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SOME FUNGUS DISEASES OF TREES.

BY L. H. PAMMEL.

The researches of Hartig, Tubeuf, Metcalf, Von Schrenk, and others have shown that quite a large number of wood destroying fungi belong to the *Agaricaceae*, *Hypochnaceae*, *Polyporaceae*, *Hydnanceae*, and *Thelephoraceae*.

In many cases these fungi attack the plant through a wound resulting from a windstorm or from injudicious pruning.

HEART ROT.

Heart rot is a very common wood destroying fungus and occurs on the Quaking Aspen (*Populus tremuloides*). This species is not abundant except in a few localities in Iowa, though the most important deciduous tree in the Rockies from New Mexico to Canada. At times it is seriously affected with fungus diseases in the Rocky mountains. In 1908 we found thousands of diseased trees in the Wasatch mountains in Utah. Many trees were dying from a heart rot caused by *Fomes igniarius*, which is common in eastern North America on the same plant according to Haven Metcalf.¹ Saccardo² reports it as occurring on *Salix*; Winter³ on the same host and *Quercus*. Tubeuf⁴ adds alder, apple, and other deciduous trees; Lindau⁵ mentions the willow and apple; Masee⁶ and Duggar⁷ give short accounts of the fungus and its injury to deciduous trees.

The fungus was named *Boletus igniarius* L.⁸ Then Fries⁹ transferred it to the genus *Polyporus* (*P. igniarius*). Subsequently the name *Fomes*¹⁰ was applied to the perennial species of *Polyporus*, with a thick

¹Yearbook U. S. Dept. Agrl. 1907.491, pl. 59, f. 1.

²Sylloge Fung. 6:180.

³Die Pilze. Abt. I:424.

⁴Diseases of Plants. Engl. Trans. 433.

⁵Handbuch der Pflanzenkrankheiten. 386.

⁶Diseases of Cultivated Plants. 373.

⁷Fungous Disease of Plants. 464.

⁸Fl. Suecia. 1250.

⁹Syst. Myc. 1:375.

¹⁰Nov. Symb. 31.

bracket or hoof shaped, hard and woody pileus, with concentric ridges, azonal and stratified tubes.

This genus includes some of the most troublesome of the wood parasitic diseases. The *Fomes fomentarius* on the beech, birch, and yellow birch; the *F. pinicola* on pines, spruces, balsam fir are excellent illustrations of very destructive wood fungi. The *F. applanatus*, the largest of our bracket fungi and one of the most common in Iowa, occurs on the oak, maple, apple, plum, and many other deciduous trees. It is a wound parasite though not as injurious as some of the others.

Hartig¹¹ long ago worked out the pathological change that occurs in the wood when attacked by *H. igniarius*. The germinating spores of this fungus enter the plant through a wound, which may have been formed by the breaking off of a branch during a wind storm or from a badly pruned branch. The mycelium spreads into the wood and soon reaches the heart wood which it changes into a brown color, then into a whitish friable substance. The mycelium then comes to the surface where the fruiting body occurs. The bark of the Quaking Asp in the vicinity of the fruiting body is of a blackish color. The fruiting bodies are at first white, merely roundish knobs then become hoof shaped; they continue to grow for several years each year adding a little more to the old layers of the fungus. It is 3-6 inches long by 2 inches thick. The surface of the fungus is brownish black and more or less cracked and hard. The spores are colorless, spherical, 6-7 μ in diameter.

Near Soldier Summit in the Wasatch mountains hundreds of trees were attacked by the fungus, from small trees less than 6 inches to older trees 8-12 inches in diameter. In many cases old trees were broken down. It was apparent here that where one tree was diseased many others could be found, and that the brackets on the surface were the sources of infection. In other portions of the same region, as in the Bear river country, Utah, the disease was not observed nor in the San Miguel mountains in Colorado.

THE OYSTER FUNGUS (*Pleurotus ulmarius* Bull.)

