The genus *Kernia*[1]

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Received July 17, 1970

MALLOCH, D., and R. F. CAIN. 1971. The genus *Kernia*. Can. J. Bot. **49**: 855–867.

The Ascomycete genus *Kernia* is emended according to revised concepts. Five species, *K. bifurcotricha* Saxena & Mukerji, ***K. hippocrepida*** sp. nov., *K. nitida* (Sacc.) Nieuwland, and ***K. pachypleura*** sp. nov., are included and a key to the species given. Two species, *K. brachytricha* (Ames) Benjamin and *K. geniculotricha* Seth, are placed in synonymy with *K. nitida*. Three species, *K. bartlettii* (Massee & Salmon) Benjamin, *K. furcotricha* Tandon & Bilgrami, and *K. spirotricha* Benjamin, are excluded from *Kernia*. *K. bartlettii* belongs in *Lophotrichus* Benjamin and is transferred to that genus as ***L. bartlettii*** (Massee & Salmon) Malloch & Cain. *K. furcotricha* is considered a possible species of *Chaetomidium* (Zopf) Sacc. *K. spirotricha* belongs in *Chaetomidium* and is transferred as *C. spirotrichum* (Benjamin) Malloch & Cain. As a result of studies of the type specimen of *Fairmania singularis* Sacc., since a Fairman collection under that name was included in *K. hippocrepida*, the new combination ***Microascus singularis*** (Sacc.) Malloch & Cain is proposed.

Introduction

The genus *Kernia* was proposed by Nieuwland (1916) for the cleistothecial Ascomycete *Magnusia nitida* Saccardo. As Nieuwland pointed out, the generic name *Magnusia* Saccardo is a later homonym of *Magnusia* Klotzsch, a genus of the Begoniaceae.

Kernia nitida and subsequent species have all been characterized by fascicled hair-like ascocarp appendages and reddish-brown to brown ascospores.

Recently, Malloch (1970) pointed out that *Kernia* has most of the characteristics of the Microascaceae such as lack of croziers, evanescent asci, dextrinoid ascospores with germ pores, and complex annellophore-type conidial stages. It should be added that here the cultural characteristics and ecology of *Kernia* species are also typical of this family. In the same paper, Malloch referred to the discovery of species of *Kernia* lacking ascocarp appendages. This represents a departure from previous concepts of the genus but can be accepted if *Kernia* is considered within the broader framework of the Microascaceae. It would be unrealistic to place two nearly identical species of Microascaceae in separate genera on the basis of ascocarp vestiture. Within the Microascaceae, then, *Kernia* has been reserved for those members with thick-walled, nonostiolate ascocarps and, usually, slow-growing colonies. The related genus *Petriellidium* Malloch can be distinguished by its thin-walled, nearly transparent ascocarps and rapidly spreading colonies. *Kernia* and *Petriellidium* bear approximately the same relationship to each other as *Microascus* Zukal and *Petriella* Curzi.

In the present paper we have attempted to draw together the species of *Kernia* as members of the Microascaceae. Although a number of problems in this genus are left unsolved we believe that it would be useful to describe and illustrate the species in accordance with revised concepts. We hope that our contribution will lead to a more confident disposition of new isolates and to a better definition of the problems yet to be confronted.

Kernia Nieuwland. Amer. Midland Natur. 4: 379. 1916.

= *Magnusia* Sacc. Michelia 1: 123. 1878. (non *Magnusia* Klotzsch, 1854)

Ascocarp initials filamentous, coiled or irregularly twisted. Ascocarps globose to ovoid, ellipsoidal, polyhedral, or irregular in shape, dark brown to black, usually somewhat hairy when young, glabrous or appendaged at maturity, nonostiolate, with a thick-walled and usually somewhat amyloid peridium. Asci irregularly disposed, not borne on croziers, pyriform to globose, evanescent. Ascospores one-celled, ellipsoidal to reniform, smooth, hyaline to orange-brown or copper colored, with one or two germ pores, dextrinoid in Melzer's solution. Conidia produced on annellophores (*Scopulariopsis* Bainier or *Graphium* Corda) or as arthrospores.

TYPE SPECIES: *Magnusia nitida* Saccardo

[1]Support from the National Research Council of Canada as grants to the junior author and a scholarship to the senior author is gratefully acknowledged.

KEY TO THE SPECIES OF *Kernia*

1. Ascocarps subglobose to globose 2
1. Ascocarps subglobose to ellipsoidal, ovoid or polygonal ..... *K. nitida*

2. Ascocarps with dark, well-differentiated, branched appendages ..... *K. bifurcotricha*
2. Ascocarps without such appendages 3

3. Ascospores ellipsoidal to ovoid 4
3. Ascospores reniform ..... *K. hippocrepida*

4. Ascospores nearly hyaline, with one germ pore ..... *K. hyalina*
4. Ascospores colored, with two germ pores ..... *K. pachypleura*

Kernia bifurcotricha Saxena & Mukerji, Trans. Brit. Mycol. Soc. 54: 146. 1970.

K. bifurcotricha appears to differ little from *Lophotrichus bartlettii* (Massee & Salmon) Malloch & Cain. It is possible, as with *L. bartlettii*, that the ostiole in *K. bifurcotricha* is difficult to demonstrate, thus making that species appear to belong in *Kernia*.

Unlike other species of *Kernia*, *K. bifurcotricha* is reported to grow fairly rapidly and lacks an annellospore conidial state. The ascospores are larger than those of other *Kernia* species and the asci tend to be elongated. All of these are characteristic of *L. bartlettii* and other species of *Lophotrichus*.

In spite of the above remarks, we believe that until *K. bifurcotricha* is proven to be a species of *Lophotrichus* it should be treated as a legitimate species of *Kernia*.

