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THE GENUS SARCODON IN SWEDEN IN THE LIGHT OF RECENT INVESTIGATIONS.

BY

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Preface.

The pileate Hydnums and especially those with terrestrial stipitate fruit-bodies have always interested Swedish mycologists. Already SWARTZ (1810) treated several species, and ELIAS FRIES in his first mycological paper (1815) tried to monograph them. Additional contributions were supplied by him during a period of almost 60 years. LINDBLAD, a pupil of his, published in 1853 a synopsis of the pileate Hydnums of Sweden. My late friend, Dr. SETH LUNDELL († 23.IX.1966) studied them continuously. Within the natural group nowadays segregated as the genus *Sarcodon* he had *i. a.* recognized two species about whose identification he felt very doubtful. Through the combined efforts of several colleagues and friends a rather rich material had been collected of rare species of *Sarcodon*, but unfortunately he published very little about his results. I thought a new synopsis of the pileate Hydnums of Sweden, mainly based on his collections and studies would be a proper homage to his memory. It soon became evident to me that there were too many problems unsolved and so I approached Dr. R. A. MAAS GEESTERANUS for help and advice. The problems turned out to be so intricate and interesting that he enthusiastically agreed to a joint publication on the Swedish Sarcodons.

The taxonomic investigations have mainly been undertaken by him, but the determinations of almost all Swedish specimens have been checked by both of us, for a few determinations I alone am responsible. The lists of Swedish collections examined are drawn up by me, but the descriptions, observations, and figures are by

his hand. The reviews of the older Swedish literature are on the whole my contributions. As will be seen below, our opinions of the interpretation of old names do not always agree, in which case attempts have been made to account for our divergent reasons as briefly as possible. Fortunately, these divergencies do not affect the nomenclature of the species treated here.

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The mycoflora of Sweden is of more than local interest, as the correct interpretations of species described by FRIES are of crucial importance for a stable nomenclature. Not even in his latest publications did FRIES pay attention to microscopical characters, and as a rule he did not preserve any material of his species. They must consequently be judged from thorough and critical comparisons of his descriptions (and illustrations, if any) with the species actually known to occur within the type areas. A *conditio sine qua non* is thus that the group in question has been sufficiently studied within the areas concerned. Through the efforts of the late Dr. S. LUNDELL a well preserved and representative material of *Sarcodon* has been brought together (often with notes on colours, taste, smell etc. in the fresh state). We consider this material large enough to substantiate the interpretations of *Hydnum laevigatum* sensu FR. (1863–), *H. scabrosum* FR. and *H. versipelle* FR.

At the very beginning of our joint studies we discovered that the spores, hitherto rather neglected on the species level, offered excellent specific characters by their size, shape, ornamentation and colour, and so it became possible *i. a.* to restore *S. versipellis* as a species of its own and to draw an unmistakable limit between *S. fennicus* and *S. scabrosus*.

The following technique has been used by M. G. for the detailed microscopical observations of the spores. One or two spines are gently heated in lactophenol-methylblue on a slide. All hymenial elements thus softened and stained are scraped off the central core of the spine, which is then removed. Before the cover glass is applied the rest is spread out to avoid concentration of tissue and spores.

The present paper is mainly based on the material from Sweden in S and UPS (several duplicates also in L), but collections from other European countries as far as available in these three herbaria have also been taken into account. We have tried to establish the European

distribution of the species treated by us. Several specific epithets of Central European origin are also relevant to the nomenclature of Swedish species. BRESADOLA's specimens (in S) are of special interest as his Iconographia was frequently referred to by LUNDELL. Some species of *Sarcodon* are already known to occur on both sides of the Atlantic, and more may have the same wide distribution. Therefore, M. G. has tried to account for those species proposed in North American literature that seemed to have close relatives in Europe. *H. subpallidum* and *H. ustale* were found to be synonyms of *S. leucopus*, and *H. crassum* of *S. versipellis*.

Loan of material from the following institutes is gratefully acknowledged: Herbarium, University of Michigan, Ann Arbor (MICH); Botanical Museum, Helsingfors (H); New York Botanical Garden, New York (NY); De Geerskolan, Norrköping (Hb. Erik Haglund); Mycological Herbarium, Plant Research Institute, Ottawa (DAOM); Botaniska Sektionen, Naturhistoriska Riksmuseet, Stockholm (S).

Sarcodon P. KARST.

Sarcodon P. KARST. in Revue mycol. 3(:9):20 (1881) & in Medd. Soc. Fauna Fl. fenn. 6: 16 (1881). — Type species: *Hydnum imbricatum* L. ex FR. (see DONK 1956: 111).

Fruit-bodies terrestrial, consisting of pileus and stipe, simple or partially connate, fleshy.

Pileus with upper surface velutinous to felted when young, then glabrescent and the cuticle becoming areolately cracked, or pileus scaly, variously coloured.

Stipe usually central, concolorous with the pileus or paler, the base in some species greenish or bluish.

Hymenium covering the spines on the underside of the pileus. Spines whitish or pallid when young, becoming dark brown with maturity.

Flesh without zonation produced by structural differences in the hyphae, not duplex, variously coloured, in some species greenish or bluish in the base of the stipe.

Context monomitic, made up of generative hyphae, which are thin-walled, branched, septate, inflating, with or without clamp-connections. Basidia clavate, 4-spored, with or without basal clamp-connection. Spores subglobose to ellipsoid, usually of a most irregular outline, roughly tubercular, brown in the mass. Cystidia none.

The Swedish species so far known all inhabit coniferous woods on sandy or gravelly soil, especially mossy spruce woods. *S. scabrosus* and, perhaps, *S. fennicus* seem however to prefer pine woods,

often rather dry. The mycelia are perennial and often form large fairy-rings. The fruit-bodies are autumnal but may fail to appear in unfavourable (too dry?) years. With the exception of *S. imbricatus*, all species are more or less rare. As only small parts of Sweden have been studied closely enough, very little can be said of distribution and ecology of the individual species. It seems evident however that *S. leucopus* is decidedly calciphilous and remarkably common on the Island of Gotland, whereas *S. scabrosus* grows mostly on very poor sand and gravel.

The Swedish *Sarcodon* flora is not exhausted by the eight species treated below. There are several collections evidently representing additional species that we have been obliged to leave out of consideration due to lack of notes and/or insufficiency of material, for *Sarcodon* is a genus, in which the collections require good descriptions (preferably colour sketches) for easy and reliable determination. Moreover, two species have been found in Norway, which may be expected to grow also in Sweden and which have been included in the key presented below. One is *S. martioflavus* (Snell *et al.* ap. Snell & Dick) Maas G., which was first published from Norway as *S. armeniacus* Maas G. n.sp. but soon found to be synonymous to *S. martioflavus* published a few weeks earlier from North America (Maas Geesteranus 1963: 169; 1964: 64). The other is *S. fuligineo-violaceus* (Kalchbr. ap. Fr.) Pat., first published from Norway as *S. talpa* Maas G. (Maas Geesteranus 1967: 13) but now considered by M. G. to be synonymous to *S. fuligineo-violaceus*, which becomes the correct name.

Key to the Scandinavian species

(mainly based on dried material).

1*a*. Flesh never white at first; dark blue in the pileus when cut fresh, bluish-grey to violet-grey when dry; vinaceous red in the stipe. (Found in Norway, to be expected in Sweden; not treated in the present paper.) *S. fuligineo-violaceus*

1*b*. Flesh whitish or faintly sepia when fresh, retaining this colour or turning yellowish on drying, sometimes becoming suffused with delicate reddish or violaceous hues.

2*a*. Flesh in the base of the stipe concolorous with that of the pileus or somewhat darkened.

3*a*. Hyphae without clamp-connections. Spores ca. 5–6.5 μ long.

4*a*. Pileus tomentose to glabrous or locally with adnate fibrils and squamules. Spores with rather few tubercles.

5*a*. Pileus and stipe of the same colour. *S. spec.* (p. 437)

5*b*. Pileus purplish-brown, stipe apricot-orange. (Found in the region around Oslo, Norway, to be expected in Sweden; not treated here).
S. martioflavus

4*b*. Pileus conspicuously scaly. Scales at least in part with the tips upturned. Spores with numerous tubercles. *S. lundellii* (p. 421)

3*b*. Hyphae with clamp-connections.

6*a*. Spores 4.5–5.5 μ long; tubercles smoothly rounded.
S. versipellis (p. 430)

6*b*. Spores (6.5–)7–8 μ long; tubercles angular.

7*a*. Pileus glabrous or cuticle becoming areolately cracked. Areoles not concentrically arranged.

8*a*. Pileus plano-convex. Flesh of stipe firm.
S. leucopus (p. 415)

8*b*. Pileus umbilicate or infundibuliform or with perforate centre. Flesh of stipe spongy or rotted away to form a cavity.
Weathered specimens of *S. imbricatus* (p. 412)

7*b*. Pileus conspicuously scaly. Scales arranged concentrically, those in the centre coarse and erect.
S. imbricatus (p. 412)

2*b*. Flesh in the base of the stipe bluish or greenish. Hyphae without clamp-connections. (Care should be taken to check the greenish colour not only from the outside. Attention is drawn to occasional forms of *S. versipellis* which may show a greenish colour to the base of the stipe.)

9*a*. Pileus tomentose or slightly floccose, glabrescent, the cuticle thus formed becoming areolately cracked. Spores up to 5.5 μ long. *S. glaucopus* (p. 407)

9*b*. Pileus in its older stages conspicuously scaly. Spores (as a rule) 6.5–7.5 μ long.

10*a*. Pileus ochraceous yellow-brown. Tubercles on the spores numerous, small. *S. fennicus* (p. 406)

10*b*. Pileus reddish-brown to purplish-brown. Tubercles on the spores moderately numerous, coarse.
S. scabrosus (p. 426)

Sarcodon fennicus (P. KARST.) P. KARST. — Figs. 1–5.

Sarcodon scabrosus var. *fennicus* P. KARST. in Bidr. Känn. Finl. Nat. Folk 37: 104 (1882). — *Sarcodon fennicus* (P. KARST.) P. KARST. in Revue mycol. 9: 10 (1887). — *Hydnum fennicum* (P. KARST.) SACC., Syll. Fung. 6: 433 (1888). — *Phaeodon fennicus* (P. KARST.) P. HENN. in Nat. PflFam. 1(: 1**): 149 (1898). — Neotype: Finland, Tavastia australis, "*Sarcodon fennicus*/Valkjärvi, m. Sept. 1886, P. A. KARSTEN" (H; Fig. 1).

Description after dried material:

Fruit-bodies simple or confluent.

Pileus up to about 10 cm across, regular to broadly lobed, plano-convex to depressed in the centre; densely fibrillose when young, becoming scaly, scales numerous, appressed, and narrow near the margin, fewer and coarser to very coarse in the centre, without upturned tips; ochraceous yellow in young specimens, ochraceous yellow-brown with a rufous tinge later on.

Stipe 3.5–7 × 1–2.5 cm, slender to fairly heavy, equal or tapering downwards, felted, glabrescent, paler than or concolorous with the pileus, the base blue-green to grey-green, but often covered with a white mycelium.

Spines more or less decurrent, up to 5 mm long, crowded, subulate, very slender, chocolate brown when mature.

Flesh whitish in the pileus and upper part of the stipe, blue-green to grey-green in the base of the stipe. Taste bitter. Smell said to be reminiscent of bitter almonds and musty earth (LUNDELL).

Context monomitic. Generative hyphae up to about 20 μ wide, inflating, thin-walled, branched, septate, without clamp-connections. Basidia 40–45 × 6–7 μ, clavate, without basal clamp, with 4 sterigmata up to 4.5 μ long. Spores 6.3–7.2 × 4.5–5.2 μ, of irregular outline, tubercular (tubercles numerous, fairly strongly prominent, moderately coarse, flat-topped to obscurely exsculpate), pale brownish, with oblique apiculus.

Swedish collections examined:

Småland: Femsjö parish, towards Lake Abborrsjön 20.IX.1949 S. LUNDELL 6174 & J. STORDAL (UPS).

Östergötland: Kvillinge parish, Hults bruk 26.VIII.1895 E. HAGLUND (Hb. ROMELL 7589; S). Skedevi parish, Rejmyra, "pr. Linsenhusen [?]" 1852 H. VON POST (S).

Bohuslän: Uddevalla 25.IX.1944 G. ISRAELSSON (UPS).

Södermanland: Nynäshamn 13.X.1908 C. H. KAUFFMAN (Hb. ROMELL 7627, S). Salem parish, Bornhuvud 26.IX.1954 N. SUBER (S); Vällinge 13.IX.1953 N. SUBER (S; Fig. 5).

Uppland: Bro parish, Säbyholm 18.IX.1922 E. INGELSTRÖM (S). Knutby parish, ca. 3 km S. of Knutby Railway Station, 20.VIII.1961 H. JAHN (UPS; Fig. 3). Lena parish, "Årby skog" 27.VIII.1927 S. LUNDELL (UPS). Sånga parish, Färjestaden 30.IX.1951 N. SUBER (S, UPS). Uppsala (Bondkyrka), Nosten 16.IX.1932 S. LUNDELL (UPS; Fig. 2).

Hälsingland: Arbrå parish, Vallsta 3.IX.1951 A. DALHEM (UPS; Fig. 4).

Apparently no specimens are left of the collection used for KARSTEN's original description. Of the two packets received on loan from H, one contains authentic material of *S. fennicus*, labelled "*Sarcodon amarus* Karst." with the epithet crossed out, and replaced by "*fennicus*". The material consists of two specimens, one of which is easily recognizable as the right hand specimen in KARSTEN's illustration (1887: Pl. 11, Fig. 59). This material is here formally chosen as the neotype.

