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Calvatia subcretacea, a synonym of *C. arctica*.

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Summary. *Calvatia arctica* is characterized by an exoperidium composed of pyramidal warts, and a greyish-violaceous gleba. The spores are remaining smooth and the capillitium is described as fragmented at the septa. *C. subcretacea* shares these characters but the capillitium is almost devoid of septa, with a jagged fragmentation. An examination of the type material of the two species shows that the type of fragmentation is a very unstable character varying over a broad scale in a series of 20 specimens from various arctic and subarctic regions. *C. subcretacea* is thus reduced to a synonym of *C. arctica*. The species belongs to subgenus *Hippoperdon* (Mont.) M. Lange.

KEY WORDS: *Calvatia arctica*-*subarctica*, synonymy, jagged fragmentation.

Introduction

Calvatia subcretacea was described by S. M. Zeller (1947). A slightly emended description was provided by A. H. Smith (Zeller & Smith 1964). The species was indicated as common in 2000–3000 m alt. in western USA. It is one of the few *Calvatia* species with the exoperidium made up of smaller or larger pyramidal warts. Macroscopically it is further distinguished by the color of the gleba, described (Zeller, loc. cit.) as passing in ripening from Olive-Buff through Drab to Burnt Amber in the standard of Ridgeway (1912). The noteworthy microscopical features are the spores which long remain almost smooth, and the capillitium which is devoid of septations, fragmented by jagged tears.

Calvatia arctica was described by Ferdinandsen & Winge (1910) on material from NE-Greenland. It was redescribed by M. Lange (1948), where a close relationship to *C. subcretacea* was indicated. Zeller & Smith (1964) include the two species in the same stirps noting the similarity in exoperidial structure. *Calvatia arctica* was described again by M. Lange (1980), now based on several specimens from E-Greenland, Svalbard and Iceland. Noting i. a. the violaceous cast of the gleba, the species was referred to as series of species showing this

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character. Finally, in M. Lange (1992) it was included in subgenus *Hippoperdon* (Mont.) M. Lange, described with *Calvatia cyathiformis* (Bosc.) Morgan as type species.

When comparing the described characteristics of *Calvatia arctica* and of *C. subcretacea*, it is evident that the two taxa show the same macroscopical features: pyramidal structure of exoperidium, violaceous colors of ripening gleba. The spores, long remaining almost smooth, also characterise both species.

The lack of septa and the corresponding jagged fragmentation of the capillitium stand out as the only clearly expressed difference. These features have recently been described by Kreisel (1989) as the main characters of his new genus *Handkea*, to which the author also referred *Calvatia subcretacea*.

A few small *Calvatia* specimens from Icelandic collections in Akureyri (AMNH) were in my revision of *Calvatia* (M. Lange, 1990) put aside, temporarily labelled as *C. subcretacea* Zeller. One of these specimens had the capillitium characters described for this species. After editing a note on the classification of *Calvatia* (M. Lange 1993) I found it necessary to undertake a renewed study of this material. The study also included the type specimen of *C. subcretacea*, and the type specimen of *C. arctica*, together with a number of specimens referred to this taxon in M. Lange (1990), a total of 20 collections.

In the type of *Calvatia subcretacea* the gleba has the characteristic violaceous cast (6D4–6E7, Kornerup & Wanscher, 1978). The spores appear almost smooth in the light microscope, almost globose to slightly drop-shaped, $3.8-4.5 \times 4.5-5 \mu\text{m}$.

The capillitium is pale yellowish-vinaceous, mostly $4-6 \mu\text{m}$ broad with V- and T-branchings frequent, and segments tapering to $1.5 \mu\text{m}$, often screw-like; almost devoid of septa, broken up in longer and shorter fragments by jagged fragmentations, walls rather thin, often ruptured, with some large corrosion pores, and also with minute pores puncturing the inner walls.

The type specimen of *Calvatia arctica* was found to have capillitium with frequent septations, fragmented at most septa. About 10% of the fragmentations were, however, of the jagged type. Many segments show single or double subseptal branching but also several V- and T-branching are noted. Large corrosion pores are frequent, indicating fragile capillitium walls. Except for the septations being frequent, the capillitium pattern is very similar to what is observed in *C. subcretacea*. The spores are almost globose, $5-5.8 \times 4.8-5.5 \mu\text{m}$, warty-spiny, the warts $0.4 \mu\text{m}$ high.

Four other specimens from NE-Greenland show great variation in the fragmentation of the capillitium. The specimens are indicated by their collection numbers (see material examined).

AL 1906 has 75% ragged fragmentations, CK 1900 and WF 90,5 have 40–50% ragged fragmentation, while this type of fragmentations is found to be less

than 5% in HK & al. 72. The Svalbard specimen ML 89-05 has 10% ragged fragmentation.

Of the Icelandic specimens, HH 9292 has 100% ragged fragmentations, HH 9291 has 60% fragmentations of this type, while a number of ragged fragmentation varies from almost 0 to 20–30%.

There is considerably variation in the shape and configuration of the spores varying from almost globose to slightly drop-shaped and from almost smooth to distinctly warty-spinulose. This variation does in part reflect differences in ripeness but not entirely. Thus the type specimen of *Calvatia subcretacea* and HH 9292 – both with 100% ragged fragmentations are on the same level of ripening but the spores are respectively almost smooth or distinctly spiny.

Except for these two types of differences the entire material is very homogeneous. Thus all specimens in the relevant ripening stages show the coherent gleba mass, becoming powdery only at a very late stage. Also the exoperidium is very typical, the warts peeling off singly or in small groups. On this basis it is evident that *Calvatia subcretacea* must be considered as a synonym of *C. arctica*.

Discussion

The jagged fragmentation of a capillitium devoid of septa seems to be a stable character of *Calvatia utriformis* (Bull.: Pers.) Jaap and of *C. excipuliformis* [(Scop.) Schaeff.: Pers.] Perdeck. They form the core of the genus *Handkea* Kreisel (1989). The present example shows that this character is unstable in *C. arctica*. Ragged fragmentation is similarly an unstable character in *C. horrida* M. Lange and in *C. bellii* (Peck) M. Lange (Lange 1990). The character has further been used to distinguish *C. fumosa* Zeller, and its var. *idahoensis* Smith. A have proposed to reject the genus *Handkea* (M. Lange, 1993), due to this instability of the main and only generic character.

Material examined: USA: Oregon, Mt. Hood 1938, type (NY) of *Calvatia subcretacea* Zeller. – NE-GREENLAND: Liverpool Land, Hurry Fjord, type (C) of *C. arctica*. Ferd. & Winge; CK 1900, AL 1906, HK & al. 72, BF 90, loc. 5. – (All. in C). – SVALBARD: ML 89-05 (C). – ICELAND: HH 47, 206, 5154, 7175, 7178, 8689, 9285, 9291, 9292, 9294, 9297, 9301 (All in AMNH).

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