

NOTES ON HYDNUMS—II

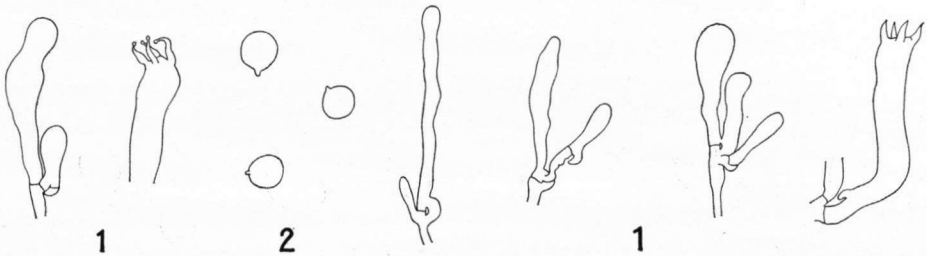
R. A. MAAS GEESTERANUS
Rijksherbarium, Leiden

(With 74 Text-figures)

This paper deals with a number of Hydnums, some of which seem not to have been reexamined since their publication. In a few cases the species appear to be Polypores, in others it is for various reasons impossible or inexpedient to indicate the generic relationship. Several names are reduced to synonymy. The following recombinations are proposed: *Deflexula sprucei* (Mont.), *Gloiodon nigrescens* (Petch), *Gyrodontium boveanum* (Mont. apud Decaisne), *G. versicolor* (Berk. & Br.), *Sarcodon carbonarius* (G. H. Cunn.), *S. martioflavus* (Snell & al. apud Snell & Dick), and *S. thwaitesii* (Berk. & Br.) Maas G.

Ambustus. — *Hydnum ambustum* Cooke & Masee apud Cooke in *Grevillea* 16: 32. 1887. — Type: "*Hydnum (Mesopus) ambustum* C & M / [Australia] Victoria, Harkaway Range, 6/87. C. French" (K).

The type consists of three fruit-bodies with confluent pilei and stipes connate at the base. Pileus plano-convex, depressed in the centre, 1-1.5 cm across; surface smooth, glabrous except for some scattered remnants of a yellowish tomentum near the margin; fulvous along the margin, darker to almost black toward the centre; margin somewhat involute in places. Stipe central, solid, slender, equal (but flattened, divaricate, and widened near the apex in one of the specimens), about 1.5 cm long, 1-2 mm thick (up to 5 mm at the widened apex), glabrous, concolorous with the pileus above, blackened below. Spines reaching the stipe, subulate, up to 1.5 mm long, fulvous. Context fleshy, monomitic; hyphae thin-walled, inflating, with clamp-connections. Basidia cylindrical-clavate, $36-50 \times 6.7-7.2 \mu$, 4-spored, with clamp-connection at the base (Fig. 1). Spores (only immature ones seen, Fig. 2) globose, smooth, colourless, $6.4-7.2 \mu$ diam., apiculus c. 1μ long. Cystidia absent.



Figs. 1, 2. *Hydnum ambustum* Cooke & Masee apud Cooke (type). — 1. Basidia, the one in the centre apparently sterile. — 2. Spores. (Both figures $\times 700$.)

The specimens described above were either past their prime when collected or perhaps dried far too slowly, and both possibilities may account for what Cooke & Massee called the "scorched appearance" and for the glassy-horny consistency. No explanation can be offered why I failed to find mature spores. However, the microscopical characters indubitably determine the species as a true *Hydnum*, and I have no doubt that it is identical with *H. crocidens* Cooke which was published at a later date. As pointed out in the discussion under *H. crocidens*, I have as yet no definite opinion how that species might be distinguished from the *Hydnum repandum* complex.

At first some difficulty was experienced in finding the clamps at the base of the basidia of the material from Victoria. They seem to degenerate and disappear at an early stage of the development.

Armeniacus. — *Sarcodon armeniacus* Maas G., see under 'martioflavus'.

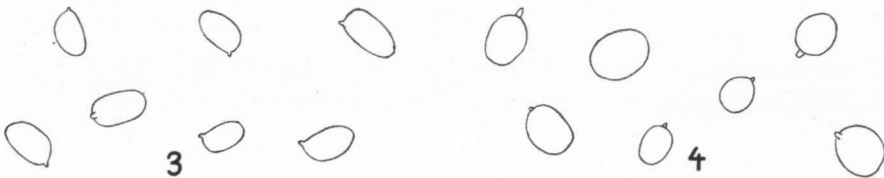
Basi-asperatus. — *Hydnum basi-asperatum* P. Henn., see under 'rawakensis'.

Boveanus. — *Hydnum boveanum* Mont. *apud* Decaisne in Ann. Sci. nat. (Bot.), Sér. 2, 4: 194. 1835; Mont. *apud* Fr., Epicr. Syst. mycol. 513. 1838; Mont., Syll. Gen. Spec. Crypt. 173. 1856. — Type: "*Hydnum boveanum* Montag. / Sur des poutres dans le palais d'Ibrahim au Caire / Com. Cl. Bové" (PC).

A thin membrane bearing a mass of crowded spines is all that is left of the fungus described by Montagne. Where one would expect to find the fruit-body proper, the context is completely replaced by a thick layer of compacted fulvous powder. Spines up to 7 mm long, 0.3–0.4 mm thick, subulate, collapsed (probably from old age), and flattened and sulcate. Hyphae of the trama of the spines for the greater part badly collapsed, but in places still recognizable: of one kind only, up to 6.3 μ wide, thin-walled, septate, without clamp-connections, branched and with occasional connecting hyphae. Basidia collapsed. Spores (Fig. 3) ellipsoid, adaxially flattened, smooth, yellow-brown under the microscope, rather thick-walled, 3.8–5.4 \times 2.7–3.6 μ , with small, oblique apiculus. Cystidia and gloecystidia not seen.

The compact powdery layer mentioned above is made up of broadly ellipsoid to subglobose spores (Fig. 4), 3.6–4.9 \times 3.1–4.5 μ , yellow-brown and moderately thick-walled (the smaller ones) to dark brown and thick-walled (many of the larger ones), often with what seems to be a median, colourless, often very prominent apiculus, but occasionally without such a structure.

While there is no reason to believe that the specimen examined should be anything else than Bové's material (for those parts of Montagne's description that can be



Figs. 3, 4. *Hydnum boveanum* Mont. *apud* Decaisne (type). — 3. Basidiospores taken from a spine. — 4. Spores taken from powdery layer. (Both figures \times 700.)

checked agree very well), it is difficult to imagine by what agent the pileus, after Montagne had described it, was completely destroyed and reduced to a powdery mass without there being left any trace of the original tissue. The symmetric shape of the spores, the median position of the apiculus (if it is an apiculus), the variable size of the latter, and its occasional absence suggest that the spores might be conidiospores or chlamydospores. Dr. M. A. Donk, in this connection, drew my attention to what seemed to be a similar kind of spores, viz. the "Gastérospores", which were stated by Heim & Malençon (1928: 69, fig. 5) to occur in the dissepiments of *Ganoderma rivulosum* Pat. & Har.¹ However, whereas these spores apparently developed in the living tissue of the fruit-body, the strange fact remains that the subglobose spores in *Hydnum boveanum* were produced after the specimen had been filed in the herbarium. Another difference is that these spores were not found to occur in the trama of the spines, which is homologous to the tissue of the dissepiments of a polyporous fungus. These considerations raise the question whether the spores under discussion belong to the species at all.

The hyphal structure of *Hydnum boveanum*, as far as can be made out, agrees with that of *Hydnum henningsii*, the type species of the genus *Gyrodontium*, while the basidiospores are exactly alike in size, shape, colour, and possession of a small, oblique apiculus. There can be no doubt, therefore, that the present species and *H. henningsii* are congeneric, but it seems advisable not to conclude yet that both are conspecific until better preserved material is available. Accordingly, the following recombination is here proposed: **Gyrodontium boveanum** (Mont. apud Decaisne) Maas G., *comb. nov.* (basionym, *Hydnum boveanum* Mont. apud Decaisne, l.c.).

Carbonarius. — *Hydnum carbonarium* G. H. Cunn. in Trans. roy. Soc. New Zeal. 85: 591, text-fig. 2, 2a, pl. 40 fig. 2. 1958; not *Hydnum carbonarium* Peck in Rep. N.Y. State Mus. nat. Hist. 40: 55. 1887. — Type: "*Hydnum carbonarium* G. H. Cunn., [New Zealand,] Otago Distr., Half Moon Bay, Stewart Island, Febr. 1948, J. M. Dingley" (Herb. Plant Diseases Div., New Zealand 17707).

The lack of zones in the context, the thin-walled, inflating hyphae, the strongly warted brown spores, and the absence of cystidia determine the present species as a true *Sarcodon* (*Hydnum* in Cunningham's sense), hence it is here transferred to that genus as **Sarcodon carbonarius** (G. H. Cunn.) Maas G., *comb. nov.* (basionym, *Hydnum carbonarium* G. H. Cunn., l.c.). The black exterior, the presence of clamp-connections, and the bluish discolouration of the hyphae in KOH solution indicate that the species belongs to that group, of which *Sarcodon atroviridis* (Morg.) Banker and *S. thwaitesii* (Berk. & Br.) Maas G. (p. 183) are further members. These last-mentioned species do turn black with age or when bruised, but they are more brightly coloured when young, and I believe this to be true for *S. carbonarius*, too. I have no doubt that Cunningham's description was based only on dried material, and

¹ It appears that time and again the formation of 'gasterospores' in *Ganoderma* has attracted the attention of mycologists. Among them Bose (1957) and Sarkar (1959) are mentioned whose papers refer to further literature on the subject.

I am convinced that the type (to judge from the specimen I had on loan) was already too far gone when it was collected, which accounts for its aforesaid black colour, the polished surface of the pileus, and the brittleness of the context. Cunningham's choice of the specific epithet is unfortunate in that '*carbonarius*', apart from being a later homonymous epithet (under *Hydnum*), suggests a quality which the fungus does not ordinarily possess. Even now the context is not black, as Cunningham described it, but of a dark olive colour and, being a *Sarcodon*, it is highly improbable that the context in the fresh condition should have been anything but fleshy.

Sarcodon carbonarius is urgently in need of a redescription from fresh material in order better to appraise the differences of this species from *S. atroviridis*. The criteria now used to distinguish *S. carbonarius* from *S. atroviridis* are the larger spore-size of the former and, rather as a last resort, the occurrence in two geographically widely separated regions.

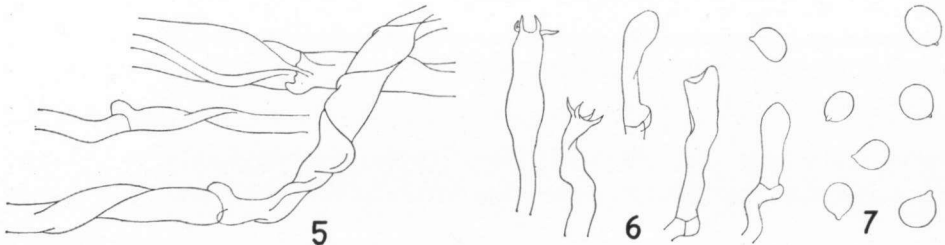
It should be pointed out that in lateral view the spores appear somewhat less broadly ellipsoid than indicated by Cunningham, being $8.1-9.0 (-9.8) \times 6.3-7.2 (-7.6) \mu$.

Crassus. — *Hydnum crassum* K. Harrison, Stip. Hydn. Nova Scotia 29, pl. 2 fig. 3. 1961. — Type: "Cape Split, Kings County, 10 Aug. 1958, K. A. H[arrison] 3548" (DAOM 53378).

The type consists of two half specimens: (i) a larger one which is yellow-brown in some places, dark brown in others and suffused with a very slight purplish hue; (ii) a smaller one which is mainly dingy ochraceous, but at one place distinctly lilaceous grey near the margin. The surface in both is cracked into areoles or adnate scales. The stipe is stocky, tapering to a pointed base which is whitish. The mature spines are chocolate brown. The context is yellowish (paler and with a greenish tint in the smaller specimen) and only a little darker in the base of the stipe.

The last-mentioned character excludes Groups 1 and 4 of the genus *Sarcodon*, and Group 2 may be left out of consideration as the hyphae possess clamp-connections. From the remaining characters the specimens are easily recognizable as belonging to *Sarcodon laevigatus*, which makes *Hydnum crassum* synonymous with the latter.

Crocidens. — *Hydnum crocidens* Cooke in Grevillea 19: 45. 1890. — *Dentinum crocidens* (Cooke) G. H. Cunn. in Trans. roy. Soc. New Zealand 85: 589. 1958. — Type:



Figs. 5-7. *Hydnum crocidens* Cooke (type). — 5. Generative hyphae from the context, showing clamp-connections at the septa. — 6. Basidia in various stages of development, with clamps at the base. — 7. Spores. (All figures $\times 700$.)

"*Hydnum crocidens* Cke / [Australia] Port Phillip / [C.] French / on ground / Aug. [18]90" (K).

Fruit-bodies solitary. Pileus plane, slightly depressed in centre, 2–3 cm across; surface apparently smooth when fresh, finely felted near margin, glabrous in centre, fulvous yellow-brown; margin somewhat involute in places, otherwise straight. Stipe central, solid, slender, equal, about 2.5 cm long, 2–4 mm thick; surface glabrous, concolorous or darker than the pileus. Spines reaching the stipe, moderately crowded, subulate, up to 2.5 mm long, orange-brown. Context fleshy, monomitic, made up of thin-walled, inflating hyphae, up to 12.5 μ wide, with clamp-connections at (all?) septa (Fig. 5). Basidia cylindrical-clavate, 45 μ or more long when mature, 5–7 μ wide, 4-spored, with clamp-connection at the base (Fig. 6). Spores broadly ellipsoid to subglobose, smooth, colourless, 6.7–8.1 \times 5.4–6.3 μ (Fig. 7). Cystidia lacking.

I have seen all the collections enumerated by Cunningham (Herbarium Plant Diseases Division, New Zealand) and both these and the type material have the habit of a small, sometimes even minute, *Hydnum repandum* var. *rufescens* (Fr.) Barla. However, particularly in the genus *Hydnum* it is unwise to decide on the identity of dried material without a reliable description of the specimens in the fresh condition. Unfortunately, some inaccurate or erroneous statements in Cunningham's account make me doubt the correctness of others. The following details are taken from his description:—

(1) "Pileus . . . polished, glabrous . . ."—It is true that in age the pileus becomes glabrous and shining from the centre outward, but initially it is completely covered with a fine felt. Remnants of this tomentum are still visible in Herb. PPD, New Zealand, Nos. 6386, 7341, 7379, and 16752.

(2) "Stems . . . sulcate, hollow . . ."—In the material examined the stipes are solid and do not give the impression of having ordinarily been marked with grooves when fresh.

(3) "Generative hyphae . . . without clamp connexions."—In all collections examined (No. 17721 was too badly dried and left out of consideration) the hyphae possess clamps at the septa.

(4) "Spores globose or subglobose, 5.5–7.5 μ diameter . . ."—Such globose spores are actually by far in the majority, but these represent, I believe, immature ones. Measurements on three different collections (Herb. PPD, New Zealand Nos. 4456, 5586, and 17720) yielded a wider range of the spore-size, viz. 6.3–8.1 \times 5.8–6.8 μ .