Sarcodon glaucopus MAAS G. & NANNF. spec. nov. — Figs. 6–9.

Holotype: Sweden: Uppland, Börje parish, "Klista skog" 11.VIII.1953 J. ERIKSSON (UPS).

Misapplication: *Sarcodon amarescens* (QUÉL.) QUÉL. sensu MAAS G. in Fungus 26: 47 (1956).

Carpophora vulgo simplicia.

Pileus usque ad 10 cm diam., tomentosus vel subfloccosus, glabrescens, cuticula eius modo formata demum areolatim dirumpente, flavo-brunneus vinaceo-tinctus vel purpureo-brunneus, centro interdum obscurato.

Stipes 2.5–6 × 1–1.5 cm, gracilis vel robustus, aequalis, deorsum attenuatus, e tomentoso fibrillosus vel glabrescens, pileo concolor, supra pallidior, infra glaucus, basi tomento albido obtecta.

Aculei decurrentes, usque ad 5 mm longi, conferti, subulati vel saepius applanati, maturi purpureo-brunnei.

Caro albida, stipitis basi glauca. Hyphae inflatae, ramosae, septatae, fibulis nullis. Sporae 5–5.4 × (3.6–)4–4.3 μ, late ellipsoideae, tuberculatae (tubercula numerosa sat prominentia, subgracilia, apicibus planis vel rotundatis), dilute brunneae, apiculo obliquo.

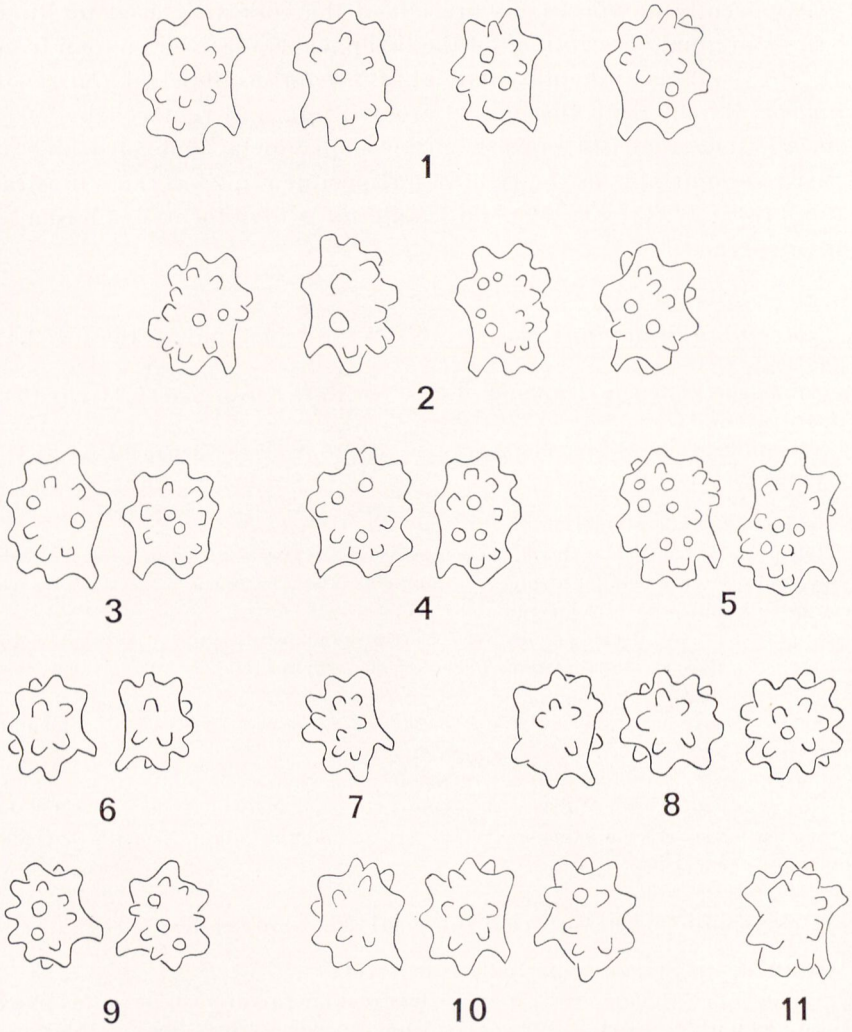
Description based on dried material and some notes:

Fruit-bodies simple or partially concrescent.

Pileus up to 10 cm across, more or less regular to variously lobed, convex to somewhat depressed in the centre; tomentose or slightly floccose, glabrescent, the cuticle formed by collapse of the tomentum becoming areolately cracked; yellowish-brown with vinaceous tint or paler to darker purplish-brown (somewhat paler than KONRAD & MAUBLANC's Pl. 467, according to one of the notes), the centre sometimes much darkened, the flesh showing up dingy yellow in the cracks.

Stipe 2.5–6 × 1–1.5 cm, slender to somewhat stocky, more or less equal with pointed base, finely felted becoming fibrillose or glabrous, of the same colour as the pileus but paler above, rather pale greyish-green below, the base usually covered with whitish tomentum.

Spines decurrent, up to 5 mm long, crowded, subulate but often markedly flattened towards the base, slender, finally chocolate brown.



Figs. 1–11. Spores of *S. fennicus* (Figs. 1–5), *S. glaucopus* (Figs. 6–9), *S. roseolus* (Fig. 10) and *S. radicatus* (Fig 11). — All ×2800.

Flesh whitish in the pileus, grey-green in the base of the stipe. Taste "not bitter" (according to one of the notes), "nearly mild with a slightly bitter after-taste" (according to another note). Smell said to be that of *Agaricus campester*.

Context monomitic. Generative hyphae up to 20 μ wide, inflating, thin-walled, branched, septate, without clamp-connections. Basidia 30–35 × 5.5–7 μ, clavate, without basal clamp, with 4 sterigmata 3.5–4.5 μ long. Spores 5–5.4 ×(3.6–)4–4.3 μ, broadly ellipsoid, tubercular (tubercles

numerous, fairly strongly prominent, rather slender, somewhat flat-topped to rounded), pale brownish, with oblique apiculus.

This species is so far not known from outside Sweden. We have examined the following collections:

Gotland: Alskog parish, SE. of Visnamyr, 29.VIII.1948 B. PETTERSSON (UPS; Fig. 6). Hörsne parish, Hörsne IX.1943 N. SUBER (S). Kräklingbo parish, Hejdeby 3.IX.1946 N. SUBER (UPS).

Södermanland: Huddinge parish, ca. 1.5 km NW of Flemmingsberg 30.IX.1950 G. HAGLUND & N. SUBER (S). Hölö parish, Vrå, Knutstorp at Lake Aspen 12.VIII.1953 G. HAGLUND & N. SUBER (S, UPS). Nacka parish, Nyckelviken 25.IX.1922 L. ROMELL (Hb. ROMELL 7766; S, UPS). Salem parish, Bornhuvud 18.IX.1949 N. SUBER (S); Vällinge 25.IX.1949, 21.IX.1952 & 21.IX.1958 N. SUBER (all S). Ytterenhörna parish, Enhörna 4.IX.1949 N. SUBER (S).

Uppland: Adelsö parish, Adelsö bruk 12.IX.1949 GRETA BERGGREN (S). Börje parish, "Klista skog" 6.IX.1945 S. LUNDELL (UPS); 11.VIII.1953 J. ERIKSSON (type; UPS; Fig. 8). Djurö parish, Runmarö, Silverträsk 25.IX. 1949 R. RYDBERG (S; Fig. 9); Runmarö, between Vitträsk and Skogsberga 8.IX.1949 G. HAGLUND (S). Funbo parish, Bärby 15.IX.1936 N. FRIES & S. LUNDELL (UPS; Fig. 7). Lena parish, "Årby skog" 15.IX.1923 & 20.VIII.1925 S. LUNDELL (Hb. ROMELL 7785 & 7830; S, UPS). Täby parish, at Lake Fjäturen 7.IX.1952 T. E. HASSELROT (S). Värmdö parish, Sandviken 28.VIII.1949 E. INGELSTRÖM (S).

S. glaucopus was initially thought to represent *S. amarescens* (QUÉL.) QUÉL., mainly on account of the small spores with slender tubercles, but the following considerations made it desirable not to continue this practice.

It has been customary to regard *S. amarescens* as a species with the base of the stipe green. The origin of this custom, of course, is QUÉLET's description and accompanying illustration from 1883 (p. 399, Pl. 11 Fig. 14). Properly speaking, however, there is nothing except QUÉLET's authority to support the assumption that this fungus from the south of France should be conspecific with the fungus collected five years earlier at Montmorency near Paris and described without mention of a green base (1880: 172). The two descriptions may actually refer to two different species. In the first description the pileus is stated to be "châtain", which is the dark, dull colour of the ripe fruit of *Castanea sativa;* in the second the pileus is described as "fauve ou abricot, puis brun-fauve", which gives a different impression, even if it is admitted that some species vary a great deal. Several characters mentioned in the first descrip-

tion were omitted in the second, and vice versa. The spores stated to be spherical and 4 μ in diameter in the first description were drawn clearly ellipsoid in the latter illustration. Specimens labelled *H. amarescens* and sent by BARLA to BRESADOLA (now in S) and to UPS are possibly an additional help in throwing more light on this matter, even though they were collected several years later, in 1889. For, if they are conspecific with the material sent by BARLA to QUÉLET, it would mean that the latter differs from the description of the Montmorency fungus by rather larger spores (6.7 × 4.5–5 μ).

In view of the discrepancies and uncertainties discussed above, it seems unwise to regard QUÉLET's later collection as conspecific with his original one from Montmorency, of which up till now no material has been traced. Similarly it is felt that the Swedish collections should not be burdened with the name *S. amarescens* as the correct interpretation of that name is so doubtful. A search in the area around Paris may result in the discovery of specimens matching QUÉLET's first description.

No doubt a most important motive to perpetuate the name *S. amarescens* has been KONRAD & MAUBLANC's illustration (1927: Pl. 467). However, these authors did not give an independent description, but adapted QUÉLET's both descriptions to their own need, here and there adding features noticed by themselves, *i. a.* the spore size ("4–7 × 4–6 μ"). From this spore size we are inclined to believe that their illustration actually represents young *S. scabrosus*, in which the tomentum of the pileus has not yet disrupted to form scales. One of us (M. G.) had reached this conclusion not knowing that LUNDELL had entered a similar suggestion in the UPS copy of KONRAD & MAUBLANC.

In North American literature *S. amarescens* has several times been mentioned in connection with *S. roseolus* BANKER (COKER 1926: 274, 1939: 375; COKER & BEERS 1951: 37; SNELL 1945: 51). Since the continued use of the name *S. amarescens* is dissuaded, the need was felt to examine the type of *S. roseolus* which, to judge from the descriptions, might be conspecific with *S. glaucopus*. In fact, the spores of *S. roseolus* are remarkably similar in size and shape (Fig. 10), but there are other differences to warrant a separation. The holotype of *S. roseolus*[1] consists of fragments only, but these are in good con-

[1] The holotype of *S. roseolus* BANKER (MURRILL & HOUSE 392; NY) consists of two incomplete, badly broken fruit-bodies. Pileus tomentose in the centre, locally develop-

dition, showing the following characteristics: pileus tomentose to finely fibrillose-scaly; stipe without a greenish colour to the base; spines less than 1 mm long and subdistant. Most basidia appear to be juvenile, indicating that the fruit-bodies were immature when collected. It is reasonable to assume that the spines would have grown longer, but it is doubtful if they would ever have become as long as in *S. glaucopus*. Even the largest of the spores examined may not have been full-grown, so that very likely mature spores of *S. roseolus* are larger than those of *S. glaucopus*.

To sum up, it seems clear that *S. roseolus*, even if it is somewhat imperfectly known, (1) has nothing to do with *S. glaucopus*, (2) differs from *S. amarescens* as understood in American literature, and (3) represents an independent species.

S. radicatus Banker,[2] which Coker & Beers (1951: 37) thought to be another synonym of *S. amarescens*, is represented in the type collection by two small fruit-bodies which likewise appear to be somewhat immature. As is apparent from our redescription *S. radicatus* differs from both *S. glaucopus* and *S. amarescens* sensu Coker in

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ing imbricated fibrillose squamules, stated to be whitish tinged with old rose when fresh, now pinkish pale brown. Stipe 30 × 3–5 mm, equal with pointed base, tomentose, glabrescent, roughened with scattered rudimentary spines, concolorous with the pileus or slightly darker, the base covered with white tomentum. Spines decurrent, up to 0.7 mm long, subdistant, subulate, pinkish-brown. Flesh of the pileus (as far as not blackened through bad drying) not zoned, pinkish pale brown, not greenish or blackened in the base of the stipe. Hyphae without clamp-connections. Spores 5.5–6.1 × 4.3–4.5 μ, broadly ellipsoid, tubercular (tubercles numerous, prominent, rounded), brownish, with oblique apiculus.

