fuscella (Fr.) On limestone. La Crosse, Wis., January, 1895. Coll., L. H. Pammel. Quite as rarely collected as the last.

Verrucaria muralis (Ach.) On limestone. Rooks county, Kan., March, 1893. Coll., E. Bartholomew. And La Crosse, Wis., January, 1895. Coll., L. H. Pammel.

Pyrenula punctiformis (Ach.) Naeg., var. *Fallax* Nyl. On trees. Emma, Mo., July, 1898. Coll., C. H. Demetrio.

Pyrenula thelena (Ach.) On trees. Emma, Mo., July, 1898. Coll., C. H. Demetrio.

POWDERY MILDEW OF THE APPLE.

BY L. H. PAMMEL.

There has been much discussion on the subject of powdery mildew of the apple. It has been referred to several genera but Sorauer* in his book on "Plant Diseases" and Tubeuff† in his work on "Plant Diseases" reports the *Podopshœra oxyacanthæ* DC., as destructive to the apple, and makes the statement that it is abundant upon the apple and pear in America. Frank‡ in the second edition of his work on "Plant Diseases" makes a statement somewhat similar to that of Tubeuf. These statements are undoubtedly based upon the work of Galloway,§ who paid some attention to the subject of a powdery mildew upon the apple. Several American writers have briefly referred to the occurrence of a mildew upon apples, among them, Fairchild and Galloway, who made some experiments in treating this disease. Professor Galloway,|| in a paper on the common mildew of the cherry, records the occurrence of this fungus upon the apple, and it is also recorded here upon the quince and wild crab. In a circular issued by Galloway,¶ mention is made of this fungus under the name of *Podosphœra oxyacanthæ* and in a later paper** the fungus is again referred to under the

* Pflanzen Krankheiten 330.

† Pflanzen Krankheiten 193.

‡ Die Pilzp. Frank. d Pflanzen 250.

§ Circ. U. S. Dept. of Agrl., Div. of Vegetable Pathology 8.

|| Rep. Dept. Agrl. 1888: 353.

¶ U. S. Dept. Agrl., Div. Veg. Path. 8. See also Zeitsch f. Pflanzen 1:97.

** Jour. Myc. 6:14.

name of *Podospaera oxyacanthae* in which Galloway* makes the statement that powdery mildew, *Podospaera oxyacanthae*, is especially destructive to seedlings in the nursery, attacking them soon after the leaves unfold and continuing throughout the growing season, making it impossible to bud them with any success. There is still another reference by Galloway† to this same fungus.

There may be several fungi concerned in this work. Dr. Magnus‡, in 1898, reported the fungus *Sphaerotheca mali* from Süd Tirol on apple in which he confirms the conclusions of Professor Burrill. The same year he reported it from Tirol.§

Galloway|| was aware of the occurrence of another fungus on the apple, as will be seen from the following, which appeared as a foot note in his article on powdery mildew: "We have recently received from Mr. Swingle, of Kansas, an *erysiphæ* infesting apple seedlings, which does not appear to be this species." Whether actual perithecia of *Podospaera oxyacanthæ* on apple have been commonly seen in this country is very doubtful. It has been assumed to be *Podospaera oxyacanthæ* in most cases. Like other mildews, climatic conditions do not always favor the development of perithecia. As an illustration we may cite *Erysiphe graminis*, which rarely produces perithecia in Iowa.

F. von Thümen¶ records the *Sphaerotheca castagnei* Lev. *F. mali* in Austria. He considers it only a well developed form of the species. In this he agrees with the well-known German phytopathologist, Sorauer. Sorauer¹ states that perithecia have not been found on leaves, although the conidia are abundant. Perithecia, however, occurring on the shoot.

Fairchild² in his report on the successful treatment of this disease, doubtfully refers this fungus to *Podospaera oxyacanthæ*.

* Rep. U. S. Dept. of Agr. 1889: 414.

† Farmers' Bulletin, Office of Exp. Sta. 7:14. (Jour. Myc. 7:256.)

‡ Ber. d. Deutsch. Bot. Gesellsch. 16: 331. 1898.

§ Die Enzypheon Tirols, Ber. Naturw.-Med. Ver. Innsbruck 24: Separate, 5. 1898.

|| Rep. U. S. Dept. of Agr. 1889: 414.

¶ Ueber einige besonders beachtenswerthe durch parasitische Pilze hervorgerufenen Krankheiten der Apfelbaumblätter. Lab. Chem.-phys. Versuchss Stat. f. Wein u. Obstbau. Klosterneuburg 14: Abst. Zeitsch f. Pflanzenk 1: 167.

¹ Phytopathologische Notizen. Der Mehithau der Apfelbaume Hedwigia 28: 8. He also has a foot note under the Galloway article, Zeitsch f. Pflanzenk 1: 97 in which he states what has been found in Germany.