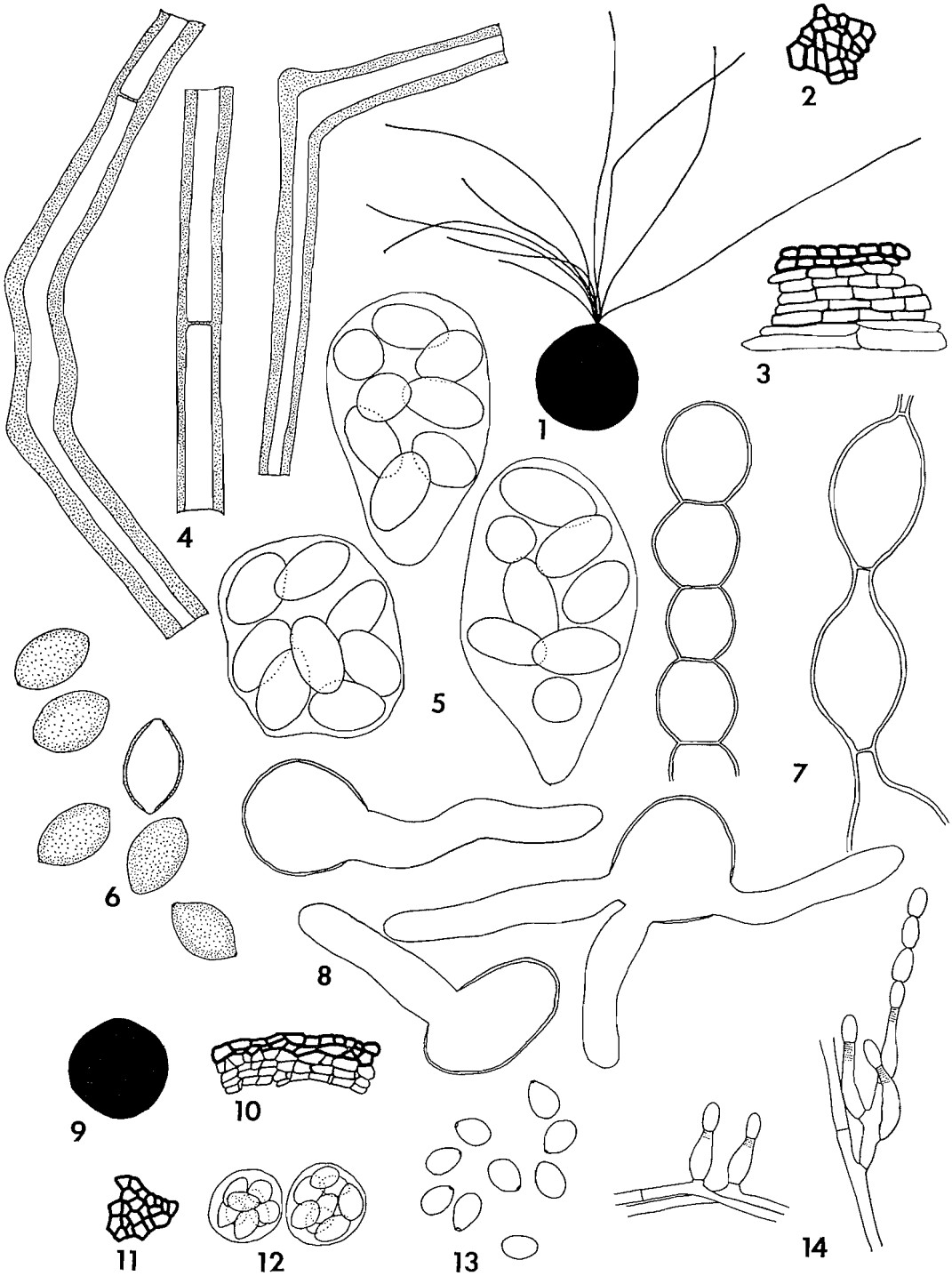
Kernia hippocrepida Malloch & Cain, sp. nov. Figs. 15–24

Coloniae in agaro "yeast–cellulose" lente crescentes, secundum diametrem aetate 35 dierum 6 cm, ab appressis floccosae, hyalinae, cum annulis brunneis, ascocarpae globosae, nigrae, nonostiolatae, 150–250 μ crassae; asci irregulariter dispositi, subglobosi vel globosi, octospori, evanescentes, nonstipitati, 10–16 μ crassi; ascosporae reniformes, aurantiacae vel aurantiobrunneae, dextrinoideae, laeves, biporosae, 5.0–7.0 × 4.2–6.0 × 4.0–5.5 μ; status imperfectus *Scopulariopsis* vel *Graphium*; conidiophorae solitariae vel aggregatae, hyalinae vel brunneae, 16–90 × 2.5–3.5 μ, ad apices ramosae; annellophorae cylindraceae, ad basas inflatae, 8.5–28 × 2.0–3.5 μ; annellosporae pyriformes, ad basas truncata, unicellares, hyalinae, laeves, 3.5–12.5 × 2.0–4.0 μ, ex conidiophoribus in capitulum mucosum successive extrusae.