[2] The holotype of *S. radicatus* Banker (Banker 724; NY) consists of two fruit-bodies. Pileus up to 27 mm across, plano-convex, wavy, squamulose in the centre, tomentose at the margin, yellow-brown, the scales darker to darkish brown with a slight purplish tinge ("light brown with vinous tinge" according to accompanying pencil notes); scales membranous and appressed in the centre of the pileus, fibrillose towards the margin. Stipe 25 × 5–6 mm, equal, with pointed base, tomentose, glabrescent, yellow-brown above, reddish-brown below, the base covered with yellowish to whitish tomentum. Spines decurrent, up to 1.8 mm long, crowded, subulate, yellow-brown. Flesh of the pileus now pale dingy brown ("pale vinous" according to the notes), horny and darkened in the base of the stipe, but neither greenish nor blackened. Context monomitic. Hyphae up to 19 μ wide, inflating, thin-walled, branched, septate, without clamp-connections. Basidia mostly immature, up to about 37 × 7–8 μ, clavate, without basal clamp, 4-spored. Spores most certainly immature, 5.4–6 × 4.9 μ, tubercular (tubercles numerous, prominent, coarse, in various stages of development, rounded to flat-topped), brownish, with oblique apiculus.

the lack of a green colour to the base of the stipe, and bears no relation to *S. roseolus* on account of the different spores (Fig. 11). Instead, we are inclined to regard *S. radicatus* as conspecific with *S. underwoodii* (comp. p. 425).

As long as there is no adequate description of fresh material, *S. glaucopus* will probably continue to a a difficult species to recognize. The collections mentioned above had been filed under *H. laevigatum, H. versipelle, H. scabrosum, H. subsquamosum* and *H.* cf. *fennicum*. However, the spores of *S. glaucopus* should be a reliable guide to correct identification, while in dried specimens the pustules occasionally sprinkling the surface of the pileus and breaking up into powdery patches may turn out to have diagnostic value.

The discontinuance of the use of the name *S. amarescens* in its current sense may affect the status of the sectional name *Amarescentes* (Maas Geesteranus 1967: 11), but no measures are contemplated for the present.

Sarcodon imbricatus (L. ex Fr.) P. Karst.—Figs. 12–14.

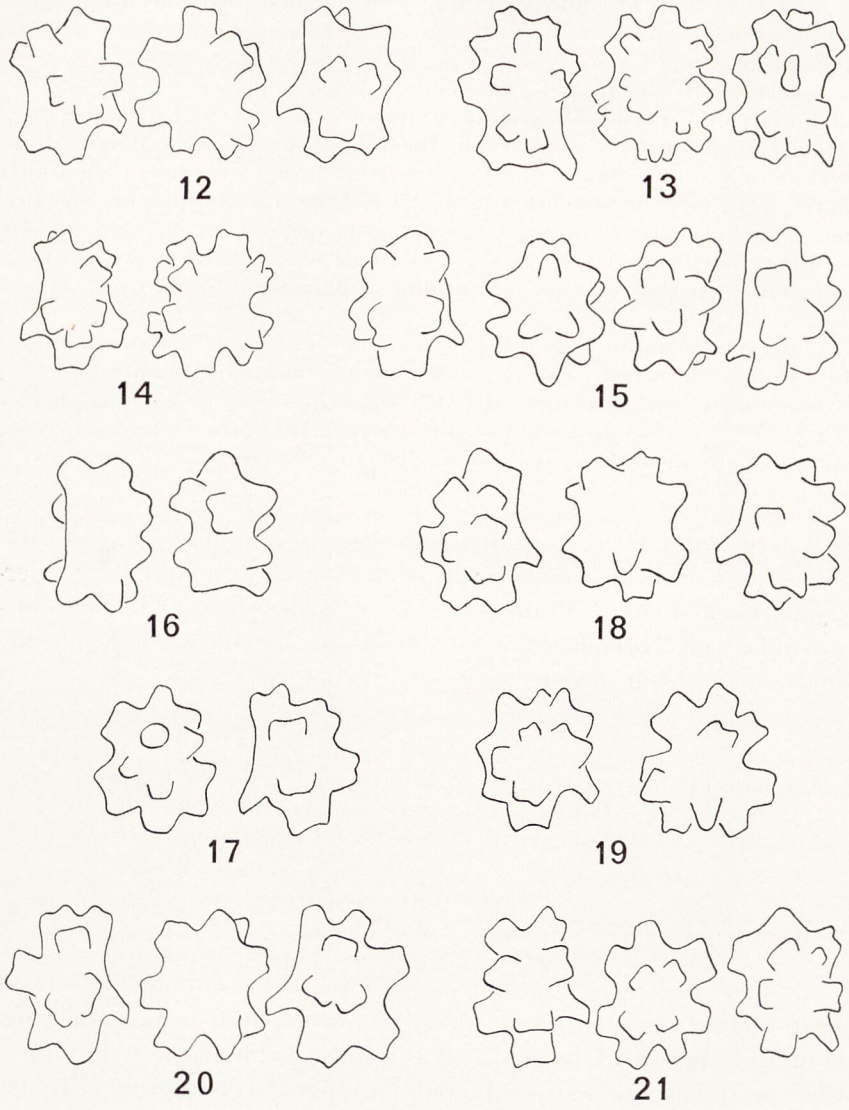
Hydnum imbricatum L., Sp. Pl. 2: 1178 (1753); ex Fr., Syst. mycol. 1: 398 (1821). — *Sarcodon imbricatus* (L. ex Fr.) P. Karst. in Revue mycol. 3(: 9): 20 (1881) & in Medd. Soc. Fauna Fl. fenn. 6: 16 (1882). — *Phaeodon imbricatus* (L. ex Fr.) J. Schroet. in KryptFl. Schles. 3(: 1): 460 (1888). — Type locality: Sweden, Uppsala (Celsius 1732: 20).

Hydnum badium Pers., Mycol. europ. 2: 155 (1825). — *Hydnum imbricatum* var. *badium* (Pers.) Duby, Bot. gall. 2: 775 (1830). — *Sarcodon imbricatus* subsp. *S. badius* (Pers.) Bourd. & Galz. in Bull. Soc. mycol. Fr. 40: 107 (1924). — *Sarcodon badius* (Pers.) Donk in Meded. Nederl. mycol. Ver. 22: 60 (1933). — Lectotype: "*Hydnum badium* Pers. Prope Bruyeres in Vogesia misit Mougeot" (L 910.256–1550, cf. Maas Geesteranus 1956: 53).

Hydnum cervinum Pers., Obs. mycol. 1: 74 (1796); ex Pers., Mycol. europ. 2: 158 (1825). — Type locality: Germany, Harz: "In pinetis inprimis hercynicis non infrequens provenit ..." (Persoon, Obs. mycol. 1: 74, 1796).

Fruit-bodies simple or sometimes with connate bases.

Pileus up to 20 cm across, more or less regular or somewhat lobed, convex to plano-convex, usually with umbilicate or depressed centre, finally infundibuliform, sometimes eventually with a central hole extending down to the base of the stipe; scaly already at a very early stage, scales in concentric rings, imbricate, coarse and upright in the centre of the pileus, decumbent farther outwards, passing into appressed fibrils near the margin, with age collapsing to papery thin membranes, finally disappearing without leaving a trace; variously coloured ranging from yellowish grey-brown with pale



Figs. 12–21. Spores of *S. imbricatus* (Figs. 12–14), *S. leucopus* (Figs. 15–19, 21) and *S. colosseus* (Fig. 20). — All ×2800.

to dark sepia brown scales to very dark purplish-brown with the scales hardly any darker.

Stipe 2–8 × 1–3 cm, usually stocky, less frequently fairly slender, equal or enlarged below, sometimes even slightly ventricose, finely fibrillose to felted, glabrescent with age and then somewhat shiny, solid but under

certain conditions becoming hollow, whitish at first, then turning progressively brown from below upwards, base long remaining white from mycelial tomentum.

Spines decurrent, up to 12 mm long, crowded, subulate, slender, long remaining pallid, eventually chocolate brown.

Flesh firm, up to 3 cm thick in the centre of the pileus, dingy white, occasionally with a slight reddish or vinaceous flush, more brownish marbled in the stipe, more or less darker in the base of the stipe, but neither blackish nor greenish. Taste becoming bitterish with age and, as it seems, in wet weather. Smell experienced by some as aromatic, by others as non-existing, or "prenant parfois une odeur chevaline désagréable" (BOURDOT & GALZIN 1928: 449).

Context monomitic. Generative hyphae up to about 14 μ wide, inflating, thin-walled, branched, septate, with clamp-connections. Basidia 35–45 × 6–8 μ, clavate, with basal clamp, with 4 sterigmata up to 5 μ long. Spores 7.2–8.2 × 4.9–5.4 μ, of irregular outline, tubercular (tubercles numerous, strongly prominent, coarse, flat-topped to exsculpate), brownish, with oblique apiculus.

A large number of specimens have been examined, *i. a.* from the following European countries: Sweden, Norway, Finland, the Netherlands, Great Britain, France, Germany, Switzerland, Italy, Czechoslovakia and Hungary. We list only those specimens of which the spores have been drawn here:

SWEDEN.

Uppland: Bälinge parish, Gullögla 7.IX.1967 J. A. NANNFELDT 20153 (L, UPS; Fig. 12). Jumkil parish, near Örnsätra 30.IX.1967 J. A. NANNFELDT 20205 (L, UPS; Fig. 13).

NETHERLANDS.

Gelderland: Hoenderlo-Otterlo 8.X.1966 C. BAS (L; Fig. 14).

S. imbricatus is a common species in the coniferous woods of Scandinavia (as of so many other countries) and, in fact, the only common species of its genus. It is unmistakable in the field, unless the specimens are too weathered or otherwise malformed. It has been known even since pre-Linnean days. The first Swedish record (from the Uppsala area) dates back to CELSIUS (1732: 20), who listed it as "*Erinaceus pileo amplissimo fusco imbricato*". The next Swedish record is that by LINNAEUS in his "Fl. lapp." (1737: 268): "*Hydna caulescens, pileo imbricatim tuberculato* ... In sylvis densissimis occurrit". With reference to this passage Lappland is often given as the type locality but this is hardly correct, for LINNAEUS certainly

did not see it in Lappland proper (and it is still doubtful if it grows there) but in the coast provinces, from which he included observations in his flora. If it is considered advisable to cite a specified type locality, the Uppsala area should be chosen with reference to CELSIUS, from whom LINNAEUS also borrowed the specific epithet. The oldest herbarium specimen seen is one in Hb. MONTIN (S): "Specimina in Uplandia lecta misit Praecl. Mag. Doc. D:nus AFZELIUS, a. 1783, sub nomine *Hydni squamosi.*"

Misled by a typographical error in LINNAEUS's "Fl. suec." ed. II, PERSOON (1796: 74) considered his German fungus different from the Swedish *H. imbricatum* and described it as *H. cervinum.* It was reduced to synonymy by himself in "Syn." (1801: 554) but in "Myc. eur." (1825: 108) *H. cervinum* became the accepted name and *H. imbricatum* a synonym.

Another PERSOON species (*H. badium*) has also proved to be synonymous, but the name has been in use until recently for several other species, *i.a.* for *S. lundellii* (MAAS GEESTERANUS 1956: 54).

Old weathered specimens may have the scales more or less completely washed off, and the pileus may at the same time show a large hole extending right down to the base of the stipe. Such specimens have caused a good deal of taxonomic confusion. They have often passed as *H. infundibulum* Sw. ex FR., but this interpretation of SWARTZ's name is hardly correct.

Sarcodon leucopus (PERS.) MAAS G. & NANNF. comb. nov. — Figs. 15–19, 21–23.

Hydnum leucopus PERS., Mycol. europ. 2:158 (1825). — Holotype: "*Hydnum leucopodium* [sic!] (mis. CHAILL.)" (L 910.262–524; Fig. 16).

Sarcodon squamosus subsp. *S. maximus* P. KARST. in Hedw. 28: 366 (1889). — *Hydnum squamosum* subsp. *H. maximum* (P. KARST.) SACC., Syll. Fung. 9: 208 (1891). — Holotype: "*Sarcodon squamosus* subsp. *maximus* KARST./Valkjärvi, mense Aug. 1889, leg. P. A. KARSTEN" (H).

Hydnum subpallidum SNELL & DICK in Lloydia 25: 162 ("1962", 1963). — Holotype: "*Hydnum subpallidum* SNELL & DICK, Black Fox Mountain, near McCloud, Siskiyou Co., Calif., 10-8-58 (?), KAY SCOTT" (Hb. W. H. SNELL 3171; Fig. 22).

Hydnum ustale K. HARRISON in Can. J. Bot. 42: 1215, Pl. 2 Fig. 4. 1964. — Holotype: "*Hydnum ustale* HARRISON, Marquette, Mich., Sept. 29, 1962, INGRID BARTELLI" (A. H. SMITH 66385, MICH); isotype: ~(DAOM 94222; Fig. 23).

Misapplication: *Hydnum laevigatum* Sw. ex FR. sensu FRIES, Monogr. Hym. Suec. 2: 275 (1863) and later publications. — *Sarcodon laevigatus*

(Sw. ex Fr.) P. Karst. in Revue mycol. 3(: 9): 20 (1881) & in Medd. Soc. Fauna Fl. fenn. 6: 16 (1881) and later authors.

Fruit-bodies simple or, more rarely, compound in that the stipe is furcate, each branch supporting a pileus.

Pileus up to about 20 cm across, more or less regular or broadly lobed, plano-convex, smooth, dry; thinly tomentose but becoming glabrous at a very early age, the cuticle thus formed eventually becoming cracked and forming arachnoid to membranous scale-like areoles, which may be fairly dark on a lighter ground; greyish-brown with a distinct tinge of "Vinaceous-Purple" sometimes approaching "Dull Dusky Purple".

