

**DIFFERENTIATION OF TRIBES AND GENERA IN
THE FAMILY* SARCOSCYPHACEAE**

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(With Plates 24-25)

Taxonomic criteria used in differentiating genera are described and illustrated. The genera are assigned to three tribes, the two existing tribes: Sarcoscyphaceae and Boedijnopezizeae, and a new tribe Pithyeae.

One product of the intensive study of operculate discomycetes in the past decade has been recognition of new families with clearly defined boundaries (Eckblad, 1968, Kimbrough, 1970). This paper discusses the internal structure of one of these new families, the Sarcoscyphaceae sensu Korf (1971). It describes criteria, common to all genera, which delimit the family, then proceeds to those which occur in some genera and not in others, and which are, therefore, useful in delimiting genera. Finally it discusses the division of the family into three tribes, including a new one, the Pithyeae.

As presently circumscribed, the family Sarcoscyphaceae no longer includes those genera with dark-colored apothecia formerly placed in the tribe Urnuleae. They have been transferred to a separate family, the Sarcosomataceae (Korf, 1971).

The family Sarcoscyphaceae is characterized by two groups of taxonomic characters. One consists of characters shared by all members of the family. Some of these also occur in the Sarcosomataceae. The other group is equally characteristic, but is made up of characters which occur in some genera and not in others. The first group is described at this point: the second will be included among the criteria for delimiting genera.

The suboperculate ascus (Le Gal, 1946) occurs in all members of the suborder Sarcoscyphineae. A characteristic organelle, the subapical pad, can be seen as a thickened addition to the inner side of the apex of the ascus wall (Plate 23, Figs. B, C).

In the families Sarcoscyphaceae and Sarcosomataceae the tissues of the medullary excipulum are filamentous, *textura intricata*, as seen either in vertical section or in crush mounts. As a consequence the texture of the apothecia in these families is tough, leathery to rubbery.

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In the families Sarcoscyphaceae and Sarcosomataceae the ascospores are single-celled, but they contain numerous nuclei, 16 or 32 in most genera (Berthet, 1964).

In the family Sarcoscyphaceae the cells of the paraphyses are multinucleate, whereas in the family Sarcosomataceae the cells of the paraphyses are uninucleate (Berthet, 1964).

In the family Sarcoscyphaceae the hymenial pigments are bright colored (red, orange, yellow) carotenoids (Arpin, 1968), and the exterior of the apothecium is light colored. In rare instances hymenial pigments are absent and the hymenium is white.

In the family Sarcoscyphaceae, apothecia occur on wood or on foliage in early stages of decomposition. In a few genera they are found on soil, although they probably arise from buried wood or roots. They seldom, if ever, occur on very well-rotted wood, on dung or compost, or on charcoal.

The family Sarcoscyphaceae consists of sixteen genera arranged in three tribes: Sarcoscypheae, Boedijnopezizeae, and Pithyaeae.

DESCRIPTION OF GENERIC CHARACTERS

The following characters are useful in delimiting genera within the family. Table 1 lists the genera and summarizes the distribution of these characters among the genera.

APOTHECIAL SIZE.—There is a wide range of apothecial size within the family. Most members of the tribe Sarcoscypheae have medium-sized to large apothecia, ranging from 1–5 cm or more in diameter. In the tribe Pithyaeae, however, apothecia are seldom more than a few millimeters across.

APOTHECIAL SHAPE.—Most genera in the family have shallow, cupshaped to discoid apothecia with short stipes. Two groups of genera depart from this pattern. In *Boedijnopeziza*, *Cookeina*, *Microstoma*, *Geodina*, and sometimes in *Sarcoscypha*, the apothecium is deeply cup-shaped or funnel-shaped with a long stipe. In *Wynnea* and *Aurophora*, on the other hand, the apothecium is strongly unequal-sided (fan-shaped or ear-shaped) with a lateral stipe.

SYNCHRONOUS ASCUS DEVELOPMENT.—In the genera *Microstoma*, *Boedijnopeziza*, and *Cookeina*, ascus development is synchronous, so that all of the asci in an apothecium are at the same stage of development (Plate 22 Fig. B). Specimens of these genera must be collected at full maturity in order to find any mature spores. In the remaining genera the asci mature a few at a time, so that a section of the hymenium shows all stages of development from young asci to mature or discharged ones.