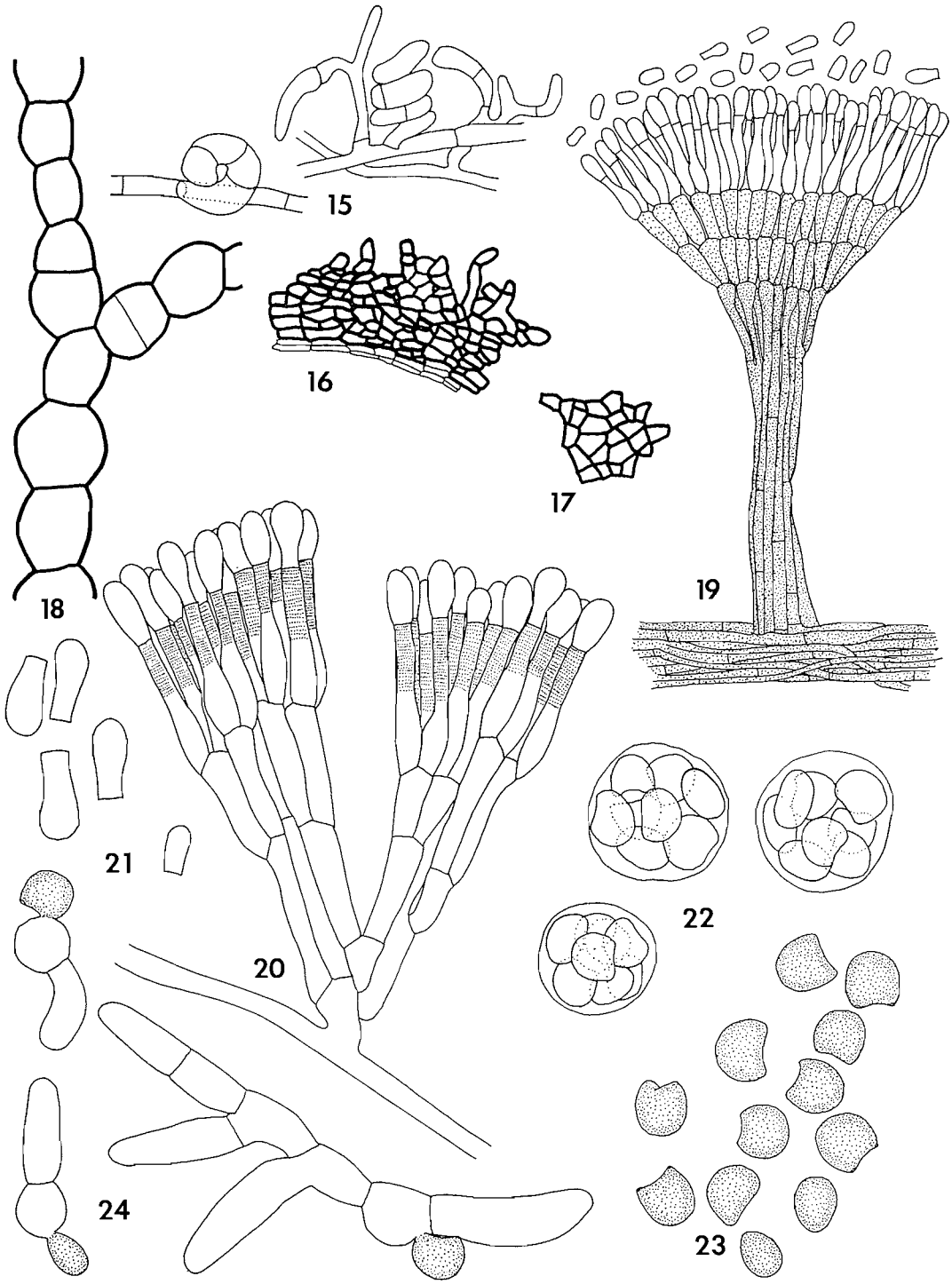
HOLOTYPUS: in fimo *Erethizonis dorsati*, 9 mi E of Brockville, Leeds Co., Ontario, Canada, 5 Sept. 1965, *Krug*, TRTC 43764. In Cryptogamic Herbarium, University of Toronto.

ETYMOLOGY: Greek, *hippos* = horse, and *krepis* = shoe, referring to the horseshoe-shaped ascospores.

Colonies on yeast–cellulose medium (see below) attaining a diameter of 6 cm in 5 weeks at room temperature, appressed to somewhat cottony, hyaline with brown growth rings, zonate; reverse brown; hyphae hyaline to light brown, abundantly septate, with numerous subglobose to globose swellings, branched, 2–13 μ in diameter; *ascocarp initials* at first simple coils, soon becoming compact and contorted and involving neighboring hyphae, *ascocarps* globose, black by reflected light, dark brown to black by transmitted light, nonostiolate, hairy as a result of numerous dark brown hyphal attachments, about 150–250 μ in diameter; *ascocarp peridium* 10–35 μ thick, consisting of a dark outer tissue and a hyaline evanescent inner tissue; peridial cells of the outer layer 3–7 × 1–7 μ, dark brown, pseudoparenchymatous in surface view, rounded in cross section, proliferating into dark hair-like hyphae from the outermost layer, 4 to 10 cells deep in cross section; peridial cells of the inner layer hyaline, thin-walled evanescent; *asci* 10–16 μ in diameter, irregularly disposed, subglobose to globose, eight-spored, evanescent, nonstipitate; *ascospores* 5.0–7.0 × 4.2–6.0 × 4.0–5.5 μ, reniform to subcircular in face view, elliptical in side view, light brown by transmitted light, orange to reddish brown in mass, smooth, with two apical germ pores, with a prominent de Bary bubble, dark orange to reddish purple in Melzer's solution, *conidial stage* a *Scopulariopsis* or *Graphium*; *conidiophores* 16–90 × 2.5–3.5 μ, solitary or more commonly united into synnemata, hyaline to dark brown, septate, penicillately branched at the apex; *annellophores* 8.5–28 × 2.0–3.5 μ, borne in groups of two to six, flask-shaped to nearly cylindrical, hyaline;



FIGS. 1–8. *Lophotrichus bartlettii*. Fig. 1. Ascocarp (× 60). Fig. 2. Peridium surface (× 650). Fig. 3. Cross section of peridium (× 650). Fig. 4. Ascocarp appendages (× 1500). Fig. 5. Asci (× 1500). Fig. 6. Ascospores (one in optical section) (× 1500). Fig. 7. Arthrospores (× 1500). Fig. 8. Germinating arthrospores (× 1500). FIGS. 9–14. *Kernia hyalina*. Fig. 9. Ascocarp (× 130). Fig. 10. Cross section of peridium (× 650). Fig. 11. Peridium surface (× 650). Fig. 12. Asci (× 1500). Fig. 13. Ascospores (× 1500). Fig. 14. Annellophores (× 1500).



FIGS. 15–24. *Kernia hippocrepida.* Fig. 15. Ascocarp initials (× 1500). Fig. 16. Cross section of peridium (× 650). Fig. 17. Peridium surface (× 650). Fig. 18. Swollen vegetative cells (× 1500). Fig. 19. Synnema (× 650). Fig. 20. Conidiophores (× 1500). Fig. 21. Conidia (× 1500). Fig. 22. Asci (× 1500). Fig. 23. Ascospores (× 1500). Fig. 24. Germinating ascospores (× 1500).

conidia 3.5–12.5 × 2.0–4.0 μ, pyriform to clavate, hyaline, one-celled, smooth, rounded at the apex, truncate at the base, collecting in wet masses at the apices of the conidiophores.