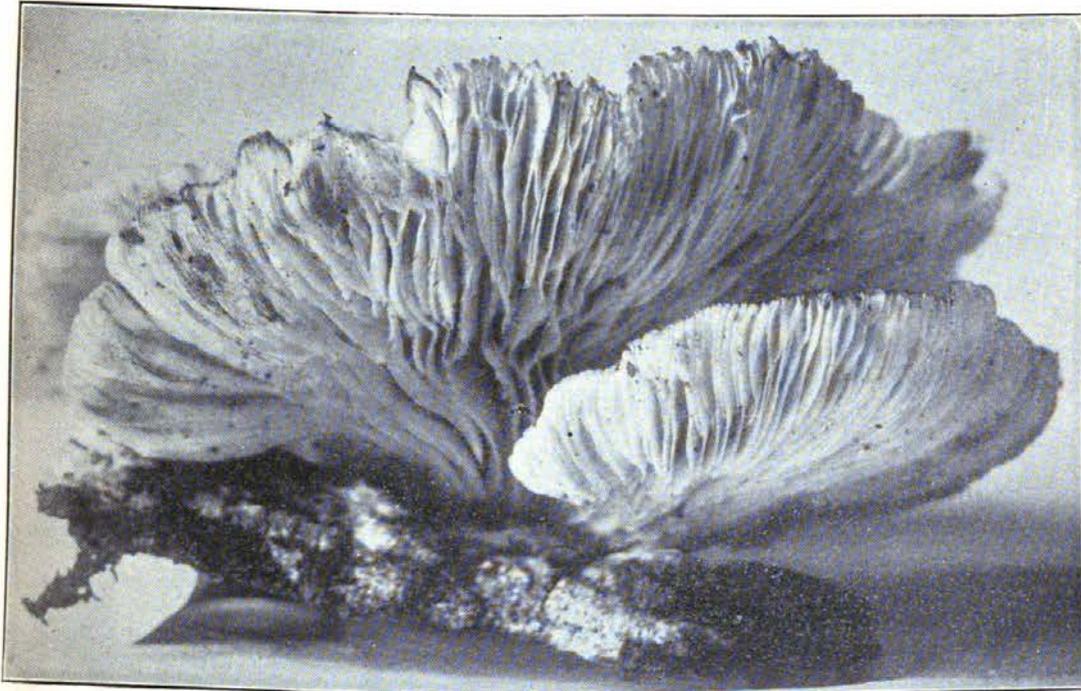
This fungus is common in many parts of Iowa and is to be regarded as a wound parasite, although not so active as the *Fomes igniarius*. Common on the Box Elder and Basswood. Metcalf¹² mentions it as a wound parasite, stating that "presumably it does not initiate the rot of the tree and certainly is not an active parasite like the false tinder fungus, but it materially hastens the decay and ultimate

¹¹Die Zersetzungserscheinungen des Holzes.



Fomes applanatus on trunk of Cottonwood.

Photograph by L. H. Pammel.

