

THE PYCNOTHYRIUM IN THE TAXONOMIC SYSTEM OF THE FUNGI IMPERFECTI

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The two currently approved systems of classification for the Fungi Imperfecti, Saccardo's of 1884 and Lindau's of 1900, do not permit the giving of adequate consideration to the striking morphological characteristics possessed by certain leaf-inhabiting fungi which, as an adjunct to sporulation, produce structures known as pycnothyria. These fungi, as a consequence, are much misunderstood and, in classification, are now interspersed on the basis of their spore forms, as required by Saccardo's and Lindau's systems, among only superficially similar fungi.

Von Hoehnel¹, in 1910, endeavored to set some of these fungi apart by suggesting for them a special family, the Pycnothyriaceae, which, it is clear, he intended should be wholly distinct from the Leptostromataceae, the family to which the majority of them has been assigned. Diedicke², in 1913, recognizing this new family and restating concisely von Hoehnel's morphological distinctions, namely, that the pycnothyria are superficial, membranous, and radiately constructed and that the conidiophores arise from the pycnothyrial cover, nevertheless transferred to it a fungus producing subcuticular pycnidia. To this von Hoehnel³, in 1915, replied emphatically that he intended the Pycnothyriaceae to include only the imperfect forms of true Microthyriaceae, the pycnidia of which sit above the surface on the cuticle of the leaf and are of inverse structure similar to their ascigerous forms. Meanwhile—in 1914—Naumoff⁴ had assigned to the Pycnothyriaceae a new genus which, although conforming morphologically, was not an imperfect form of any Microthyriaceae and possessed, as an additional feature, a central columella immersed basally in the parenchyma of the leaf.

Clements and Shear⁵, in 1931, omitting the Pycnothyriaceae from their treatment of the Fungi Imperfecti, apparently considered that recognition of the family

would "serve no useful purpose." However, Grove⁶, in 1937, treating British imperfect fungi, acknowledged the value of von Hoehnel's segregation by giving it subfamily rank in the Leptostromataceae.

Thus at present there are recorded and to some extent recognized in literature three distinct forms of dimidiolate reproductive structures: a parenchymatous, basally sporuliferous pycnidium situated within the host tissues of the plant; a radiately constructed, inversely sporuliferous pycnidium situated on the surface of the host; and a radially constructed, superficial pycnidium supported by a columella seated in the host. To the last two forms the term pycnothyrium has been applied.

The third form, obviously incompatible in characteristics with either the Leptostromataceae or the Pycnothyriaceae as defined by von Hoehnel and other critical students, appears to have been adequately described only by Naumoff (*l.c.*) in connection with a single species, *Rhizothyrium Abietis*, parasitic on *Abies* in Europe. It occurs not uncommonly, however, on leafspots of a number of deciduous trees in Illinois, notably species of *Acer*, *Carya*, *Fraxinus*, *Quercus*, *Sassafras*, and *Ulmus*.

Study of Illinois material has revealed morphological details (Figs. 1, 2, 3) which, besides supporting Naumoff's brief description, give the following characterization.

The pycnothyria are strictly limited in situation to the outside surface of the host, possess no external mycelium but have an extensive internal mycelium limited largely to the spongy parenchyma of the leaf, are without ostioles and have none of the usually recognized means of dehiscence, and exist as individual units which do not become truly confluent as a result of growth. They arise by the extrusion through the host's epidermis and cuticle of a single hypha which, at

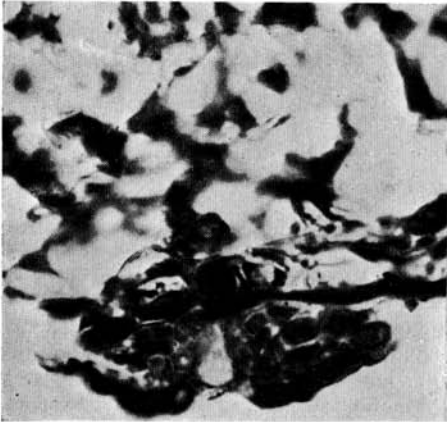


Fig. 1.—Vertical section of a hypophyllously enascent rhizothorium pycnothyrium on *Quercus palustris* Muench., X675, showing the columella, the shield attached near the apex of the columella, conidiophores pendent from the shield near its origin, and conidia about to escape beneath the shield margin.

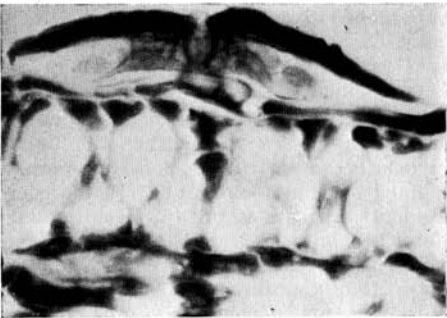


Fig. 2.—Section of an epiphyllously enascent rhizothorium on *Fraxinus pennsylvanica* Marsh., X575, showing the isthmus-like connection between columella and enlarged hyphal cells which lie in the host's epidermal layer.

the point of emergence, swells immediately into a thick, cylindrical columella.

