

## Studies of Species of *Hebeloma* (FR.) KUMMER from the Great Lakes Region of North America I. \*)

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### Introduction

The genus *Hebeloma* is a member of the family Cortinariaceae of the order Agaricales. In recent times it has emerged from relative taxonomic obscurity largely, apparently, because most of its species are thought to be mycorrhiza formers with our forest trees, and this phase of forest ecology is now much in the public eye. The genus, as recognized by SMITH, EVENSON & MITCHEL (1983) is essentially that of SINGER (1975) with some adjustments in the infrageneric categories recognized. It is also, the same, for the most part, as the concept proposed by the late L. R. HESLER in his unfinished manuscript on the North American species which SMITH is now engaged in completing. In the past there have been few treatments of the North American species which recognized more than a dozen species. MURRILL (1917) recognized 49 species but a number of these have been transferred to other genera. In the recent past, however, European mycologists have showed renewed interest in the genus as is to be noted by the papers of ROMAGNESI (1965), BRUCHET (1970), and MOSER (1978).

The species included here are some that have been observed for years by the author (1929—1983) in local localities, and the observations on them have clarified their identity and allowed their probable relationships to be proposed. The ultimate aim, of course, is the eventual completion of a treatment of the species for North America, the project HESLER was unable to complete. For details relative to clarification of descriptive terms here used for the spores, cystidia, and cuticular layers as well as tramal features, see SMITH, EVENSON & MITCHEL (1983).

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\*) This contribution is dedicated to Prof. Dr. M. MOSER, on occasion of his 60th birthday (cf. SYDOWIA 36: 331, 1983).

### Species Redescribed

1. *Hebeloma albidulum* PECK, N. Y. State Mus. Ann. Rept. 54: 148. 1901.

**Pileus** 2.5—5 (7) cm broad, obtuse becoming convex or  $\pm$  broadly umbonate, finally plane or with a broad umboe, glabrous, viscid but soon dry, white over all, dull white in age or when dried. — **Context** white, thin, odor and taste pungent-raphanoid, neither KOH (on pileus) nor  $\text{FeSO}_4$  (on base of stipe) causing a color change. — **Lamellae** pallid (dull white), soon brownish and finally  $\pm$  "Verona Brown", close, moderately broad, adnate, edges even and not spotted. — **Stipe** 4—8 cm long, 3—7 mm thick, equal, solid, brownish within, surface whitish and innately fibrillose to pruinose-scurfy at apex, naked in age and white over all (a slight discoloration confined to the interior but the exterior remaining white). — **Veil** none.

**Spore deposit** pale "Verona Brown". — **Spores** 9—12  $\times$  6—7.5  $\mu\text{m}$ , in profile view  $\pm$  inequilateral (ventral line in profile view slightly convex, dorsal line more convex than the ventral line, apex  $\pm$  obtuse to (rarely) somewhat snoutlike, an apical hyaline discontinuity typically present; surface rugulose (spore rarely slightly "calyptrate"),  $\pm$  clay color in KOH, weakly dextrinoid. — **Basidia** broadly subcylindric, 20—25  $\times$  9—10  $\mu\text{m}$ , reddish in Melzer's reagent but slowly fading to orange; hyaline refractive material in the interior present as a few particles (no significant presence of hyaline globules seen). — **Pleurocystidia** none. — **Cheilocystidia** abundant and forming a continuous band, variable in size and shape: 32—110  $\times$  3—4  $\times$  3—7  $\mu\text{m}$ , filamentose, elongate-clavate or (more rarely) narrowly fusoid-ventricose, apex obtuse to slightly enlarged or enlargement tapered to a blunt point (no capitate or subcapitate cells seen); hyaline, walls slightly refractive but not agglutinated. — **Cuticle of pileus** an isolattice, the hyphae 1.5—3.5  $\mu\text{m}$  in diam., clamped, refractive, wall roughened in some. Hypodermium nearly hyaline in KOH, intermediate as to type (both cellular and hyphal elements present); no colored incrustations noted on the walls (however, some wall irregularities noted). Pilear trama of radially-interwoven hyphae red in Melzer's but soon fading. — **Gill trama** of  $\pm$  parallel hyphae reddish in Melzer's but soon fading to orange-ochraceous.

**Habit, habitat and distribution.** — Gregarious under grass and "weeds" and various shrubs such as *Vaccinium*. Gorman Lake, Washtenaw, Michigan, Sept. 28, 1977; legit W. PATRICK and A. H. SMITH, 88103 (MICH).

**Observations.** — The above collection checks with HESLER's restudy of the type in spore features and in the features of the cheilocystidia (though here the ratio of elongate-clavate to fusoid ventricose types is reversed).

The diagnostic features for *H. albidulum* as seen at present are as follows; the pileus is white and dries withish; the stature is that of the small to medium sized range for the genus. The gill edges do not become spotted; the stipe undergoes only slight discoloration near the base in age; the spores are in the  $9-12 \times 6-7.5 \mu\text{m}$  range and are weakly dextrinoid.