The discrepancies indicated above make me suspicious of the colours described by Cunningham (pileus "at first shining white", spines "ferruginous", context "ferruginous") which are radically different from the colour notes accompanying the collection from Wellington, Mt. Waiopahu (Herb. PPD, New Zealand, No. 533). These pencilled annotations (probably in Cunningham's own hand) read as follows:—

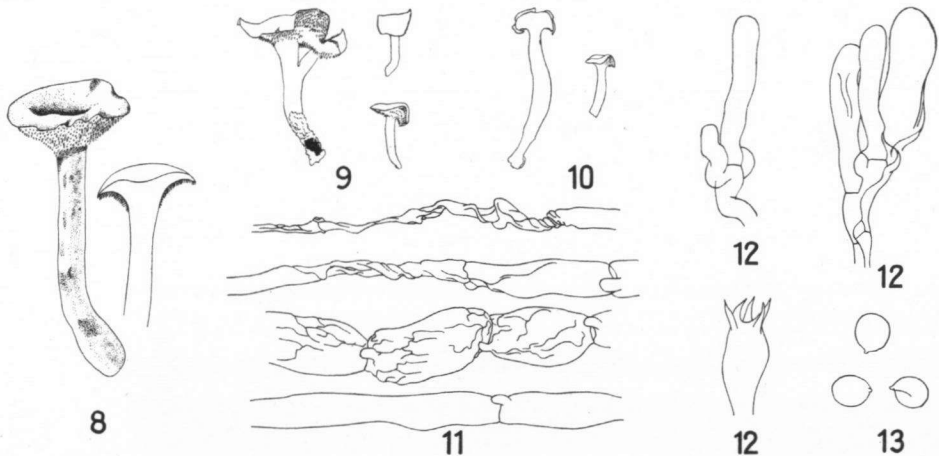
"P. cream plane. up to 4 cm diam. Stem excentric decurrent. colour of pileus. grooved. 2–4 cm long. 1 cm thick. Spines distinct at base awl-shaped acute, colour of pileus. about .5 cm long".

These notes are well in agreement with what Cleland (1934: 244) described as *Hydnum repandum*. The main parts of this description are here copied for facilitating comparison since Cleland's book may not be easily accessible.

"Pileus . . . 1.8 to 3.7 cm . . . , nearly plane . . . usually irregular, surface dull, edge turned in when young, fleshy, pallid with a buffy tint becoming Light Ochraceous Buff Spines adnate with a decurrent tendency, . . . 3.5 to 10 mm long, crowded, unequal, entire, subulate to conical or blunt, buffy cream becoming Light Ochraceous Buff Stem . . . 3.2 to 5 cm, moderately slender, equal or slightly attenuated upwards, solid, white or whitish, with ochraceous buff stains appearing. Flesh brittle, whitish, becoming near Ochraceous Orange Taste none. Spores subspherical to irregular, whitish, 5.6 μ . Single or subcaespitose, on the ground".

Figure 55, accompanying Cleland's description, depicts two partly confluent fruit-bodies which remind one of a small *H. repandum* var. *repandum* rather than var. *rufescens*, and resemble several of the New Zealand collections, such as Herb. PPD, New Zealand, Nos. 5586, 7379, 17720, and 20105.

Taking stock of the material now available—(i) the type specimens, (ii) the collections from New Zealand, (iii) the pencil notes with one of them, and (iv) Cleland's description and illustration—I regard *Hydnum crocidens*, in contradistinction from Cunningham's opinion, as a member inseparable from the *Hydnum repandum* complex. I am, however, unable to say what status it would have within that complex or how it might be distinguished from the other members on account of its broad range of variability. Some extreme forms on one end of the range resemble minute specimens of variety *rufescens* as far as habit is concerned, while the extremes on the other end have all the characters of a small variety *repandum*. To add to the embarrassment, it should be noted that collections No. 7379 and No. 17720 each



Figs. 8–13. *Hydnum elatum* Masee. — 8. Habitus, after the water-colour (left) and pencil drawing (right) accompanying the type ($\times \frac{1}{2}$). — 9. Specimens from bottom packet ($\times \frac{1}{2}$). — 10. Specimens from top packet ($\times \frac{1}{2}$). — 11. Hyphae of the context ($\times 700$). — 12. Basidia in various stages of development ($\times 700$). — 13. Spores ($\times 700$).

contain both extremes. The one feature which may prove to be a differential character is that the basidia of *H. crocidens* consistently produce four sterigmata, whereas those of *H. repandum* not infrequently have five, more rarely even six.

Hydnum ambustum Cooke & Masee, which see for a description, proves to be identical, and as it was published three years prior to *H. crocidens*, it provides the correct name for the present species.

Elatus. — *Hydnum elatum* Masee in Bull. misc. Inf., Kew 359. 1914. — Type: “*Hydnum elatum* / Singapore / Botanic Gardens / on ground in garden jungle / colour above yellowish salmon / colour below dirty cream / 9 Oct. 1913 / Ethel M. Burkill / No. 183” (K).

Fruit-bodies solitary. Pileus (Figs. 8–10) plano-convex, depressed in centre, up to 6.5 cm across; surface smooth, finely felted, glabrescent, yellowish salmon; margin involute when young, becoming straight to wavy. Stipe central, solid, slender, straight with bent base, equal or somewhat enlarged below, up to 12 cm long, 1.3–1.5 cm thick, 2 cm at the base; surface smooth, felted, glabrescent, dirty white with scattered yellowish patches (according to the water-colour accompanying the type), brownish orange in one of the dried specimens. Spines decurrent, moderately crowded, subulate, up to 2 mm long, dirty cream. Context fleshy, monomitic, made up of thin-walled, inflating hyphae, 6–25 μ wide, with clamp-connections at all septa (Fig. 11). Basidia cylindrical-clavate, 8–9 μ wide when mature, 4–5-spored, with clamp-connection at the base (Fig. 12). Spores subglobose, smooth, 7.2–7.6 \times 5.4–6.5 μ (Fig. 13). Without cystidia.

The type, accompanied by a water-colour and a pencil drawing, consists of several specimens divided between two packets glued to the same sheet. On the label of the top packet is a line in a different hand (probably Miss Wakefield's) which reads, “*Hydnum elatum*, Mass. (= *H. ferreum* Lloyd)”. The bottom packet contains a note by E. M. W[akefield] to state that “Mr. Masee described this as *H. elatum* from the figure only, for the specimen was in my possession at the time” (the words here spaced were underlined). It is unknown to me whether this note refers to the material of one or both packets. In the latter case it is hard to see how Masee could describe the pileus as “squamuloso-diffractus” from the figure only which shows a perfectly smooth and uniform surface. One of the specimens from the top packet actually shows the surface of the pileus slightly cracked. On the other hand, Masee does seem to have been an imaginative observer, for neither the water-colour drawing nor the material give reason to describe the flesh as “fibrosa”.

From the microscopical characters it is clear that the present species is a true *Hydnum*, while the colours, the central position of the slender stipe, and the decurrent spines are certainly reminiscent of *Hydnum repandum* var. *rufescens* (Fr.) Barla. The spores of *H. elatum*, however, seem to have a somewhat smaller maximum length and breadth than those given for *H. repandum* by Bourdot & Galzin (1928: 445), Coker & Beers (1951: 16), and Donk (1933: 15). Perhaps this character should not be given too much value as the spores measured may not have been quite mature, but then the habitus of the full-grown specimens of *H. elatum* is rather unusual for variety *rufescens*. As long as the *Hydnum repandum* group even in Europe

is still far from being satisfactorily unravelled, the best course for the time seems to leave the taxonomic rank of *Hydnum elatum* unchanged.

Fragilis. — *Hydnum fragile* Petch, see under 'scaber'.

Gilvus. — *Hydnum gilvum* Berk. in Lond. J. Bot. 3: 168. 1851. — Type: "*Hydnum gilvum* Berk. / Darjeeling" (K).

The type at Kew consists of two fruit-bodies torn from their base and a fragment glued to a piece of paper. Pileus plano-convex, fibrous-strigose, shining and sticky in places, coarsely strigose-hairy toward the margin, yellow-brown with the fibres more rufous. Spines crowded, subulate, reddish brown, shining, agglutinated. Context stringy, fairly soft, yellowish, not well preserved but clearly monomitic. Generative hyphae near the margin narrow, branched, septate, without clamp-connections, very thin-walled; those farther away from the margin gradually somewhat wider and with one clamp at each septum; the widest (up to 10 μ) with two or three clamps and often an abortive side-branch at the septa, somewhat thick-walled. Interweaving and connecting hyphae present. Trama of spines monomitic. Generative hyphae much branched, septate, without clamp-connections. Hymenial elements badly agglutinated, interspersed with quantities of yellow-brown resinous matter. Gloecystidia present.

This belongs to the genus *Donkia* and *Hydnum gilvum* is a synonym of *Donkia pulcherrima* (Berk. & Curt.) Pilát. Under this name, the species would seem to be unreported from India.

Glabrescens. — *Hydnum glabrescens* Berk. & Rav. apud Berk., see under 'rawakensis'.

Gleadonii. — *Hydnum gleadonii* Masee in Bull. misc. Inf., Kew 166 "1899" [1901]. — Type: "26475 / *Hydnum Gleadoni*, Masee (sp. nov.). India, Dehra Dun, [18]98, coll. F. Gleadon, on dead wood" (K).

This is a polypore. Part of the dissepiments of the tubes are elongated into subulate laciniae which resemble the spines of a hydnoneous fungus. C. J. Humphrey made the following note on the label: "a true *Polystictus*, & must be called *P. Gleadoni*", whilst there is an additional note in Miss Wakefield's hand reading: "surely *P. funalis* or near".

In a paper on *Polystictus leoninus* Klotzsch (1950: 290), Chothia stated that "Masee's description of the fungus agrees closely with those of *P. leoninus* and *P. funalis* except in the character of spores . . ." He thought Masee's measurements of the spores were doubtful, in which case he considered *Hydnum gleadonii* (consistently spelled "*gleadowii*") to become a synonym of *Polystictus leoninus*. He concluded by saying that "Masee himself has endorsed on Kew specimens of *H. gleadowii* that the fungus is a true *Polystictus* . . ." It should be pointed out that it was Humphrey who wrote that note.

I am not in a position to offer an opinion in this matter, but can only add that I failed to find spores on the type.

Henningsii. — *Hydnum henningsii* Bres., see under 'versicolor'.

Inquinatus. — *Hydnellum inquinatum* Banker in *Mycologia* 5: 202. 1913. — Type: “*Hydnellum inquinatum* Banker / On ground under hemlocks / Indian Brook / Lake George, N.Y. / 3–8. 8. '06” (NY).

I once (Maas Geesteranus, 1957: 56) was in doubt as to whether *Hydnellum inquinatum* would be identical with *H. caeruleum*, reasoning that (i) it was hard to believe that Banker should have overlooked the bluish zones in the context of the pileus and the orange-brown colour in the stipe, and (ii) material in Herb. Donk, presented by Banker under the name of *H. inquinatum*, turned out to be a different species. This material is part of a larger collection (NY) and proves to be *Hydnellum velutinum* var. *spongiosipes*. The type, however, as well as a collection marked “Paratype” (No. 191 / Hebron, New Hampshire / *P[ercy] W[ilson]*, 14 VIII 1905; NY) are genuine *H. caeruleum*, but the three specimens of the type material are old, with the bluish zones in the context almost faded away and the originally bright orange-brown colour of the stipe dulled to a dark brown.

Kummerae. — *Hydnum kummerae* P. Henn. in *Bot. Jb.* 28: 321. 1900. — Type locality: East Africa, Usambara, Nguelo near Tanga.

The type (*Kummer* 51, July 1899) was preserved at Berlin, but lost during the last war.

Hennings himself indicated the relationship of *Hydnum kummerae* with *H. henningsii* Bres. (which in this paper is taken to be a synonym of *Gyrodontium versicolor*), but considered his species sufficiently distinct by “den fast hutförmigen, oberseits behaarten Fruchtkörper, sowie durch die cylindrischen stumpfen Stacheln . . .” The alleged differences may be immaterial, and even the different sizes of the basidia and spores as given by Bresadola and Hennings might be regarded as an expression of the variability of one and the same species.

Going by the description, *Hydnum kummerae* seems remarkably similar to another species, viz. *Gyrodontium boveanum*. For the time being the latter and *G. versicolor* are treated as two separate species, mainly because *G. boveanum* is incompletely known. It seems improbable that *Hydnum kummerae* should represent a third species; it is more likely that it is identical with either of the two species of *Gyrodontium* mentioned, but probably neither case can ever be proved.

Martioflavus. — *Hydnum martioflavum* Snell & al. *apud* Snell & Dick in *Lloydia* 25: 161. “1962” [11 Febr. 1963]. — Type: “*Hydnum martioflavum* Snell, Harrison & Jackson, Ste. Anne de la Pocatière, Quebec, 13 Sept. 1954, *H. A. C. Jackson & W. H. Snell*” (Herb. W. H. Snell 3011).

Sarcodon armeniacus Maas G. in *Nytt Mag. Bot.* 10: 169, figs. 1–4. 1 March 1963.

Barring such minor discrepancies as can be found in the texture of the surface of the pileus and the decurrence of the spines, the type and an additional collection of *Hydnum martioflavum* (Herb. W. H. Snell 3010) are identical with the type of *Sarcodon armeniacus*. Needless to say that *H. martioflavum* lacks clamp-connections, a character not mentioned by its authors.

Snell & al. indicated the size of the spores as $4-5.5 \times 4-5 \mu$, but I found the length to be somewhat greater, $5.4-6.3 \times 3.6-4.9 \mu$.

Following a different school of thought from that of Snell, *Sarcodon* is maintained as the correct name of the genus to which the present species belongs. Consequently, the species is hereby transferred to that genus as ***Sarcodon martioflavus*** (Snell & al. apud Snell & Dick) Maas G., *comb. nov.* (basionym, *H. martioflavum* Snell & al. apud Snell & Dick, l.c.).

Merulioides. — *Hydnum merulioides* Berk. & Br., see under 'versicolor'.

Modestus. — *Hydnum modestum* Snell & Dick in *Lloydia* 25: 162. "1962" [1963]. — Type: "Peterson's Forest, Pleasant Creek, Sanpete Co., Utah, 30 July 1954, K. H. McKnight" (Herb. W. H. Snell 3192).

The pale dingy ochraceous colour of the spines prove that the specimens of the holotype are very young, but the spores are sufficiently developed to show a yellowish colour and an irregular outline. These characters, coupled with thin-walled, inflating hyphae of the context, determine the specimens as a species of the genus *Sarcodon*. The lack of clamp-connections, the colour of the context (which the authors described as "pallide olivaceo-cineracea"), and the lack of greenish or bluish colours in the base of the stipe, lead to Group 2 of that genus. This group contains the following species: *Hydnum badium* Pers. sensu Lundell, *Sarcodon bubalinus* (Pers.) Maas G., *S. martioflavus* (Snell & al. apud Snell & Dick) Maas G., *S. stereosarcinon* Wehm., and *Hydnum subfelleum* K. Harrison.