Below the apex of the columella, cells are proliferated in a ring. They grow radially, branching as they extend, and form a subcircular, centrally umbonate plate, the margin of which often is made fimbriate by the uneven growth of its component hyphae. Sporophores arise from ventral parts of the cells first proliferated by the columella and project downward into the cavity surrounding it. Spores, abscised from the apices of conidiophores in the usual manner, escape from beneath the margin of the pycnothyrium, either because of the pressure they themselves create or as a result of

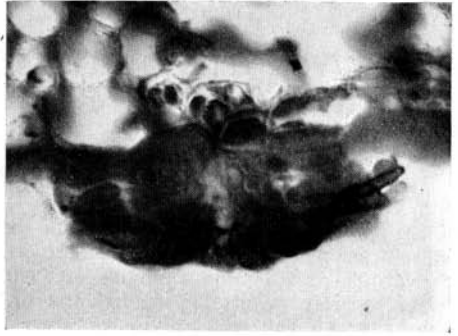


Fig. 3.—Section of a hypophyllously enascent rhizothorium on *Cercis canadensis* L., X700, showing, in the host's cuticle, the pore through which a hyphal cell in the host's epidermal layer extrudes the columella.

the hyroscopic action of the pycnothyrial cover.

The three types of sporuliferous structures discussed above are readily recognized. For differentiation microtome sections and high magnifications are not necessary. For the most part an ordinary hand lens is sufficient, and only the magnifications commonly used in specific identification are required for determining all details.

Although it was not intended that the classification of imperfect fungi should parallel the natural classification of their perfect forms, the existence of such a parallel has been acknowledged for certain groups. Wherever the recognition of parallel relationships will assist in grouping together similar kinds of fungi and will facilitate recognition and identification, it would appear to have definite value.

The dimidiolate, parenchymatous, internal pycnidium which von Hoehnel has designated as truly Leptostromataceous is frequently the imperfect form of a member of the Hysteriaceae or the Phacidia-ceae. The superficial, radiate, inversely sporuliferous pycnothyrium is, by his definition, the imperfect form of a member of the Microthyriaceae, a fact readily determined in most cases by its observable connection with characteristic external mycelium. The third form, described above, is equally readily recognized by its radiate construction, its superficial situation, and its remarkable connection with an internal mycelium. Its perfect form is not yet recognized, but its mor-

phology strongly suggests a connection with the Polystomellaceae of the Hemisphaeriales.

Because of the differences in morphology exhibited by the three types of structures and because it is believed that recognition of these differences would provide an aid for classification and identification, it is suggested that the following re-arrangements be made:

1. That the Leptostromataceae be hereafter limited to the inclusion of dimidiate, internal, parenchymatic pycnidia with basal sporulation and that the family shall continue in the Order Phomales of Saccardo, the Sphaeropsidales of Lindau, as at present.

2. That a new order shall be recognized under the name Pycnothyriales, which shall include external, radiate pycnothyria with inverse sporulation. In general, but not without exception, the imperfect forms of the Hemisphaeriales will constitute the Order.

3. That within this Order two families shall be recognized:

- 1.) the Pycnothyriaceae of von Hoehnel, having essentially the characteristics of the Order but having the distinctive characteristic that the pycnothyria are connected with an external mycelium or subiculum.
- 2.) the Rhizothyriaceae, a new family, having essentially the characteristics of the Order but hav-

ing the distinctive characteristics that the pycnothyria are mounted on columellae and are connected with an internal mycelium. [The term rhizothyrium may distinguish the type of pycnotherium found here.]

Pending further study of described genera and species, the two families of the Order can be tentatively organized as to genera as here indicated.

PYCNOTHYRIACEAE

- Hyalosporae: *Sirothyriella* von Hoehn., *Diedickia* Syd., *Eriothyrium* Speg., *Peltaster* Syd., *Trichopeltulum* Speg.
 Phaeosporae: *Asterostomella* Speg., *Asterostomula* Theiss., *Asteronia* Sacc., *Hyphaster* Henn., *Oothecium* Speg.
 Hyalodidymae: *Leptothyriella* Sacc.
 Phaeodidymae: *Diplopeltis* Pass., *Pycnothyrium* Died.
 Hyalophragmiae: *Septothyriella* von Hoehn.
 Phaeophragmiae: *Peltosoma* Syd.

RHIZOTHYRIACEAE

- Hyalosporae: *Actinothecium* Ces.
 Phaeosporae: *Pirostoma* Sacc., *Pirostomella* Sacc.
 Hyalophragmiae: *Rhizothyrium* Naoumoff.
 Scolecosporeae: *Actinothyrium* Kze., *Cylindrothyrium* Maire.

¹ Sitzungsber. K. Akad. Wissensch. Wien 119:451. 1910.

² Annales Mycologici 11:172-184. 1913.

³ Sitzungsber. K. Akad. Wissensch. Wien 124:131-132. 1915.

⁴ Bul. Soc. Myc. France 30:429. 1914.

⁵ The Genera of Fungi. The H. W. Wilson Company, N. Y. 1931.

⁶ British Stem- and Leaf-fungi (Coleomycetes). Cambridge University Press, London. vol. 2, 1937.