Stipe 4–8 × 2–5 cm, simple or, exceptionally, bi- or tri-furcate, straight to somewhat curved, equal or enlarged below, with blunt base, thinly tomentose, glabrescent, smooth, of the same tinge as the pileus but paler, sometimes very much so, whitish at the base.

Spines little decurrent, up to ca. 15 mm long, crowded, subulate, slender, at first pallid with white tips, finally chocolate brown.

Flesh of the pileus up to ca. 2.5 cm thick, soft, homogeneous, whitish, not changing on exposure or slowly and faintly becoming flushed with violaceous. Taste bitter. (For smell, see remarks.)

Context monomitic. Generative hyphae up to 27 μ wide, strongly inflating, thin-walled, branched, septate, with clamp-connections. Basidia 30–33 × 8–9 μ, clavate, with basal clamp, with 4 sterigmata 4.5–6.3 μ long. Spores (6.7–)7.2–7.6 × (4.5–)4.7–5.4 μ, of irregular outline and markedly flattened dorsiventrally, tubercular (tubercles numerous, strongly prominent, coarse, many with the apex exsculpate), pale brownish, with oblique apiculus.

Swedish collections examined:

Småland: Tranås VIII–IX.1914 R. von Bahr (Hb. Romell 7653; S, UPS).

Gotland: Endre parish, Stensta 27.VIII.1946 Löwin (UPS). Follingbo parish, Follingbo 5.IX.1952 N. Suber (UPS); Rosendalsvägen 1949 comm. N. Suber (S). Hejdeby parish, Tjautet 9.X.1950 B. Pettersson (= L. & N., F. exs. suec. 2204). Lummelunda parish, Etebols 8.X.1950 E. Th. Fries (UPS); 10.X.1950 E. Th. Fries (= L. & N., F. exs. suec. 2203; Fig. 15); Lummelundsbruk 24.VII.1947 E. Th. Fries (UPS). Träkumla parish, Davidshage 29.IX.1949 & 23.VIII.1950 E. Th. Fries (L, S, UPS). Västerhejde parish, Hallbros 19.VIII.1947 & 28.X.1949 E. Th. Fries (UPS). Västkinde parish 19.VIII.1947 E. Th. Fries (UPS); Björkome 29.VIII.1951 E. Th. Fries (L, UPS).

Östergötland: Ringarum parish, Askedal 5.VIII.1954 L. J. Söderström (L, UPS).

Södermanland: Botkyrka parish, Tumba 10.IX.1951 comm. N. Suber (S, UPS). Huddinge parish, ca. 800 m S. of Flemmingsberg 6.X.1949 N. Suber (S). Julita parish, Äs aut. 1911 A. von Post (L, UPS).

Uppland: Danmark parish, "Danmarks allmänning" near Bergsbrunna 13.IX.1923 S. Lundell (Hb. Romell 7782; S, UPS); "Danmarks allmän-

ning" near Svedden 4.IX.1936 S. LUNDELL (UPS). Järfälla parish, Jakobsberg 19.VIII.1953 E. HALLBERG (S).

The colours in the above description are those mentioned by LUNDELL, but they do not take into account the changes that take place on drying, particularly on the surface of the pileus and in the flesh. The pileus in well dried young specimens shows a delicate purplish-brown, either with more greyish or more yellowish undertones. In full-grown specimens the colour is warmer and darker, purplish-brown to very dark purplish-brown. The flesh, when exposed to the air before allowed to dry, turns pale yellowish grey-green, but may become suffused locally with lilaceous to purplish-brown hues.

The colour change in the flesh is of particular interest in connection with the question whether or not the Central European fungus described and depicted by KONRAD & MAUBLANC (1927: Pl. 468) and BRESADOLA (1892: Pl. 138; 1932: Pl. 1042) as *H. laevigatum* should be considered conspecific with our fungus.

KONRAD & MAUBLANC and BRESADOLA concurred in describing a violet to purplish discolouration of the flesh on exposure. They also mentioned a nauseating smell.

Part of the material KONRAD & MAUBLANC used for their description is preserved in Hb. BOURDOT (PC), but insufficient attention was given to the shape of the spores when studied by MAAS GEESTERANUS (1956: 57). As to size, however, those spores agree with those of BRESADOLA's material, the measurements given by KONRAD & MAUBLANC being 5.5–7 × 4–5.5 μ.

In Hb. BRESADOLA (S) three of the packets labelled *H. laevigatum* stand out on account of their spores which are exactly alike. They are "Sopramonte 1891" (Fig 17), "Sopramonte Oct. 1899" (Fig. 18) and "Mendola Aug. 1903" (Fig. 19). In view of its collecting date, it seems reasonable to assume that the first of them was used for the illustration in "F. trid." (1892 Pl. 138), subsequently reprinted for "Icon. myc." (1932: Pl. 1042). We are thus now much better informed of the fungus as it grows in BRESADOLA's collecting grounds, whilst it is of interest to note that its spores are identical with those of the Swedish material.

Since a particular smell seems unknown in Swedish specimens, and LUNDELL kept maintaining that discolouration of the flesh was not known to him (although there is a note by ROMELL accompanying

a collection in S communicated by STELIN in 1923 and certainly from the Stockholm region, indicating that several hours after sectioning the flesh had acquired a faint "subviolascent" colour), it would seem that these are the only characters to distinguish *H. laevigatum* sensu KONRAD & MAUBLANC and BRESADOLA from the Swedish fungus. It is not an impossible supposition even that both characters, instead of being uncorrelated, actually might have the same chemical background. We certainly do not wish to separate species on purely chemical grounds, but the following considerations cannot be left unheeded. (1) Chemical differences may be correlated with morphological differences as yet undiscovered. (2) Whereas only one kind is known from Sweden, both kinds occur in Central and South Europe, i.e. both the kind with unchanging flesh and that in which the flesh discolours and smells. (3) Our knowledge of the latter kind may well prove insufficient. It therefore seems prudent to accept for the present the latter kind as an independent species. The name available for it is *S. colosseus* (BRES.) BATAILLE, which MAAS GEESTERANUS (1960: 350) formerly synonymized with *S. laevigatus*. Spores taken from the type of *H. colosseum* are shown in Fig. 20.

The name *H. laevigatum* SW. ex FR. has been in common use for our species during at least 100 years, and the correctness of the interpretation has hardly been called in question (comp. LUNDELL 1954: 2 and MAAS GEESTERANUS 1956: 57). A critical study of the relevant literature reveals, however, that SWARTZ's original *H. laevigatum* must be different, that our fungus does evidently not take part in the "mixtum compositum" FRIES described in "Obs. myc." (1815) and "Syst. myc." (1821) under SWARTZ's name and that it does not make its entrance in the literature before his "Monogr." (1863) and "Sv. ätl." (1866).

Although lacking important characters nowadays considered necessary, SWARTZ's Latin description (1810: 243) is unusually detailed for its time and is accompanied by a discussion in Swedish. His text contains several points irreconcilable with the current interpretation: the stipe is rather long (2–3 inches) but thin ("crassitie digiti minoris"); the pileus is "pallide castaneus l. ferrugineus" and paler than in *H. imbricatum*, its diameter "sub 2 pollic. & ultra", the flesh very brittle etc. SWARTZ had evidently seen his species more than once ("funnen i Barrskogar kring Stockholm"), otherwise he would certainly have given a more exact locality, as was his custom, and not have used the plural "-skogar" (forests). J. A. N., from his knowledge

of Swedish conditions, can only see one possible interpretation of SWARTZ's fungus, viz. *Bankera violascens* (A. & S. ex FR.) POUZ., whereas M. G. would prefer to leave *H. laevigatum* Sw. as a nomen dubium.

FRIES was from his early youth very interested in the stipitate Hydnums. Already at the age of 21, in "Obs. myc." (1815: 131–149) he treated them in detail, designating his treatment as "harum specierum monographia". He took *H. laevigatum* collectively with three varieties: α ("legit Cel. SCHWARTZ" [sic!]), var. β *coriaceum* and var. γ *brachypus* ("β, γ a me lecta sunt"). FRIES considered his specimens rather different from SWARTZ's ("Varietatem α descripsit SWARTZ l. c. et ad hanc fungum meum pertinere vix credissem, nisi Ipse illustr. vir specimina mea pro suo fungo agnovisset.") The specimens FRIES sent to SWARTZ have unfortunately not been preserved and it is not clear from FRIES's text whether they represented var. β, var. γ or both. The disposition of the text speaks in favour of var. β, but FRIES's wording almost 50 years later (1863: 275) points rather to var. γ.

Var. β *coriaceum* became in "Syst. myc." (1821: 400) β *gracile*, which in "Epicr." (1838: 506) was changed into *H. laevigatum** *H. gracile* and in "S. veg. Scand." (1849: 326) given specific rank. As *H. gracile* it was treated in his later publications (1851: 53, 1863: 176 and 1874: 600). In "Monogr." (1863: 176) we get the following important information: "In pinetis arenosis in par. Fryeled, Tofteryd etc. Smolandiae 1813 legi sat copiosum; dein aliis locis non legi, quare *H. laevigato* (collectivo) subjunxi, serius vero lectum ab amic. VON POST Dalekarliae ad Furudal, Vestmanniae ad Skinskatteberg etc ... Icon adhuc desideratur." From the last sentence we understand that the drawing executed by P. ÅKERLUND in 1861 (UPS) was not accepted by FRIES; it lacks also the usual "Approb. E. FRIES". This drawing was discussed by MAAS GEESTERANUS (1960: 362), who came to the conclusion that it could not be regarded as representing *H. gracile*. (The second drawing referred to by M. G. is irrelevant, for through an unfortunate distraction *H. gracile* and *H. fragile* had been mixed up.) There are no authentic specimens and no approved drawings of *H. gracile* to be found in the herbaria of FRIES, SWARTZ and VON POST (UPS, S, and S resp.), and so we have to rely exclusively on the descriptions for its interpretation. Most important is of course "Obs. myc.", for there FRIES's recollection of his find must have been most vivid: "*Stipes* ... crass. pennae anserinae l. digiti minimi ... erectus 2–3 unc ... dilute cinereus. *Pileus* carnoso-coriaceus tenax ... glaber laevis azonus cinereus. *Caro* alba tenax. *Subuli* ... tenaces albi, siccati vero rufescentes." Although certain expressions such as "pileus carnoso-coriaceus tenax", "caro tenax" and "subuli tenaces" make M. G. hesitate, *Bankera violascens* seems to be the only possible interpretation.

The third variety in "Obs. myc.", viz. γ *brachypus*, was once declared by MAAS GEESTERANUS (1960: 47) to be uninterpretable because of the unsatisfactory description. J. A. N. reasoning along different lines, is of the opinion that in order to interpret γ *brachypus* its fate in FRIES's later publications should be followed. It then turns out that this is the first report of what much later (in 1851) became *H. fragile* FR. and what in the meantime formed the major part of FRIES's *H. laevigatum*. In "Monogr." (1863: 275)

FRIES states about *H. fragile*: "In silvis acerosis Smolandiae haud raro. Haec eximia species hactenus, ex ipsius SWARTZII determinatione, cum *H. laevigato* confusa, a quo vero maxime differt. Hujus loci est *H. laevigatum* β,[1] γ Fr. Obs. et descriptio *S. Myc.* pro maxima parte. In Suecia media, in qua *H. laevigatum* haud rarum, hoc numquam vidimus." There is general consent that *H. fragile* FR. is *Bankera fuligineo-alba* (SCHM. ex FR.) COKER & BEERS ex POUZ., and to this we agree.

In 1851, FRIES described still another species, viz. *H. molle* ("in pinetis Uplandiae, hinc inde") also that "videtur confusum" with e.g. *H. laevigatum*. The interpretation of this species remains doubtful. MAAS GEESTERANUS (1960: 367–369) suggests it to be the same as the so far exclusively North-American *Bankera carnosa* (BANKER), whereas J. A. N. is inclined to suggest *B. fuligineo-alba*.

After the raising of the varieties β and γ (of "Obs. myc.") to specific rank (as *H. gracile* and *H. fragile* resp.) and the describing of *H. molle*, SWARTZ's fungus should be the only one to remain in FRIES's *H. laevigatum*, but in the meantime FRIES had detected "haud rarum" a fungus at Uppsala that he identified with SWARTZ's and on which he based his following descriptions of *H. laevigatum* as well as his plate in "Sv. ätl." (1866: Pl. 81). This fungus was ascribed a large, thick, fleshy, brown ("umbrino") pileus and "aculeis fuscescentibus" and is undoubtedly a *Sarcodon*, most probably that accepted as *H. laevigatum* by ROMELL and LUNDELL (1954: 2).

The plate and text in "Sv. ätl." form the base for all subsequent interpretations of *H. laevigatum*. FRIES declared it to be an edible species, which had considerable preference over *H. imbricatum* by its firm, "cheesy" flesh and regrets its being so rare. On his authority *H. laevigatum* has up till now appeared in almost all popular Swedish books on edible fungi but there is nothing in the books to indicate that their authors (or compilers) had ever seen the species themselves. An exception is a recent book by SUBER (1968), who from autopsy described (pp. 168–169) not only this species but also *H. fennicum*, "*H. badium* (*subsquamosum*)" (i.e. *S. Lundellii*) and *H. scabrosum*.