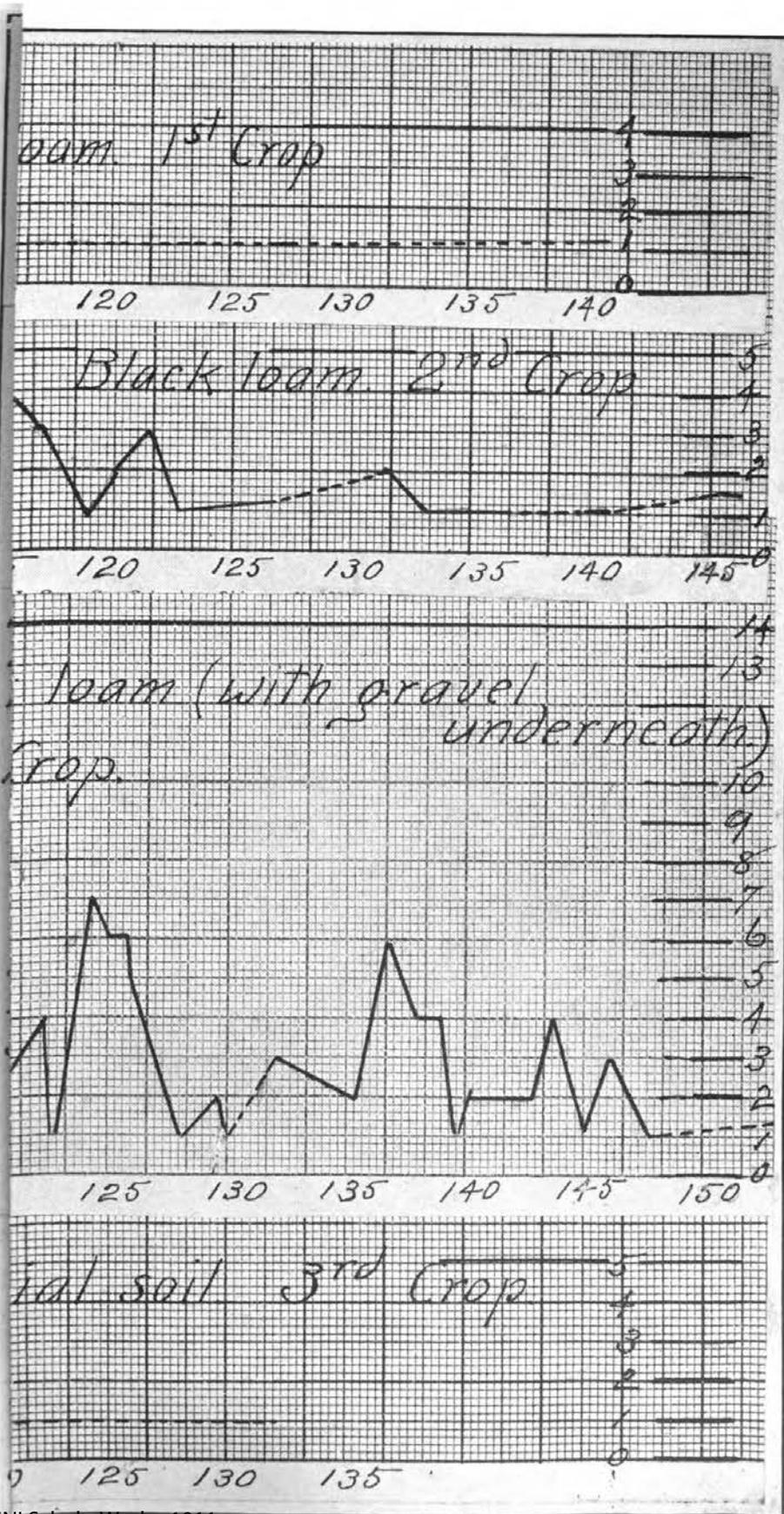


Pleurotus ulmarius Bull., frequent on boxelder. (Ia. Agrl. Exp. Station.)



Fomes igniarius on Quaking Aspen.

Photograph by Prof. E. Colburn.



death of the tree." It is certainly a very active agent in the destruction of the wood of the Box Elder in Iowa. The Box Elder (*Negundo aceroides*) is one of the most easily injured of our trees, by wind storms which often leave broken branches exposed to the attacks of the wound parasites.

The Oyster Fungus is an edible species. The spores germinate in the pockets left in a wounded tree, the mycelium enters the wood where it causes a slow disintegration; the wood frequently turns a pinkish color. The white mycelium comes to the surface where the fleshy white brackets appear; sometimes one or two, but frequently more may occur. The fruiting body 2-5 inches broad is generally convex or sometimes nearly flat, firm and smooth, white or sometimes tinted with reddish yellow or brownish yellow in color. The lamellæ broad, extending down on the stem, white. The stipe is usually curved, white or whitish, smooth, 2-4 inches long; spores white, spherical.

ROOT ROT FUNGUS.

Root Rot Fungus (*Polystictus versicolor* Fr.) This is one of the most common of our wood destroying fungi in Iowa, very common on the soft maple, box elder, oak, apple, cherry, and other deciduous trees. This fungus has been mentioned by a few writers like Earle, Galloway and Woods, but has not been regarded as causing serious trouble. However, F. S. Earle¹² many years ago attributed a root rot of pear trees in Illinois to it. Galloway and Woods¹³ considered that it was the cause of root rot of many trees.