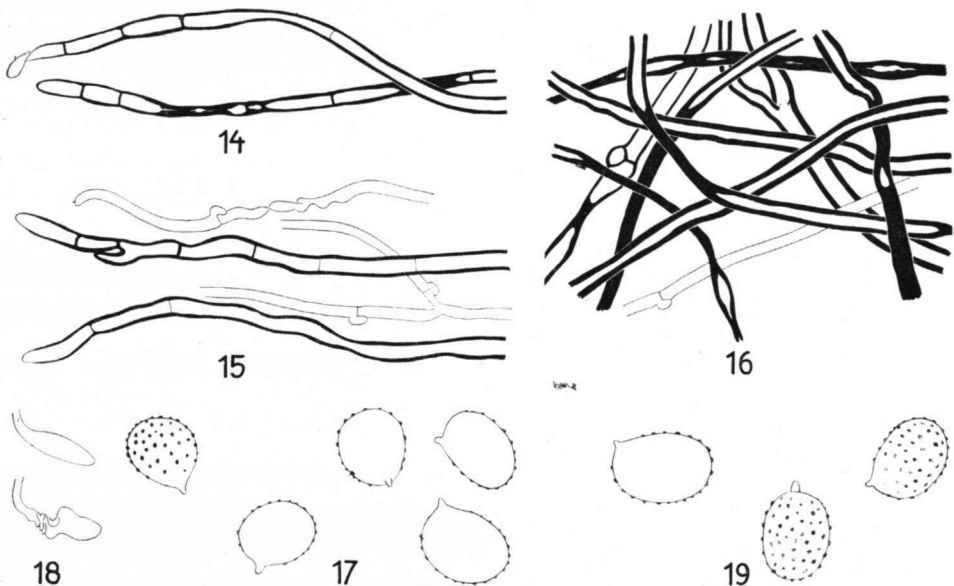
Hydnum badium differs from *H. modestum* in the yellow-brown pileus and the free scales. Both *Sarcodon martioflavus* (which see for particulars) and *S. stereosarcinon* are different from *H. modestum* in that the surface of the pileus is velutinous to granular or somewhat scurfy at first. *Sarcodon bubalinus* and *Hydnum subfelleum* are best discussed in the same breath. There is no doubt that both are very close, but I still hesitate to accept them as identical. Dismissing *Sarcodon bubalinus* for the time being leaves *Hydnum subfelleum* as the only species to be compared with *H. modestum*. However, comparison of the type specimens of *H. modestum* with the notes and water-colour drawings I once made of the type of *H. subfelleum*, fails to give a decisive solution. The pileus in both species is decidedly purplish and the surface (although Snell & Dick described it as "even, glabrous" in their species which, it should be remembered, was based on young fruit-bodies) is partly smooth and continuous, partly cracked into areoles and adnate membranous scales. The stipe is more yellowish in *H. modestum* than in *H. subfelleum*, and so is the context in the dried material. Odour and taste seem to differ in both species, but I fail to find more significant differences. I would not be surprised, therefore, if further collections should prove both species to be identical.

Morgani. — *Steccherinum morgani* Banker, see under 'rawakensis'.

Mülleri. — *Hydnum mülleri* Berk., see under 'rawakensis'.

Nigrescens. — *Hydnum nigrescens* Petch in Ann. R. bot. Gdns Peradeniya 7: 288. 1922. — Type: "*Hydnum nigrescens* Petch / 5110 / [Ceylon] Hakgala, April 1917" (K).

Fruit-bodies resupinate or partly reflexed, more or less orbicular, about 2 cm across, becoming laterally confluent and forming larger patches. Subiculum plushy, becoming matted and shining, light brown. Upper side of reflexed parts rough, pitted, in places with fasciculate 'hairs', the surface matted and fairly soft, brown. Spines, arising from the subiculum and the underside of the reflexed parts, crowded, subulate, up to 6 mm long, dark brown or with bluish bloom. Context not fleshy, but consisting of a homogeneous brown tomentum traversed by occasional black veins. Tomentum up to 3 mm thick, for the greater part made up of brown skeletal-like hyphae running in various directions and interspersed with few colourless generative hyphae which are often collapsed and hard to find. The skeletal-like hyphae, best studied in the plushy subiculum (Fig. 14) and in the 'hairs' on the surface of the reflexed portions (Fig. 15), where they form firmly cohering bundles, are 2.7–3.6 μ wide and thin-walled at their tip. They retain much the same width over a considerable distance when traced rearward, but their walls thicken rapidly to about 0.9 μ or even obliterate the lumen. In their radial arrangement (at least where they approach the surface of the fruit-body), the thick walls, the 'cloisons de retrait', and the lack of clamp-connections, these hyphae resemble true skeletals, but they differ from the latter in their occasional branching and the lack of a predominantly



Figs. 14–18. *Hydnum nigrescens* Petch (type). — 14. Skeletal-like hyphae from plushy subiculum. — 15. Generative and skeletal-like hyphae from a 'hair' of upper surface of fruit-body. — 16. Elements from tomentum of which fruit-body is made up. — 17. Spores, seen in Melzer's reagent. — 18. Tips of two gloecystidia. (Figs. 14–16, 18, $\times 700$; Fig. 17, $\times 2100$.)

Fig. 19. *Gloiodon strigosus* (Sw. ex Fr.) P. Karst. — Spores, seen in Melzer's reagent, 5.2–5.8 \times 4.2–4.5 μ ($\times 2100$).

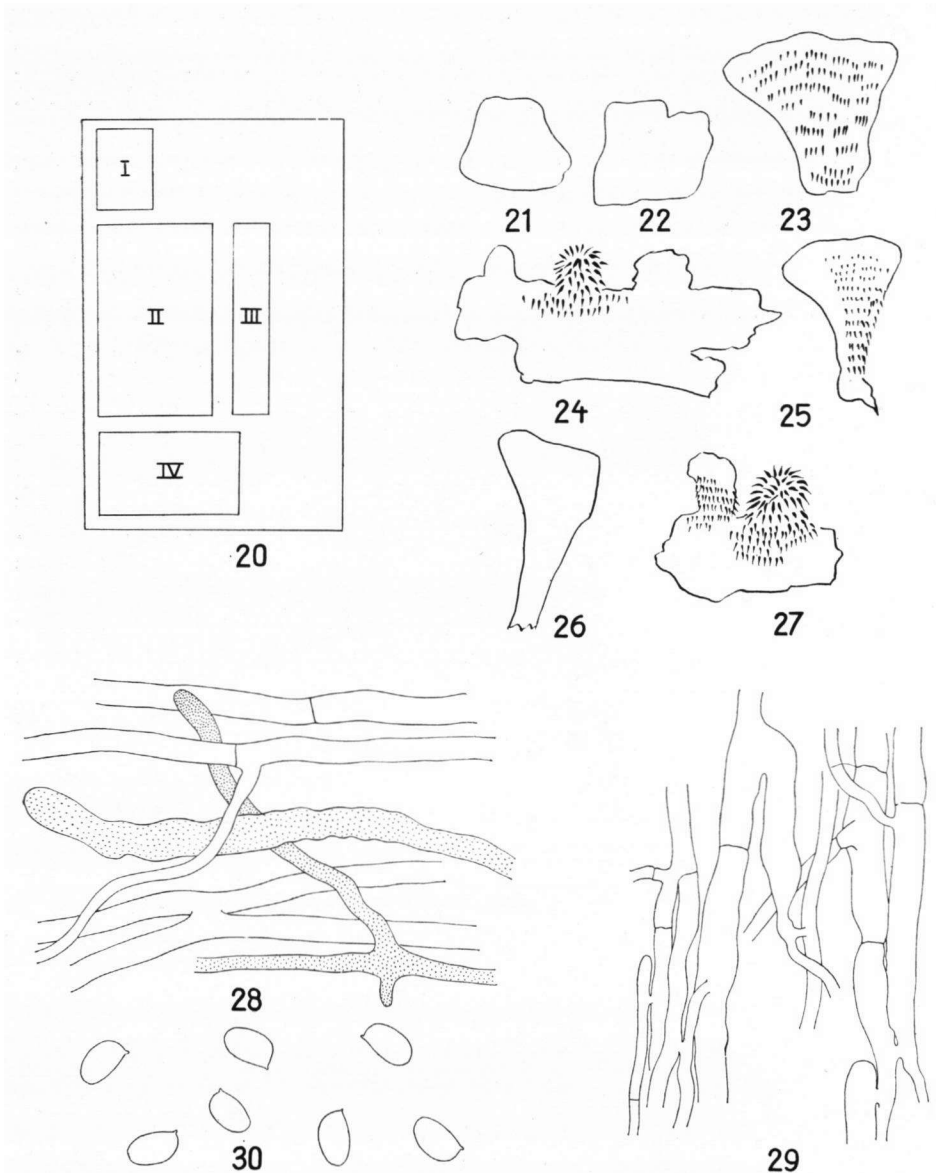
radial alignment deeper inside the tomentum (Fig. 16). Generative hyphae, at least the younger branches, 2.2–2.7 μ wide, very thin-walled (the cell-wall less than 0.5 μ thick), septate, with clamp-connections at every septum (Fig. 15), becoming wider and thicker-walled with age (Fig. 16). The construction of the spines is similar to that of the 'hairs' of the upper surface of the reflexed portions, only the generative hyphae are even more difficult to find. The hymenial elements are badly preserved. Basidia probably 4-spored. Spores subspherical to broadly ellipsoid, minutely rough to asperulate (ornamentation most clearly visible in the younger spores), with small oblique apiculus and central oil drop, colourless to pale brownish, strongly amyloid, 4.5–5.4 \times 3.6–4.5 μ (Fig. 17). Gloeocystidia very hard to trace, the deflected portion projecting well beyond the collapsed hymenium, cylindrical to fusiform, very thin-walled, colourless, 15–18 \times 4–6.5 μ (Fig. 18).

In addition to the type, two more packets (Nos. 5582 and 3961) are glued to the same sheet. No. 3961 ("Hakgala, April 1914") is of particular interest as it contains a specimen with a well developed dimidiate pileus and with the 'context' up to 4 mm thick. This demonstrates that the growth form of the fungus is a variable character and in this connection a fourth collection has to be mentioned as it shows yet another aspect of the pileus. This collection is of additional interest in that it comes from far outside the type locality: Island of Enggano (west of South Sumatra), Buah-buah, 3 June 1936, *W. J. Lütjeharms 4136*, on decayed wood, c. 100 m alt. (L). The pileus in one of the specimens is nearly spatulate, 3 cm long and wide, and its surface is radiately wrinkled with broad and low ridges. Farther outward these ridges pass into coarse veins which toward the margin become reticulately connected. Some of the veins are raised above the surface and bear a terminal black spine, while in one part of the pileus the veins form separate tiers of small pileoli, each with their own system of spines hanging down from the underside.

The three collections from Ceylon and the one from Enggano all belong to the same species which, as it has all the characters of *Gloiodon*, is hereby transferred to that genus as ***Gloiodon nigrescens*** (Petch) Maas G., *comb. nov.* (basionym, *Hydnum nigrescens* Petch, l.c.).

The differences between *Gloiodon nigrescens* and *G. strigosus* are shown below:—

<i>G. nigrescens</i>	<i>G. strigosus</i>
<p>Spines springing directly from the subiculum.</p> <p>Reflexed portions showing a matted surface with few stiff hairs or no hairs at all.</p>	<p>Spines arising from ramifying processes which remain clearly visible as they are raised above the surface of the subiculum.</p> <p>Reflexed portions strongly strigose.</p>



Figs. 20-30. *Hydnum polymorphum* Berk. & Br. (sensu lato). — 20. Type sheet with four packets. — 21-27. Contents of II. — 21, 22. Not closely examined. — 24-27. Species A. — 23, 28-30. Lectotype of *H. polymorphum*. — 28. Hyphae of context from near margin. — 29. Hyphae from spine. — 30. Spores. (Figs. 28 and 29, $\times 700$; Fig. 30, $\times 1400$.)

Pini. — *Boninohydnum pini* S. Ito & S. Imai, see under '*versicolor*'.

Polymorphus. — *Hydnum polymorphum* Berk. & Br. in J. Linn. Soc. (Bot.) 14: 59. 1873. — Type: "178. *Hydnum polymorphum* B. & C. / Ceylon (Peradenia) G. H. K. T[*hwaites*] Nov. 1867" (K).

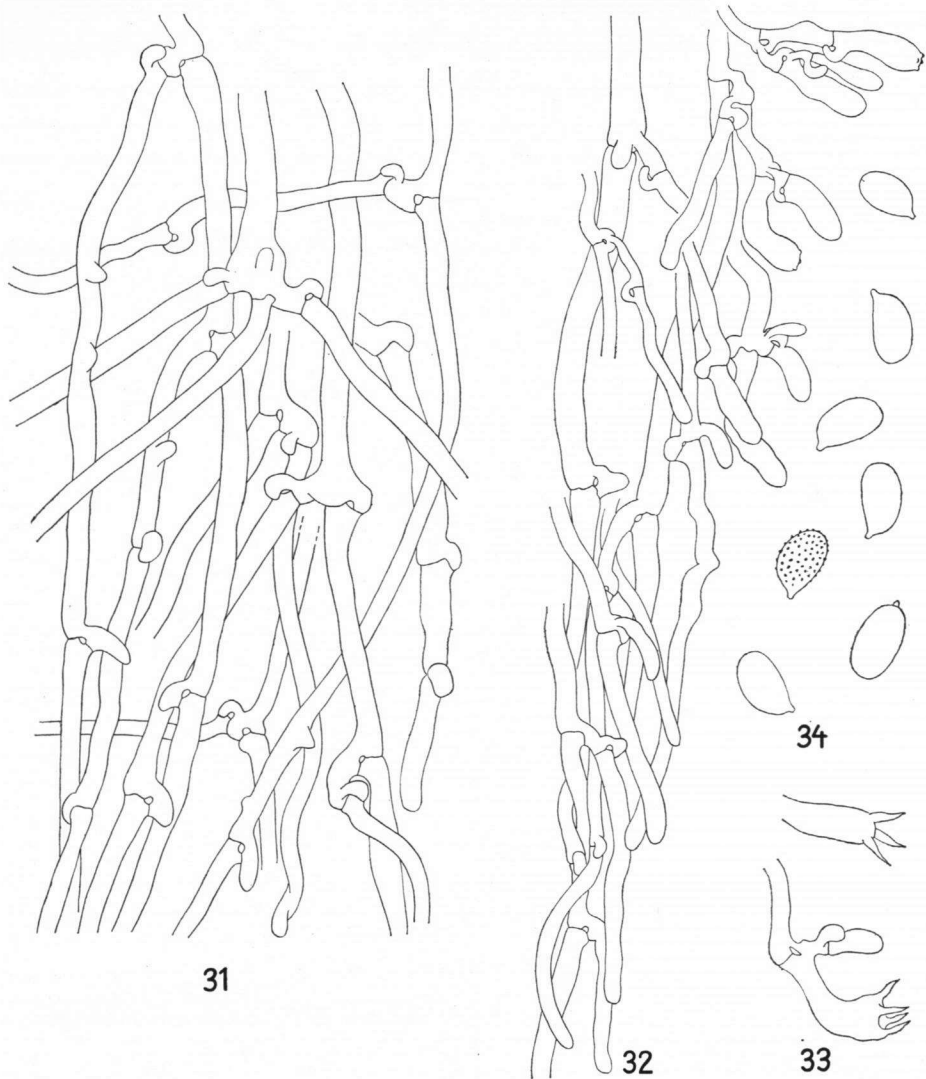
This is a somewhat complicated case and one of the difficulties, a minor one, was caused by Berkeley himself who erroneously labelled the material "*Hydnum polymorphum* B. & C". A graver error is that Berkeley thought the material consisted of a single species, whereas in fact it contains two.

On the sheet are glued four packets of variable size here numbered I, II, III, and IV (Fig. 20). No. I has nothing to do with the present species, being some Polypore from the Neilgherries. No. II contains several fragments (Figs. 21–27). Figure 23 is marked with a pencil line which outside the packet points to the words "Cf. *H. meruloides*" written in a hand unknown to me. Packets III and IV are both labelled "*Hydnum polymorphum*" (heavily pencilled) and "178. Dup." (in a thin handwriting), and they contain several slices of what apparently was a single pileus. In the upper right hand corner of packet IV Banker wrote in pencil: "These specc are identical with *Hydn. versicolor* B. & Br. and bear the same number. H. J. Banker". On account of the identical hyphal structure, I have no doubt that the contents of III and IV and the material represented by Figure 23 are conspecific (Species B), while Figs. 24–27 represent another species (A). Figs. 21 and 22 may also belong to Species A, but of that I am not certain. According to Article 9 of the Code, in case of the type sheet containing "parts belonging to more than one taxon, the name must remain attached to that part (*lectotype*) which corresponds most nearly with the original description". Unfortunately, it is not possible to decide which species (A or B) fits the original diagnosis best, as is shown by the following annotations:—

Cuneiforme [A, B], e mycelio communi effuso oriundum [A, in part only], postice radiato-rugosum [A, B] umbrinum [B], antice farinaceum luteum marginatum [A, B]; aculeis acutis [A, B] quandoque furcatis [A] farinosis [A] vel subgelatinosis [B] (no. 178).