As indicated in "Monogr." (1863: 275) FRIES had two plates drawn of his *H. laevigatum*. One (showing the "typical" species) is the published plate, the second (in S) represents var. *rivulosa* ("*H. laevigatum* ... magnitudo *H. imbricati*, at legimus var. duplo majorem, in qua pileus minute rimoso-rivulosus, neutiquam squamosus"). In a MS note from 1941 LUNDELL declares that this water-colour is an excellent illustration of "typical" *laevigatum* and that it would have been much more worthy of being published than the other which he characterized as rather mediocre. Later (LUNDELL 1947: 47) he called the published plate "a failure".

This long discourse has proved that the name *H. laevigatum* Sw. ex FR. has been misapplied and that another name must be sought for the species generally known under that name. There can be no

[1] FRIES's citing of also var. β must be a *lapsus memoriae vel calami*, as this variety is *H. gracile* as shown above.

doubt that the Swedish fungus is conspecific with the *H. "laevigatum"* with white unchanging flesh of Central and South Europe, as exemplified by *H. leucopus*, collected by CHAILLET in the Jura and described by PERSOON (1825: 158) "stipite ... intusque albo" and by *H. laevigatum* as described by BARLA (1859: 79): "La chair est ... d'un blanc persistent ...". PERSOON's *H. leucopus* affords the valid name for our species.

The type of *H. leucopus* is in very poor condition, badly damaged by insects, and glued to a sheet with the spines down. On the few accessible spines practically all spores turned out to be collapsed or otherwise unrecognizably distorted. Only two spores were recovered that had reasonably retained their shape (Fig. 16). Spores of a specimen collected by BARLA is his favourite region ("Alp. Marit. région montagneuse, bois de la Fracha, Luceram ... automne 1886," S) are shown in Fig. 21.

Examination of the type of *H. subpallidum* SNELL & DICK revealed that this name is a synonym of the present species (MAAS GEESTERANUS 1964: 181). The angular spores (Fig. 22) are in agreement with this disposition. SNELL & DICK recorded them as 4–5 × 3.5–5 μ, but these were certainly immature. Approximately ripe spores measure 6.3–7 × 4.5–4.9 μ, which is in harmony with the size given above.

A further synonym is *H. ustale* K. HARRISON, but owing to the shape of the spores and the juvenile state of the type specimen it gave some trouble to prove this statement. *S. leucopus* is one of the species with the spores markedly flattened dorsiventrally, so that they often cannot be seen in lateral view unless they are forced into that position by pressure from the surrounding spores or hymenial tissue. The type of *H. ustale* was found to be immature, yielding comparatively few spores, and of these again few were ripe. The two spores, however, that were eventually found to be ripe as well as in the correct position, leave no doubt about the identity (Fig. 23).

Sarcodon lundellii MAAS G. & NANNF. spec. nov. — Figs. 24–28.

Type: LUNDELL & NANNFELDT, F. exs. suec. 252 (*"Hydnum subsquamosum"*; holotype: UPS).

Misapplication: *Hydnum badium* PERS. sensu LUNDELL ap. LUNDELL & NANNFELDT, F. exs. suec., Fasc. 29–30: 47 (1947).

Carpophora vulgo simplicia.

Pileus usque ad 9 cm diam., margine lanato-tomentosus vel radiato-fibrillosus, centrum versus membranaceo-squamosus; squamis margine proceris acutis adpressisque

centro latis mucronibusque allevatis; statu recente quam *Tricholoma vaccinum* subpallidior, desiccatus subochraceo-, vel rufo-, vel subpurpureo-brunneus, squamis colore obscuriore vel fusco.

Stipes 2.5–8 × 0.4–2 cm, gracilis vel crassus, aequalis vel deorsum subincrassatus, radice nullo, e tomentoso glabrescens subnitidusque, subalbidus, hinc inde roseo- vel lilacino-perfusus, denique pileo subconcolor.

Aculei decurrentes, usque ad 4.5 mm longi, conferti, subulati, maturitate purpureo-brunnei.

Caro albida vel subbrunnea, stipitis basin versus obscurior. Hyphae inflatae, ramosae, septatae, fibulis nullis. Sporae 4.9–5.8 × 3.6–4.2 μ, irregulariter ellipsoideae, tuberculatae (tubercula numerosa sat prominentia, modice crassa, apicibus planis vel rotundatis), dilute brunneae, apiculo obliquo.

Description after dried material and some notes:

Fruit-bodies simple or consisting of 2–3 separate or confluent pilei borne on fused stipes or branches of a single stipe.

Pileus up to 9 cm across, regular to broadly lobed, plano-convex to more or less depressed in the centre; woolly-tomentose to radiately fibrillose along the margin, membranous-scaly towards the centre, the scales slender, acute, and appressed near the margin, broad and with upturned tips in the centre; when fresh somewhat paler than *Tricholoma vaccinum*, with age acquiring a copper tinge (LUNDELL), dull yellowish-brown to rufous brown or somewhat purplish-brown when dry ("Wood Brown" (RIDGWAY), "Sayal Brown", "Snuff Brown", "Auburn", and "Verona Brown"), with the scales darker to very dark brown ("Bister").

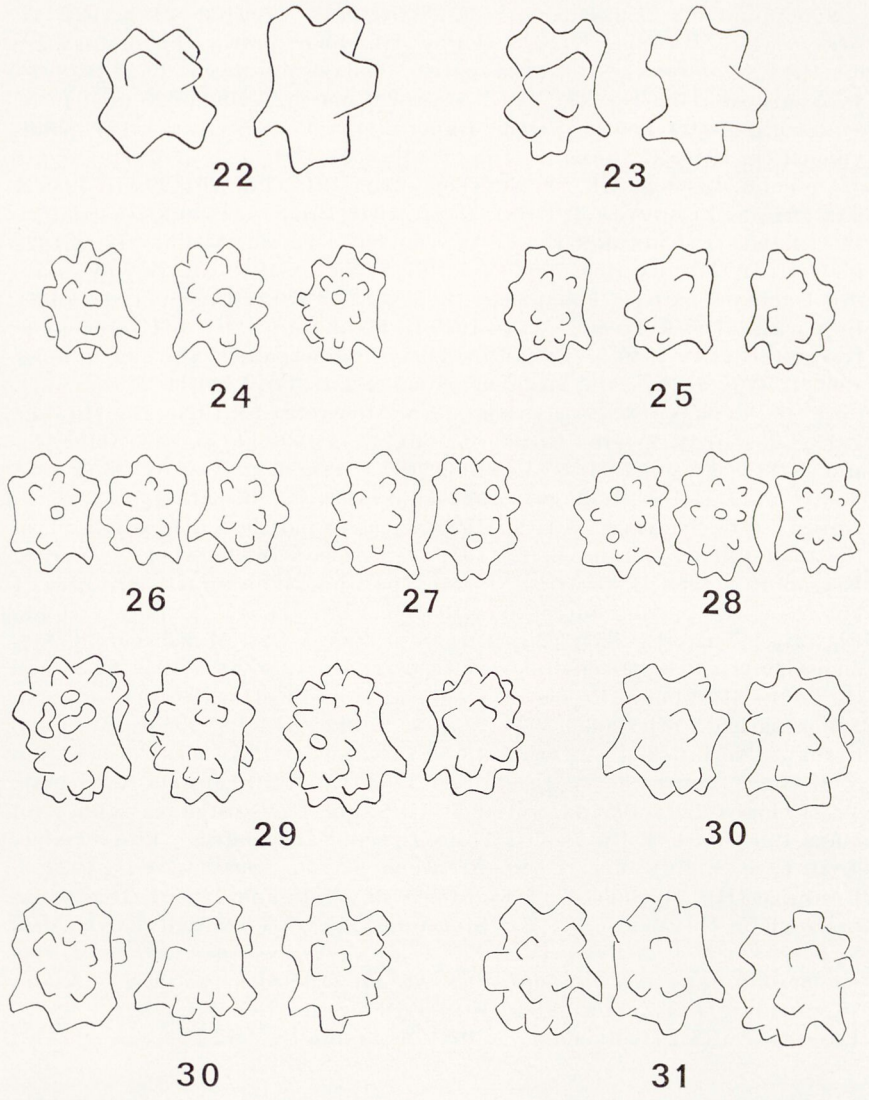
Stipe 2.5–8 × 0.4–2 cm, slender to fairly heavy, equal or slightly enlarged below, with no traces of a rooting base, finely felted, becoming glabrous and faintly shining, brownish-whitish, locally suffused with delicate pinkish or lilaceous tints, eventually almost concolorous with the pileus.

Spines decurrent but rarely reaching the middle of the stipe, up to 4.5 mm long, crowded, subulate, chocolate brown when mature.

Flesh not zoned, whitish or pale brownish in the pileus, somewhat darker in the base of the stipe. Taste mild when young, somewhat burning or peppery when old. Smell faint when young, reminiscent of meal or cucumber, becoming unpleasant with age, reminiscent of sour paste.

Context monomitic. Generative hyphae up to 22 μ wide, inflating, thin-walled, branched, septate, without clamp-connections. Basidia 30–36 × 6–7 μ, clavate, without basal clamp, with 4 sterigmata 3.6–4.5 μ long. Spores 4.9–5.8 × 3.6–4.2 μ, irregularly ellipsoid, tubercular (tubercles numerous, fairly strongly prominent, moderately coarse, flat-topped to rounded), pale brownish, with oblique apiculus.

This species is so far not known from outside Sweden but there it has been collected repeatedly in some eastern provinces. Collections examined:



Figs. 22–31. Spores of *S. leucopus* (Figs. 22–23), *S. lundellii* (Figs. 24–28), *S. bubalinus* (Fig. 29), *S. underwoodii* (Fig. 30) and *S. murrillii* (Fig. 31). — All ×2800.

Gotland: Ardre parish, Ljugarn 18.VIII.1946 E. TH. FRIES (UPS). Barlingbo parish, Barlingbo IX.1944 N. SUBER (S). Buttle parish, Buttle IX.1945 N. SUBER (S, UPS). Kräklingbo parish, Hejdeby 3.IX.1946 N. SUBER (S, UPS).

Östergötland: Simonstorp parish, the wood of the parsonage 22.IX.1912 E. HAGLUND (Hb. HAGLUND, S).

Södermanland: Enskede parish, Södertörns villastad 24.IX.1922 H. STELIN (Hb. ROMELL 7765; S, UPS). Huddinge parish, Flemmingsberg 6.X.1949 N. SUBER (S). Nacka parish, Saltsjö-Storängen 25.IX.1919 E. INGELSTRÖM (Hb. ROMELL 7697; S). Salem parish, Vällinge 25.IX.1949 N. SUBER (S). Ytterenhörna parish, Enhörna 4.IX.1949 N. SUBER (S); Sandviken 4.IX. 1949 N. SUBER (S).

Uppland: Börje parish, "Klista skog" 22.IX.1941 (Fig. 26), 29.VIII.1945 & 6.IX.1945 S. LUNDELL (all UPS); 29.VIII.1948 BIRGITTA NORKRANS (UPS); 11.VIII.1953 J. ERIKSSON (L, UPS). Danderyd parish, Svalnäs 19.IX.1922 L. ROMELL (Hb. ROMELL 7762; S, UPS); Sätra 2.X.1949 GRETA BERGGREN (S). Danmark parish, "Hammarby skog" 12.IX.1930 S. LUNDELL (L, UPS). Ed parish, "Eds kyrkostig" 25.IX.1949 G. HAGLUND (S, UPS). Ekerö parish, Kärsgatan 21.IX.1949 N. SUBER (S, UPS). Funbo parish, Storudden 30.IX. 1966 E. ÅBERG (L, UPS). Kalmar parish, Fånäs VIII.1890 H. KUGELBERG (S, UPS). Lena parish, "Årby skog" (near Storvreta) 4.X.1920 (Hb. ROMELL 7715), 28.VIII.1922 (Hb. ROMELL 7736), 13.IX.1922, 17.IX.1923 (Hb. ROMELL 7815) & 5.VIII.1930 S. LUNDELL (S, UPS); near Ängeby 26.IX.1951 S. LUNDELL (UPS). Lidingö X.1922 H. STELIN (S); Kottla 18.IX.1922 L. ROMELL (Hb. ROMELL 7761; S, UPS). Ljusterö parish, S:a Ljusterö, N. of the road Linanäs–Grundvik 1.X.1952 O. PERSSON (S, UPS). Lovö parish, Kersön 15.X.1950 B. CORTIN (S). Läby parish, "Svinskinnsskogen", ca. 1 km N. of the parish church 20.IX.1950 S. LUNDELL & J. ERIKSSON (UPS; Fig. 27); "Västerby skog" 2.IX.1945 N. FRIES (UPS). Munsö parish, Sjöängen 29.VIII.1948, 27.VIII.1950, IX.1950, 26.VIII.1951 & 9.X.1953 N. SUBER (S, UPS). Stockholm, Frescati 6.X.1917 L. ROMELL (Hb. ROMELL 7684; S). Sånga parish, Färjestaden 30.IX.1951 N. SUBER (S, UPS). Uppsala (Bondkyrka), "Norby skog" 22.VIII.1945 S. LUNDELL (UPS); Nosten, ca. 1 km S. of Håga 16.VIII.1965 N. LUNDQVIST 4683 (L, UPS). Uppsala-Näs parish, W. of Högby 22.IX.1951 H. SMITH (L, UPS; Fig. 28); Nosten, ca. 5 km S. of Håga 12.IX.1954 H. BELIN & L. HOLM (UPS). Vänge parish, "Fiby urskog" 4.VIII.1930 S. LUNDELL (UPS). Ärentuna parish, Storvreta 8.IX.1922 S. LUNDELL (Hb. ROMELL 7750; S); Storvreta, Vretalund 24.IX.1921 S. LUNDELL (Hb. ROMELL 7727; S); Storvreta, above Vretalund 29.VIII.1933 S. LUNDELL & J. A. NANNFELDT (= L. & N., F. exs. suec. 252 as *H. subsquamosum;* type of *S. lundellii;* Figs. 24, 25). Österåker parish, S. of Åsätra 25.VIII.1948 G. HAGLUND (S). Östra Ryd parish, Bogesund 5.IX.1949 E. INGELSTRÖM (S); Rydboholm 7.X.1951 N. SUBER (S, UPS).