It is common in Europe as in the United States and was known to Linnæus, who described it. Fries, however, placed the fungus in the genus *Polystictus*¹⁴, the species becoming *P. versicolor* Fr.¹⁵

The spores germinate in the moisture which collects in the pockets of wounds and in the wood forms a white mycelium, which occurs not only on the roots, but in the interior of the wood as well. It causes disintegration. Cherry and other fruit trees diseased have a tendency to overbear; a gust of wind will cause such a tree to split more easily in the crotches or to break off exposing the thoroughly disintegrated heart and sapwood. According to Earle on pear trees the white mycelium covers the root causing the decay, the growth of the tree becomes stunted and there is a tendency to overproduction of fruit. It

¹²Pear Diseases Caused by Fungi. Trans. Ill. Hort. Soc. 20:168.

¹³Yearbook U. S. Dept. Agr. 1896:250, f. 55.

¹⁴Nov. Symb. 54.

¹⁵Syst. Mycol. 3:368.

usually takes several years before the tree is killed. The fruiting bodies of the fungus occur on the surface where they form numerous thin brackets with a zonal marking on the upper surface and white underneath.

ROOT ROT OF OAK, ETC.

Hallimasch, Honey Agaric (*Armillaria mellea Vahl.*). The Honey Agaric or Honey Mushroom has long been recognized as the cause of root-rot disease of trees. Its parasitic nature was first described by Hartig¹⁶ and later verified by many other investigators. During the autumn of 1910 a large number of specimens were found in an oak forest near Ames. They are found mostly, however, on the stumps of young oaks cut off the previous winter; a few, however, in connection with living trees. The general symptoms of the disease are a stunted growth and gradual dying. In other cases the trees die suddenly, especially during dry weather. The diseased trees show a white mycelium of a leathery consistency on the roots. There are also dark strands or rhizomorphs, which are connected with the mycelium between the bark and the wood. These rhizomorphs undoubtedly spread the fungus from plant to plant. The fruiting bodies of the fungus appear in great numbers in the fall and come from the rhizomorphs. They are yellowish brown, 2-4 inches across, with dark scales. The gills (lamellæ) are attached to the stem. There is also present an inner veil which forms a distinct ring. The fruiting body is 3-8 inches high. The spores are elliptical, white and abundant.

THE SPOT DISEASE OF THE BUTTERNUT AND BLACK WALNUT, OR ANTHRACNOSE. *Gnomonia leptostyla* (FR.) CES. AND DE NOT.
Marsonia Juglandis (LIB.) SACC.

For nearly twenty years the writer has observed this disease on the black walnut and butternut. Though generally not regarded as a serious disease by most observers, the writer is inclined to consider it as much more serious than is usually supposed. It is not an uncommon thing for the black walnut and butternut to lose their foliage during the latter part of August because of the attacks of the *Marsonia*. Few accounts have appeared in American literature. Selby¹⁷ states it may do serious injury. I have also referred to its injurious nature in

¹⁶Wichtige Krankheiten d. Pflanzen. also Zersetzungserscheinungen, etc. Galloway & Woods. Yearbook U. S. Dept. Agrl. 1896:249. Tubeuf. Diseases of Plants. 455.

¹⁷Bull. Ohio Agric. Expt. Sta. 214:452.

several publications.¹⁸ Tubeuf¹⁹ refers to the injury of the fungus in Great Britain on the English walnut. Masee also refers to it and describes the character of the fungus. Klebahn²⁰ not only refers to injurious nature of the fungus in Germany but gives an account of the life history as worked out from cultures and in the field. Lindau²¹ also discusses the disease, adding, "Most of the species produce diseases hardly worth mentioning except the *M. Panattoniana* on head lettuce." The imperfect fungus was described by Madam Libert as *Leptothyrium Juglandis*. Subsequently Saccardo²² placed it in the genus *Marsonia*. Magnus²³ called attention to the prior use of the name *Marsonia* for one of the flowering plants and hence cannot be used. He therefore suggested that the genus be changed to *Marsonina*. The cultural work of Klebahn demonstrated the connection of this fungus with *Gnomonia leptostyla* (Fr.) Ces. and de Not. the ascigerous form. This stage of the fungus was found on dead leaves of *Juglans regia* in the spring. A connection with this fungus had previously been suggested by Frank.²⁴ Winter²⁵ and Krieger²⁶ suggested the same connection without, however, furnishing the proof.