Under these circumstances the material depicted in Fig. 23 is here chosen as the lectotype of *Hydnum polymorphum*. The specimen represents a species which, as will be shown presently, is identical with *Gyrodontium versicolor*. This makes *Hydnum polymorphum* a synonym of that species and leaves us with Species A which seems undescribed.

The type of *Hydnum polymorphum* is a single segment glued with its back to a piece of paper. Hymenial surface badly soiled. Spines crowded. Context yellowish, monomitic. Generative hyphae (Fig. 28) 3.1–6.3 μ wide (up to 7.2 μ wide when filled with oily matter), colourless, thin-walled (cells-walls less than 0.5 μ thick), branched, anastomosing, septate, without clamp-connections. Hyphae in trama of spines similar, without clamps (Fig. 29). Basidia collapsed, gelatinized. Spores (Fig. 30) ellipsoid, adaxially flattened, smooth, yellow-brown under the microscope, fairly thick-walled, (4.3–)4.5–5.4(–5.6) \times 2.9–3.4 μ , with small oblique apiculus. Cystidia lacking.



Figs. 31-34. *'Hydnum'* species A. — 31. Hyphae from near margin of subiculum. — 32. Detail near tip of spine. — 33. Mature basidia. — 34. Spores. (Figs. 31-33, $\times 700$; Fig. 34, $\times 1400$.)

The description of Species A is as follows: —

There are two pairs of fragments (Figs. 24 and 27, and Figs. 25 and 26). In the former pair pieces of leaf-litter appear covered with patches of a yellow-brown subiculum from which arise blunt protuberances, up to 1 cm tall and wide, and shaggy from crowded spines of the same colour. The latter pair consists of two yellow-brown wedge-like segments, of which the one in Fig. 25 shows the hymenial surface covered with spines. The segments are 4–4.5 cm long and up to 2 cm broad. In spore characters and also anatomically the two pairs are identical, but it is not now apparent what the natural position of the specimens in Figures 25 and 26 was, or how they developed from stages as pictured in Figures 24 and 27. The subiculum and context, which are spongy when soaked, are monomitic (Fig. 31). Hyphae from near the margin of the subiculum 2.7–6.3 μ wide, thin-walled (cell-walls less than 0.5 μ thick), with clamp-connections at all septa, frequently branching from a clamp. Hyphae from the trama of the spines similar, 2.7–4.5 μ wide (Fig. 32). Basidia (Figs. 32, 33) 27–30 \times 6–8 μ , with four sterigmata 6.3–6.7 μ long, and with basal clamp-connection. Spores (Fig. 34) ellipsoid, minutely prickly-verrucose, colourless with yellowish oily contents, non-amyloid, 5.4–7.5 \times 3.4–3.8 μ .

From the anatomical description and figures the species should be easily recognizable when found again. It seems undescribed and there is no genus to accommodate it. However, for a new genus to be described, the material should not only be in perfect condition but also consist of a number of complete fruit-bodies, of which the position of the various parts need not be guessed.

Pumilus. — *Hydnum imbricatum* f. *pumilum* Roum. in Rev. mycol. 12: 119. 1890. — Type locality: France, Central Pyrenees, Sode.

This is a nomen nudum, no description being supplied.

Pygmaeus. — *Hydnum pygmaeum* Yasuda in Bot. Mag., Tokyo 35: (220). 1921. — *Sarcodon pygmaeus* (Yas.) S. Ito, Mycol. Fl. Japan 2 (4): 184. 1955. — Type locality: Japan, Kyushu.

Yasuda's description runs as follows (translated): —

Fruit-body rather small, stalk central, rather soft, 15–22 mm high. Pileus thin, funnel-shaped, diam. 5–12 mm, height 5–13 mm, thickness 0.5–1.2 mm; outer surface rather dark brown, with soft dense hairs, without concentric rings. Context rather thin, wood-coloured. Stalk rather slender and long, surface smooth, dark brown to black, 7–14 mm long, 0.5–1.5 mm thick. Inner surface [of pileus, apparently] with soft dense spines, very light brown, 0.4–1.0 mm long. Spores globose, uncoloured, with spines, 4 μ .

Another description, mentioning the greyish purple colour of the pileus when fresh, was published by Lloyd (1922: 1107) who also furnished a photograph (pl. 189 fig. 2038).

The type of the present species may still be in existence, but thus far I have received no information on its whereabouts. Yasuda's description, however, leaves no doubt as to the identity of the species. The characters of the spores are those of a *Phellodon*. Of the European and North American species (as far as I know the latter), *Phellodon alboniger*, *P. cokeri*, *P. confluens*, *P. niger*, and *P. putidus* may be ruled out on account of the smooth surface of the stipe. *Phellodon tomentosus* differs from the

present species by the lighter colours and concentric rings of its pileus. *Phellodon delicatus*, which has about the same size as *Hydnum pygmaeum*, is different on account of the colours of the pileus which Coker & Beers described as “whitish drab or darker brownish drab”, while the pileus, moreover, is not funnel-shaped. *Phellodon ellisianus* requires no further discussion, as Harrison (1961: 20, 21) recognized it as a synonym of *P. melaleucus*. This leaves only the latter species to be considered, and from the original description it is sufficiently clear that *Hydnum pygmeum* is just another synonym of *Phellodon melaleucus*.

Rawakensis. — *Hydnum rawakense* Pers. *apud* Gaud. in Freyc., Bot. Voy. Monde 175. 1827. — *Mycoleptodon rawakensis* (Pers. *apud* Gaud.) Pat., Essai taxon. Hym. 117. 1900. — *Steccherinum rawakense* (Pers. *apud* Gaud.) Banker in Mycologia 4: 312. 1912. — Type: “*Hydnum rawakense* / Ded. Gaudichaud” (L 910.262–648; part in PC).

Hymenium reniforme Berk. & Curt. in J. Linn. Soc. (Bot.) 10: 325. 1868. — *Mycoleptodon reniformis* (Berk. & Curt.) Pat., Essai taxon. Hym. 117. 1900. — *Steccherinum reniforme* (Berk. & Curt.) Banker in Mem. Torrey bot. Cl. 12: 127. 1906. — Type: “301 / *Hydnum reniforme* B. & C. / Cuba / Wright (Curtis)” (K).

Hydnum mülleri Berk. in J. Linn. Soc. (Bot.) 13: 167. 1872. — Type: “*Hydnum mülleri* B. / [Australia] Tweed [River], Guilfoyle” (K).

Hydnum glabrescens Berk. & Rav. *apud* Berk. in Grevillea 1: 97. Jan. 1873; *apud* Berk. & Br. in J. Linn. Soc. (Bot.) 14: 59. Apr. 1873. — Type: “1634 / *Hydnum glabrescens* B. & R. / Sept. in putrid logs of *Carya* (all I have to spare) [North America] S[outh] C[arolina]. *H. W. R[avenel]*” (K).

Hydnum basi-asperatum P. Henn. in Hedwigia 36: 199. 1897. — Lectotype: “743 / *Hydnum basi asperatum* P. Henn. / [Brazil] Pr. St. Catharina / Auf Baumstamm am Bugarbach / Blumenau / April / [18]88” (Herb. Ule, HBG). — Isotype: “*Hydnum basiasperatum* P. Henn. n. sp. / *H. rawacensi* aff. / *E. Ule* 743” (Herb. Schroeter, BRSL).

The type of *Hydnum rawakense* consists of a sector of a pileus and, confluent with its base, a fragment of another pileus, both glued to a sheet of paper with their spines downward. Pileus laterally sessile, semicircular, flat except for a few low and broad concentric corrugations, the margin somewhat involute; surface smooth, glabrous except for traces of a tomentum at the base and along the margin, fulvous at the base, more yellow-brown farther outward, with darker concentric zones and minute spots (where the tomentum has collapsed and turned into innate squamules); remnants of the tomentum yellow-brown. Spines crowded, subulate, up to 1.5 mm long, corneous, brown. Context thin, tough, fibrous, without apparent zones, yellow-brown, dimitic, made up of generative hyphae (with clamp-connections at the septa) and skeletal.

As the hymenium in the type is almost completely destroyed, the description of this part has been made after material from New-Zealand (Auckland: Piha, Waitakere Ranges, Sept. 1949, *J. M. Dingley*; Herb. P.D.D., New Zealand, No. 17724).

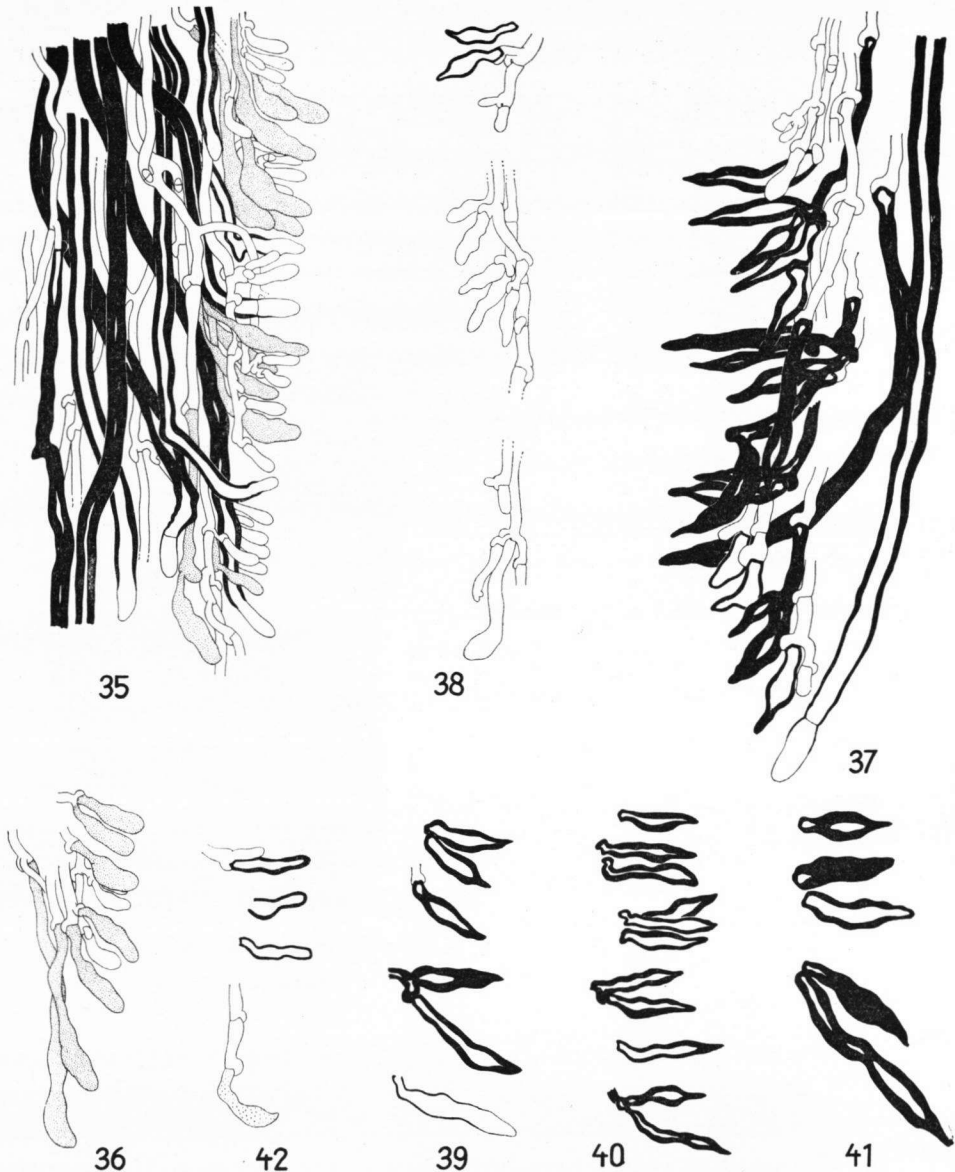
Trama of the spines dimitic. Generative hyphae and basidia with clamp-connections. The tips of the skeletal farthest from the axis of the spine bent outward, forming tramal cystidia which terminate in the hymenial layer or project beyond it; these cystidia usually more or less covered at the apex with crystalline matter dissolving in KOH solution (Fig. 35, illustrating the situation at about 650 μ back from the tip of the spine, shows the cystidia after removal of the crystals). The generative hyphae of the hymenium and/or the subhymenium (the exact position being hard to make out in squashed mounts) produce a second type of cystidia (dotted in Figs. 35–36) which are clavate or fusiformly swollen (up to 6 μ), thin-walled, and filled with oily matter. The cystidia originating as side-branches are short-stalked, those produced at the end of a generative hypha having a stalk of variable length (up to 60 μ).

Examination of several spines of the type eventually resulted in the find of a few thin-walled cystidia, in addition to a great number of tramal cystidia, which proved the material from New Zealand and the specimen in Persoon's Herbarium to be identical.

As may be gathered from Banker (1912: 312) and Cunningham (1958: 597), *Steccherinum rawakense*, although not reported from Africa,² has a very wide distribution in the tropics, while it is recorded by Cunningham as far south of the equator as Auckland, New Zealand, and by Miller (1935: 363) and Miller & Boyle (1943: 52) as far north as Iowa, United States. The descriptions given by Cunningham and by Miller and Miller & Boyle present an interesting difference in that Cunningham mentioned only the occurrence of "rudimentary cystidia" (i.e. the "terminal ends of skeletal hyphae"), while Miller & Boyle described thick-walled, fusiform, pointed hymenial cystidia. As the descriptions of these authors agree in other respects it seemed indicated to investigate further into this matter. For this purpose material of the first Regnell expedition (Brazil, Matto Grosso, Sante Anna da Chapada, 20 II 1894, *G. A:n Malme*, No. 535; UPS) was used. A detail of a spine (about half-way between its base and tip), with the exclusion of most of the basidia, is reproduced in Figure 37. Figures 35 and 37 are in such a marked contrast that they may easily be taken to represent two different species, but the following discussion purports to show that actually the same species is involved.

Two details in Figure 37 call for special attention. First, the gradual transition from true skeletal to hymenial cystidia indicates that the latter are nothing but shortened skeletal. This implies that the hymenial cystidia do not differ essentially from the tramal cystidia (the terminal ends of skeletal hyphae), being a modification owing to their position in the spine. A similar transition from cystidia to skeletal hyphae was described by Boidin & Ahmad (1963: 35, fig. A) in *Duportella tristicula* Pat. Secondly, it is noteworthy that not all of the hymenial cystidia are equally thick-walled, the younger ones farther down the spine tending to have thinner walls. An illuminating case is exemplified by Figure 38 (drawn from the same specimen) which, with the exclusion of all other elements, shows a number of thin-walled

² However, Lloyd (1913, Lett. 48: 9) published a note from which may be derived that he had seen specimens from Madagascar.



Figs. 35-38. *Steccherinum rawakense* (Pers. apud Gaud.) Banker. — 35, 36. (Herb. P.D.D., New Zealand, No. 17724). Detail of spine, showing generative and skeletal hyphae, basidia, tramal cystidia, and (dotted for greater clarity) thin-walled hymenial cystidia. — 37, 38 (1st Regnell Exp. No. 535). Detail of spine, showing thick-walled hymenial cystidia which farther down the spine pass into thin-walled cystidia. (All figures $\times 700$.)

Fig. 39. *Hydnum reniforme* Berk. & Curt. (type). — Hymenial cystidia ($\times 700$).

Fig. 40. *Hydnum basi-asperatum* P. Henn. (lectotype). — Hymenial cystidia ($\times 700$).

Figs. 41, 42. *Hydnum glabrescens* Berk. & Rav. — 41 (Ravenel No. 1634, type). Hymenial cystidia. — 42 (Thwaites No. 385). Hymenial cystidia. (Both figures $\times 700$.)

cystidia toward the tip of a spine and two moderately thick-walled ones farther back from the tip. The thin-walled cystidia are not filled with oily matter, but otherwise resemble those of Figure 35 in shape.