This species was found and recognized by S. LUNDELL in the early 20's. When distributing it in F. exs. suec. 252 (1936) he considered it to be *H. subsquamosum* FR. (non BATSCH) and gave *H. badium* PERS. and *H. versipelle* FR. p.p. as synonyms. Later (1947: 47) he changed his opinion, considering *H. subsquamosum* to be conspecific with the true *H. versipelle,* and *H. badium* to be the valid name of the species under discussion. His opinion about *H. badium* was based mainly on BRESADOLA's Iconographia (Pl. 1038). The

type specimen of *H. badium* in L proves it to be *S. imbricatus*, and the same applies to a specimen in Hb. BRESADOLA (now in S) which might have been used for BRESADOLA's plate. The meanings of the name *H. subsquamosum*, both in its original sense and in FRIES's, must remain riddles. There seems to be no other species to which LUNDELL's fungus can be referred and so it has to be described as new (cf. MAAS GEESTERANUS 1956: 49–50, 1960: 378). Its closest relative in Europe is certainly *S. bubalinus* (PERS.) MAAS G., still known only from the type. It was stated (MAAS GEESTERANUS 1956: 49) to differ among others from *H. badium* sensu LUNDELL (i.e. the present species) in the purplish hue of the pileus, but this colour appears to occur also in *S. lundellii*. More reliable points of difference, however, are to be found in the spores, which are appreciably larger in *S. bubalinus*, viz. 6.3–7.6 × 4.3–4.5 μ, and have more tubercles (Fig. 29).

Two further species that have a number of characters in common with *S. lundellii* are the North American *S. underwoodii* BANKER[1] and *H. rimosum* K. HARRISON. The former differs in its much larger spores (6.7–8.6 × 4.5–5.4 μ, Fig. 30) and bitter taste, while the latter is at once distinguished by the different colour pattern of its pileus ("deep 'Quaker drab', scales dark 'vinaceous fawn' and cracks tinged 'army brown', 'vinaceous drab' on the margin or with a zone of dark 'plumbago slate' ...").

Originally *S. murrillii* BANKER[2] was taken to be another related

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[1] The holotype of *S. underwoodii* BANKER (UNDERWOOD & EARLE 598; NY) consists of 4 fruit-bodies, all immature and badly dried. Fruit-bodies solitary. Pileus largest diameter 5 cm (but in accompanying notes stated to be 6–10 cm when fresh), scaly, dull ochraceous yellow-brown, the scales somewhat darker to reddish-brown; scales membranous to fibrillose, narrow, fully adnate at the margin of the pileus, with upturned tips towards the centre. Stipe 3–4.5 × 1–1.5 cm ("3–6 × 1–3 cm" when fresh), tomentose-fibrillose, studded with abortive spines, concolorous with the pileus, the base pointed, thickly covered with white mycelium (the extreme end being broken off in all specimens). Spines decurrent, ca. 2 mm long, crowded, subulate, the more developed ones brown at their base. Flesh (stated in the notes to be white, bitter) neither greenish nor blackish in the base of the stipe, monomitic. Hyphae inflating, without clamp-connections. Basidia without basal clamp. Spores 6.7–8.1(–8.6) × 4.5–5.4 μ, of irregular outline, tubercular (tubercles numerous, prominent, coarse, flat-topped to slightly exsculpate), brownish, with oblique apiculus.

[2] Dr. K. A. HARRISON, who studied the material in 1962, found the type collection (MURRILL & HOUSE 397; NY) to contain two different species. One portion "with typical rosy flesh" he separated as *H. fuligineo-violaceum* KALCHBR. [which is actually

but independent member of this group, but examination of the type revealed that it is conspecific with *S. underwoodii* (Figs. 30, 31).

Sarcodon scabrosus (Fr.) P. Karst. — Figs. 32–34.

Hydnum scabrosum Fr., Anteckn. Sverige växt. ätl. Svamp. 62 (1836). — *Sarcodon scabrosus* (Fr.) P. Karst. in Revue mycol. 3(: 9): 20 (1881) & in Medd. Soc. Fauna Fl. fenn. 6: 16 (1881). — *Phaeodon scabrosus* (Fr.) P. Henn. in Nat. PflFam. 1(: 1**): 149 (1898). — Type locality: Sweden, Småland, Femsjö, "in pinetis montanis raro" (Lindblad 1853: 5). — Neotype: Småland, Femsjö 6.ix.1945 S. Lundell (UPS; Fig. 33).

Fruit-bodies simple or with connate bases.

Pileus up to 14 cm across, more or less regular to variously lobed, convex to more or less depressed in the centre; velvety or felted at first, then scaly in the centre, the scales fairly coarse with upturned tips, gradually passing into appressed fibrils towards the margin, sometimes the greater part of the pileus surface cracked into areoles; scales and fibrils reddish-brown to purplish-brown or paler to darker fuscous suffused with vinaceous on a yellowish-brown to paler concolorous ground.

Stipe 4–7 × 2–5 cm, usually stocky, more rarely slender, tapering downwards or more or less equal with pointed base, finely felted becoming finely fibrillose or glabrous, greyish-pink or brownish with vinaceous tints, finally concolorous with the pileus, the base dark bluish-grey or blackish-green under a white mycelial cover.

Spines decurrent, up to 6 mm long, crowded, subulate, very slender, pinkish-grey, then dark grey-brown to chocolate-brown.

Flesh up to 2 cm thick in the centre of the pileus, firm, white to whitish-cream, often and at least partly becoming flushed with reddish or pale vinaceous tints, more dingy or mottled with brownish farther down, bluish or greenish in the base of the stipe. Taste bitter, and sometimes producing

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S. joeides (Pass.) Bat.] and the remainder he regarded "as described by Banker". The latter may be redescribed as follows: Fruit-bodies simple (as can be judged by the stipe-bases there must have been several specimens, but fragments and dust are all that remain). Pileus scaly, ochraceous yellow-brown or with a slight reddish-brown tinge, the scales darker; scales near the margin small, narrow, fibrillose, adnate, and only upturned at their tips, those in the centre coarser, less adnate, and somewhat darker. Stipe tomentose, roughened with scattered rudimentary spines, concolorous with the pileus, darker below, the base pointed, covered with white tomentum. Spines decurrent, up to 1.8 mm long, crowded, subulate, brown. Flesh whitish in the pileus, not greenish or blackish in the base of the stipe, monomitic. Hyphae up to 24 μ wide inflating, branched, septate, thin-walled, without clamps. Basidia 4-spored, without basal clamp. Spores (mostly immature) 6.3–8 × 4.5–4.9 μ, of irregular outline, tubercular (tubercles numerous, prominent, coarse, flat-topped), brownish, with oblique apiculus (Fig. 31).

an acrid feeling in the throat. Smell of intact specimens sweetish, but when cut, strongly of water melon (*Citrullus vulgaris*).

Context monomitic. Generative hyphae up to 30 μ wide, inflating, thin-walled, branched, septate, without clamp-connections. Basidia 38–43 × 6–7 μ, clavate, without basal clamp, with 4 sterigmata 4–5 μ long. Spores (5.4–)6.3–7.3 × (3.6–)4–5 μ, of irregular outline, tubercular (tubercles numerous, strongly prominent, coarse, flat-topped to exsculpate), pale brownish, with oblique apiculus.

Collections examined:

SWEDEN.

Skåne: Åhus, 27.VIII & 3.IX.1919, 28.IX.1922 P. TUFVESSON (Hb. ROMELL 7690, 7691 & 7751; S, UPS).

Småland: Femsjö parish, at the NW. part of Lake Hallasjön, between Näset and the rivulet SW. of Haghult 6.IX.1945 S. LUNDELL (neotype; UPS; Fig. 33). Tranås 16.IX.1915 R. VON BAHR (Hb. ROMELL 7808, S).

Gotland: Barlingbo parish, Barlingbo 4.IX.1944 N. SUBER (S). Visby, above Snäckgärdet 16.X.1949 E. TH. FRIES (UPS).

Södermanland: Nacka parish, "Nacka urskog" 18.IX.1923 L. ROMELL (Hb. ROMELL 7788; S, UPS); Nyckelviken 3.IX.1924 L. ROMELL (Hb. ROMELL 7800, 7800*b* & 7813; S, UPS); S. of Saltsjö-Duvnäs 5.VIII.1948 G. HAGLUND & R. RYDBERG (S); between Saltsjö-Duvnäs and Lake Kalltorpssjön 5.VIII.1948 G. HAGLUND & R. RYDBERG (S, UPS). Södertälje, Saltskog 26.IX.1919 L. ROMELL (Hb. ROMELL 7699; S, UPS). Ytterenhörna parish, Sandviken 12.IX.1948 N. SUBER (S). Åker parish, Åkers styckebruk, near Lake Mörtsjön 16.IX.1951 O. PERSSON (S).

Uppland: Danmark parish, ca. 1 km NW. of Bergsbrunna Railway Station 15.VIII.1948 A. MELDERIS (= L. & N., F. exs. suec. 2206; Fig. 32). Djurö parish, Runmarö, between Söderunda and Lake Vitträsk 3.IX.1948 R. RYDBERG (S, UPS). Gustavsberg parish, Mörtnäs VIII.1891 H. KUGELBERG (S). Ingarö parish, Ingarö 6.IX.1953 R. RYDBERG (S, UPS). Munsö parish, Sjöängen 1.X.1953 N. SUBER (S, UPS). Stockholm, Skanstull X.1886 H. KUGELBERG (S, UPS). Stockholms-Näs parish, Almarestäket 10.IX.1922 E. INGELSTRÖM (Hb. ROMELL 7754; S). Älvkarleby parish, Brämsand 24.IX.1950 G. FÅHRÆUS & G. STENLID (= L. & N., F. exs. suec. 2205); Ytterboda 23.IX.1950 G. FÅHRÆUS & G. STENLID (UPS); between Ytterboda and Sågarbo 9.IX.1945 G. FÅHRÆUS & G. STENLID (UPS); Älvkarleö near Lanforsen 16.IX.1917 L. ROMELL (Hb. ROMELL 7682; S, UPS). Östra Ryd parish, Rydboholm 7.X.1951 N. SUBER (S, UPS).

Hälsingland: Harmånger parish, Strömsbruk, between Påboda and Lake Andratjärn 4.IX.1949 BERIT & J. ERIKSSON 3920 (UPS). Ramsjö parish, N. of Lake Trolltjärn, at the road Ramsjö–Enskogen 23.IX.1944 T. E. HASSELROT (UPS).

Ångermanland: Ramsele parish, Nyland IX.1945 W. GRANLUND 3398 (UPS).

Norrbotten: Övertorneå parish, S. of Lake Orjasjärvi 5.IX.1954 O. LÖNNQVIST 93 (L, UPS).

NORWAY.

Sogn & Fjordane: Sogndal parish, Ambla, ca. 1 km NE. of the Heiberg-museum 12.VIII.1950 J. STORDAL 4918 (UPS).

DENMARK.

Sjælland: Tisvilde Hegn VIII.1953 anonymus (UPS).

U.S.S.R.

"Regio Leningradensis, Isthmus Karelicus, prope Gorovskoje" VIII.1954 T. L. NIKOLAJEVA (UPS).

NETHERLANDS.

Friesland: Beetsterzwaag 14.IX.1954 H. KIJLSTRA (L).

Drente: between Annen and Eext IX.1967 N. J. L. JANSONIUS (L). Dwingelo 21.VIII.1966, 28.VIII.1967 & 3.XI.1967 A. K. MASSELINK (L); Dwingelo, Lheederzand 29.VIII.1963 R. A. MAAS GEESTERANUS 13936 (L; Fig. 34). Steenwijk, De Eese 17.IX.1961 A. K. MASSELINK (L).

Overijsel: Bathmen 1.X.1957 A. GROENEWEG (L). Ootmarsum, near the German frontier 11.VIII.1966 W. A. VAN HEEL (L).

Gelderland: Apeldoorn IX.1890 C. A. J. A. OUDEMANS (L). Gorssel, Hassink 29.IX.1951 R. A. MAAS GEESTERANUS 8042 (L). Wageningen-Hoog 24.VIII.1952 R. A. MAAS GEESTERANUS (L).

Zeeland: Zeeuws Vlaanderen, Hulst 13.IX.1952 B. J. J. R. WALRECHT (L).

Noord-Brabant: Ulvenhout 22.VII. & 25.VIII.1953 C. PH. VERSCHUEREN (L).

GREAT BRITAIN.

England: Berkshire, Windsor, Swinley Park 3.X.1968 E. E. GREEN & R. A. MAAS GEESTERANUS 15312 (L).

Scotland: Inverness-shire, near Loch Morlich 10.IX.1957 D. A. & P. M. REID (L).

GERMANY.

Oberlausitz: Gablenz M. SEIDEL (S).

CZECHOSLOVAKIA.

Bohemia: Vlastiboř near Soběslav 15.VII., 24.VII. & 6.X.1954 F. KOTLABA & Z. POUZAR (L).