The spore size readily distinguished it from *H. album* Pk. but dried basidiocarps of the two are easily confused.

2. *Hebeloma album* PECK, N. Y. State Mus. Ann. Rept. 54: 147. 1901.

Pileus 2—4 cm broad, convex with an incurved margin, becoming broadly convex, plane or margin uplifted; surface glabrous, viscid, creamy white but soon pale pinkish buff to (rarely) pinkish buff. — Context white, thin but firm; odor  $\pm$  raphanoid, taste mild then bitter, KOH on cuticle no color change;  $\text{FeSO}_4$  on base of stipe no color change. — Lamellae withish to pale brown to dull cinnamon ("Sayal Brown"), close, thin, broad, adnate to adnexed, not spotted. — Stipe 3—7 cm long, about 3.5 mm thick, equal, stuffed, pith silky, white throughout, surface not staining appreciably, minutely fibrillose-squamulose, becoming  $\pm$  striate.

Spore deposit "Sayal Brown" (dull cinnamon). — Spores  $11-15 \times 6.5-8 \mu\text{m}$ ,  $\pm$  inequilateral in profile view, in face view elongate-ovate, the apex blunt to obscurely snoutlike, surface very faintly ornamented and layers of the wall not separating, pale ochraceous in KOH, quickly dextrinoid, in profile view the ventral line often straight or nearly so. — Basidia 4-spored,  $23-32 \times 8-10 \mu\text{m}$ , narrowly clavate,  $\pm$  persistently reddish in Melzer's. — Pleurocystidia none. — Cheilocystidia  $37-75 \times 3-4 \times 7-10 \mu\text{m}$ , elongate-clavate or with a small ventricose bulge near the base, hyaline or some  $\pm$  cinnamon colored in apical region; apex merely  $\pm$  enlarged (not capitate), spores often adhering in bunches along the gill edge. — Cuticle of pileus an isolattice of very narrow ( $1-2 \mu\text{m}$ ) refractive hyphae. — Clamps present. — Hypodermium hyphoid and scarcely distinct from the trama. — Pilear trama typical of the genus, little pigmentation and no incrustations present on the walls, in Melzer's red but slowly fading.

Habit, habitat and distribution. — Gregarious to scattered on wet fallen leaves in a  $\pm$  dried up woodland pool surrounded by button bush and other shrubs. Horner Woods, Ann Arbor, Mich., Sept. 30, 1977, SMITH 88131 (MICH).

Observations. — The distinguishing features of this species as defined here are: 1) The spores are practically smooth as viewed in Melzer's reagent, and very soon become strongly dextrinoid. 2) The cheilocystidia most certainly agglutinate but adhering spores often

make observations difficult. The cheilocystidia seem to become colored in one gill edge but not in others. The hypodermium is  $\pm$  indistinct from the pilear trama as both have hyphae of  $\pm$  the same diameter. BRUCHET (1970) reports on this species from Europe. It has not been redescribed critically previously from North American specimens.

3. *Hebeloma lubriciceps* (KAUFFMAN & SMITH) HESLER & SMITH, comb. nov.

Bas.: *Naucoria lubriciceps* KAUFF. & SMITH, Pap. Mich. Acad. Sci. Arts and Letters 17: 18. 1933.

**Pileus** 1—3.5 cm broad, obtuse at first, expanding to broadly umbonate, campanulate, or nearly plane; with a white hoary coating when young but this soon vanishing; surface lubricous to subviscid; color soon "Cinnamon Buff" to "Pinkish Cinnamon" but as canescence disappears finally darker yellow-brown and blotched "Tawny Olive" to "Bister". — **Context** at first watery brownish, fading to whitish but becoming pinkish buff finally except for the cuticle; odor slight, taste not recorded. — **Lamellae** adnate with a decurrent tooth, whitish at first, then pinkish buff and finally a dingy dark yellow-brown, close,  $\pm$  4 mm broad, edges entire (not crenulate or beaded with drops of moisture). — **Stipe** 5—6 cm long, 3—4 (5) mm thick, equal, innately silky, white, staining fuscous from the base upward, watery within becoming pallid, stuffed solid; apex naked.

**Spores** 7—9 (10)  $\times$  5—5.5  $\mu$ m, broadly inequilateral in profile, broadly ovate to oval in face view; surface minutely roughened, spore apex obtuse but a slight hyaline apical discontinuity present in most (under oil immersion); dull rusty brown in KOH and in Melzer's rather bright rusty brown (slowly becoming slightly dextrinoid). — **Basidia** 4-spored,  $\pm$  25  $\times$  5—6  $\mu$ m, narrowly clavate, reddish in Melzer's but soon fading. — **Pleurocystidia** none. — **Cheilocystidia**  $\pm$  35  $\times$  6—7  $\mu$ m, subcylindric to narrowly clavate, *not prominent*, hyaline in KOH. — **Pilear cuticle** a thin ixocutis, the hyphae 1.5—3 (5)  $\mu$ m diam. — **Hypodermium**  $\pm$  cellular, the walls of the elements rusty brown in KOH and with colored incrustations and/or wall thickenings on them. — **Pilear trama** floccose and the hyphae radial to interwoven, reddish in Melzer's but soon fading to pale ochraceous. — **Clamps** present.