The thickening of the cell-walls of the hymenial cystidia as these grow older is probably nothing out of the ordinary. It also occurs in other groups of fungi, and in this connection a comparison is recommended with Corner's illustrations of the hymenial area in *Polystictus microcycclus* (Lév.) Cooke in which the thickening of the cell-walls of similar elements is shown (Corner, 1935: figs. 12, 13).

The cystidia in the type specimens of *Hydnum reniforme* (from Cuba; Fig. 39), *H. basi-asperatum* (from Brazil; Fig. 40), and *H. glabrescens* (from South Carolina, U.S.A.; Fig. 41) all resemble those of Figure 37 in being more or less fusiform, thick-walled, and pointed. However, one of the cystidia, the youngest, in *Hydnum reniforme* is still thin-walled.

A collection from Ceylon, which Berkeley identified with his *Hydnum glabrescens*, possesses apart from a few thin-walled cystidia (only one shown in Figure 42) mainly moderately thick-walled cystidia which are not pronouncedly fusiform and have blunt tips.

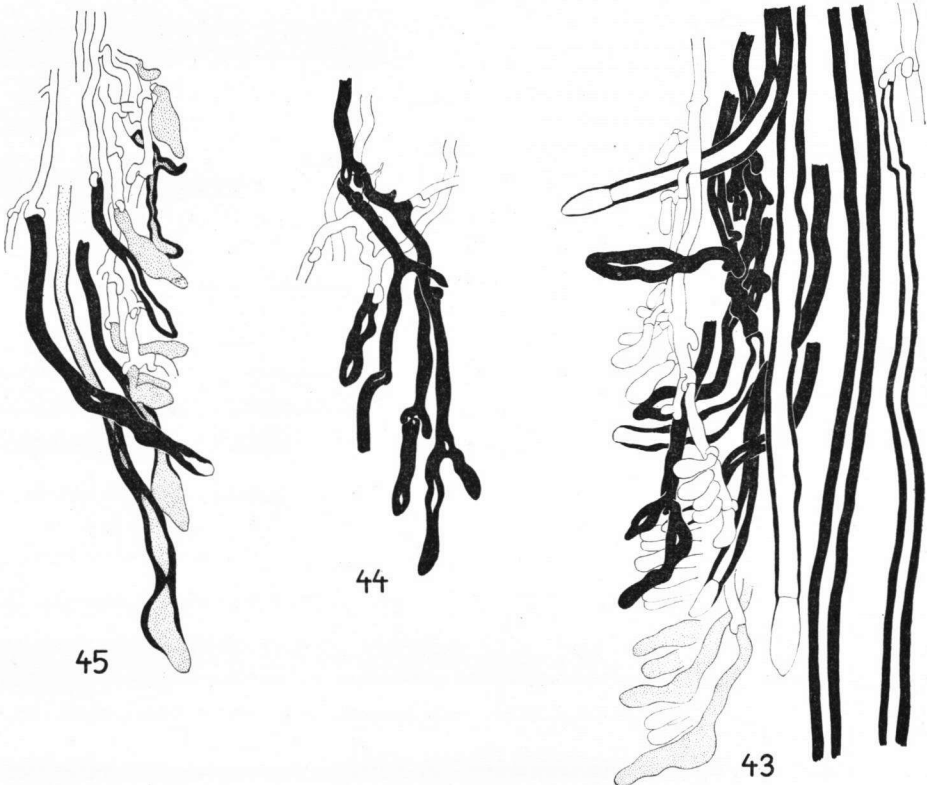
Hydnum mülleri (from Tweed River, New South Wales, Australia; Fig. 43) also possesses thick-walled and, farther down the spines, thin-walled cystidia (the latter should have been drawn farther separated from the former, according to their actual position on the spine). The thick-walled hymenial cystidia differ from those of Figure 37 in having rather more rounded tips, but otherwise they are similar and likewise pass gradually into the tramal cystidia. Another detail of importance is that not only the terminal ends of the hyphae (generative or skeletal) undergo a change in the hymenial region, but also large portions of the generative hyphal system farther back in the subhymenium. Figure 43 and 44 clearly show the hyphae to be partially very thick-walled or even solid.

Finally, a collection identified by Cunningham as *Steccherinum rawakense* (Auckland: Waipoua, Dec. 1951, *M. E. Lancaster*; Herb. P.D.D., New Zealand, No. 10984) is taken as an example to demonstrate the modification of the cystidia in the hymenial region. Figure 45 shows in the same spine the gradual change from a skeletal hypha to a thick-walled hymenial cystidium on the one hand, and intermediate forms between skeletal and thin-walled hymenial cystidia on the other.

From the examples discussed above it is, in my eyes, apparent that from a region possibly centred between New Guinea (approximately the type locality of *Hydnum rawakense*) and New Zealand (where *Steccherinum rawakense*, P.D.D. 17724 comes from), in various directions and in gradual steps, the hymenial cystidia of *Steccherinum rawakense* alter in outward appearance to culminate in entirely different-looking structures in South America and adjacent parts of North America. The potentiality of the hymenial cystidia to become thick-walled with age, remaining latent in one region, becomes manifest in varying degrees in others, while in another again the early thin-walled stage is largely suppressed. For the gradual change of a certain character in a species, J. Huxley (1938: 219) introduced the term cline. This par-

particular kind, denoting the gradient from one end of the distributional area of the species to the other, has been called geocline.

The presence of true hymenial cystidia was not mentioned in the anatomical description of *Steccherinum* (Maas Geesteranus, 1962: 403), and might, therefore, lead to questioning the correctness of the inclusion of *Hydnum rawakense* in that genus. However, renewed examination of the spines in a number of European collections of *Steccherinum ochraceum*, including collection L958.319-049, brought to light that thin-walled hymenial cystidia of the type as shown in Figure 36 (but without oily contents, which may be of minor importance) do occur. It is now hard to explain how these structures could have passed unnoticed. In view of the incompleteness of the previous anatomical characterisation of *Steccherinum* and the variable aspect of the hymenial cystidia, it is necessary to give an emended description:—



Figs. 43, 44 *Hydnum mülleri* Berk. (type). — 43. Detail of spine, showing among others thick-walled and thin-walled hymenial cystidia. — 44. Generative hyphae which are partially solid. (Both figures $\times 700$.)

Fig. 45. *Steccherinum rawakense* (Pers. apud Gaud.) Banker (Herb. P.D.D., New Zealand, No. 10984). — Detail of spine showing tramal cystidia, thin-walled hymenial cystidia, and intermediate structures ($\times 700$).

STECCHERINUM S. F. Gray (emend. descr.). — Context pliable to rigid, tough, not (visibly) zoned, pallid to white, dimitic, consisting of generative and skeletal hyphae. Generative hyphae branched, septate, with clamp-connections, thin-walled. Skeletals arising from the generative hyphae, either as a terminal continuation or as a side-branch, thick-walled, not septate. Trama of the spines also dimitic. Basidia with clamp-connections. Cystidia of tramal and hymenial origin, either clearly separated or showing various transitions; those of tramal origin being the terminal ends of skeletal hyphae curved outward and mostly thick-walled except at the tip which may be encrusted with crystalline matter; the cystidia of hymenial origin originating from generative hyphae in the (sub)hymenial region and either thin-walled or very thick-walled or again thin-walled when young, becoming thick-walled with age.

Hymenial cystidia are certain to be found in *Irpex* also. Some of the cystidia in Figure 13 (Maas Geesteranus, 1963: 454) are clearly intermediate between tramal and hymenial cystidia.

Banker (1912: 312) considered the specimen of *Hydnum rawakense* (collected by Gaudichaud, not C. Sandrenaud) he had found at Paris "to be in all probability the type of the species". I presume this is actually a portion of the specimen at Leiden.

Cunningham (1958: 597) gave the type locality of *Hydnum rawakense* as Sarawak, Borneo, but that is an error. Gaudichaud collected the type on the Island of Rawak (also spelled Lawak) which is a mere speck just off the north coast of the Island of Waigeo, north-west of Vogelkop Peninsula, New Guinea.

The type of *Hydnum reniforme* consists of two specimens and a fragment, still exhibiting the dense, partially collapsed surface tomentum.

Of *Hydnum mülleri* there are two packets, of which I prefer to indicate the one bearing the annotation "Tweed. *Guilfoyle*" as containing the type. This type consists of at least two confluent pilei with the upper surface glued to a piece of paper and badly destroyed by insects along the margin, but with a profusion of well-preserved spines.

The type folder of *Hydnum glabrescens* contains two different collections, one annotated "No. 385" and marked "Typus" in a different hand, the other bearing the number 1634 on a label which is obviously Ravenel's. As already explained by Banker (1912: 316) it is the latter packet which contains the type of *Hydnum glabrescens*. No. 385, as may be gathered from Berkeley's account in Grevillea, must have been collected by G. H. K. Thwaites in Ceylon. When he was at Kew, Banker found some more collections from Ceylon, all of which he did not hesitate to identify with *Steccherinum morgani* Banker, maintaining that this latter species was different from the "South Carolina plant of Ravenel, No. 1634", which he identified with *S. rawakense*. It has been reduced to the synonymy of that species by Miller (1935: 363) and Miller & Boyle (1943: 52).

I have no opinion as yet on *Hydnum guaraniticum* Speg., of which I did not see the type.

It was Banker again who (1912: 313) showed the truth about the "curious mare's-

nest" *Hydnum basi-asperatum*.⁸ However, he was not correct in thinking that the material of this species at Berlin represented *the* type. Hennings (l.c., p. 190) stated that he gave an enumeration of Basidiomycetes "welche, zum grossen Theil vom E. Ule gesammelt, sich im Herbar des verstorbenen Professors Dr. Schröter in Breslau vorgefunden haben". From this it may be surmised that Ule's collection was distributed after it had been named, one of the isotypes being sent to Berlin. The latter material was destroyed during the last war, which leaves, as far as I know, the isotypes at Hamburg and Wroclaw (Breslau). Of these I prefer to indicate the collection at Hamburg as lectotype, owing to its more complete annotations, but otherwise the material in Schroeter's herbarium at Wroclaw is in no way inferior.

Reniformis. — *Hydnum reniforme* Berk. & Curt., see under '*rawakensis*'.

Ridleyi. — *Calodon ridleyi* Masee in Bull. misc. Inf., Kew 5. 1908. — *Hydnum ridleyi* (Masee) Trott. *apud* Sacc., Syll. Fung. 23: 472. 1925 ("*Rydleyi*"). — Type locality: Singapore.

Masee's diagnosis ("Pileus suberosus . . . Sporae subglobosae, verrucosae, brunneae . . .") suggests that the species is a *Hydnellum*, but to judge from a copy of the original drawing, it might just as well be a species of *Sarcodon*. The species may even be brought in relation with *Sarcodon thwaitesii*, but there can be had no certainty until the type is discovered. Up till now this has not been located in the herbaria of both Kew and Singapore.

Scaber. — *Hydnum fragile* Petch in Ann. R. bot. Gdns Peradeniya 7: 287. 1922; not *Hydnum fragile* Pers. *ex* Fr., Syst. mycol. 1: 417. 1821; not *Hydnum fragile* Fr. in Öfvers. svensk VetAkad. Förh. 8: 53. 1851. — *Hydnum scabrum* Petch in Ann. R. bot. Gdns Peradeniya 10: 134. 1926 (name change). — Type: "*Hydnum fragile* Petch [*fragile* crossed out and rewritten *scabrum*] / [Ceylon] Peradeniya, Dec. 1913, No. 3994" (K).

The type at Kew consists of two portions of a pileus roughly 6 cm long and wide. Near the basal part they are covered with spines which toward the margin are more and more conspicuously arranged in radial rows. Besides, the spines are more flattened and several spines in the same row are connected by an elevated line, thus rendering the hymenium toothed-lamellate. At the very margin the spines are wholly replaced by lamellae, several of which are reticulately connected.

The features described above are reminiscent of the hymenial configuration in some Polypore, and Dr. M. A. Donk in this connection suggested some relationship with *Hirschioporus*. The duplex nature of the context and its dimitic structure, the presence of cystidia crowned with a head of crystalline matter which disappears in a KOH solution, and the colourless spores are all characters corroborating this suggestion. However, the small size of the spores, given by Petch as $3-5 \times 3 \mu$,

⁸ Lloyd (1918: 801) told the same story in his own words, but omitted to mention his source of information.

may prove an obstruction to the inclusion of the present species in that genus.

On the sheet is a note in pencil in Miss E. M. Wakefield's hand which reads: "cfr. *H. duriusculum* Lloyd".

Serpuloides. — *Hydnum serpuloides* P. Henn., see under '*versicolor*'.

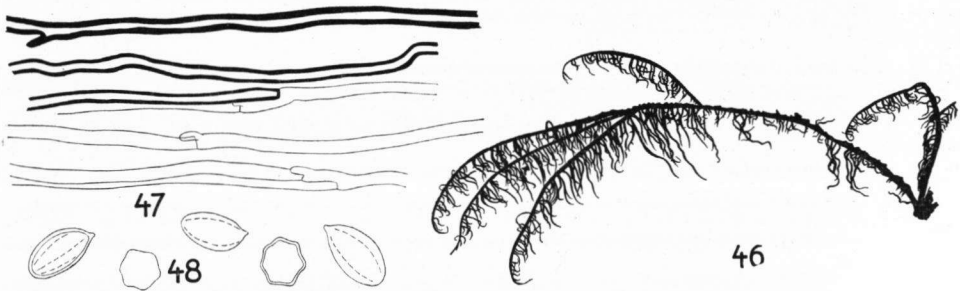
Sinclairii. — *Hydnum sinclairii* Berk. in Hooker, Handb. New Zeal. Fl. 756. 1867. — *Phellodon sinclairii* (Berk.) G. H. Cunn. in Trans. Roy. Soc. New Zeal. 85: 590. 1958. — Type: "*Hydnum sinclairii*, B. / New Zealand / 1860 / Dr. Sinclair" (K).

Several of the collections cited by Cunningham were received on loan and compared with the type. Cunningham's description, although good in general lines, needs a few supplementary and corrective remarks.

Phellodon sinclairii is a well-defined, independent species which comes close to *P. melaleucus* on account of the glabrous surface and dark colour of its stipe, but which has the black and hard context in common with *P. niger*. The stipe, which may be as long as 35 mm, has a tendency to proliferate, producing pointed processes. The latter may remain awl-shaped and sterile or broaden into flattened divisions bearing spines on the underside. The pileus, too, may proliferate and is sometimes deeply lacerated, which results in a profusion of narrow slips. The surface of the pileus in most cases is radiately fibrillose to striate, sometimes even rugulose or ridged (not sulcate). Near the margin, shallow concentric depressions may cause a structural zonation, but there may also occur a colour-zonation owing to an alternation of dark olive and blackish zones. Apparently, the superficial felt is very thin, collapsing very soon behind the growing margin, but in one collection (Otago Distr., Tapanui, Black Gully, Apr. 1957, S. D. & P. J. Brook; Herb. P.P.D., Auckland, No. 17715) this tomentum is still visible as a dingy whitish marginal rim. The spines, which Cunningham described as black with an olivaceous tinge, are ash grey when mature.

Sprucei. — *Hydnum sprucei* Mont., Syll. Gen. Spec. Crypt. 173. 1856. — *Pterula sprucei* (Mont.) "McGinty" / Lloyd, Mycol. Writ. 5: 865. 1919 (not validly publ.). — Type: "*hydnum (Merisma) Sprucei* Montg. / São Gabriel / supra ligna putrida. Junio, 1852" (PC).