Moravia: Věžná, Teplá 27.IX.1946 F. ŠMARDA (L).

HUNGARY.

Vas: Szakonyfalu 12.VIII.1958 M. BABOS (L).

YUGOSLAVIA.

Mt. Medvednica, Gračci (near Zagreb) 15.IX.1963 & 31.VII.1966 M. TORTIĆ (L); 23.IX.1968, I. FOCHT (L).

ITALY.

"Regio tridentina" VIII.1928 G. BRESADOLA (UPS).

H. scabrosum is still another Friesean species that must be judged from descriptions only, but in this case there has on the whole been general agreement on its interpretation, only the delimitation of the species has remained vague. The Swedish species most likely to be confused with it are *S. fennicus* and *S. glaucopus*.

H. scabrosum was described already in "Ant. Sv. ätl. sv." (1836: 62). The description is rather brief mentioning *i.a.* the originally tomentose pileus turning squamulose and rough only from the fluff which conglutinates into small upright sharp spikes, the very short tapering stipe and the white very thick flesh in the centre of the pileus. Two years later in "Epicr." (1838: 62) "basi nigrescens" was added to the description of the stipe. The characters given are almost sufficient to make the interpretation unambiguous. It should not disturb us too much that it was described in a work on edible fungi without any reservation as to its edibility, for it is evident that FRIES at that time took it for granted that all fleshy Hydnums were mild and edible. From LINDBLAD (1853: 5) we learn that *H. scabrosum* had been found only at Femsjö "in pinetis montanis", and "Monog." (1863: 273) adds "inter acus *Pini* coacervatos nascitur". In a memorandum from 1854 written by FRIES (published by LUNDELL 1936) for LINDBLAD, who was then sent to Femsjö to have drawings made of rare species for FRIES's planned "Icones", an exact spot was indicated (p. 274) where *H. scabrosum* had been found growing "on the road side amongst needles of pines". This special habitat removes the last doubts about its identity. All Scandinavian Sarcodons grow in coniferous woods and prefer spruce woods with deep moss carpets but *S. scabrosus* (and perhaps *S. fennicus*) occurs also—and mostly—in drier pine woods with the soil covered by a thick layer of needles. As the neotype we have chosen a collection by LUNDELL from a locality a few kilometers from the spot indicated by FRIES.

No plate was published in FRIES's "Icones", but there is a watercolour in S. This has no real documentary value (although approved by FRIES) as it was drawn by VON POST (in 1861) from material found by himself in Östergötland. LUNDELL (in a MS note) characterized the plate as unrecognizable. It may, however, be worth mentioning that a few years earlier (1852) VON POST had collected *S. fennicus* in the same locality.

LUNDELL (1954: 3) stated that "no really good illustration of this species" was known to him. This still holds true. However, LIND-

BLAD (1853: 5) referred to an illustration that gives a very acceptable rendering of the *colour* of the pileus, viz. SCHAEFFER, Fung. Icon. 3 Pl. 271 (1770). This, of course, does not imply that we accept the illustration as actually representing the present species. It is practically certain—also from the size of the spores given—that the illustration of *S. amarescens* by KONRAD & MAUBLANC (1927 Pl. 467) represents young fruit-bodies of *S. scabrosus* (see remarks under *S. glaucopus*).

S. scabrosus, although easily recognizable when fully mature, changes its aspect a great deal during development. In very young fruit-bodies the surface of the pileus is velvety to felted, the scales appearing through repeated rupturing of the surface.

Sarcodon versipellis (FR.) QUÉL. — Figs. 35–40.

Hydnum versipelle FR. in Öfvers. Vet.-Akad. Förh. 18: 31 (1861); Mon. Hym. Suec. 2: 274 (1863); Ic. sel. Hym. 1: 4, Pl. 1 (1867). — *Sarcodon versipellis* (FR.) QUÉL., Ench. Fung. 188 (1886); LITSCH. ap. LITSCH. & LOHWAG, F. sel. exs. europ. 176 (1939) (preoccup.); NIKOL. in Fl. Pl. cryptog. URSS, Fungi 6 (2): 283 (1961) (preoccup.). — *Phaeodon versipellis* (FR.) P. HENN. in Nat. PflFam. 1(: 1**): 149 (1898). — Neotype: LUNDELL & NANNFELDT, F. exs. suec. 2643 (Holoneotype: UPS; Fig. 35).

Hydnum versipelliforme ALLESCH. in Ber. bot. Ver. Landshut 10: 21 (1887). — Authentic material (syntype?): "*Hydnum versipelliforme* ALLESCHER, Tölz, Waldung bei Fischbach, 8. 87, ALLESCHER" (S; Fig. 39).

Hydnum crassum K. HARRISON, Stip. Hydn. Nova Scotia 29, Pl. 2 Fig. 3 (1961); in Can. J. Bot. 42: 1218 (1964). — Type: "*Hydnum crassum* HARRISON, Cape Split, Kings County, N[ova] S[cotia], Aug. 10, 1958, K. A. HARRISON 3548" (Holotype: DAOM 53378, Fig. 40; isotype: MICH).

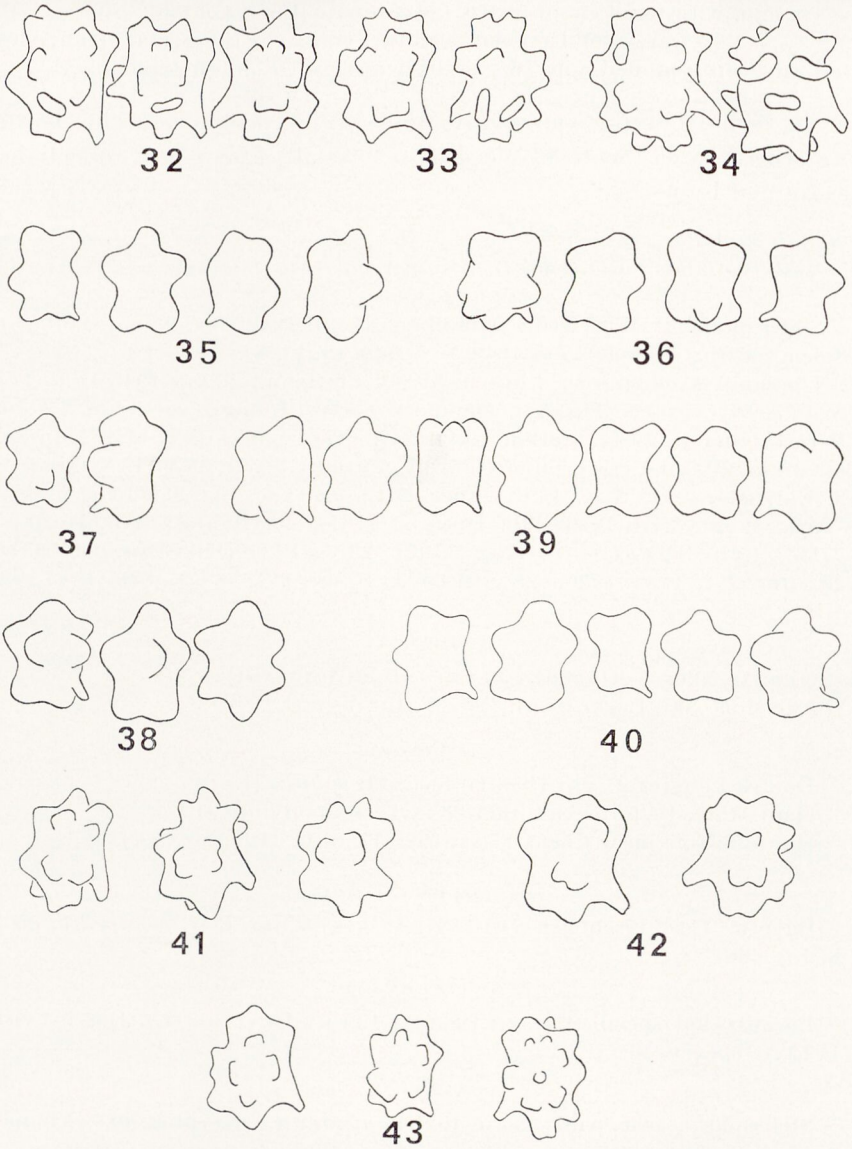
Fruit-bodies simple or compound with the stipes connate.

Pileus up to about 13 cm across, simple or subdivided into three or more cuneate segments, often more or less irregular or eccentric, plano-convex or depressed in the centre; with thin, appressed to adnate, fibrillose scales in the central part, radiately fibrillose farther outwards, tomentose at the margin; turning from dingy brownish-white or fulvous to orange-brown in maturing (from "Pecan Brown" (RIDGWAY) over "Orange Cinnamon" to "Vinaceous Cinnamon", according to LUNDELL), paler and more ochraceous brown at the margin, the scales darker.

Stipe 3–9 × 2–3 cm, simple to connate or branched, straight or somewhat crooked, equal, tapering to a point at the base, fibrillose, glabrescent, concolorous with or paler than the pileus, tomentose and white at the base.

Spines strongly decurrent, up to 10 mm long, crowded, subulate, slender, at first pale with white tips, then brownish-grey, finally chocolate brown.

Flesh of the pileus up to 2 cm thick, soft, without zones, whitish, at least in part slowly turning faint greyish-green. Taste mild, farinaceous, with a



Figs. 32–43. Spores of *S. scrabrosus* (Figs. 32–34), *S. versipellis* (Figs. 35–40), *S. sp.* (Fig. 41), *H. modestum* (Fig. 42) and *H. subincarnatum* (Fig. 43). — All ×2800.

slight astringent after-taste, more pronounced in older specimens. Smell none or peculiar, not unpleasant. (For taste and smell, see remarks.)

Context monomitic. Generative hyphae up to 14 μ wide, inflating, thin-walled, branched, septate, with clamp-connections. Basidia 21–27 ×5.5–6.5

μ, clavate, with basal clamp, with 4 sterigmata 4.5–5.4 μ long. Spores 4.5–5.5 × 3.5–3.6(–4.5) μ, of irregular outline, coarsely tubercular (tubercles few and with rounded apices), pale brownish, with oblique apiculus.

As seen from the synonymy this species occurs also in North America (Nova Scotia). We list below all European collections examined by us:

SWEDEN.

Västergötland: Lerum parish, Lerum 1.VIII.1943 T. NATHORST-WINDAHL (L, UPS).

Södermanland: Mariefred, Dammkärr, 9.VIII.1942 TH. ARWIDSSON (S). Salem parish, Vällinge 25.IX.1949 N. SUBER (S, UPS).

Uppland: Alsike parish, Lunsen, SE. of Flottsund 26.VIII.1945 BIRGITTA NORKRANS (S, UPS; Fig. 36). Danmark parish, Lunsen, ca. 1 km SW. of Bergsbrunna Railway Station 19.VIII.1945 G. FÅHRAEUS (UPS); Lunsen, ca. 2 km SW. of Bergsbrunna Railway Station 25.VIII.1954 H. NILSSON & J. ERIKSSON (= L. & N., F. exs. suec. 2643; neotype; Fig. 35). Lena parish, "Årby skog" 8.VIII.1923 (Hb. ROMELL 7781), 20.VIII.1923 (Hb. ROMELL 7783), 4.VIII.1924 (Hb. ROMELL 7796), 22.VII.1925 (Hb. ROMELL 7831), 28.VIII.1927, 30.VII.1930, 28.VII.1936 & 10.VIII.1942 S. LUNDELL (L, S, UPS).

NORWAY.

Oslo: V. Aker, Vettakollen 30.VIII.1915 J. EGELAND (S).

Akershus: Ski, Boger 27.VII.1967 T. LUNDER (L).

FRANCE.

Doubs: Lougres 27.VIII.1956 H. S. C. HUIJSMAN (L).

Haut-Rhin: Belfort exhibition 23.IX.1956 anonymus (L).

Haute-Savoie: near Chens 17.VII.1960 H. S. C. HUIJSMAN (L).

GERMANY.

Bayern: Tölz, Fischbach VIII.1887 A. ALLESCHER (*"H. versipelliforme"*, S; Fig. 39).

SWITZERLAND.

Locality not specified 18.VII.1963 A. FLURY-BLATTER (L). Basel 3.VIII. 1924 A. KNAPP (S).

AUSTRIA.

Steiermark: near Aussee VIII. C. RECHINGER (= Kryptog. exs. Vindob. 2615; L, S, UPS).

Tirol: Leutasch, Berglental 24.VIII.1933 V. LITSCHAUER (= LITSCHAUER & LOHWAG, F. sel. exs. eur. 176; UPS). Lienz, Tristachersee VII.1932 K. LOHWAG (UPS). Mutters (near Innsbruck) 6.VII.1920 V. LITSCHAUER (UPS; Fig. 37).

CZECHOSLOVAKIA.

Moravia: Dubcové hills, Vsetín 31.VII.1944 V. POSPÍŠIL (L; Fig. 38).

ITALY.

Trentino-Alto Adige: "in silva Ruffrè (Mendola)" 14.VIII.1903 G. BRESADOLA (S).

The colours described above have largely been taken from LUNDELL's description in F. exs. suec. 2643, from notes accompanying some collections in UPS and a water-colour sketch in S, as well as from the water-colour made by one of us (M.G.) after fresh specimens sent from Switzerland. In his MS notes LUNDELL also compared the colour of fresh specimens with that of *Polyporus* (*Albatrellus*) *confluens* and that of faded *Lactarius helvus*. It should be remembered, however, that on drying these colours fade and change a great deal, which then may render the distinction from *S. leucopus* without the aid of the microscope rather uncertain. Young, dried specimens usually have pale colours, those of the pileus ranging from violaceous-grey or purplish-grey to pale purplish grey-brown. Older specimens have richer and more saturated colours, ranging from yellow-brown to fairly dark purplish grey-brown.