LATERAL OPERCULUM.—In nine genera the operculum is strongly eccentric and the opening is to one side of the apex of the ascus. In undischarged asci, the subapical pad may be seen in this position (Plate 23 Fig. C.). The remaining genera have terminal, or nearly terminal operculi and subapical pads (Plate 23 Fig. B.).

FOUR-SPORED ASCI.—In the monotypic genus *Thindia* (Korf & Waraitch, 1971); in two of the three species of *Nanoscypha* (Denison, 1971); and in some species of

| Table 1. Generic Characters of the family Sarcoscyphaceae | | | | | | | | | | | | | | |
|--|---|-----------------------|-----------|---|--------------|----------|---|---|------------------|---|---|---|---|-----------|
| <u>Desmazierella</u> | + | 1-9 mm | apothecia | + | spherical | flexuous | ? | ? | tropical | | | | | |
| <u>Thindia</u> | + | 10-90 mm | | + | | | | | | + | ? | ? | + | |
| <u>Pseudopithyella</u> | + | ear-shaped | | + | | | | | | + | ? | ? | + | temperate |
| <u>Pithya</u> | + | funnel-shaped | | + | | | | | | + | ? | ? | + | on wood |
| <u>Nanoscypha</u> | + | discoid or cup-shaped | + | + | asymmetrical | ? | ? | + | on foliage, etc. | | | | | |
| <u>Phillipsia</u> | + | | + | + | sculptured | ? | ? | + | on soil | | | | | |
| <u>Rickiella</u> | + | | + | + | | ? | ? | + | | | | | | |
| <u>Aurophora</u> | + | | + | + | | ? | ? | + | | | | | | |
| <u>Sarcoscypha</u> | + | | + | + | | ? | ? | + | | | | | | |
| <u>Wynnea</u> | + | | + | + | | ? | ? | + | | | | | | |
| <u>Acervus</u> | ? | | + | + | | ? | ? | ? | | | | | | |
| <u>Pindara</u> | + | | + | + | | ? | ? | ? | | | | | | |
| <u>Geodina</u> | + | | + | + | | ? | ? | ? | | | | | | |
| <u>Cookeina</u> | + | | + | + | | ? | ? | ? | | | | | | |
| <u>Boedijnopeziza</u> | + | | + | + | | ? | ? | ? | | | | | | |
| <u>Microstoma</u> | + | | + | + | | ? | ? | ? | | | | | | |

Phillipsia, the asci are regularly four-spored and the ascospores are larger than in related eight-spored species. Species which are normally eight-spored produce a few four-spored asci, but in these one usually finds the remains of four aborted spores.

ASCOSPORE SHAPE.—The species of *Pithya* have spherical ascospores. In ten other genera the ascospores are symmetrical and ellipsoidal (Plate 23 Fig. B.). In the remaining five genera most ascospores are asymmetrical. They are slightly unequal-sided to curved (Plate 23, Fig. C.). Although in *Phillipsia* and *Nanoscypha* a majority of species have unequal-sided ascospores, there is in each genus at least one species with symmetrical ascospores.

CYANOPHOBIC SCULPTURING.—Five genera of the family have cyanophobic sculpturing on the surface of their ascospores. This consists of longitudinal ridges or folds which do not stain in aniline or cotton blue dye (Plate 23 Fig. C.). In *Geodina* and sometimes in *Cookeina* the longitudinal ridges are connected by cross ridges (Denison, 1965). The remaining genera have smooth ascospores.

PARAPHYSES.—In the tribe Boedijnopezizeae the paraphyses branch freely and the branches anastomose laterally to form a network enclosing each ascus. In the other tribes the paraphyses are less frequently branched and form no such network. In two species, *Desmazierella acicola* and *Cookeina sulcipes*, some of the paraphyses have thick-walled, bristle-like appendages which project above the hymenium. The adaptive significance of these elements, if any, is unknown.

HAIRS.—Many genera have species with excipular hairs which may take several distinctive forms. The most common is a flexuous, hypha-like, hyaline hair (Plate 22 Fig. A.). *Cookeina* and *Geodina* have compound hairs composed of bundles of parallel, unbranched, thick-walled hyphae (Plate 23 Fig. A.). *Boedijnopeziza* has scales composed of excipular hairs adhering side by side. In *Thindia* and *Desmazierella* the hairs are simple and bristle-like, with thickened, dark brown walls.