HABITAT: on dung and wood; Canada, Germany, U.S.A.

SPECIMENS EXAMINED: CANADA: Ontario: York Co.: Toronto, on dung, Nov. 1935, *Jackson*, TRTC 33491. Leeds Co.: 9 mi E of Brockville, on porcupine dung, 5 Sept. 1965, *Krug*, HOLOTYPE TRTC 43764. GERMANY: Tamsel, on partridge dung, 18 Feb. 1935, *Vogel*, TRTC 33490. U.S.A.: New York: Monroe Co.: Lyndonville, on wood chips, Sept. 1910, *Fairman*, (in Farlow Herbarium, Harvard University, as *Fairmania singularis* Sacc.).

Cultures of TRTC 43764 have been deposited with the American Type Culture Collection (ATCC), the Centraalbureau voor Schimmelcultures (CBS), and the Commonwealth Mycological Institute (IMI).

K. hippocrepida differs from the other species of *Kernia* in having strongly reniform ascospores. They most closely resemble those of *Microascus longirostris* Zukal or *M. singularis* (Saccardo) Malloch & Cain but are even more strongly curved. The ascocarps lack appendages.

There is some discrepancy in the ascospore measurements cited above. All have distinct but overlapping dimensions.

These are
5.0–7.0 × 4.2–6.0 × 4.0–5.5 μ
(TRTC 43764)
4.0–5.5 × 3.5–5.0 × 3.5–4.2 μ
(Fairman collection)
4.5–5.0 × 3.8–4.2 × 2.8–3.2 μ
(TRTC 33490 and 33491)

As will be readily seen there is no overlap between the dimensions of the largest and smallest and thus two species might be established. The Fairman collection, however, has a broader range of measurements and overlaps both. Thus any separation on spore measurements must await further collections. Only one collection (TRTC 43764) has been studied in culture, the other collections being old and dead. Thus, there is no way of knowing whether or not they would appear identical in culture. The Fairman collection appears to have an associated conidial stage similar to that of TRTC 43764 but there is no trace of conidial stage with the others.

The Fairman collection is interesting from another point of view. It had been identified by Fairman as *Fairmania singularis* Saccardo, the type species of *Fairmania*, but is not the type collection (holotype) of that species. Since the genus *Fairmania* (Saccardo 1906) predates *Kernia* by 10 years it would, if congeneric, have to take precedence as the correct generic name. We have obtained the type specimen of *F. singularis* from the Saccardo herbarium in Padova and found that it is not the same as the Fairman collection studied here. It is, in fact, an ostiolate species identical with *Microascus doguetii* Moreau. The conidia with germ slits, typical of *M. doguetii*, are present on the surface of the substrate. Although the type of *Fairmania* is not identical with *Kernia*, *Fairmania singularis* does predate *Microascus doguetii*. The following new combination is made.

Microascus singularis (Saccardo) Malloch & Cain, comb. nov.

BASIONYM: *Fairmania singularis* Saccardo. Ann. Mycol. 4: 276. 1906.

SYNONYM: *Microascus doguetii* Moreau. Rev. Mycol. 18: 177. 1953.

Because *Microascus* Zukal predates *Fairmania*, *Fairmania* becomes a synonym of *Microascus*.

The purpose of the above discussion has been to emphasize the fact that *K. hippocrepida* is a species based entirely on the type specimen. The other collections can only be regarded as possible members of that species.

The conidial state of *K. hippocrepida* is often difficult to obtain in culture. It is produced most abundantly at temperatures below 18°C and on media rich in peptone and yeast extract. Thus Leonian's medium (Leonian 1924) plus 1 g/l yeast extract, or a medium consisting of 6 g/l peptone, 6 g/l yeast extract, 10 g/l Alphacel, and 2% agar has proved useful. The latter medium has also been successful when the Alphacel is replaced by strips of sterile filter paper placed on the surface of the medium. The conidiophores are most commonly united into synnemata of the *Graphium* type.

K. hippocrepida (and the other similar collections cited) are quite similar to species of *Fragosphaeria* Shear when observed on the natural substrate. Species of *Fragosphaeria*, however, have nondextrinoid ascospores without germ pores.

Kernia hyalina Malloch & Cain, sp. nov. Figs. 9–14

Coloniae in agaro "Weitzman & Silva-Hutner" lente crescentes, secundum diametrem aetate 60 dierum 6 cm, appressae vel granulatae, ochroleucae vel viridi-griseae, azonatae; ascocarpae globosae, nigrae, laeves, nonostiolatae, 55–175 μ crassae; asci irregulariter dispositi, ad ovoideis subglobosi, octospori, evanescentes, 7.0–10.5 μ crassi; ascosporae ovoideae, hyalinae, laeves, uniporosae, dextrinoideae, 4.0–5.0 × 2.5–3.5 μ; status imperfectus modo *Scopulariopsis* productus; conidiophorae simplices vel ramosae, hyalinae; annellophorae solitariae vel gregariae, cylindraceae, ad basas inflatae, 5.5–8.0 × 2.0–3.0 μ; annellosporae ovoideae, ad basas truncatae, hyalinae vel griseobrunneae, laeves vel spinulosae, 3.5–5.0 × 2.0–3.5 μ, catenulatae.

HOLOTYPUS: in fimo vaccino, Potter, Cheyenne Co., Nebraska, U.S.A., 16 Aug. 1964, *Cain*, TRTC 45422. In Cryptogamic Herbarium, University of Toronto.

ETYMOLOGY: Greek, *hyalinos* = transparent, referring to the nearly colorless ascospores.