**Habit, habitat and distribution.** — Gregarious on black muck and among mosses, on wet ground under *Thuja* in boggy areas. Rock River, Michigan, Sept. 8, 1929, legit A. H. SMITH.

**Observations.** — It will be noted that the spore size given here is larger than as given in the type description (5.5—7  $\times$  3—4  $\mu$ m) and that the spore surface is faintly ornamented. The type collection was made during a long rainy period and the effects of the weather



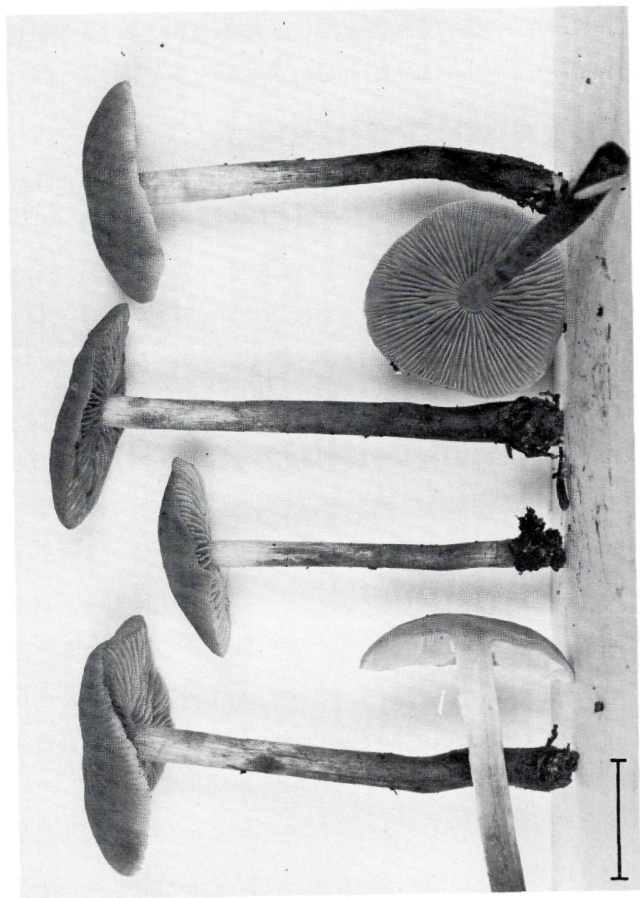


Fig. 1: *Hebeloma spoliatum*, Sm-17530 a. (bar = 2 cm).



on the mushrooms collected during that period were evident in the color of the pilei and their degree of viscosity. No veil was noted by SMITH when he collected the specimens or by KAUFFMAN who wrote up the description of the collection. Because of the lack of a veil the species is placed in section *Denudata* of *Hebeloma*. The small cheilocystidia do not aggregate in bunches, hence the gill edge is entire. It is a common occurrence among viscid-capped species of the Cortinariaceae for most of the slime to be washed from the pileus in the course of a week or two of  $\pm$  steady rain.

#### 4. *Hebeloma spoliatum* (Fr.) GILLET. — Fig. 1

Bas.: *Agaricus spoliatus* FRIES, Epicr. Syst. p. 182, 1836—68.

Pileus 2.5—3.5 cm broad, convex becoming plane or nearly so, glabrous, viscid, hygrophanous; color  $\pm$  buff on the disc (yellowish), on margin grayish brown when moist, fading slowly. — Lamellae moderately broad, dull pinkish cinnamon, depressed-adnate, edges  $\pm$  serrate. — Stipe 5—6 cm long, 3.5—5 mm thick, nearly bister at base, paler above and colored like the lamellae but paler, striate near the base, appressed fibrillose above, at apex merely furfuraceous; solid.

Spores  $8-10 \times 5-5.5 \mu\text{m}$ , pale clay color in KOH and fading to paler, dextrinoid in Melzer's inequilateral in profile, in face view ovate, apex obtuse or  $\pm$  snoutlike in some, only very faintly ornamented over the surface — appearing practically smooth under a 3 mm dry objective. — Basidia 4-spored,  $18-23 \times 7-8 \mu\text{m}$ , short, not red in Melzer's. — Pleurocystidia none found. — Cheilocystidia  $\pm$  imbedded in gill edge,  $23-35 \times 7-10 \mu\text{m}$ , filamentose to clavate, or  $18-26 \pm 4-5 \mu\text{m}$  and cylindric, some irregularly clavate (but no sign of the beginnings of antlerlike branching). — Cuticle of pileus a thick isolattice of hyphae  $1-2.5 \mu\text{m}$  diam., refractive, smooth and possibly originating as an ixotrichodermium, clamps present. — Hypodermium as revived in KOH a band of pale tawny hyphae soon fading to pale ochraceous, merely ochraceous in Melzer's and smooth. — Pilear trama yellowish-hyaline in either KOH or Melzer's, not red at any stage revived in Melzer's. — Gill trama of  $\pm$  parallel hyphae, but in wide gills  $\pm$  interwoven.