CHARACTERS OF THE FUNGUS

The fungus causes brownish spots which at first are circumscribed but later the spots may become confluent, the leaves turning yellow, and falling. The spots contain on their lower surface small blackish brown pustules appearing above the surface of the leaf. These are formed by the pushing up of the stroma and the spores, the latter are borne on short conidiophores. The mycelium develops between the cuticle and the wall of the epidermis. Finally by the continued formation of the stromatic cells it is pushed up and ruptured. The mycelium is light colored, septate and branched. It secretes a ferment which destroys the tissues and produces the brownish or blackish color of the leaf. The conidia are colorless, short, straight or somewhat sickle-shaped, $14-26\mu \times 2 \times 3\mu$, usually two celled.

Klebahn describes a second kind of spore found in these pustules. It is colorless, straight or nearly so and rod-like, $6 \times 12\mu \times$

¹⁸Contr. Bot. Dept. 41:22. Proc. Ia. Acad. Sci. 16:62. Jour. Myc. 7:103.

¹⁹Diseases of Plants. 491.

²⁰Zeitschrift für Pflanzenkrankheiten. 17:223, Pl. 8 and f. 1. 2.

²¹Sorauer Pflanzenkrankheiten. 429.

²²*Marsonia Juglandis* (Lib.) Sacc. F. ital. t. 1095.

²³Hedwigia. 45:88.

²⁴Die Krankheiten der Pflanzen. (Ed. 2) 453.

²⁵Die Pilze. 2:580.

1-15 μ . This is the *Leptothyrium Juglandis Rabenh.*, or *Cryptosporium nigrum Bon.* The perfect form of the fungus occurs in dead leaves in the spring. The perithecia are brown, spherical 200-300 μ with a long beak; each ascus has 8 two-celled, spindle-shaped, colorless ascospores, 19-25 μ x3 μ . Klebahn was able to secure positive infectious inoculation by sowing the ascospores on young leaves of the English walnut. The fungus can be cultivated very easily in nutrient agar containing a decoction of walnuts. In these cultures an abundance of conidia were produced, also an excretion of calcium oxalate.

It may be added that I have seen the fungus abundant on the black walnut and butternut in Iowa, Wisconsin, Illinois and Minnesota, and on the black walnut in Missouri.

THE MAPLE EXOASCUS (*Taphrina*).

