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STUDIES ON SECOTIACEOUS FUNGI

1. A new species of Cystangium

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SUMMARY: A new species of Cystangium, C. pineti sp. nov. is described from Mexico and its position in this genus as well as the position of the genus Cystangium is reviewed.

RÉSUMÉ: Une espèce nouvelle de Cystangium, C. pineti est décrite et la position de cette espèce et la position du genre Cystangium sont révisées.

ZUSAMMENFASSUNG: Eine neue Art von Cystangium, C. pineti sp. nov. wird aus Mexiko beschrieben und ihre Stellung in dieser Gattung sowohl wie die der Gattung selbst werden kritisch untersucht.

During the field trips of the First National Congress of Mycology at Xalapa, Mexico, in 1982, a new species of Cystangium was discovered.

Cystangium pineti Sing. spec. nov. — *Gastrocarpio semiglobato* sub *subtus depresso*, 15 mm lat. *Peridio laete rubro-roseo*, *tenui*, *levi*, *glabro*, *margine obtuso*. *Gleba lacunosa*, *flavidula*, *subtus denudata*. *Stipite albo*, *cylindrico*, *glabro*; *velo pallido*, *tenuissimo*, *fugacissimo*. *Carne alba*, *immutabili*, *inodora*, *miti*. — *Sporis haud*

ballistosporialibus, 8.5-10.5 x 7.5-8.5 μm , plurimis cristulato reticulatis, ornamentatione 0.2-0.5 μm alta, amyloidea appendiculo hilari plerumque excentrico, pariete flavidulis, ellipsoideis vel subglobosis. Basidiis plerumque bisporis, plerumque forma sua autobasidiis simillimis sporas haud projicientibus, 22-35 x 7-10 μm , fibula basali parentibus, tenui-parietalibus matibus curviatis rarius strictis munitis. Cystidiis non macrocystidialibus sed contentu visibili destitutis, 64-80 x 18-19 μm , pariete tenui, rarius \pm crassa (0.3-1 μm) instructis, plerumque obtusis, hyalinis, ventricosis, moderatim numerosis. Subhymenio cellulari, lato; tramate hymenophorali hyphoso, paucis elementis subisodiametricis praesentibus. Epicute peridii e cellulis globosis et subglobosis frequenter catenulatis efformata; dermatocystidiis haud visis. Hyphis defibulatis. -- Typus in pineto sub Pino occarpa, semihypogaeus, subtropicali-montanus, a R. Singer (M 9514, F) in Mexico, Jalapa, supra Vigos collectus.

Gastrocarp solitary, semiglobate with deeply depressed underside, about 15 mm broad and about 11 mm high. -- Peridium very bright reddish-roseous, very thin, smooth, glabrous, with rounded-obtuse margin, not viscid nor hygrophanous. -- Gleba chambered, not showing traces of lamellar arrangement, occupying the entire internal portion of the gastrocarp, yellowish, lower portion largely exposed. -- Stipe white, glabrous, central, inserted in the cavity of the lower portion of the gastrocarp, cylindrical, about 6 x 3.5 mm. Columella white, thin, not quite percurrent. -- Context white, unchanging. Odor none; taste mild.