Habit, habitat and distribution. On moss in a bog. Cheboygan Country, Michigan, Oct. 11, 1934, SMITH 1139 (MICH).

Observations. — This species and *H. lubriciceps* are very closely related. At the time no. 1139 was collected *H. lubriciceps* was also found and both were compared fresh. In 1139 the color is paler, the cap is more viscid, the stipe is not as striate, and at the apex it is more fibrous-punctate. *H.* 1139 is perhaps best regarded as an American variation of the European *spoliatum*. It is distinct from *H. lubriciceps* in not having pigmented hyphal incrustations on the hypodermal hyphae.

5. *Hebeloma sporadicum* A. H. SMITH, Mycologia 30: 34. 1958. — Fig. 2

Pileus 5—10 (15) cm broad, convex with an inrolled margin when young, expanding to plane or the margin finally elevated and often wavy, glabrous, at times with honey-colored zones or spots near the margin, surface thinly coated with slime when fresh, in age subviscid to nearly dry, margin delicately cottony to white-tomentose at first, otherwise glabrous; color "Pale Ochraceous Buff" (very pale dull yellow at first, darker by maturity ("Tawny Olive" to "Cinnamon Buff" on the disc), rarely becoming avellaneous, at times whitish over all when young to nearly mature, pallid as dried. — Context white, thick, firm, and the taste mild to slightly bitterish; odor slight but not raphanoid. — Lamellae close, narrow to moderately broad (in large caps 8—12 mm wide), adnate-adnexed, narrowed toward pilear margin, pure white at first and beaded with drops of moisture, edges white-fimbriate; faces "Wood Brown" (grayish brown) at maturity but the edges still white-crenulate, becoming eroded but apparently not becoming spotted. — Stipe (4) 6—10 cm long, 1—2 cm thick, equal or enlarged slightly below at first, stuffed with a whitish pith, pure white over all at first but becoming dingy sordid honey color on lower portion in age; apex white-pruinose to scabrous or white-punctate and beaded with droplets. — Veil none.

Spores 9—12 × 5.5—7 μm, in profile view inequilateral, ± ovate in face view but apex often ± snoutlike; pale tawny in Melzer's (not dextrinoid), surface punctate-rugulose and the outer layer of some spores tending to slough off (some spores calyptrate), pale ochraceous in KOH. — Basidia 4-spored, 29—34 × 9—10 μm, elongate-clavate to subcylindric. — Pleurocystidia none. — Cheilocystidia scattered to clustered, 36—70 × 3—5 × 5—9 μm, pedicle in some faintly ventricose midway up, mostly merely narrowly clavate. Some clusters at least partly agglutinated (outlines of cells blurred and groups of spores adhering to the edge). — Subhymenium a narrow ochraceous zone of narrow hyphae. — Gill trama proper of ± parallel hyphae, their cells greatly elongated, in Melzer's reddish and in place soon fading to yellowish. — Pilear trama of ± radialinterwoven hyphae reddish in Melzer's but soon fading or merely yellowish in local areas, nearly hyaline as revived in KOH; hypodermium not differentiated as a layer of the trama as viewed either in KOH or in Melzer's; no incrustations present. — Cuticle of pileus an ixocutis of hyphae 1.5—2.5 μm with hyaline refractive walls, arrangement of hyphae interwoven; clamp connections present.

Habit, habitat and distribution. — Cespitose in large arcs under spruce, Saginaw Forest, Ann Arbor, Michigan, Oct. 1, 1936. SMITH 4977 (MICH).

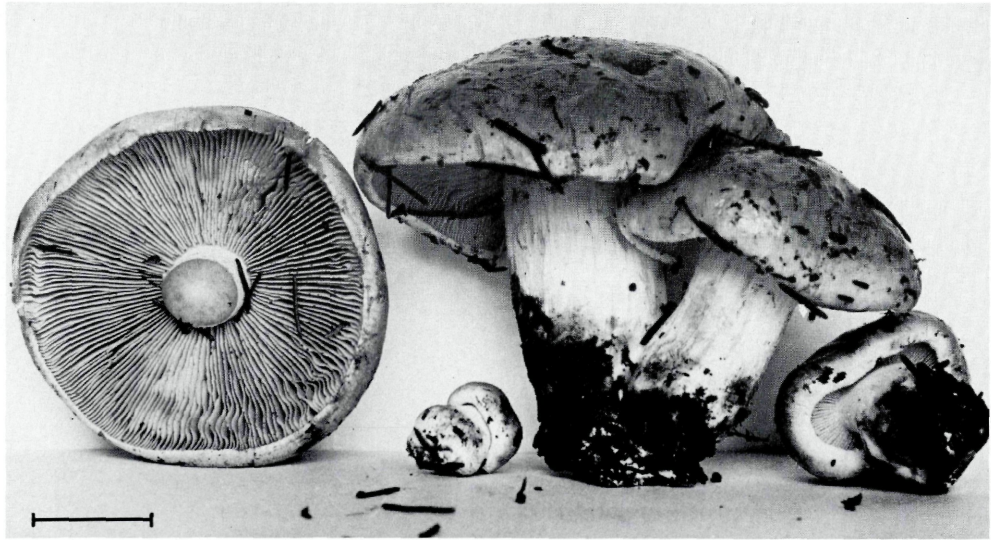


Fig. 2: *Hebeloma sporadicum*, Sm-4960. (bar = 2 cm).