The type consists of two complete fruit-bodies and two fragments. Fruit-bodies delicate, subfasciculately branched from a short stem, main branches patent, filiform, simple or dividing once or twice, up to 32 mm long, 0.5 mm wide near their base, tapering to 0.1 mm at their tip, floccose-tufted above and on the sides, producing on the underside secondary branches in one or two rows (Fig. 46). Secondary branches up to 6 mm long, subulate, simple or with short side-branches projecting at right angles, covered on all sides with the hymenium. Context horny when dried, dimitic, consisting of very firmly cohering generative and skeletal hyphae (Fig. 47). Generative hyphae up to 3.6(-4.9) μ wide, very thin-walled (cell-walls less than 0.5 μ), branched, septate, with clamp-connections, giving rise to the skeletal which are 1.8-3.6 μ wide, thick-walled but not solid (cell-walls 0.5-1 μ), straight, flexuous, or kinked, with occasional excrescences and rarely with a side-branch. The floccose-tufted covering composed of the ends of the generative hyphae. Hymenium not thickening, composed of basidia only, of which not a single mature one was found, clavate, up to 15 μ wide (with a clamp at their



Figs. 46–48. *Hydnum sprucei* Mont. (type). — 46. One of the fruit-bodies of the type collection ($\times 2$). — 47. Generative and skeletal hyphae ($\times 700$). — 48. Spores ($\times 700$).

base?). Spores (Fig. 48) numerous, subamygdaliform, smooth, with 5–7 longitudinal ribs, colourless, $12.8\text{--}14.8 \times 7.9\text{--}9.0 \mu$, with somewhat thickened wall, apiculus c. 1μ long.

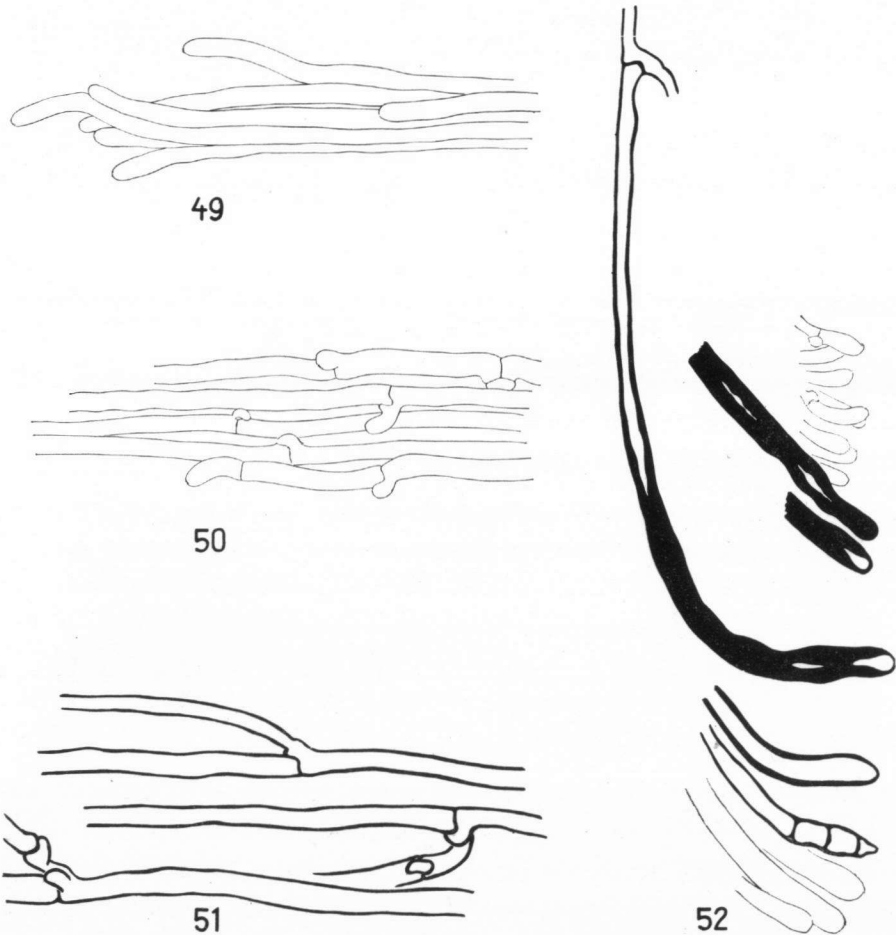
To judge from the characters described above (such as the filiform branches, the dimitic context, the smooth and colourless spores, the absence of cystidia, and the occurrence on wood), the present species obviously is a member of the genus *Deflexula* as defined by Corner (1952: 275). Further characters, such as the way the secondary branches are born on the underside of the main branches, and the size of the amygdaliform spores, indicate that *Hydnum sprucei*, in spite of a somewhat different outward appearance, is identical with and provides an earlier name for *Deflexula pennata*.

The genus *Deflexula* as emended by its author comprises two series of species which seem well distinguishable. One series, including the type species *D. fascicularis* (Bres. & Pat.) Corner, may be characterized by a thickening hymenium and globose spores, and the second by a not thickening hymenium and ellipsoid (amygdaliform, fusiform, ovoid, obovoid) spores. These characters may prove of generic value, but a formal separation of the two groups would appear premature as no definite information is available on the nature of the hymenium in *D. vanderystii* (P. Henn.) Corner (of the first group) and in *D. subsimplex* (P. Henn.) Corner (of the second group). *Hydnum sprucei*, which would enter the second group, is therefore retained in *Deflexula* as **D. sprucei** (Mont.) Maas G., *comb. nov.* (basionym, *Hydnum sprucei* Mont., l.c.), while *Pterula pennata* P. Henn. and *Deflexula pennata* (P. Henn.) Corner are reduced to its synonymy.

Stereoides. — *Hydnum stereoides* Cooke in Grevillea 20: 90. 1892. — Type: "No. 1660 / [*Stereum* crossed out] *Hydnum stereoides* / [Malaya, Perak] Gunong Batu Puteh / 1891 / L. Wray Jr." (K).

The type is composed of numerous imbricated pilei attached with narrowed base to pieces of wood and bark. Pileus flabelliform, deeply lacerated or divided into several cuneate lobes, up to about 1.5 cm long, of a peculiar horny aspect; upper surface smooth, sometimes glabrous, sometimes scantily covered with radially

arranged, short, white or yellow fibrils which especially along the margin may be more numerous, forming a narrow zone of thin tomentum, while in a few cases there are two to three tomentose zones separated by concentric glabrous areas; black-brown near the base, chestnut near the margin; lower surface sterile for a distance of up to several millimeters; margin upturned, wavy, fimbriate or torn. Spines crowded, 0.2–0.3 mm long, subulate, brittle, brownish flesh-colour, with a white bloom from protruding cystidia. Context horny, 0.3–0.4 mm, dark brown, monomitic. Generative hyphae (Figs. 49–51) firmly coherent, thin-walled (at least at the margin and in the upper parts of the context; cell-walls less than 0.5μ), with clamp-connections at all septa, unbranched near the margin, sparingly branched



Figs. 49–52. *Hydnum stereoides* Cooke (type). — 49. Generative hyphae from margin of pileus. — 50. Same hyphae, about 100μ rearward, showing clamp-connections, one of the latter budding into a side-branch. — 51. Hyphae about 1 mm back from margin, showing ramification. — 52. Detail of spine, showing cystidia and basidia. (All figures $\times 700$.)

farther back, 2.7–4.5 μ wide at the margin, very gradually widening to about 5.5 μ . Hyphae in the lower parts of the context have appreciably thicker cell-walls, up to 1.5 μ . Trama of the spines neither truly monomitic nor dimitic (Fig. 52). Generative hyphae similar to those of the context, but toward their tips curving outward and terminating as cystidia, 3–5.5 μ wide. The cystidia at the tips of the spines are very thin-walled to moderately thick-walled, those higher up the spines very thick-walled to solid; the latter resembling skeletal hyphae. Basidia with basal clamp-connection. Whether the spores seen belong to the present species cannot be stated with certainty.

Hydnum stereoides fits in with none of the genera I have studied up till now and may well represent an undescribed genus. A full description, however, must be postponed until better preserved material is available and the identity of the spores is beyond doubt.

Subpallidus. — *Hydnum subpallidum* Snell & Dick in *Lloydia* 25: 162. "1962" [1963]. — Type: "*Hydnum subpallidum* Snell & Dick, Black Fox Mountain, near McCloud, Siskiyou Co., Calif., 10-8-58 (?), *Kay Scott*" (Herb. W. H. Snell 3171).

The tuberculate brownish spores and the thin-walled, inflated hyphae of the context determine the species as a *Sarcodon*. On account of the white context (somewhat flushed with vinaceous in the stipe) and the presence of clamp-connections, the species belongs to Group 3 of that genus. The smooth, adnate scales of the pileus rule out *S. imbricatus* (L. ex Fr.) P. Karst., which leaves *S. laevigatus* (Sw. ex Fr.) P. Karst. as the only possibility.

Snell & Dick compared their species with *S. laevigatus*, from which they found it to differ in (i) the depressed pileus perforated into the stipe, (ii) the shorter spines, (iii) the whiter stipe, and (iv) the smaller spores.

Ad (i). — *Sarcodon imbricatus* is the species best known for the phenomenon described as "pileus perforated into the stipe", and here the perforation often is a sign of old age or appears after a spell of wet weather. Now, from an anatomical point of view, perforation of the pileus is a sign of loosening of the context, and that is a feature shared by several other species of *Sarcodon* I know, including *S. laevigatus*.

Ad (ii) and (iv). — In the present case, shorter spines and smaller spores are no independent characters. The specimens of the holotype are only half-way mature, which accounts for the shortness of the spines, their pale colour, the comparative scantness of the spores, and the size of the latter which Snell & Dick found smaller than in *S. laevigatus*.

Ad (iii). — There is nothing unusual in the fact that the stipe darkens with age. The white colour of the stipe in *Hydnum subpallidum* is in keeping with the immature condition of the type specimens. Also, apart from the age, there is the individual variability depending on the fruit-body's exposition to daylight. The specimens may well have been collected in a dark corner.

My conclusion is that *Hydnum subpallidum* represents an immature state and possibly somewhat pale form of *Sarcodon laevigatus*.

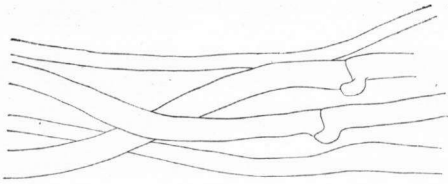
Tapeinus. — *Hydnum tapeinum* Masee in Bull. misc. Inf., Kew 171. "1899" [1901] ("*tapienum*"). — Type: "*Hydnum tapeinum* Mass. / Malay Peninsula / State of Selangor / Aug. 1897 / 75 / H. N. R[idley] (and an illegible word or name which may stand for a second collector)" (K).

A single pileus. Pileus fan-shaped, convex in the central portion and along the margin, deeply depressed in the intervening area, about 60 mm long and 65 mm wide, tough, 4 mm thick at the basal part, which is broken off, thinning out to about 0.2 mm at the strongly involute margin. Surface azonate, glabrous, finely innate-fibrillose and minutely radiately rugulose, holding dirt and grains of sand, fissured near the margin, dull, dingy ochraceous yellow-brown, somewhat more fulvous toward the margin and with tiny spots of that colour scattered over the whole of the surface. Spines probably decurrent, crowded, subulate, straight, often two or more connate, up to 4 mm long, corneous-translucent and reddish brown, with scurfy whitish apices. Context firm, fibrous, homogeneous throughout, azonate, pale yellow-brown, not staining in KOH solution, non-amyloid, odourless, monomitic, consisting of generative hyphae. The hyphae at some 10 mm distance from the margin and close under the surface are 3.6–6.3 μ wide, very thin-walled (cell-walls less than 0.5 μ), occasionally branched and anastomosing (not drawn), and with clamp-connections at all septa (Fig. 53). Farther down in the context the side-branches become more numerous, the hyphae attain a width of 5.4–6.7 μ , and the thickness of the cell-walls increases to 1–2 μ or lumina of the hyphae may become obliterated in places (Fig. 54). In the basal portion of the pileus the hyphae are up to 8 μ wide, thick-walled, and frequently branched. The side-branches often form intricate knots of anastomoses and more (transverse) side-branches which serve to connect the radially arranged hyphae (Fig. 55). The hyphae in the spines lack transverse connecting hyphae, but branching and anastomosing are frequent, and clamp-connections occur at all septa. The axial hyphae reach a width of 4.5 μ and are moderately thick-walled, becoming increasingly narrower and thinner-walled toward the sides of the spines, eventually to develop the tortuous hyphae of the subhymenium (Fig. 56). The hymenium is not developed. Cystidia-like elements (10–25 \times 2–5 μ , very thin-walled) which project beyond the collapsed subhymenial tissue, both on the sides and near the tip of spines, may or may not be true cystidia, which is impossible to determine in this material. As all attempts to trace these

EXPLANATION OF FIGURES 53–60

Figs. 53–56. *Hydnum tapeinum* Masee (type). — 53. Thin-walled hyphae from close under the surface of the pileus. — 54. Thicker-walled and more branched hyphae from deeper parts of the context. — 55. The side-branches, in their turn producing branches and forming anastomoses, serve to connect the radially arranged hyphae. — 56. Detail of a spine, showing hyphae from the axial part (right) to the subhymenium (left). (All figures \times 700.)

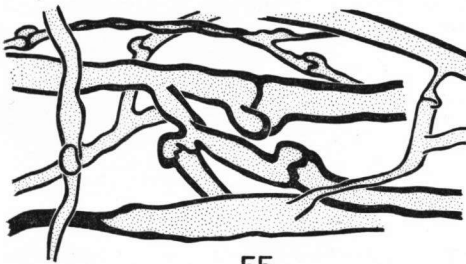
Figs. 57–60. *Hydnum aitchisonii* Berk. (type). — 57. Hyphae from the context, at about 7 mm distance from the margin of the pileus and close under the upper surface, 3.6–4.5 μ wide, thin-walled (cell-walls less than 0.5 μ thick), septate, with clamps, occasional side-branches and anastomoses. — 58. Hyphae from deeper down the context, up to 6.3 μ wide, cell-walls 0.9–2.7 μ thick, in places obliterating the lumen. — 59. Hyphae from near the base of the pileus, inflated in places, up to 14.5 μ wide, very thick-walled (cell-walls 1–3 μ thick) or solid. — 60. Detail of a spine. Hyphae frequently branched, septate, clamped at all septa; 3.6–4.5 μ wide, moderately thick-walled to solid in the axis; 1.8–2.7 μ wide and very thin-walled toward the sides. Subhymenium of very tortuous, narrow hyphae. (All figures \times 700.)



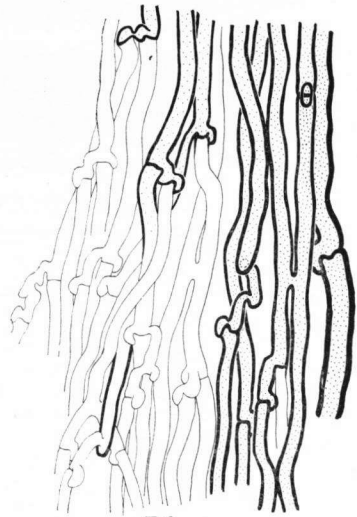
53



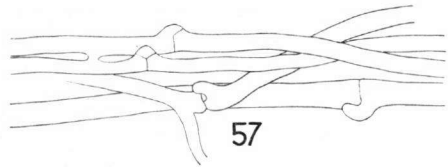
54



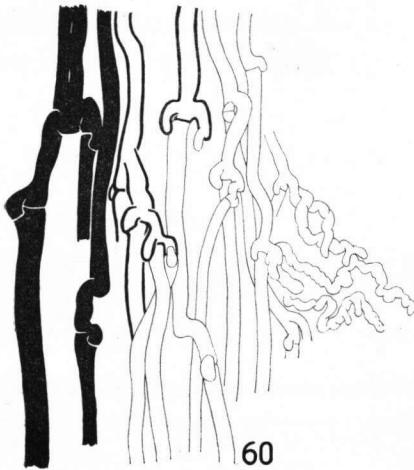
55



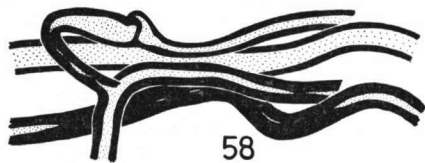
56



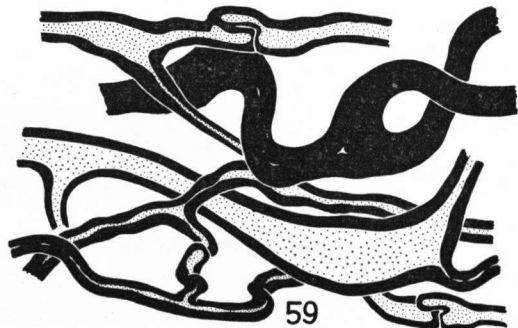
57



60



58



59

Figs. 53-60

elements rearward failed, I am unable to say in what part of the spine they have their origin.