Spores 8.5-10.5 x 7.5-8.5 μm (including ornamentation), varying from subglobose to ellipsoid, with a mostly eccentric, more rarely central hilar appendage, with pale yellowish (KOH) wall, with a completely amylaceous cover over an ornamentation 0.2-0.5 μm projecting, mostly with crests (type II), more rarely reticulate with thinner connecting lines (type IIIa), rarely very low (type VII), without a distinct plage and without an amyloid suprahilar spot. -- Hymenium: Basidia not functioning as autobasidia, but the majority with autobasidial structure with the sterigmata half-sickle-shaped curving inward, in a minority all sterigmata curving in the same direction or some or all sterigmata straight, narrowly pyramidal, basal clamp absent. Cystidia not of the macrocystidial type, moderately numerous, 64-80 x 18-19 μm , ventricose, mostly obtuse, hyaline, with thin (0.2 μm) to \pm thickened wall (0.3-1 μm), without optically noticeable contents. -- Hyphae without clamp connections, not gelatinized, inamyloid. -- Subhymenium with subisodiametric cells but these not regularly rounded, 7.5-20 x 6-14 μm , hyaline, a rather broad layer; hymenophoral trama regular, of 1.3-8.5-(14) μm broad hyphae, only at the branching areas of the trama plates some chains of cells, cells here up to 22 x 13 μm . -- Cortical layers: Epicutis of the peridium consisting of globose to subglobose cells forming a chain here and there, basically an epithelium. Dermatocystidia and dermatopseudocystidia not seen. Hyphal outgrowths scattered, not forming a dense layer.

In pine woods under Pinus oocarpa, in the montane zone of the north slope, semihypogeous. Mexico: Veracruz, 5 km N of Vigos,

at 2800 m alt., road to Las Lajas, Sierra de Agua. 30 X 1982, R. Singer M 9514 (F) typus.

Until recently only the two original species of Cystangium, (Singer & Smith 1960), the type species and C. depauperatum, were known. Aside from these, A. H. Smith (1962) transferred an additional species to Cystangium: C. rodwayi and G. Beaton et al. (1984) described as new another species, C. phymatodisporum. With C. pineti, which is closest to C. rodwayi, the genus has now five species, three from Australia, and two from the Americas; the Australian species apparently associated with Eucalyptus, the South American one with Nothofagus, and the Mexican one being the only one to be associated with pine. These species can be identified with the following key:

1. Spores with quite or almost isolated spines or warts (ornamentation type VI) with rare exceptions (few spores with type IV, V, IV-II ornamentation); hyphal extensions rising from the upper layer of the epithelium reminiscent of *Virescens* structure, often forming a dense, rather deep layer.
2. Ornamentation moderately dense, up to 2.2 μm high.
3. Peridium bright rosy red with pallid areas; cystidia inconspicuous; associated with Nothofagus. C. depauperatum Sing. & Sm.
3. Peridium white, often browning; cystidia rare to numerous, always conspicuous and large, 50-115 x 7-27 μm ; associated with Eucalyptus.

C. sessile (Mass. & Rodway ex
Rodway) Sing. & Sm.

2. Ornamentation of very dense, low (less than 0.5 um)

warts. C. phymatodisporum Beaton, Pegler
& Young

1. Spores mostly with crests (type II), more rarely reticulated of type IIIa; hyphal extensions of the uppermost cells of the epithelium inconspicuous, not forming a dense, continuous layer, but scattered to rare.

4. Peridium pale brown with large grayish rusty red patches (Beaton et al.); basidia predominately 4-spored; associated with Eucalyptus.

C. rodwayi (Mass.) Sm.

4. Peridium bright rosy red with some pallid areas, basidia predominately 2-spored; associated with Pinus.

C. pineti Sing.

The taxonomic position of Cystangium has been judged differently by modern taxonomists. It is undoubtedly part of the astrogastraceous series as defined by Malençon, Heim, and Singer & Smith. If this is inserted in the nomenclatorial hierarchy valid today, the correct name for it is Hydnangiaceae. However, there is a significantly wider hiatus between the Hydnangiaceae (Hydnangium and Podohydangium) sensu stricto and the rest of the astrogastraceous series leading to the Russulaceae than between the various genera of each of these groups. Pegler has divided this rest of the astrogastraceous group into two families, Elasmomycetaceae and