ECTAL EXCIPULUM.—In the tribe Boedijnopezizeae, and in the genus *Geodina*, the ectal excipulum is sharply differentiated from the medullary excipulum and consists of rows of cells, *textura globulosa* to *textura prismatica*, with the rows perpendicular to the exterior of the apothecium (Plate 22 Fig. B.). In the tribe Pithyeae, and in the genus *Nanoscypha*, the ectal excipulum is also sharply delimited from the medullary excipulum, but the cells are smaller, *textura angularis* to *textura epidermoidea*, and not arranged in rows (Plate 22 Fig. D.). In *Sarcoscypha* the ectal excipulum is easily identified, but there is a broad zone of transition to the medullary excipulum. The ectal excipulum is *textura porrecta* with the long axes of the cells parallel to the exterior of the apothecium (Plate 22 Fig. A.). In *Phillipsia*, *Rickiella*, and *Aurophora* the ectal excipulum is poorly differentiated from the medullary excipulum and of *textura intricata* to *textura epidermoidea* (Plate 22 Fig. C.).

PIGMENTS.—The family Sarcoscyphaceae has apothecia in which the hymenium is brightly colored. The pigmentation, localized in the paraphyses, consists, according to Arpin (1968) of carotenoids including: beta-carotene, lycopene, torulene, torula-rhodine, phillipsiaxanthine, and plectaniaxanthine. The latter two are of

particular interest because of their uneven distribution within the family. Plectanioxanthine occurs in *Pithya*, *Sarcoscypha*, and *Phillipsia*, whereas phillipsioxanthine occurs in *Phillipsia* and *Cookeina*.

SUBSTRATE.—All species of the tribe Pithyeae occur on the foliage and twigs of conifers. *Nanoscypha* occurs on the foliage and twigs of angiosperms. *Acervus*, *Geodina*, *Pindara*, and *Wynnea* are found on soil. The remaining genera occur on wood, usually on wood in early stages of decay.

DISTRIBUTION.—The family is sharply divided between temperate and tropical genera. When temperate genera, such as *Pithya*, are found at low latitudes, they occur at high elevations where the temperatures resemble those of the temperate zone. The temperate genera are: *Desmazierella*, *Thindia*, *Pithya*, *Sarcoscypha*, *Pindara*, *Acervus*, *Wynnea*, and *Microstoma*. The remaining genera are tropical.

GROUPING INTO TRIBES

There is a suprageneric structure to the family Sarcoscyphaceae. There is a group of core genera, the tribe Sarcoscyphaeae sensu Korf (1971), in which *Phillipsia* occupies a central position surrounded by smaller, mostly specialized genera. There are two other small, closely related groups of genera. The tribe Boedijnopezizeae Korf (1971) consists of three genera in which the asci mature synchronously, in which the apothecia are deeply cupulate, and the paraphyses form a reticulum. The remaining group I choose to recognize as a new tribe, Pithyeae, consisting of four genera: *Pithya*, *Pseudopithyella*, *Thindia*, and *Desmazierella*, in which the apothecia are small, resembling those of inoperculate discomycetes. All occur on foliage of conifers; all have similar excipular tissues; and all are temperate in distribution.

Pithyeae Denison, *trib. nov.*

Asci suboperculati, in apothecio singulo deinceps maturescentes; ascospori unicellulares, hyalini, laeves; apothecia clare colorata, minuta, ad folia gymnospermi, clima temperati vigentes.

Type genus: *Pithya* Fuckel.

Other included genera: *Pseudopithyella* Seaver; *Thindia* Korf & Waraitch; and *Desmazierella* Libert.

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EXPLANATION OF PLATES 24, 25

PLATE 24

FIGS. A-D. — A. *Sarcoscypha coccinea*. Vertical section through the ectal excipulum and part of the medullary excipulum. Note the hypha-like excipular hairs. $\times 200$. — B. *Cookeina sulcipes*. Vertical section showing appendaged paraphysis (upper right), synchronous asci, and excipular tissues. $\times 200$. — C. *Phillipsia domingensis*. Vertical section through the ectal excipulum and part of the medullary excipulum. $\times 200$. — D. *Pithya cupressina*. Vertical section through the ectal excipulum and part of the medullary excipulum. $\times 400$.

PLATE 25

FIGS. A-C. — A. *Cookeina tricholoma*. Longitudinal section of a fasciculate hair. $\times 200$. — B. *Sarcoscypha coccinea*. Apex of an ascus stained with Congo red. Note the nearly terminal position of the subapical pad. $\times 3000$. — C. *Phillipsia domingensis*. Apex of an ascus stained with Congo red. Note the lateral position of the subapical pad. $\times 3000$.