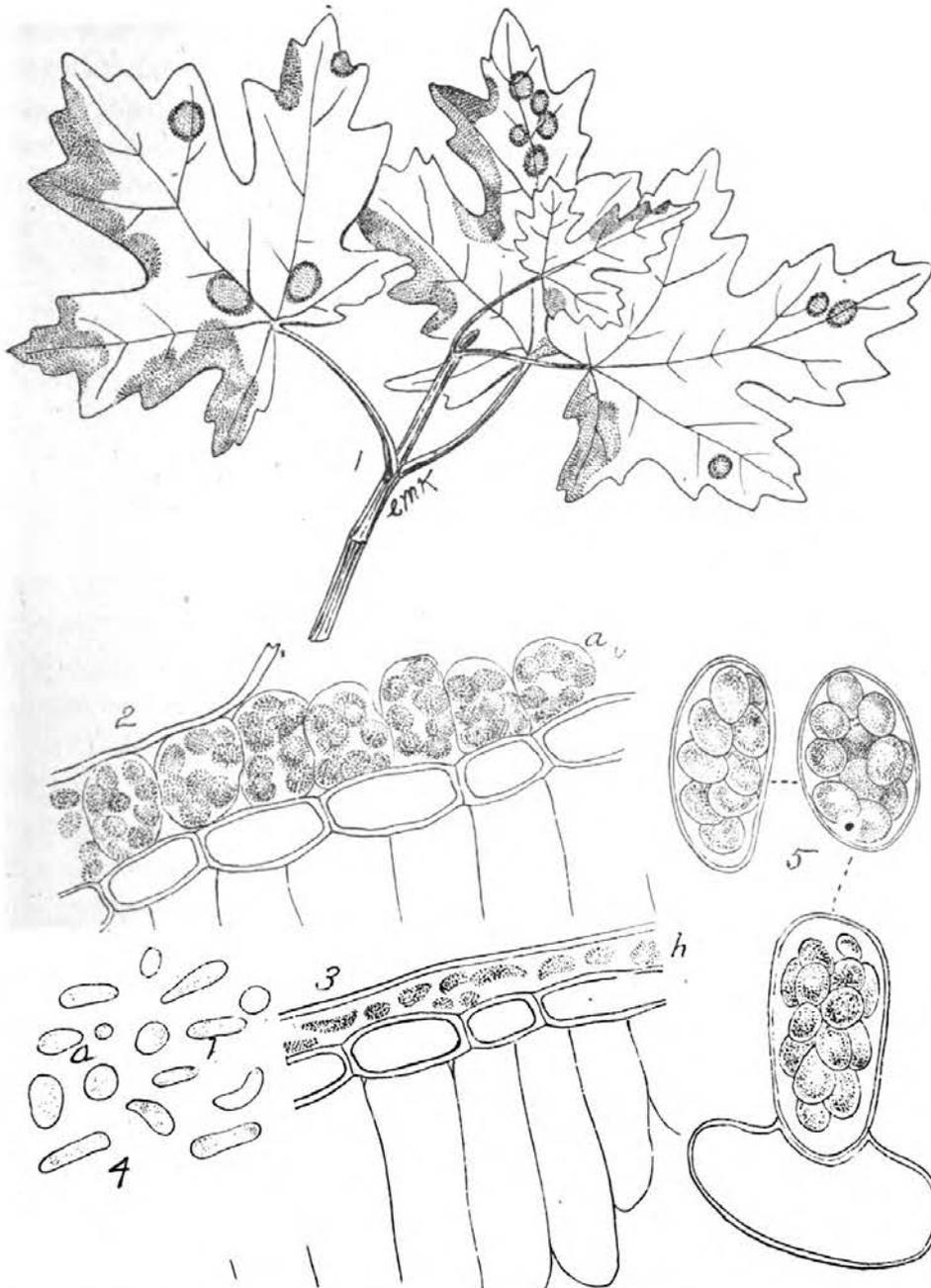
During the early part of July, 1908, the writer found a species of *Taphrina* abundant on the Rocky Mountain hard maple (*Acer grandidentatum*) in the Wasatch mountains near Logan, Utah, especially in Logan canon and along the adjacent streams emptying into the Logan river. In some cases the trees were entirely defoliated, in others a majority of the leaves were attacked. At lower altitudes the disease was too far advanced to indicate the cause of this abundant epidemic, but at higher elevations the younger leaves had the characteristic pale color above, with a whitish somewhat mealy substance on the under surface, also in some cases the mealy substance was on the upper surface as well.

This fungus is of particular interest since no fungus of this group on the maples is common in the United States. Peck²⁷ described an *Ascomyces lethifer* upon the Mountain Maple (*Acer spicatum*). He regarded this species as very distinct from *Taphrina polyspora* (Sorok.) Johan., because this species forms definite spots and the leaves soon turn black, wither and die.²⁸ "Sometimes all the leaves on a branch are affected and the fungus then causes a veritable blight."

The *T. polyspora* was described as an *Ascomyces* (*Ascomyces polyspora* Sorok.)²⁹ and subsequently placed in the genus *Taphrina* by

²⁷Rep. N. Y. State Museum. 40:66.

²⁸Indefinite, hypophyllous, often occupying the whole lower surface of the leaf and suffusing it with a glaucous bloom; asci cylindrical, obtuse or subtruncate, 40—50x15—20 μ ; spores minute, varying from narrowly elliptical to subglobose, 4—5x2—3 μ .



- 1 Leaves of *Acer grandidentatum* affected by *Taphrina*.
- 2 Section of upper side of affected leaf; *a* ascus, lying between cuticle and remainder of cell-wall.
- 3 Section of leaf showing earlier stage; *h*, hyphae divided.
- 4 Group of young asci (*a*) and short hyphae (*h*).
- 5 Group of three asci with ascospores, indefinite in number.

—Figures drawn by Miss Charlotte M. King.