**Observations.** — The following are the diagnostic features of this species: The slowly developing discoloration of the stipe from the base upward; the lack of both a distinct raphanoid odor and taste, the firm stipe showing no signs of splitting longitudinally, the generally pale ochraceous buff color of the cap, the beaded lamellae, the pattern of fruiting in large masses under spruce, the lack of a differentiated hypodermal layer in the pileus, the non-dextrinoid spores, and the agglutination of the cheilocystidia.

Both *H. sporadicum* and *H. eburneum* MALENÇON have many features in common and it would not be surprising if a critical study showed them to be conspecific. I recognize a stirps *Crustuliniforme* containing at least *H. sporadicum* and *H. eburneum* as closely related species in addition to those included by BRUCHET.

6. *Hebeloma sarcophyllum* (Pk.) SACCARDO, Syll. Fung. 5: 804. 1887.

Bas.: *Agaricus sarcophyllus* PECK, New York State Cab. Ann. Rept. 23: 96. 1873.

**Pileus** (1.5) 3—7 cm broad, conic to convex, expanding and finally the margin uplifted, white, slowly becoming dingy reddish gray, surface slightly viscid, glabrous, under a lens appearing innately fibrillose. — **Context** white becoming watery gray rather firm and cartilaginous, odor fungoid, taste bitter. — **Lamellae** close, broad, becoming ventricose in age, close, adnate to emarginate, pure white becoming flesh color and finally dark reddish brown ( $\pm$  "Kaiser Brown"), edges becoming white-fimbriate, not beaded. — **Stipe** 2.5—5 cm long, 2—6 mm thick, solid, fleshy within, at the base often tapered slightly, white and unchanging; surface appressed-fibrillose. — **Veil** absent to very slight (check unexpanded buttons).

**Spore deposit** "Cameo Brown" to "Chocolate". — **Spores** 7.5—10  $\times$  4.5—5.5 ( $\mu$ m), in profile inequilateral, in face view ovate or apex  $\pm$  snoutlike, surface distinctly rugulose (some spores calyptrate), yellowish brown in KOH under the microscope; dextrinoid. — **Basidia** 4-spored, 28—35  $\times$  7—8  $\mu$ m, 4-spored (rarely 2-spored). — **Pleurocystidia** none. — **Cheilocystidia** 27—36 (50)  $\times$  5—7 (9)  $\mu$ m,  $\pm$  ventricose near base, the apex clavate to  $\pm$  capitate (basically fusoid-ventricose), some  $\pm$  cylindric. — **Gill trama** narrow,  $\pm$  parallel hyphae (typical for the genus) in Melzer's reddish but soon fading. — **Cuticle** of pileus an ixocutis, the hyphae hyaline and 1—4  $\mu$ m diam; clamped at the septa. — **Hypodermium**  $\pm$  indistinct, intergrading with tramal tissue. — **Cuticle** of stipe of repent non-gelatinous hyphae.

**Habit, habitat and distribution.** — On soil in open grassy woods of hardwoods and conifers mixed, June to October, New York, May to September, New York and Michigan.

**Observations.** As we know them here in North America, *H. sarcophyllum* has smaller spores than *H. porphyrosporum* but in very young basidiocarps a rudimentary veil can at times be observed in both. Since these fungi are very sporadic in their appearance in North America more data are needed on such features as odor, taste,  $\text{FeSO}_4$  reaction on base of stipe and reaction of the tissues in Melzer's reagent. *H. porphyrosporum* MAIRE has distinctly larger spores and fewer of them show a tendency to become calyptrate. Both species, we now know (JOSSEAND & SMITH, 1941) occur in North America and are about equally frequent. We have five collections of *H. porphyrosporum* from Michigan and four of *H. sarcophyllum*. June 13 to July 28 are extremes in the collecting dates for PECK's species in Michigan. For MAIRE's species the collection dates are May 1 in Tennessee and around the 20th of August in Michigan.

It has been noted, in the course of studying herbarium specimens, that in drying the color of the sporeprints has become merely a dingy reddish brown and is not sufficiently different from sporeprints of many of the American species to justify using it as a principle character on which to recognize subgenera or sections (see SMITH, EVERSON & MITCHEL, 1983).