LUNDELL stated that the flesh slowly changes "into a faint greyish-green" when cut, but it occasionally also shows faint violaceous hues when exposed to the air while drying.

Another feature, which is not always shown, but obvious when present, even when dry, is a grey-green to bluish-green colour within and without at the very base of the stipe. This colour is exhibited by the collections from Årby skog 30.VII.1930 (Sweden), Ski (Norway), Belfort and Lougres (both in France). It is not known as yet what value should be attributed to the presence or absence of this feature.

Smell and taste are notoriously difficult to put into words. The following data, conflicting though they seem, are recorded because it is the only way of showing their range of variability, if not that of human perception and/or mental associations.

Smell: "when fresh peculiar, sweetish, not exactly of liquorice but rather of vanilla, when dried smell fainter" (Årby skog 8.VIII. 1929); "pleasant, sweetish + of liquorice + a faint tinge of vanilla" (Årby skog 27.VIII.1927); "rather strong, mild and pleasant, difficult to describe, of liquorice + sweetish" (Årby skog 30.VII.1930); "peculiar, reminding one of aniseed with a touch of cucumber. On drying ... reminding one of newly baked bread with bitter orange" (F. exs. suec. 2643); "difficult to explain" (Ski); "of water melon

(*Citrullus vulgaris*)" (Switzerland); "strong, like lysol" (Belfort); "odore grato" (Bresadola 1932: Pl. 1040); "mildly medicinal" (Harrison).

Taste: "mild, farinaceous" (27.viii.1927); "faintly farinaceous, somewhat resembling that of cucumber, after a while with an astringent after-taste" (30.vii.1930); "mild, or, in old specimens, astringent" (F. exs. suec. 2643); "not observed" (Ski); "farinaceous, not becoming bitter, but specimens very young" (Switzerland); "disagreeable, bitterish-farinaceous, old specimen" (Belfort); "sapore amaricante" (Bresadola l.c.); "mild or slightly acrid" (Harrison).

Also in this case Fries did not preserve any material, and so *H. versipelle* has to be interpreted from descriptions and illustrations. It was described in 1861 but had entered the literature already ten years earlier (Fries 1851: 52–53) as an unnamed variety of *H.* "*subsquamosum*": "Upsaliae passim. Icon a nobis exhibita ab hactenus datis valde recedit et peculiarem saltem varietatem exhibit. Stipites caespitoso-connati, hinc subramosum fere instar *Polyp. cristati* l. *pedis Capreae*. Color fusco-ferrugineus, intus dilutior." Lindblad (1853 p. 5) mentioned this fungus (under *H. subsquamosum*) as follows "Caro albo-lutescens [i.e. in speciminis typicis]; etiam ferruginascens in specim. Upsaliensibus, in Mus. Ac. S. H. depictis, quae ceterum ratione crescendi subcaespitosa recedunt."

Already in "Monogr." (1863: 274) *H. versipelle* became polymorphous or at least dimorphous: "In silvis Uplandiae pluries lectum sub duabus formis ... seorsim pictis". In "Icon." (1867: 4) it has become "maxime mutabilis tam quoad staturam, quam pilei cuticulam". The published plate "sistit formam optime explicatam stipite ramoso, pileo fibrilloso-lacerato. Formae simplices et pileo laevigato simul depictae exstant in Mus. Acad. Sc. Holmiensis, quae vero h. l. negligere cogimur, ne tabularum numerus multiplicatur."

As in the case of *H. laevigatum* also *H. versipelle* was evidently judged by later students mainly from the published plate and so undue weight was laid upon its caespitose growth. There is in fact no *Sarcodon* with the stipes constantly or even normally connate, although this peculiarity is evidently less rare in certain species than in others. For decennia no new finds were reported.

The name became actualized in 1932, when Bresadola (Pl. 1040) published a plate entitled *H. versipelle* Fr., also this plate

showing a cluster of connate fruit-bodies. There is a specimen (14.VIII.1903) in S, from which this plate may have been drawn and this represents our species.

In the early 20's at the very beginning of his mycological career LUNDELL found and recognized two species of *Sarcodon* which neither he nor ROMELL was able to name. One was the species described above as *S. lundellii*. The other species, which ROMELL happened to receive simultaneously from Switzerland, was provisionally designated by ROMELL as *H. fulvum*, and LUNDELL used for years the sobriquet *H. uplandicum*. After seeing BRESADOLA's plate of *H. versipelle* he thought that this plate showed his species of which he had meanwhile received material also from Tirol sent by LITSCHAUER. On the other hand he thought that the true *H. versipelle* of FRIES might rather be the same as *H. badium* sensu LUNDELL (i.e. *S. lundellii*), which he had not rarely found clustered (cf. LITSCHAUER & LOHWAG 1939 n. 176 and MAAS GEESTERANUS 1960: 381). Later, when he had found also his *H. uplandicum* with connate stipes he became convinced that this was the species shown in FRIES's published plate.

FRIES's second (unpublished) plate (in S) originally inscribed "*Hydnum subsquamosum* BATSCH var. *contigua*" with "*versipelle*" added by O. ROB. FRIES shows a singly-growing (non-concrescent) fruit-body, which according to a MS note by LUNDELL (from 1941) is exactly matched by the specimens distributed in F. exs. suec. 252 (i.e. *S. lundellii*). This species is decidedly less rare in the Uppsala region than "*H. uplandicum*", and FRIES had certainly seen it too and perhaps even included it in his *H. versipelle*. It is not realistic to expect FRIES to have had a better conception of the species of *Sarcodon* than most mycologists of much later date. He did not use either the microscope or chemical reagents; clamp-connections, spore-ornamentation and similar features were of course totally unknown to him.

The unanimous interpretations by BRESADOLA, LITSCHAUER and LUNDELL seem well-founded and should be followed. The specimens distributed in F. exs. suec. 2543 were collected in a forest which is known to have been a favourite "hunting ground" of FRIES's and in which he not unlikely saw the species. It seems thus appropriate to select this collection as the neotype of *H. versipelle* FR.

On an earlier occasion, one of us (MAAS GEESTERANUS 1962) regarded *H. versipelle* as a link in the chain of forms constituting the

highly variable taxon *S.* "*laevigatus*", but it is actually well separated from that species, now called *S. leucopus*. Apart from the colours of the pileus and the size and colour of the spores, the two species can be told from each other as follows: *S. versipellis*: pileus tomentose, becoming fibrillose-squamulose; stipe with pointed base; spines much decurrent, sometimes reaching the base of the stipe; spores with few and obtusely rounded tubercles. *S. leucopus:* pileus glabrous, becoming cracked; stipe with blunt base; spines little decurrent; spores with numerous, apically exsculpate tubercles.

Judging from the collections studied by us, it would seem that *S. versipellis* is more common in Central Europe than *S. leucopus* (and *S. colosseus*). For obvious reasons, records in the existing literature cannot be relied upon.

It is most unfortunate that good illustrations of these two species are still lacking. The plate of *H. versipelle* in FRIES's Icones (Pl. 1), although giving an acceptable idea of a compound fruit-body, is poor in rendering and colour. The plate in BRESADOLA's Iconographia (Pl. 1040) is much better in these respects, but still far from perfect.

On a former occasion MAAS GEESTERANUS (1960: 382) left the matter undecided as to how *H. versipelliforme* should be identified. Now that an authentic (syntype?) collection has been found in S, the name proves to be a later synonym of *S. versipellis* (Fig. 39). Unfortunately, the colour of the pileus has been destroyed by treatment with $HgCl_2$. But it is still possible to demonstrate that (1) the hyphae possess clamp-connections, (2) the base of the stipe is not greenish, and (3) the spores, although possibly somewhat affected by $HgCl_2$ are essentially identical with those of recent, untreated collections of *S. versipellis*. The colour of the stipe, which ALLESCHER found to agree with FRIES's description "stipite ... cinerascente," seems unusual for *S. versipellis*, but in view of the agreement in all essential characters, we are inclined to ignore this difference.

The colour photograph of *H. crassum* reproduced in HARRISON's earlier work (1961) needs some comment. Judging from the accompanying description, the colours of the pileus would seem to contain too much orange-red, as probably do those in most of the other photographs. It would, in fact, be difficult to reconcile a fungus with a "yellowish, later dull yellow-brown" pileus with *S. versipellis*, which shows bright orange-brown colours. Actually, however, the colours of Pl. 2 Fig. 3 are almost correct, appearing even somewhat

dull as compared with those given in the author's later paper (1964): "orange cinnamon, zinc orange, and cinnamon".

As regards the identification of the two species, it may be observed that the colours of the pileus of both the young and old specimen of the type of *H. crassum* in dried condition are well matched by those in the UPS copy of F. exs. suec. 2643 (*H. versipelle*). It should also be observed that HARRISON, too, compared the colour of his fungus with that of *Polyporus confluens*. Besides, the spores (Fig. 40) leave not the slightest doubt.

Another species which when dry looks rather similar to *S. versipellis* is *H. calvatum* K. HARRISON. However, its pileus when fresh lacks orange hues, and, moreover, its spores show more tubercles, are somewhat differently shaped, and are rather characteristic in that it is difficult to find the apiculus (not figured).

Sarcodon spec. —Fig. 41.

Fruit-bodies simple or with the stipes basally connate.

Pileus up to 6 cm across (when dry), more or less regular, plano-convex, smooth, dry; thinly felted, tomentum collapsed to form a glabrous surface (when dry somewhat shiny), which locally shows adnate fibrils and fibrillose squamules, and may become cracked; pale greyed orange-brown to dingy reddish-grey, or purplish-grey, the fibrils and squamules somewhat darker.

Stipe 3.5–4 × 1–2 cm (when dry), straight to somewhat curved, enlarged below, tapering to a pointed base, finely tomentose, glabrescent, studded with abortive spines, pale buff to almost concolorous with the pileus, darkening with age from base upwards, not blackened at the base, which is covered with white cottony mycelium.

Spines decurrent, about 2 mm long (when dry), moderately crowded to subdistant, subulate, slender, at first pallid, then grey-brown.

Flesh of the pileus firm, homogeneous, dingy yellowish-grey, not changing on exposure. Taste stated to be mild, then (slightly) astringent, but not bitter (FÅHRAEUS & STENLID). Smell aromatic, reminiscent of allspice (*Pimenta officinalis*) (F. & S.).

Context monomitic. Generative hyphae up to 15 μ wide, inflating, thin-walled, branched, septate, without clamp-connections. Basidia 32–37 × 6.5–7 μ, clavate, without basal clamp, with 4 sterigmata 3.6–4.5 μ long. Spores 5.4–6.3 × 3.6–4.5 μ, of irregular outline, tubercular (tubercles not numerous, coarse, rounded or flat-topped to exsculpate), pale brownish, with oblique apiculus.

Collection examined:

SWEDEN.

Uppland: Älvkarleby parish, E. of Gårdskär 27.VIII.1950 G. FÅHRÆUS & G. STENLID (UPS; Fig. 41).

Some words may be added to the above description. The collectors observed that their fungus very much resembled BRESADOLA's illustration of "*H. subsquamosum*" (1932: Pl. 1037), but that the pileus was of a more dingy colour ("dingy helvus").

There are several collections named *H. subsquamosum* in Hb. BRESADOLA (S), and one ("Val di Sole, in silvis coniferis, 1880, G. BRESADOLA") seems to contain the specimens which served for the illustration. Examination of these specimens reveals that they, although looking somewhat similar and equally lacking clamps to the hyphae, are not identical with the species described above but differ in (1) the pileus showing free scales near the margin, and (2) the spores possessing more numerous tubercles, which are more sharply angular (not figured).

The present collection is rather characterized by its unobtrusiveness, which is the main reason for our hesitation to assign a name to it. A search in the North American literature suggested two species as possibly related. These are *H. modestum* SNELL & DICK (1963: 162) and *H. subincarnatum* K. HARRISON (1964: 1216). Examination of the type specimens revealed the interesting fact that these two are conspecific (Figs. 42, 43). It is clear that the name *H. modestum* has priority. Dried, the colour of the pileus of this species is different from that of the Swedish collection, but it is not known how much of the difference is due to the way the collections were dried. The difference in spore ornamentation between *H. modestum* and the Swedish collection is equally inconclusive.

Summary.

This paper critically revises the taxonomy and nomenclature of the Swedish species of *Sarcodon*. The treatment of the species in the publications of ELIAS FRIES is analysed in detail. In the descriptions special emphasis is laid upon the spore morphology. Two new species are described, viz. *S. glaucopus* and *S. lundellii*. *Hydnum laevigatum* Sw. ex FR. is found to have been misunderstood. The valid name for the species generally known under that name is *S. leucopus* (PERS.) MAAS G. & NANNF. comb. nov., and the North American *H. subpallidum* SNELL & DICK and *H. ustale* K. HARRISON are shown to be synonyms. *S. versipellis* (FR.) QUÉL. is restored as a distinct species and *H. versipelliforme* ALLESCH. and *H. crassum* K. HARRISON are shown to be synonyms. Neotypes are selected for *S. fennicus*, *S. scabrosus* and *S. versipellis*. The North American *H. modestum*

SNELL & DICK (1963) and *H. subincarnatum* K. HARRISON (1964) are shown to be conspecific.

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