The similarity in outward appearance of *Hydnum tapeinum* and *H. aitchisonii* is extraordinary and at first led me to regard them as conspecific. The hyphal characters (with the exception of the questionable cystidia-like outgrowths) certainly agree with those of the genus *Mycoleptodonoides* Nikol. and resemble those of *M. aitchisonii* (Berk.) Maas G. However, there are certain discrepancies which make me hesitate actually to declare them conspecific.

The hyphal structure of *Mycoleptodonoides aitchisonii* is reproduced in Figs. 57–60, and on comparing these with Figs. 53–56, the following differences may be enumerated: (i) the hyphae deeper in the context seem to be more often solid in *M. aitchisonii* than in *H. tapeinum*; (ii) inflated hyphae are much in evidence in the former species, particularly in the basal portion of the pileus, but little pronounced in the latter; (iii) the axial hyphae in the spines in the former species are often completely solid, whereas those of the latter are moderately thick-walled at the most; (iv) the tips of the spines in the former are smooth and glabrous, those of the latter scurfy from the projecting cystidia-like outgrowths.

It is possible of course, that these differences are accidental and of an individual rather than specific nature, but until I have seen fully mature material from the State of Selangor, I am not quite prepared to identify *Hydnum tapeinum* with *Mycoleptodonoides aitchisonii*.

Thwaitesii. — *Hydnum thwaitesii* Berk. & Br. in J. Linn. Soc. (Bot.) 14: 58. 1873. — *Phaeodon thwaitesii* (Berk. & Br.) P. Henn. in Nat. PflFam. 1 (1**): 149. 1898. — Lectotype: “*Hydnum thwaitesii*, B. & Br. / [Ceylon] Peradeniya / Aug. 1868 / [*Thwaites*] No. 735” (K).

One of the three packets containing the syntypes from Peradeniya bears the annotation (by Thwaites): “This is the only example I have found of this species unless it can possibly be a state of No. 728. — The colour but little altered in drying”. This material, consisting of two slices of the fungus, is here chosen as the lectotype, as it best exhibits the habit and size of the species. A fourth packet, on which the words “*Hydnum thwaitesii* / 735 Dup.” are written in pencil, contains slices of a completely different species; possibly representing No. 728 to which Thwaites referred?

A second sheet bears two more packets of the same species, one from Neilgherries (mentioned by Berkeley & Broome), and the other from the Botanic Gardens at Singapore, collected on 4 May 1920. The half specimen in the latter packet is in perfect condition and accompanied by the following note: —

Singapore 5702. Pileus fleshy, above dark purple, context greyish, 10 cm diam. Stipe central, outside dark purple, context greyish, 7 cm long. Tubes [!] greyish, discrete, readily breaking from hymenophore when dry, 1 mm long. Growing in the ground.

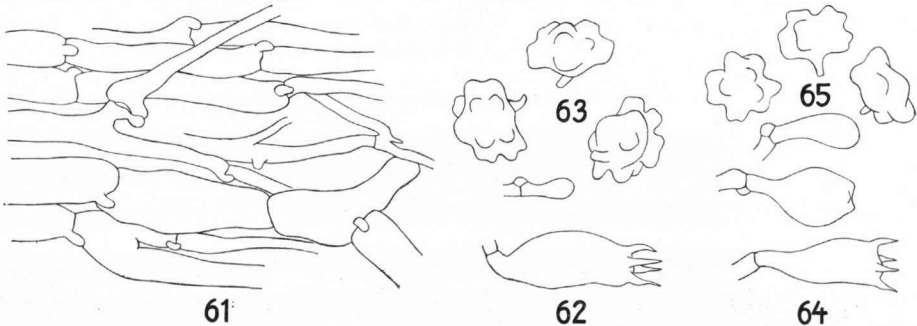
The following redescription of the species is chiefly based on the latter material, supplemented with data taken from both the material and the diagnosis of the type.

Pileus conical to convex, about 55 mm across, covered with a fine tomentum which becomes areolate, and from centre outward seems to collapse to form a glabrous, shining surface; greyish lilac (type) to dark purple (Singapore 5702) when fresh, blackish olive when dried. Stipe central, solid (Berkeley & Broome's "stipite . . . cavo . . ." is probably accidental), tapering downward, 60 mm long, 14 mm wide at the apex, 10 mm at the base, minutely tomentose, glabrescent, dark purple (Singapore 5702) when fresh, blackish when dried. Spines not decurrent, about 1 mm long, subulate, apparently white (type) to greyish (Singapore 5702) when young, dark brown from the spores when dried. Context fleshy, not zoned, greyish (Singapore 5702) when fresh, dark rufous brown (type) to black (Singapore 5702) when dried. Taste and odour unknown. Hyphae of the context (Fig. 61) of one kind only, inflating, thin-walled, branched, septate, with clamp-connections, 2–12.5 μ wide. Hyphae of the trama of the spines similar. When soaked in KOH solution both the context of the pileus and the trama of the spines rapidly stain the surrounding fluid red-brown, while the crystalline matter remaining on the hyphae dissolves and turns blue-green to ink blue. Basidia (Figs. 62, 64) with clamp-connections at the base when young, 4-spored, clavate, 28–30 \times 10–11 μ (type) or 25–27 \times 10–13 μ (Singapore 5702). Spores (Figs. 63, 65) irregular in outline, roughly tuberculate, yellowish brown, 8.1–9.4 \times 5.8–7.2 μ (type) or 7.6–8.0 \times 5.4–6.3 μ (Singapore 5702) (warts included). Cystidia lacking.

To judge from the hyphal structure and the spore characters, this is a true *Sarcodon*, and the species is accordingly transferred to that genus as ***Sarcodon thwaitesii*** (Berk. & Br.) Maas G., *comb. nov.* (basionym, *Hydnum thwaitesii* Berk. & Br., l.c.).

The very dark colour of the fruit-body may seem unusual in *Sarcodon* at first sight, but appears to be no isolated case and not even restricted to that genus. The combination of such characters as (i) blackening of the fruit-body, (ii) bluish green discolouration of the hyphae in an alkaline solution, and (iii) thin-walled, inflating generative hyphae is known to occur also in two other members of the Thelephoraceae, viz. the monotypic genera *Boletopsis* Fayod and *Polyozellus* Murrill.

Within *Sarcodon*, the blackening of the fruit-body and the bluish green discolouration of the hyphae in an alkaline solution are common to *S. atroviridis* (Morg.) Banker and *S. carbonarius* (G. H. Cunn.) Maas G. (both with clamp-connections) and *S. fumosus* Banker (a species lacking clamps).



Figs. 61–65. *Hydnum thwaitesii* Berk. & Br. — 61. Hyphae from context of pileus (Singapore 5702; \times 700). — 62, 64. Basidia (62: type; 64: Singapore 5702; not quite \times 700). — 63, 65. Spores (63: type; 65: Singapore 5702; not quite \times 1400).

Sarcodon thwaitesii differs from *S. atroviridis* in the different colours of the context both fresh and dried; from *S. carbonarius* in the different colour of the context in the dried condition; and from both in the much smaller, very crowded spines.

The Rijksherbarium possesses two Malaysian collections (Island of Enggano, Buah-Buah, 2 June 1936, *Lütjeharms 4081*; 5 June 1936, *Lütjeharms 4274*) which I do not hesitate to refer to the present species although they are much smaller than either the type or the specimen from Singapore. The determining characters are the black colour of the fruit-bodies, the very short and crowded spines, the presence of clamp-connections, and the bluish green discolouration of the hyphae in a KOH solution. From the field notes accompanying these collections the probable colour change of the fruit-bodies may be reconstructed.

	<i>Lütjeharms 4081</i>	<i>Lütjeharms 4274</i>
pileus	fairly dark purple	dark grey, nearly black
stipe	not mentioned	somewhat purple
spines	purple	brown
context	purple	greyish
spores	6.3-7.6(-8.1) × 4.9-5.4 μ.	7.0-8.1 × 5.4-6.0 μ.

Not only was *Lütjeharms 4081* collected a few days earlier than *Lütjeharms 4274*, but judging from the brown colour of the spines and the slightly larger spores, the latter collection would seem to be the older. It thus appears that the purple colour in *S. thwaitesii* is most pronouncedly in evidence in young specimens, passing into black (the surface of the pileus), grey (the context), and brown (the spines) when growing older.

Uleanus. — *Hydnum uleanum* P. Henn. in *Hedwigia* 36: 198. 1897. — Lectotype: "*Hydnum uleanum* P. Henn. "[in Hennings's hand] / "*Polyporus* / Auf einem Baumstamm, VIII[18]85, Itajahy, Brazil / *E. Ule 490*" [Ule's handwriting] (Herb. Schroeter, BRSL).

The type, consisting of one larger and two smaller confluent pilei, is badly pressed but otherwise in satisfactory condition, and perfectly recognizable from its microscopical features. The context is monomitic. The generative hyphae at the margin of the pileus and in the spines, as well as the basidia, lack clamp-connections. However, clamps do occur in the older portions of the context, and in the widest hyphae, on opposite sides of the septa or even in whorls. Finally, the presence of (i) a brownish oily substance in most of the hyphae, (ii) connecting and interweaving hyphae, and (iii) gloeocystidia readily determines the type as *Donkia pulcherrima* (Berk. & Curt.) Pilát.

Bresadola (1916: 231) identified *Hydnum uleanum* with *H. helvolum* Zipp. ex Lév., whilst Lloyd (1916: 7) regarded the latter as "an analogue, probably a thin form

of *Hydnum pulcherrimum*". Both authors were in error. From the hyphal structure it is apparent that *Hydnum helvolum* is different from *H. pulcherrimum* and not even generically related.

Hennings designated two different collections from Brazil in Schroeter's herbarium as the types of his *Hydnum uleanum*, one from Sta. Catharina near São Francisco (*Ule 492*), the other from Itajahy (*Ule 490*). If there were duplicates of these syntypes at Berlin, they have gone lost. It is not known what happened to *Ule 492* at Wrocław (Breslau), but *Ule 490* is still extant and hereby chosen as the lectotype.

Versicolor. — *Hydnum versicolor* Berk. & Br. in J. Linn. Soc. (Bot.) **14**: 59. 1873. — Type: "*Hydnum versicolor* B. & Br. / No. 178, Peradeniya, July 1868 / The whole plant, when fresh, of a beautiful bright yellow colour, except the growing edges which are pure white" (K).

Hydnum merulioides Berk. & Br. in Trans. Linn. Soc., Ser. 2, **2**: 63, pl. 13 fig. 4. 1883. — *Irpex merulioides* (Berk. & Br.) Lloyd, Mycol. Writ. **4** (Lett. 51): 3, 1914 ("*merulioides*"; nomen nudum). — Type: "*Hydnum merulioides* B. & Br. / Brisbane No. 246. F. M. Bailey" (K).

Hydnum henningsii Bres. in Bull. Soc. mycol. France **6**: xlviii, pl. 9 fig. 2. 1890; Iconogr. mycol. **22**: pl. 1061 fig. 1. 1932. — *Gyrodontium henningsii* (Bres.) Pat., Essai taxon. Hym. 117. 1900. — Type: "*Hydnum Schiederm.* Heufl. var. *Kamerunensis* Bres. [cf. also Sacc., Syll. Fung. **9**: 210. 1891; specific and varietal epithets crossed out and rewritten:] *Henningsii* Bres. / Kamerun ad ligna ? / Leg. Joh. Braun / comm. Hennings" (S).

Hydnum serpuloides P. Henn. in Verh. bot. Ver. Brandenb. **40**: 122, pl. 1 fig. 3. 1898. — *Gyrodontium serpuloides* (P. Henn.) Reid in Kew Bull. **17**: 267, fig. 1 (1). 1963. — Type: not seen (S).

Boninohydnum pini S. Ito & S. Imai in Trans. Sapporo nat. Hist. Soc. **16**: 127. 1940. — Type: "*Boninohydnum pini* S. Ito & Imai / Bonin Islands, Chichishima, Omura / 14 XI 1936. leg. S. Ito, S. Imai & K. Hino" (Herb. Faculty Agric., Sapporo).

Of the names enumerated above and here considered synonymous, *Hydnum henningsii* was selected by Donk (1956: 79) as the type species of *Gyrodontium* Pat. In the following lines a full description of the microscopical structures of this species is given, followed by those of the other types.

If the figure of *H. henningsii* published by Bresadola was drawn from nature, the type specimen at Stockholm represents only a small portion of the original material. The specimen is a shapeless fragment, measuring roughly 2 × 2 cm, with bits of wood attached to it on one side, and bearing spines on the opposite side. Most spines seem not fully developed as they are rounded at the apex, while quite a few are broken off. The longest undamaged spine measures 1.5 mm, its width ranging between 0.1 and 0.3 mm. The spines are covered with a yellow-brown to fulvous powdery layer. The context of the fruit-body and the trama of the spines are hard, glassy, and nearly black. Contrary to expectation, the microscopical structures are surprisingly well preserved. Context monomitic, composed of generative hyphae and connecting hyphae (Fig. 66). Generative hyphae (in the one slide made) up to 6.3 μ wide, thin-walled, septate, without clamp-connections,

branched, anastomosing. Connecting hyphae 2–3 μ wide, probably nothing but modified side-branches (Fig. 66a). Trama of the spines made up of the same elements (Fig. 67). Hyphae up to 6.3 μ wide in the axis of the spines, somewhat thick-walled; hyphae becoming narrower toward the sides of the spines, eventually giving rise to much branched and very tortuous subhymenial hyphae, 1 μ wide. Basidia (Fig. 68) slender, clavate, 22–27 \times 5.4–6.3 μ , 4-spored, without basal clamp-connection, sterigmata 2.7–3.6 μ long. Spores (Fig. 69) ellipsoid, adaxially flattened, smooth, yellow-brown under the microscope, rather thick-walled, 4.5–5.6(–6.3) \times 2.7–3.4(–3.6) μ , with small oblique apiculus. Cystidia and gloecystidia absent.

The description of the type of *Hydnum versicolor* is as follows: —

To a piece of paper are glued several slices of a fruit-body. The abhymenial side of some of these slices is covered with dirt and grains of sand, but in others it is collapsed to a smooth brown surface, and from this it may be deduced that at least part of the fruit-body, presumably near the margin, was easily separable from the substrate. The flesh is up to 6 or 7 mm thick in places, fairly soft and dirty white to pallid. The spines are crowded, up to 9 mm long, subulate, longitudinally grooved, dark brown. The context is a perfect replica of that of *H. henningsii*, only it is so badly preserved that, except for a few scattered fragments, which would be meaningless in a drawing, the hyphae fail to be restored to their original shape, even after prolonged boiling in KOH solution. Generative hyphae up to 6.3 μ wide, septate, branched, anastomosing, thin-walled, without clamp-connections. Connecting hyphae abundant, with all intergrading forms to side-branches, arranged in all directions (which accounts for the spongy nature of the context), some as narrow as 1.3 μ . Hyphae in the spines more compacted, parallel to the axis of the spines. Hymenium collapsed. Spores (Fig. 70) ellipsoid, adaxially flattened, smooth, yellow-brown under the microscope, rather thick-walled, 3.8–4.5 \times 2.7–2.9 μ . Cystidia and gloecystidia not seen.