7. *Hebeloma sinapizans* (Fr.) GILLET. — A North American variant:

**Pileus** (4) 7—12 (15) cm broad, convex to broadly convex, margin incurved, expanding to nearly plane or with the margin arched or uplifted, glabrous, viscid, with a pallid sheen obscuring the cinnamon-tan or deeper colored ground color, slowly becoming shaded with "Wood Brown", edge white and cottony at first. — **Context** hard at first, soon soft, odor and taste strongly of radish. — **Lamellae** adnexed, broad, close, pallid becoming pale clay color or tinged cinnamon, edges soon serrulate and beaded with droplets. — **Stipe** 6—12 cm long, 15—30 mm thick, rigid, nearly equal above a  $\pm$  bulbous base, stuffed then hollow, white, the cuticle soon broken up into series of scales, finally sordid over all. — **Veil** none.

**Spores** 11—14 (14.5)  $\times$  6.5—8  $\mu\text{m}$ ,  $\pm$  obscurely inequilateral to inequilateral in profile, in face view ovate to oval but with an apical "snout"; surface rugulose and rarely the spore calyptrate from loosening of the outer layer; clay color or paler revived in KOH; quickly dextrinoid in Melzer's; apex showing a hyaline discontinuity in most spores. — **Basidia** 4-spored, 24—27  $\times$  8—10  $\mu\text{m}$ , clavate, hyaline in KOH (no hyaline globules noted), in Melzer's red but quickly fading to orange and paler. — **Pleurocystidia** none. — **Cheilocystidia** (33) 40—60 (80)  $\times$  6—10  $\mu\text{m}$ , subcylindric to clavate, or  $\pm$  ventricose near midportion or below, agglutinating and becoming  $\pm$  ochraceous as seen adhering in bunches, with adhering aggregations of

spores. — Cuticle of pileus an isolattice collapsing to an ixocutis, hyphae 1.5—3  $\mu\text{m}$  diam., clamped at septa, hyaline, refractive, smooth. — Hypodermium hyphoid and pale clay color in KOH, in Melzer's reddish soon fading, walls smooth. — Pilear trama of broad loosely interwoven hyphae red in Melzer's but quickly fading to dull ochraceous. — Lamellar trama of  $\pm$  parallel hyphae 4—12  $\mu\text{m}$  broad, red but soon ochraceous in Melzer's.

Habit, habitat and distribution. — Caespitose to gregarious in mixed deciduous-conifer forests. Mackinaw City, Michigan, Sept. 16, 1950, SMITH 35888 (type of variant, MICH).

Observations. — This is one of the large species of the genus. Its diagnostic features are the strong raphanoid odor and taste, the vinaceous brown pileus slowly becoming grayish brown ("Wood Brown"), and the white stipe with the cuticle breaking up into scales (but lacking a veil). This variant differs from the European type in slightly more vinaceous brown colors when fresh and the cheilocystidia were more frequently clavate than fusoid-ventricose (the latter as shown by BRUCHET). In other species, however, it has been our tendency to "allow" considerable variation in the shape and size of these cells. For the present I regard Sm-35888 as an American variant of *H. sinapizans*, and so do not present this account as describing formally an infraspecific taxon. BRUCHET (1970) illustrated only one type of cheilocystidium (fusoid-ventricose), and pleurocystidia were lacking — in contrast to HESLER's studies (in ms.) on European collections.

### Previously Undescribed Species and Changes in Rank

#### 1. *Hebeloma calvini* HESLER & SMITH stat. et nom. nov.

Syn.: *Hebeloma crustuliniforme* f. *sphagnophilum* KAUFF., Agar. Mich. p. 477, 1918.

Pileus 4—7 cm broad, obtuse to convex, the margin inrolled, expanding to plane or with a slight umbo, at times depressed around the umbo; surface glabrous, viscid, even, color whitish overall on some. in some the disc becoming pale tan; margin opaque. — Context white, odor of alcohol esthers, taste not recorded. — Lamellae emarginate and with a decurrent tooth, moderately close and broad, white becoming brownish from the spores, edges crenulate and beaded with droplets. — Stipe 7—9 cm long, 5—8 mm thick, equal to a slightly bulbous base, readily splitting lengthwise; stuffed becoming hollow, white-mealy over upper half; white overall and surface undulating, becoming brownish in drying.

Spores (9) 10—11 (12)  $\times$  5—6.5 (7)  $\mu\text{m}$ , in profile view inequilateral in most spores, in face view ovate, minutely rugulose-roughened, dextrinoid, in KOH pale clay color; apex with a slight hyaline discontinuity. — Basidia 4-spored, 26—32  $\times$  6.6—8  $\mu\text{m}$ , hyaline in

KOH, red in Melzer's but soon fading. — *Pleurocystidia* absent. — *Cheilocystidia* abundant,  $40\text{--}65$  ( $74$ )  $\times$   $6.5\text{--}9$   $\mu\text{m}$ , subcylindric to narrowly clavate or often ventricose toward the base, thin-walled, smooth, slightly refractive in KOH, rarely capitate. — *Caulocystidia* similar to cheilocystidia but mostly more elongated. — *Lamellar trama* of hyphae arranged  $\pm$  parallel to each other, reddish in Melzer's reagent but soon fading. — *Pilear trama* red in Melzer's but fading to orange to ochraceous,  $\pm$  radial-interwoven, walls lacking incrustations. — *Hypodermium* (in KOH) a layer of brownish hyphae lacking distinct incrustations but minute irregularities present on many hyphae. — *Cuticle* of pileus an ixocutis, the hyphae  $1\text{--}2$   $\mu\text{m}$  diam, smooth, usually clamped at the septa; branching sparse.