Colonies on Weitzman and Silva-Hutner's medium (Weitzman and Silva-Hutner 1967) attaining a diameter of 6 cm in 2 months at room temperature, appressed to granular, greenish grey where ascocarps abundant, cream colored in sterile areas, azonate, tending to produce sterile sectors; reverse colorless to greenish; *hyphae* 1.0–3.5 μ diameter, hyaline, rarely brown, remotely to abundantly septate, branched, anastomosing; *ascocarp initials* at first coiled or contorted hyphal filaments, soon forming compact masses as a result of profuse branching; *ascocarps* 55–175 μ in diameter, globose, dark greenish by reflected light when young, black when mature, opaque, smooth, glabrous except for a few hyphal attachments, nonostiolate; *ascocarp peridium* 7–20 μ thick, consisting of three poorly differentiated tissue types; peridial cells of the outer layer 3.5–7.0 μ in diameter, pseudoparenchymatous in surface view, thick-walled, brown, one cell deep in cross section; peridial cells of the middle layer 3.5–10 μ in diameter, thinner walled than those of the outer layer, brown, one to three cells deep in cross section; peridial cells on the inner layer 4.0–18 × 1.5–3.5 μ, thin-walled, hyaline to light brown, strongly flattened in cross section, nearly isodiametric in surface view; *asci* irregularly disposed, ovoid to subglobose, eight-spored, nonstipitate, evanescent, 7.0–10.5 μ in diameter; *ascospores* 4.0–5.0 × 2.5–3.5 μ, broadly ovoid, hyaline by transmitted light, hyaline to very pale yellowish in mass, thin-walled, smooth, with a prominent de Bary bubble, with a single germ pore at the narrow end, dark reddish orange in Melzer's solution when young; *conidial stage* a *Scopulariopsis*; *conidiophores* arising from the aerial or substrate mycelium, usually simple, rarely branched, hyaline, bearing one to several annellophores at the apex; *annellophores* 5.5–8.0 × 2.0–3.0 μ, borne singly on the mycelium or in clusters at the tips of the conidiophores, swollen just above the base, abruptly narrowing into the annellated zone; *conidia* 3.5–5.0 × 2.0–3.5 μ, ovoid, truncate at the base, pointed to rounded at the apex, hyaline to light brown by transmitted light, greyish brown in mass, smooth to slightly spinulose, often covered with mucilaginous material, forming long chains.

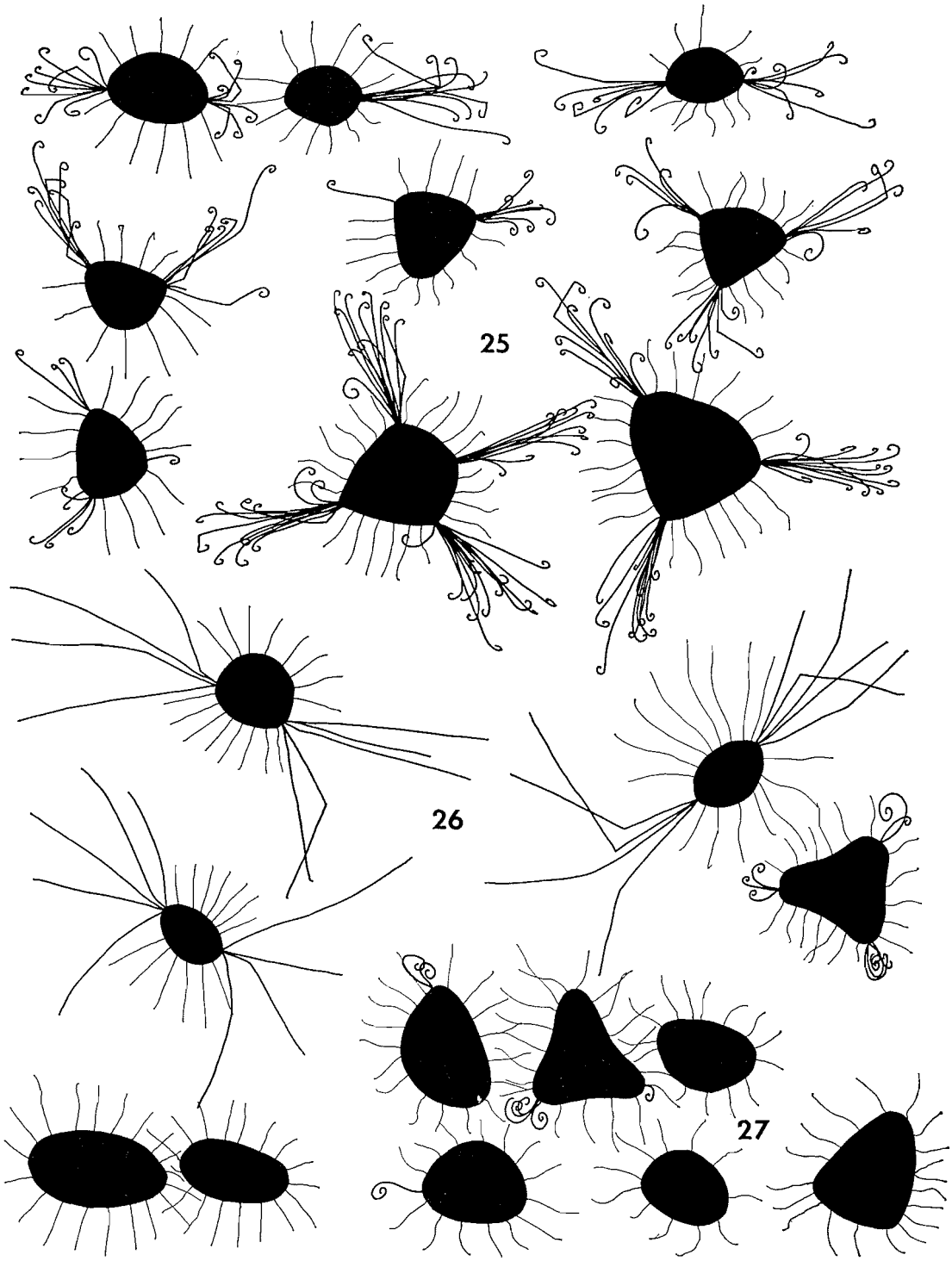
SPECIMENS EXAMINED: U.S.A.: Nebraska: Cheyenne Co.: Potter, culture from cow dung, 16 Aug. 1964, *Cain*, HOLOTYPE TRTC 45422.

Cultures derived from TRTC 45422 have been deposited with ATCC, CBS, IMI.