Hydnum merulioides was described as a sessile-pileate form and this caused Cunningham (1953: 280) to identify it with *Hydnum cirrhatum* Pers. ex Fr. However, two of the chief differences which separate this species from *H. merulioides* are the presence of gloecystidia in the hymenium and clamp-connections at all septa. The redescription of *H. merulioides* follows: —

The type consists of two overlapping lobes of a specimen of which it is hard to decide whether it is truly pileate or only loosened from its substrate. The overall size is about 35 \times 40 mm. The flesh is 2–3 mm thick, yellowish white. The spines are overgrown with mould and broken in some places, but well discernible in others, crowded, up to 4 mm long, subulate, dark brown. Context moderately well preserved, monomitic, consisting of generative and connecting hyphae, completely resembling those in *H. henningsii* (Fig. 71). Generative hyphae up to 7.2 μ wide, septate,

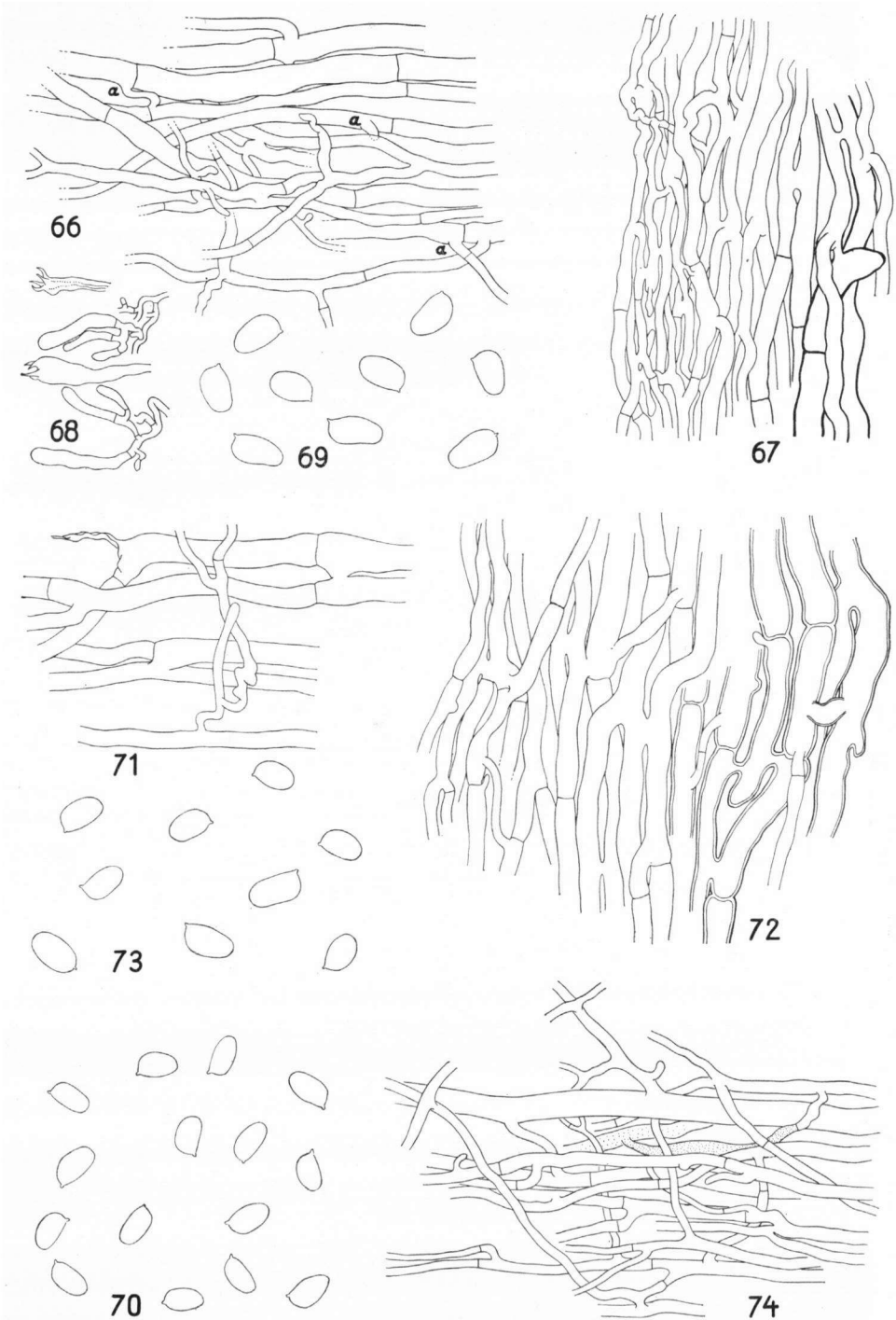
EXPLANATION OF FIGURES 66–74

Figs. 66–69. *Hydnum henningsii* Bres. (type). — 66. Context composed of generative hyphae and connecting hyphae (a). — 67. Detail from spine. — 68. Basidia. — 69. Spores. (Figs. 66–68, \times 700; Fig. 69, \times 1400.)

Fig. 70. *Hydnum versicolor* Berk. & Br. (type). — Spores (\times 1400.)

Figs. 71–73. *Hydnum merulioides* Berk. & Br. (type). — 71. Hyphae from context. — 72. Detail from spine. — 73. Spores. (Figs. 71 and 72, \times 700; Fig. 73, \times 1400.)

Fig. 74. *Boninohydnum pini* S. Ito & S. Imai (type). — Hyphae from context (\times 700.)



Figs. 66-74

branched, anastomosing, thin-walled, without clamp-connections. Trama of the spines somewhat better preserved (Fig. 72), the hyphae parallel to the axis of the spines, closely coherent, frequently anastomosing, branched, septate, without clamp-connections, up to 6.3μ wide and fairly thick-walled in the axis, as narrow as 2.7μ and thin-walled towards the periphery. Hymenium collapsed and gelatinized. Spores (Fig. 73) ellipsoid, adaxially flattened, smooth, yellow-brown under the microscope, rather thick-walled, $4.4-4.9(-5.4) \times 2.7-3.1 \mu$. Cystidia and gloecystidia not seen.

Although *Boninohydnum pini* was described as a sessile-pileate species, all that was sent of the type material were three bits of wood, to which adhered some shreds of floccose-felted, yellowish white subiculum and context with no trace of spines. Yet, this sufficed for making the following description: —

Context monomitic consisting of generative and connecting hyphae (Fig. 74). Generative hyphae up to 9μ wide, septate, branched, anastomosing, thin-walled, without clamp-connections.

Comparison of the original diagnoses and the descriptions given above shows that *Hydnum henningsii*, *H. versicolor*, *H. merulioides*, and *Boninohydnum pini* have the following characters in common: (i) they are wood-inhabiting, (ii) the flesh is thick and yellowish white, (iii) the context is monomitic, consisting of generative and connecting hyphae; (iv) the generative hyphae lack clamp-connections; (v) the hymenium is yellow to orange; (vi) the spores are smooth, yellow-brown under the microscope, rather thick-walled, of the same shape, and so little different in size as to form a continuous series. It is considered of minor importance that some of the species were described as pileate, others as resupinate. From this it is concluded that the names mentioned above actually refer to one and the same species, for which the following recombination is proposed: **Gyrodontium versicolor** (Berk. & Br.) Maas G., *comb. nov.* (basonym, *Hydnum versicolor* Berk. & Br., l.c.).

In this connection it is convenient here to discuss *Hydnum serpuloides* P. Henn. Reid (1963: 268) regarded *Gyrodontium henningsii* and *G. serpuloides* as closely related species, but found the former different on account of "(1) growth form (2) colour (3) shape of needles and (4) tough, fleshy texture."

Ad (1). — As stated above, not much weight should be attributed to growth form; it probably also depends to some degree on external factors.

Ad (2). — The colour of the spines is a variable character and depends on the maturity of the spores. When the spines in Bresadola's figure of *H. henningsii* are paler than those of *H. serpuloides* as described by Hennings, it may be pointed out that this is quite natural as the spines in the type of *H. henningsii* give the impression of being immature.

Ad (3). — The shape of the spines can rarely be used as a distinguishing character, and this is especially true if they are not fully developed.

Ad (4). — There is no evidence that Bresadola's description of *Hydnum henningsii* was based on field notes of the collector. When, therefore, the texture was described as "carnoso-lentus", this may well be put down to the author's "disciplined imagination guided by intuition" (Dennis, 1960: xvii). Bresadola's guess may

have been correct, but even so it is very hard to distinguish *H. henningsii* ("carnosolentus") from *H. serpuloides* ("carnosum") by the nature of the context.

From the preceding discussion it may be gathered that the differences indicated by Reid are not considered to have specific value. Reid described the hyphal structure of a specimen of *Gyrodontium serpuloides* from Melbourne, Australia. Allowing for some anomalies in the Australian material, probably owing to the fruit-body having developed in a mine, his description demonstrates that the hyphal structures of *Hydnum serpuloides* and *H. henningsii* are alike. In my opinion, therefore, there is no doubt that *Hydnum serpuloides* is conspecific with *H. henningsii* and hence with *Gyrodontium versicolor*.

Another synonym of *Gyrodontium versicolor* is *Hydnum polymorphum* which is discussed separately (p. 166).

It is possible that *Hydnum boveanum* (p. 156) is yet another name for the present species, in which case it would be the oldest name, but some of its characters make it advisable to keep the two species temporarily apart.

Washingtonianus. — *Hydnum washingtonianum* Ell. & Ev. in Proc. Philad. Acad. 323. 1894. — Type: "No. 214. *Hydnum washingtonianum* E. & E. / Tracyton, Kitsap Co., Wash. / Dec. 27, 1893 / on ground in deep coniferous woods / Adella M. Parker" (NY).

The type is a smallish specimen which has the pileus "slightly depressed in the center". The context is monomitic made up of inflating, thin-walled, septate hyphae with clamp-connections. The spores are subglobose, smooth, colourless, with small oblique apiculus, $7.2-8.1 \times 6.3-6.7 \mu$. These characters suffice to identify the specimen as *Hydnum repandum* L. ex Fr. The fairly short and thick stipe (about 9 mm thick near the apex, as opposed to the 3 millimeters mentioned by the American authors), the colour of the pileus ("pale orange"), and that of the spines ("nearly white when fresh") give further evidence of the specimen belonging to variety *repandum*. Ellis & Everhart were well aware of the close affinity of their species to *H. repandum*, but thought it to be different "in its decurrent aculei and tougher substance". I am unable to assert the latter statement, and as far as the decurrence of the spines is concerned, it is often true but by no means a rule that in variety *repandum* the spines do not reach the apex of the stipe. *Hydnum washingtonianum*, therefore, is here formally reduced to the synonymy of *Hydnum repandum* var. *repandum*.

Hydnum decurrens is a herbarium name used by the American authors on a slip of paper inside the packet, but afterwards apparently abandoned in favour of the epithet '*washingtonianum*'.

Wellingtonii. — *Hydnum wellingtonii* Lloyd, Mycol. Notes 7: 1200, pl. 247 figs. 2468, 2469. 1923. — Type: New Zealand, District Wellington, York Bay, *E. H. Atkinson* 628 (Lloyd 27122, not seen; BPI).

Cunningham (1958: 590) remarked that: "Part of a collection from York Bay was forwarded to C. G. Lloyd, who named it *Hydnum wellingtonii* . . ."

I have seen the collection from York Bay, correctly identified by Cunningham as *Hydnum crocidens* ("Dentinum"), and refer to that name for further particulars.

REFERENCES

- BANKER, H. J. (1912). Type studies in the Hydnaceae. II. The genus *Steccherinum*. In *Mycologia* 4: 309-318.
- (1913). Type studies in the Hydnaceae. III. The genus *Sarcodon*. In *Mycologia* 5: 12-17.
- BOIDIN, J. & AHMAD, S. (1963). The position of *Duportella tristicula* Pat. (Basidiomycetes: Thelephoraceae). In *Biologia* 9: 33-38.
- BOSE, S. R. (1957). Gasterospores (Chlamydospores) in tropical *Ganoderma*. In *Sydowia*, Beih. 1: 176-178.
- BOURDOT, H. & GALZIN, A. (1928). Hyménomycètes de France. Sceaux.
- BRESADOLA, G. (1916). Synonymia et adnotanda mycologica. In *Ann. mycol.*, Berl. 14: 221-242.
- CHOTHIA, H. P. (1950). *Polystictus leoninus* Klotzsch, a wound parasite. In *Ind. For.* 76: 290-291.
- CLELAND, J. B. (1934). Toadstools and mushrooms and other larger fungi of South Australia. Adelaide.
- COKER, W. C. & BEERS, A. H. (1951). The stipitate Hydnums of the Eastern United States. Chapel Hill.
- CORNER, E. J. H. (1952). Addenda clavariacea I. Two new Pteruloid genera and *Deflexula*. In *Ann. Bot.*, Ser. 2, 16: 269-291.
- (1953). The construction of Polypores—1. Introduction: *Polyporus sulphureus*, *P. squamosus*, *P. betulinus* and *Polystictus microcycclus*. In *Phytomorphology* 3: 152-167.
- CUNNINGHAM, G. H. (1953). Revision of Australian and New Zealand species of Thelephoraceae and Hydnaceae in the Herbarium of the Royal Botanic Gardens, Kew. In *Proc. Linn. Soc. New S. Wales* 77: 275-299.
- (1958). Hydnaceae of New Zealand. Part 1.—The pileate genera *Beenakia*, *Dentinum*, *Hericum*, *Hydnum*, *Phellodon* and *Steccherinum*. In *Trans. roy. Soc. New Zealand* 85: 585-601.
- DENNIS, R. W. G. (1960). British cup fungi and their allies. London.
- DONK, M. A. (1933). Revision der niederländischen Homobasidiomycetae-Aphylophoraceae II. In *Meded. Nederl. mycol. Ver.* 22.
- (1956). The generic names proposed for Hymenomycetes—V. "Hydnaceae". In *Taxon* 5: 69-80, 95-115.
- HEIM, R. & MALENÇON, G. (1928). Champignons du Tonkin recueillis par M. V. Demange. In *Ann. Cryptog. exot.* 1: 58-74.
- HUXLEY, J. (1938). Clines: an auxiliary taxonomic principle. In *Nature* 142: 219-220.
- LLOYD, C. G. (1913). Determination of specimens sent by Henri Perrier de la Bathie, Madagascar. *Mycol. Writ.* 4: (Lett. 48).
- (1918). Rare or interesting fungi received from correspondents. *Mycol. Writ.* 5: 801.
- (1922). *Hydnum pygmaeum* from A. Yasuda, Japan. *Mycol. Writ.* 7: 1107, pl. 189 fig. 2038.
- MAAS GEESTERANUS, R. A. (1962). Hyphal structures in Hydnums. In *Persoonia* 2: 377-405.
- (1963). Hyphal structures in Hydnums. IV. In *Proc. Kon. Nederl. Akad. (Ser. C)* 66: 447-457.
- MILLER, L. W. (1935). The Hydnaceae of Iowa IV. The genera *Steccherinum*, *Auriscalpium*, *Hericum*, *Dentinum* and *Calodon*. In *Mycologia* 27: 357-373.
- MILLER, L. W. & BOYLE, J. S. (1943). The Hydnaceae of Iowa. In *Univ. Iowa Stud. nat. Hist.* 18 (2).
- REID, D. A. (1963). New or interesting records of Australasian Basidiomycetes: V. In *Kew Bull.* 17: 267-308.
- SARKAR, A. (1959). Developmental anatomy and differentiation of tissue systems of *Ganoderma lucidum* (Leyss, ex Fr.) Karst. In *Φυτον* 13: 89-104.