*Habit, habitat and distribution.* — On *Sphagnum*, Mud Lake Bog, Washtenaw County, Michigan, Oct. 20, 1906, legit C. H. KAUFFMAN. Apparently known to date only from the type locality.

*Observations.* — The important features which remove this taxon from *H. crustuliniforme*, are the fragrant odor when fresh, the readily splitting stipe (as observed by KAUFFMAN), and the stipe changing to dull brown in drying. The basidiocarps in the type collection resemble rather closely those of *H. incarnatum*, a species featuring the same habitat but lacking a fragrant odor and not having a fragile, splitting stipe.

The caulocystidia measure up to  $90$   $\mu\text{m}$  or more long. This taxon is named in honor of Prof. Calvin Henry KAUFFMAN, its discoverer.

## 2. *Hebeloma incarnatum* A. H. SMITH sp. nov. — Fig. 3

Pileus  $3\text{--}5$  ( $8$ ) cm latus, late convexus vel leviter umbonatus, viscidus, glaber, pallide vinaceobrunneus, ad marginem sordide pallidus. Sapor raphanius demum amarus; odor  $\pm$  raphanius. Lamellae angustae, confertae, adnatae demum subdecurrentes. Stipes  $5\text{--}9$  cm longus,  $5\text{--}10$  ( $12$ ) mm crassus, subbulbosus, sursum aequalis, albidus demum sordidus, sursum furfuraceus, substriatus. Velum nullum. Sporae  $9\text{--}12$   $\times$   $5.5\text{--}7$  ( $7.5$ )  $\mu\text{m}$ , dextrinoideae. Basidia tetraspora. Pleurocystidia nulla. Cheilocystidia ( $37$ )  $50\text{--}74$   $\times$   $4\text{--}6$  ( $8$ )  $\mu\text{m}$ , elongate clavata, anguste, fusoido-ventricosa, subcylindrica, etc. Specimen typicum in Herb. Univ. Mich. conservatum est; legit prope Whitmore Lake, Washtenaw Country, Mich. Oct. 14, 1961, Sm-64680.

Pileus  $3\text{--}5$  ( $8$ ) cm broad, broadly convex, slightly umbonate or expanded and  $\pm$  plane, margin finally recurved in some; "Fawn Color" or darker vinaceous brown at first, becoming paler to "Pinkish Cinnamon", margin often paler than the disc but in drying becoming pinkish brown to pinkish tan overall; surface viscid and glabrous, pellicle separable, margin even. — *Context* white, thick in the disc, thin over the marginal area; odor raphanoid; taste bitterish to radish like,  $\pm$  nauseous. — *Lamellae* adnate with a decurrent tooth, narrow, crowded, avellaneous but with a tint of cinnamon, edge white-





Fig. 3: *Hebeloma incarnatum*, Sm-33-1129. (bar = 2 cm).



floccose, seldom beaded with moisture and none seen with brownish spots (presumably such spots are from beads of moisture on the gills). — *Stipe* 5–9 cm long, 5–10 (12) mm thick, equal above a more or less distinct bulb, white to pallid overall, apex furfuraceous to pruinose, surface often  $\pm$  longitudinally striate, surface undulating. *Veil* absent.

*Spore deposit*: dingy reddish cinnamon. — *Spores*  $9\text{--}12 \times 5.5\text{--}7$  (7.5)  $\mu\text{m}$ , inequilateral in profile view, ovate in face view, at apex at most only slightly snoutlike; surface appearing smooth under a high-dry 3mm objective. Pale clay color revived in KOH; in Melzer's tawny reddish to distinctly dextrinoid. — *Basidia* 4-spored,  $24\text{--}32 \times 8\text{--}12 \mu\text{m}$   $\pm$  utriform as sterigma begin to form, hyaline in KOH and lacking hyaline globules as revived in KOH; bright red in Melzer's reagent but soon fading. — *Pleurocystidia* absent. — *Cheilocystidia* (37)  $50\text{--}70 \times 4\text{--}7 \mu\text{m}$ , versiform: hockeystick-like, filamentose, cylindric, short to long-clavate, all blunt at apex, some elongate fusoid-ventricose, some with a subapical swelling to a rudimentary branch, often in bunches and apparently somewhat agglutinated (but not discolored). — *Cuticle of pileus* an ixocutis, the hyphae narrow ( $1\text{--}2.5 \mu\text{m}$ ), clamped and near hypodermium mostly  $2\text{--}5 \mu\text{m}$  diam. — *Hypodermium* a layer of cells and hyphal segments, color  $\pm$  clay color in KOH, no incrustations present on the walls.

*Habit, habitat and distribution*. — Solitary to scattered on living *Sphagnum* moss especially in the larch-poison-sumac zone in bogs in Michigan, especially those in the lower part of the southern peninsula. Common in this habitat during many seasons. The type collection (Sm-64680) was made at Mud Lake Bog in Washtenaw Country, Oct. 14, 1961. My first collection of it from that bog was made in 1929.