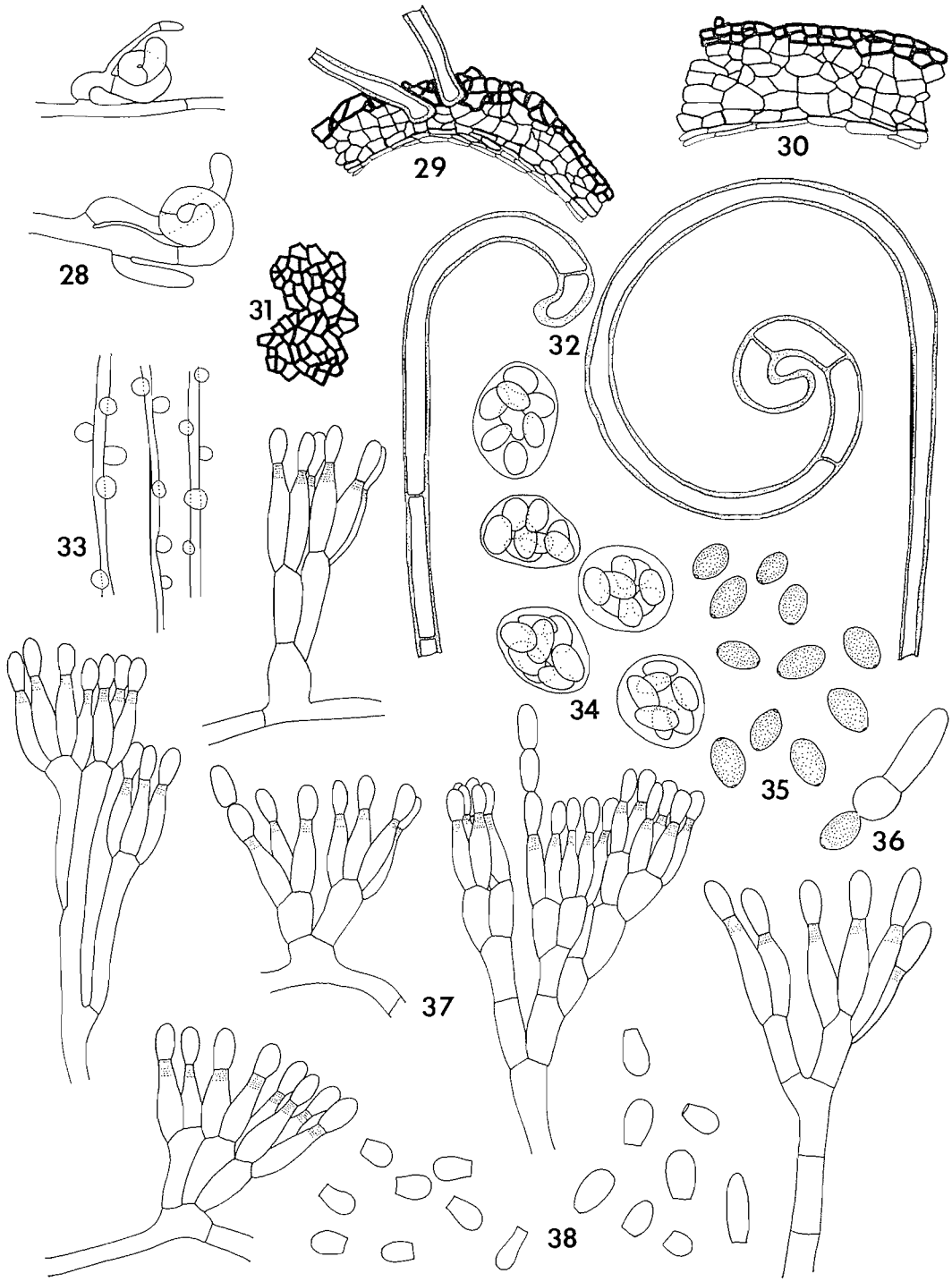
K. hyalina serves to illustrate the usefulness of generic concepts based on multiple characters. In this species ascocarp appendages are lacking, the ascospores are hyaline rather than colored and have one germ pore instead of two. The colony characteristics, developmental details, dextrinoid ascospores, and *Scopulariopsis* conidial stage, however, clearly indicate that it is a *Kernia*. The colorless ascospores with only one germ pore make this species unique.

Kernia nitida (Saccardo) Nieuwland. Amer. Midland Natur. 4: 379. 1916. Figs. 25–38
≡ *Magnusia nitida* Saccardo. Michelia, 1: 123. 1878.
= *Magnusia brachytricha* Ames. Mycologia, 29: 223. 1937.
≡ *Kernia brachytricha* (Ames) Benjamin. El Aliso, 3: 344. 1956.
≡ *Kernia brachytricha* (Ames) Tandon & Bilgrami. Lloydia, 24: 168. 1961.
= *Kernia geniculotricha* Seth. Acta Bot. Neerl. 17: 481. 1968.

Colonies on V8 juice medium (Miller 1955) attaining a diameter of 3–5 cm in 3 weeks at room temperature, appressed to felty or cottony, grey



FIGS. 25–27. *Kernia nitida.* Fig. 25. Ascocarps of TRTC 41909*a* (× 60). Fig. 26. Ascocarps of TRTC 41909*b* (× 60). Fig. 27. Ascocarps of TRTC 45337 (× 60).



FIGS. 28–38. *Kernia nitida*. Fig. 28. Ascocarp initials (× 1500). Fig. 29. Cross section through a corner of an ascocarp showing origin of appendages (× 650). Fig. 30. Cross section of peridium (× 650). Fig. 31. Peridium surface (× 650). Fig. 32. Detail of two ascocarp appendages (× 650). Fig. 33. Hyaline ascocarp hairs showing bubble-like swellings (× 650). Fig. 34. Asci (× 1500). Fig. 35. Ascospores (× 1500). Fig. 36. Germinating ascospore (× 1500). Fig. 37. Conidiophores (× 1500). Fig. 38. Conidia (× 1500).