Russulaceae. However, even though the family Elasmomycetaceae is fully acceptable, the distribution of the genera among Elasmomycetaceae and Russulaceae sensu lato (Pegler & Young 1979) is not acceptable because between the gastroid "Russulaceae" and Elasmomycetaceae there is no hiatus and the only supposedly distinguishing character consists in the configuration of the basidium-sterigma-spore complex whereby the spores are called ballistosporic, asymmetric (Beaton *et al.*, *Kew Bull.* 39: 670. 1984) in Arcangeliella, Cystangium and Macowanites, and "statismosporic, symmetric" in Elasmomyces, Martellia, Zelleromyces and Gymnomyces. In the numerous species of these genera that Smith or I have studied, and this includes Cystangium, an actual spore discharge does not take place and the so-called ballistospores are therefore (with few exceptions where we probably have to deal with a phenomenon of gasteromycetation in Russula) not ballistospores and the basidia are not auto-basidia. The real difference, then, in an ideal case, is the fact that a majority of the spores, or all spores, are axially symmetric i.e. orthotropic and the majority or all the sterigmata are straight and not half-sickle-shaped (there are frequently some not precisely apical sterigmata recurved toward the line of symmetry of the basidium) in the Elasmomycetaceae, whereas the majority of the spores and sterigmata are shaped as in the Russulaceae proper in the species of so-called gastroid Russulaceae. Not enough with this narrowing down of the family characters involved, there are also species which are intermediate between the two families in the sense that their spore and sterigmatal characters indicate a

relationship with Elasmomyces, whereas other anatomical characters and their affinity to other astrogastraceous species place them in Macowanites, for example M. mollis Sing. & Sm. Another intermediate species between the two families is Zelleromyces striatus (Cunn.) Beaton, Pegler & Young (see Beaton et al. 1984, p. 684-688).

Only two possible consequences can be drawn from these observations: Either we adhere to a wide concept of order and family, as Pegler & Young (1979) but combining both Elasmomycetaceae and Russulaceae to be part of an order Russulales, or we combine the gastroid "Russulaceae" with the Elasmomycetaceae into one family--Elasmomycetaceae Pegler--and consider them as belonging in the Gasteromycetes. It is obvious that the first solution is an expression of the theory that, phylogenetically, the agaricoid forms are ancestral to the gastroid forms, while the second solution is an expression of the opposite theory (see Singer 1985).

As for Cystangium, the statements by Singer & Smith (1960) that Cystangium depauperatum is close to Martellia idahoensis (p. 70), that "Elasmomyces and Cystangium are at a lower level in this scale than the other two [Macowanites and Arcangeliella]," and that "[Cystangium] could have arisen easily from Martellia..." are still defendable. They have been taken from the data of a large number of species and take into account all, not merely the spore characters.

If we compare C. pineti with Russula, the weak columella, absence of any trace of a spore print or even spores deposited on the stipe, the strongly reduced number of spherocysts in the hymenophoral

trama and the broad subhymenium set it apart from all known species of Russula. The veil, the epithelium of the peridium (pileus), the pale yellowish spores and the thinness of the peridium (pileus trama) as well as the absence of a suprahilar amyloid spot on the spores make the Cystangium comparable only to the most primitive sections of Russula, and the absence of macrocystidia and gloeocystidia of any kind, the mild taste, and the absence of a gelatinous subcutis confirm this statement. Even so, there is no group or species known in Russula that by the totality of its characters might suggest an affinity close enough to assume an origin of any Cystangium by a process of gasteromycetation. Furthermore, the species of primitive Russulaceae comparable to Cystangium are mainly found in the tropical lowlands, whereas the distribution of the known Cystangiums follows a pattern I have already characterized in a communication (unpublished) at the 2nd International Mycological Congress in Tampa: An island-like scattering of areas (Nothofagus and Eucalyptus areas of South America and Australia-New Zealand, and Mexico often continuing into northwestern North America), which is rather similar to the disjunct areas of other secotioid groups (Elasmomycetaceae, Thaxterogastraceae, Gastroboletaceae). A pattern of this kind suggests taxa which are ancient and in retreat rather than a series of recent successful organisms.

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