Johanson.³⁰ Sadebeck, in one of his earlier papers on *Taphrina*, makes mention of *T. polyspora*³¹ and in a subsequent paper gives a good description.³²

The following comments on *Taphrina* have been furnished me by Dr. Farlow:

“The different species of *Taphrina* and *Exoascus* on maples are somewhat confusing. *E. acericola* C. Massalonga was described in *Malpighia* VIII, 121, 1894, but his variety *Pseudoplatani* of that species had been previously referred to *Taphrina polyspora* as a variety.”

“*Taphrina polyspora* (Sorokin) Johan. was described a good many years ago as an *Ascomyces* by Sorokin, if I remember correctly, and was called *Taphrina polyspora* by Johanson in 1887. The *Taphrina aceris* of Linhart is a synonym of this species. *Taphrina acerina* Eliasson, a more recent species, dates from 1895.”

Sadebeck places the form on *Acer pseudoplatanus* as a variety of *polyspora* the variety *pseudoplatani*. This form having asci from 16-24x10-12 μ in diameter. Producing like the species an abundance of yeast-like conidia occurring in the asci. According to Massalonga, the asci only develop on the lower surface of the leaf. This variety is also found in Italy, while the species occurs in southern Russia, Hungary, and Scandinavia.

The *Taphrina acerina* was described and figured by Eliasson.³³ The mycelium is subcuticular, the apex of the asci is roundish or truncate: 15-23 μ long by 9-12 μ wide, crowded, the stalk cells not entering into the epidermis, round at the base 79 μ by 12-15 μ ; ascospores globose, 415 μ in diameter. This was also found upon *Acer platanoides* in Upsala, Sweden, and evidently is distinct from the *Taphrina lethifer* of Peck.

The characters of the disease upon *Acer grandidentatum* are as follows: The leaves are yellowish, then finally becoming blackish and fall; they are not crinkled. The asci usually occur upon the lower surface of the leaves although in some cases upon the upper; the mycelium is perennial in the buds forming a subcuticular mycelium; densely crowd-

³⁰Ofv. af. Kgl. Vet.-Akad. Forhandl. Stockholm 1885; 1:41 Bihang. Till. Kgl. Svenska Vet.-Akad. Handlingar. 13:19, No. 4.

³¹Kritischen Untersuchungen. Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten. 8:35.

³²Die parasitschen Exoascen. Jahrbuch. der Hamburgischen Anstalten. 10:76.

³³Bihang Till. Svenska Vet.-Akad. Handlingar. 20:3: No. 4. Pl. 1.

ed, so much so that it is difficult to make out the character of the asci in mounts that are not stained. The asci are cylindrical, rounded or somewhat flattened, $20-18 \times 12-18 \mu$. The ascospores are usually numerous in the ascus and measure $4-5 \mu$ in diameter. Comparison of the material from Eliasson (specimens kindly furnished by Dr. Farlow) indicates that the asci of this species are different from those of the other species. It has not, however, been compared with *lethifer*, but as indicated above it apparently differs from that.

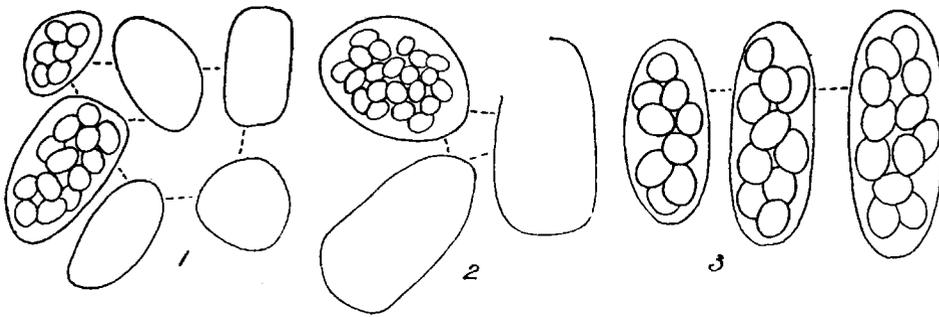


Fig. — Groups of asci. with ascospores; 1 *Taphrina acerina*, 2 *Taphrina polyspora*, 3 *Taphrina* on *Acer grandidentatum*.

Drawn by Charlotte M. King.