or black, occasionally white when aerial mycelium is abundant, azonate to zonate; reverse greyish brown to purple orange to nearly colorless; *hyphae* 1.0–5.5 μ in diameter, hyaline to brown, remotely septate, frequently anastomosing, usually darkest in color and of greatest diameter when submerged; *ascocarp initials* at first simple coils or sparsely branched filaments 1.5–3.5 μ in diameter, septate, soon becoming surrounded by a mass of hyphae arising from adjacent cells or from the coil itself, not usually involving the neighboring mycelium; *ascocarps* 75–400 μ in diameter, ranging in shape from subglobose to ovoid, ellipsoidal, polyhedral, or somewhat irregular in outline, black by reflected light, opaque, shining, covered with numerous white to grey hairs when young and thus appearing somewhat *Chaetomium*-like, glabrous at maturity or more commonly producing clusters of 1 to 15 or more dark hair-like appendages at the angles, nonostiolate, often slightly amyloid when young; *ascocarp appendages* 40–1500 × 3.0–7.0 μ, borne in fascicles of 1 to 15 or more at one to four points on the ascocarp, arising from the inner peridial cells, dark brown by transmitted light, black by reflected light, thick-walled, remotely septate, usually unbranched but occasionally bearing a few abortive branches, straight to broadly spiralled, often sharply bent or geniculate, straight or sharply circinate or contorted at the tips, smooth or marked by warts or rings, usually somewhat broader at the tip; *hyaline ascocarp hairs* disappearing in age, uniformly distributed over the surface of the ascocarp, producing large bubble-like structures along the outer walls, indefinite in length, 1.0–3.0 μ thick; *ascocarp peridium* 10–35 μ thick, thicker at the corners where the appendages arise (up to 50 μ), consisting of three poorly to well-differentiated tissue layers; peridial cells of the outer layer 2.0–7.0 μ in diameter, pseudoparenchymatous in surface view, rounded in cross section, dark brown, thick-walled, one to three cells deep in cross section; peridial cells of the middle layer 2.0–14 μ in diameter, thinner walled and lighter colored than those of the outer layer, nearly isodiametric in cross section or slightly flattened, two to six cells deep in cross section, often poorly differentiated from the outer layer; peridial cells of the inner layer 3.5–16 × 1.5–3.5 μ, hyaline to light brown, flattened in cross section, evanescent; *asci* 7–14 μ in diameter, irregularly disposed, ovoid to globose, eight-spored, nonstipitate, evanescent; *ascospores* 4.5–7.0 × 3.5–4.5 μ, ellipsoidal, rarely slightly asymmetrical, light brown to honey-colored by transmitted light, light brown to orange brown in dry mass, orange brown to copper-colored in wet mass, thin-walled, smooth, with a germ pore at each end, with a prominent de Bary bubble, reddish orange to dark red in Melzer's solution when young (dextrinoid); *conidial* stage a *Scopulariopsis*; *conidiophores* arising from the aerial or substrate mycelium, simple or branched, often united to form small synnemata, hyaline to light brown, bearing a cluster of annellophores directly at the apex or repeatedly and compactly branching to form a dense penicillus, 3.5–100 μ or more in length, 3.0–4.5 μ broad; *metulae* 8–11 × 2.0–3.0 μ, in groups of two or three or lacking, hyaline to light brown, smooth; *annellophores* 5.5–14 × 2.0–4.0 μ, produced in clusters of two to seven at the tips of the conidiophores or metulae, rarely solitary, flask-shaped to nearly cylindrical; *conidia* 3.5–12 × 2.0–4.5 μ, ovoid to nearly cylindrical, occasionally clavate, truncate at the base, rounded at the upper end, nearly hyaline by transmitted light, grey to tan in mass, smooth, adhering in chains and occasionally forming compact columns.

HABITAT: on dung of various kinds, soil, and decaying plant materials; cosmopolitan.

SPECIMENS EXAMINED: CANADA: Ontario: York Co.: near Toronto, on dung, Nov. 1935, *Jackson*, TRTC 6355. NW of Nobleton, on racoon dung, 18 Oct. 1960, *Cain*, TRTC 36459. Nashville, culture from an old burlap bag, 1 July 1960, *Cain*, TRTC 45650. Peel Co.: near Belfountain, on carnivore dung, 16 April 1967, *Malloch*, TRTC 45337. Simcoe Co.: S of Coldwater, on deer dung, 13 May 1967, *Malloch*, TRTC 45646. FRANCE: near Montpellier, on *Chrysolina sanguinolenta*, *T. Moreau* (Mycotheque Museum Paris 780). KENYA: E of Wamunyu, on dung, 22 Aug. 1966; *Cain*, *Griffin & Krug*, TRTC 66.1409*c*. MEXICO: San Luis Potosi: Villa Hidalgo, on goat dung, 18 Aug. 1960, *Cain*, TRTC 36801. Durango: N of Durango, on goat dung, 13 Aug. 1960, *Cain*, TRTC 36813. Tamaulipas: Reynosa, on burro dung, 20 Aug. 1960, *Cain*, TRTC 37013. Guanajuata: S of San Luis de la Paz, on cow dung, 6 Aug. 1961, *Cain*, TRTC 45463. PAKISTAN: Karachi, on camel dung, 11 July 1961, *Wasif*, TRTC 45707. SPAIN: Valencia, 2 km NE of Quintana del

Puente, on sheep dung, 7 May 1959, *Lundqvist* 1943-*e*, portion in TRTC. SW AFRICA: Gamsberg Pass, 95 km W of Rehoboth, on baboon dung, 24 April 1963, *Nordenstam*, TRTC 45658. U.S.A.: Arizona: Grand Canyon, on jack rabbit dung, Aug. 1934, *Harris*, Rel. Farlowiana 714, NY. Louisiana: Audubon State Park, on dung, 24 Aug. 1960, *Cain*, TRTC 38175. Massachusetts: Cambridge, 1906, *Thaxter*, 886, 889, FH. Nevada: White Pine Co.: McGill, on cow dung, 21 Aug. 1957, *Cain*, TRTC 41909*a* and 41909*b*. Tennessee: Great Smokey Mountains, Gregory Bald, on horse dung, Spring 1934, *Ames* (Type of *K. brachytricha*, FH). U.S.S.R.: near Moscow, on horse dung, 1919, *Satina*, NY.

Cultures of TRTC 41909*a*, 41909*b*, 45337, 45463, 45646, 45650, 45658, and 66.1409*c* have been deposited with ATCC, CBS, and IMI.