² Jour. Myc. 7: 256.

A reference to the occurrence of the disease in New Jersey is made by Dr. Halsted,* who states that the fungus is very destructive to young twigs, and does its greatest damage to young nursery stock.

Professors Burrill and Earle† do not record it under *Spaerothæca castagnei*, or *S. pannosa*, the form occurring upon other members of the order *Rosaceæ*, nor do they mention the fungus *Podosphaera oxyacanthæ* as occurring upon *Pyrus*, although they record it upon several species of *Crataegus*. Professor Earle,‡ in a paper on notes on North American forms of *Podosphaera oxyacanthæ*, discusses the various American forms of this polymorphic species in which he records the variability of the species upon various members of genus *Prunus*, e. g., *Prunus cerasus*, *P. americana*, *P. domestica*, *P. padus*, and describes the fungus also on *Spiræa tomentosa* and *Amelanchier canadensis*. The *Podosphaera oxyacanthæ* on *Amelanchier canadensis* is also mentioned by Tracy and Galloway,§ and likewise on two species of *Crataegus*.

Bessey|| reports the occurrence of *Podosphaera kunzei* Lev., which is of course synonymous with *Podosphaera oxyacanthæ* on seedling apples, frequently producing much injury. In a later paper Bessey¶ records the same species on the apple.

Atkinson,¹ in his paper on Erysiphææ, from Carolina and Alabama, reports *Podosphaera oxyacanthæ* upon *Crataegus punctata*, but makes no mention of a mildew on the apple.

Dr. Davis,² in a supplementary list of parasitic fungi of Wisconsin, makes a statement that *Podosphaera oxyacanthæ* was rather common on *Pyrus coronaria* in 1888, and records it also on *Crataegus tomentosa*.

Trelease³ under *Podosphaera tridactyla*, which is synonymous with *P. oxyacanthæ*, mentions the common occurrence of this species on *Prunus*, but does not refer to its occurrence on the apple.

Seymour⁴ lists the *Podosphaera oxyacanthæ* on *Prunus* and

* Rep. Bot. Dept. New Jersey Agr. Ex. Sta. 1892: 337.

† Parasitic fungi of Ill. State Lab. Nat. Hist. Pt. 2.

‡ Bot. Gazette 9: 24.

§ Jour. Myc. 4: 34.

|| Erysiphæi, Biennial Rep. Ia. Agr. Coll. 1877: Separate 4.

¶ Bull. Ia. Agr. Coll. Dept. Bot. 1884: 141.

¹ Jour. of Elisha Mitchell Sci. Soc. 7: Separate 9.

² Wis. Acad. Sci. Arts and Letters, 9: 157.

³ Preliminary list of Parasitic Fungi of Wis. Trans. Wis. Acad. Sci. Arts and Letters 6: 112. Separate 9.

⁴ List of fungi Coll. in 1894 along Northern Pacific R. R., Proc. Boston Soc. Nat. Hist. 24: 184.

Spiraea, but there is no mention of its occurrence on *Pyrus*.

Hitchcock* records the occurrence of *Podosphaera tridactyla* upon *Crataegus tomentosa*, *C. punctata* and seedling cherries, but he does not mention the apple.

Weber† reports *Podosphaera tridactyla* on cultivated cherry and wild plum, but nowhere is any mention made of *Sphaerotheca mali* or any other mildew upon the apple.

In the *Perisporaceae* of the Kellerman & Werner‡ list in the catalogue of Ohio plants, *Podosphaera oxyacanthia* is reported on *Spyraea* and *Prunus cerasus*, but there is no mention of the occurrence of powdery mildew on the apple.

Ellis and Gerard,§ who worked up the fungi in catalogue of plants of New Jersey, do not report the apple as affected.

Burrill|| correctly refers the apple powdery mildew to *S. mali* (Duby), Burrill.

Duby¶ wrote a very short description of this species under *Erysiphe mali*. Burrill who examined the *E. mali* Duby, in Roumeger's fungi Gallici exsiccati, says it appears to be a *Sphaeratheca* and the same as the American material. There is also another *E. mali*, Moug¹ which is considered to be by these authors a form of *Alphitomorpha adunca*. There can be little doubt that our fungus is identical with that described by Duby, and that the European *Sphaerotheca castagnei* f. *mali*, sometimes referred to this species, is identical with the American form. The *S. leucotricha* E. and E.,² has also been referred to the species.

The writer, in 1893, called attention to the common occurrence of this fungus in Iowa³ under the name of *Sphaerotheca mali*, following the Burrill nomenclature.