*Observations*. — The vinaceous brown to pinkish tan pileus, the long white stipe with its bulbous base, lack of a veil, and the medium sized obscurely ornamented spores are its distinctive features along with the odor and taste of fresh material, the failure of the stipe to discolor, and the gills which do not become spotted. SMITH (1936) published a description and illustration of this species under the name *H. elatum* Fr. But it appears that *H. elatum* is still somewhat of a "nomen ambiguum" in Europe and our species shows features which should have been mentioned for *H. elatum* if the material of the latter species possessed them.

*H. longicaudum* (Pers.: Fr.) KUMMER sensu BRUCHET is said to have a very rudimentary veil, but apparently is not sufficiently well developed to show or leave any traces. In addition BRUCHET emphasized even coloration overall for the pileus of *H. longicaudum* — a feature the opposite of that shown by the pileus of *H. incarnatulum*.

3. *Hebeloma mackinawense* L. R. HESLER & A. H. SMITH sp. nov.

Pileus 3—11 cm latus, convexus demum late convexus vel planus, glaber viscidus, pallide alutaceus, margine pallidior, aquoso-zonatus vel aquoso-maculatus. Lamellae pallido — brunneae deinde paene rufobrunneae, confertae, latae. Stipes albidus, deorsum brunnaceus, sursum squamulosus, Velum deest. Sporae  $9-12 \times 6-7.5 \mu\text{m}$ , dextrinoideae. Pleurocystidia  $50-90 \times 8-11 \mu\text{m} \times 4-6 \mu\text{m}$ . Hypodermium nullum. Specimen typicum in Herb. Univ. Mich. conservatum est, legit H. D. THIERS et A. H. SMITH, Sm-35841.

Pileus 3—11 cm broad, convex and with the margin at first incurved, finally broadly convex to nearly flat, glabrous, viscid, disc pale tan ("Pinkish Buff") to darker ("Cinnamon Buff"), the margin usually paler (whitish near the edge), at times with zones of watery spots or these scattered over the surface, in age at times darkening overall to alutaceous. — Context white, moderately thick, odor none or faintly fragrant, taste mild or puckery but *not* raphanoid or bitter. — Lamellae pallid to brownish at first but soon dull reddish brown ("Verona Brown"), close, moderately broad, adnexed at maturity, edges becoming uneven to eroded and often spotted rusty brown or darker from clumps of spores. — Stipe 6—11 cm long, 1—2 cm thick at the apex, at the base slightly bulbous, solid but in age riddled with larvae, white at first, becoming merely pallid but finally dark dingy yellow brown from the base upward. — Veil absent.

Spores  $9-12 \times 6-7.5 \mu\text{m}$ , clay color as revived in KOH, strongly dextrinoid when revived in Melzer's reagent; surface faintly roughened. — Basidia 4-spored,  $22-28 \times 8-11 \mu\text{m}$ ,  $\pm$  utriform at beginning of sporulation, hyaline in KOH, in Melzer's reagent red but soon fading. — Pleurocystidia readily demonstrated,  $50-90 \times 8-11 \times 4-6 \mu\text{m}$ , fusoid-ventricose with cylindric neck ending in an obtuse apex, thin-walled, smooth, rarely with a secondary cross wall usually distal to the ventricose portion. — Cheilocystidia  $\pm$  similar to pleurocystidia in part but also mostly not as long and more with flexuous walls, basically  $\pm$  cylindric. — Gill trama subparallel to interwoven, hyaline in KOH, subhymenium not distinctive; red in Melzer's but soon fading, hyphae hyaline in KOH, red as revived in Melzer's but soon fading. — Hypodermium not differentiated either by color or size of the hyphal elements, reddish in Melzer's but fading (as in the rest of the pilear trama). Cuticle of pileus a thick isolattice to an ixocutis (possibly an ixotrichodermium in very young basidiocarps), the hyphae  $2-3 \mu\text{m}$  diam, hyaline, smooth, clamps present; no incrustations evident in hypodermal or cuticular region either in KOH or in Melzer's.

Habit, habitat and distribution. — Subcespitate-gregarious in mixed conifer and hardwood stands. Mackinaw City, Michigan, Sept. 16, 1950, legit H. D. THIERS and A. H. SMITH 35841 (MICH).

**Observations.** — This species bears some resemblance to *H. crustuliniforme* in stature but is at once distinguished by the odor and taste as well as the long pleurocystidia. *H. sinapizans* sensu HESLER (in ms.) is described as having pleurocystidia, but differs in a strongly raphanoid odor and taste. In over-mature basidiocarps the hypodermium of *H. mackinawense* can finally be discerned by the pale brownish color-tinge of the hyphal walls.

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Jahr/Year: 1984

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Autor(en)/Author(s): Smith Alexander H.

Artikel/Article: [Studies of Species of Hebeloma \(FR.\) KUMMER from the Great Lakes Region of North America I. 271-283](#)