Fink⁴ called attention to its occurrence in the vicinity of Fayette, in 1894. The writer distributed this fungus from Iowa⁵ in 1893⁶, and A. J. Grant,⁶ from Newfane, Vt., in 1895. Quite recently Grant⁷ has figured and described the fungus.

* Bull. Ia. Agr. Coll. Bot. Dept. 1886: 64.

† Cat. Fl. Nebr. 50.

‡ Geology of Ohio, 7: 350.

§ New Jersey Geological Survey 2: 507.

|| In Ellis and Everhart, N. A. Pyrenomycetes 6.

¶ Bot. Gallicum 1: 809.

¹ Wallroth Fl. Cypri. Germ. 4: 755.

² Jour. Myc. 4: 58 Burrill, in Ellis and Everhart N. Am. Pyreu. 6.

³ Bull. Ia. Agri. Exp. Sta. 23: 921. Proc. Ia. Acad. of Sci. 14: 93. 1893.

⁴ Proc. Ia. Acad. of Sci. 14: 103. Blights, Orchids and Ferns 7: 1894.

⁵ Ellis and Everhart N. Am. Fung. No. 2215.

⁶ Fung. Columb. No. 926.

⁷ Bull. Torrey Bot. Club. 26: 373. pl. 364.

He first found the fungus late in November, 1892, on a few belated leaves clinging to the adventitious shoots from the stump of a young apple tree in Newfane, Vt. He has had access to the material in the Ellis herbarium, and finds it represented from Missouri (Demetrio), Kansas (Kellerman & Swingle). Grant observes that this mildew is probably not uncommon, but is rarely collected because its perithecia are on the shoots instead of the leaves, and also because the perithecia do not mature until very late in the autumn. In the Mississippi valley the perithecia mature much earlier. They are common in September, and some may be found in August. But our climate is so much drier than that of the New England states, and this accounts for the early maturation of the perithecia at Ames.

So far as the writer knows the apple fungus occurring in Iowa is *Sphaerotheca mali* and not *Podosphaera oxyacanthæ*. Professor Burrill, however, also reports the *Podosphaera oxyacanthæ* on *Pyrus malus*. This fungus may be characterized as follows: Amphigenous, mycelium white or frequently slightly fuscous, submembranaceous, persistent. Perithecia few or numerous, immersed in the mycelium; small; seventy-five to eighty-five appendages of two kinds; one kind consists of one or more dark, straight, jointed, occasionally forked at the end; the other consists of short, colorless, floccose, rudimentary appendages. Each perithecium has a single ascus which usually contains six ascospores. This fungus occurs on the leaves and stems in the nursery, especially sprouts around old trees. In such places it is extremely abundant at times. It is as abundant in Illinois as in Iowa.

Professor Burrill in commenting upon this fungus says: "This exceedingly interesting species has not been well separated from *Podosphaera oxyacanthæ* which occurs on the same host and to casual observation has much the same appearance. In our species the tips of the large appendages are occasionally forked (once or even slightly twice), which again may have been confusing. But these vague, stiff branches are totally unlike the dichotomous divisions of *Podosphaera*, and otherwise the species are very distinct. The tuft of short, interwoven rudimentary appendages, like a dense cluster of short roots, is a very characteristic mark."

This fungus is of considerable economic importance. Mr. Stewart writes me he has not commonly met with it in New

York the past season. The colorless mycelium creeping over the surface sends small rounded suckers (haustoria) into the epidermal cells, and produces numerous colorless erect hyphæ (conidiophores) that bear the spores (conidia) in chains. The conidia germinate in a short time by producing a short thread. They may often be found germinating on the plant. These spores serve to propagate the fungus during the summer while the spores found in the brown perithecia tide the fungus over the following spring. As a result of the attacks of this fungus the leaves become dry and so far as their function is concerned, that of assimilating food, are entirely worthless. As stated from the quotation from Professor Galloway they are unfit for budding.

Treatment.—Professor Galloway has shown that ammoniacal carbonate of copper will effectually prevent the disease, and I may add that inasmuch as Bordeaux mixture has proved so effectual on the college grounds in holding in check the powdery mildew of the cherry, it may prove efficacious for this disease, and we advise the use of this fungicide in preference to ammoniacal carbonate of copper.

QUINCE FRUIT WITH AN IMMENSE NUMBER OF SEEDS.

BY L. H. PAMMEL.

Several years ago there was brought to me a quince, *Pyrus cydonia*, containing much more than the usual number of seeds. The genus *Pyrus* has from two to five ovaries and in each ovary are two ovules. Bailey in the revised edition of "Gray's Field, Forest and Garden Botany"* states that the five cells are normally many seeded. In the case under consideration the fruit had a perfectly normal appearance of five cells and over one hundred seeds. They are shown in the accompanying illustrations.

*161.