As will be concluded from the list of collections examined, *K. nitida* is a very common species. It is also, we believe, a variable species. Unlike most previous authors we are including under *K. nitida* all of the isolates with subglobose to ellipsoidal or polygonal ascocarps. Attempts have been made to segregate from *K. nitida* similar forms with short ascocarp hairs (*K. brachytricha*) or ones with the hairs bent at various points along their length (*K. geniculotricha*). On examining a large number of isolates, however, we have found that the hairs are the most variable characteristic. Both Bainier (1909) and Satina (1923) illustrated this variability. Bainier's illustrations clearly show types which would be placed in both *K. nitida* and *K. brachytricha*. The knee-like joints in *K. geniculotricha* are more prominent in some isolates than in others but can usually be found to some degree in all of them. Among our isolates, TRTC 45337 and 45646 seem closest to the concepts of *K. brachytricha* and TRTC 45658 closest to *K. geniculotricha*. Other variations of hair types are those which usually lack circinate tips (41909*a*) and those which are helical or contorted throughout their length (TRTC 45463). One collection (Thaxter 886) has hairs which occasionally branch. Sometimes the hairs are marked by warts or rings (TRTC 45650). Some of this variation is illustrated in Figs. 25–27.

The most characteristic feature of *K. nitida* is the shape of the ascocarps. These are almost never spherical, but tend to be ovoid, ellipsoidal, or polyhedral. The peridium is usually quite thick and rigid. The ascospores are quite constant in size and shape although in at least one collection (TRTC 45646) they show some tendency toward bilateral symmetry.

The conidial state is almost invariably present although sometimes not apparent. The conidiophores range from simple annellophores arising from the vegetative mycelium to complex synnemata. There is some variation in the size of the conidia. The conidial stage is a *Scopulariopsis* and resembles that of some species of *Microascus* Zukal.

The collection of *K. nitida* illustrated by Massee and Salmon (1902) appears to be a collection of *Lophotrichus bartlettii* with apically circinate ascocarp appendages. We have occasionally observed apically circinate appendages in cultures of *L. bartlettii* but this characteristic appears to be less common than straight hairs.

Kernia pachypleura Malloch & Cain, sp. nov. Figs. 39–46

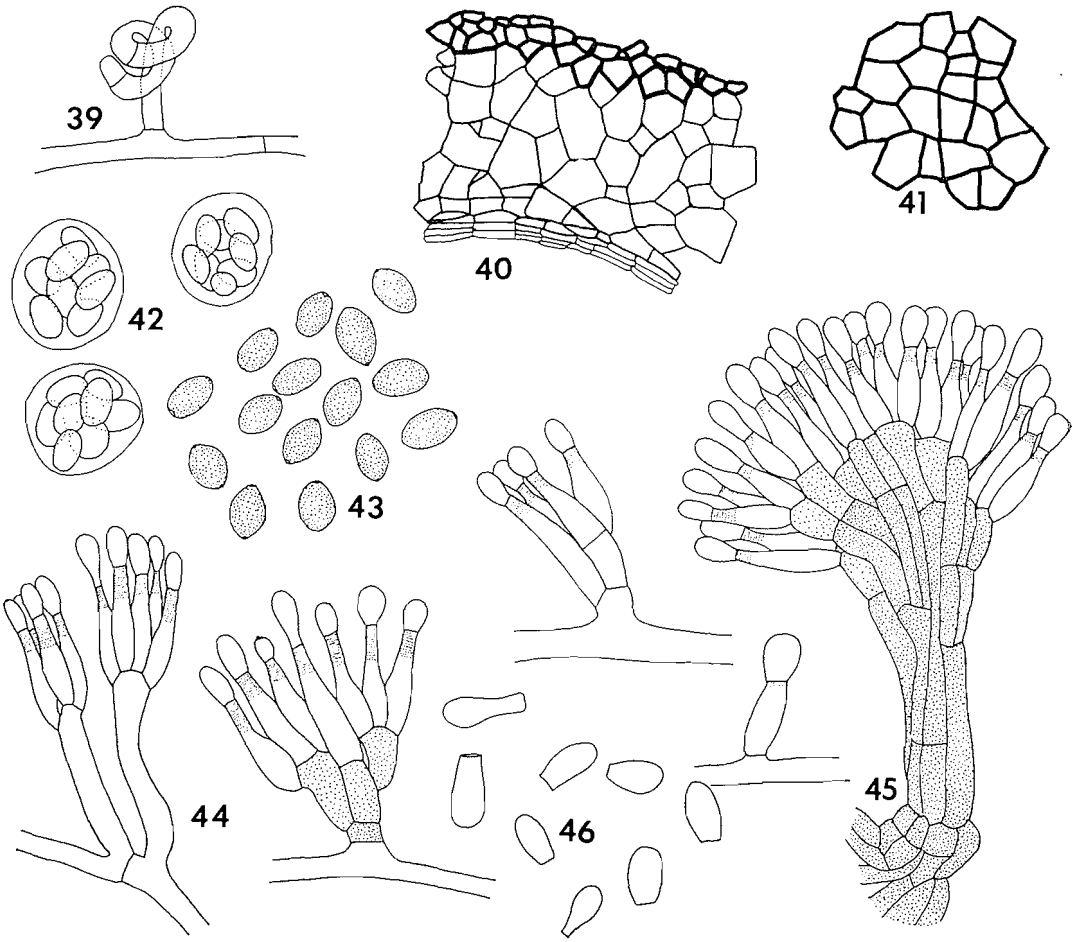
Coloniae in agaro "yeast–cellulose" lente crescentes, secundum diametrem aetate 19 dierum 3.5–4.0 cm, ab appressis floccosae, hyalinae vel brunneae, zonatae; ascocarpae globosae, nigrae, primo tomentosae, deinde glabrae, nonostiolatae, 195–315 μ crassae; peridium 37–46 μ crassum, initio amyloideum; asci irregulariter dispositi, ovoidei vel globosi, octospori, evanescentes, 7–14 μ crassi; ascosporae ellipsoideae, aurantiobrunneae, laeves, biporosae, dextrinoideae, 4.5–7.0 × 3.5–5.0 μ; status imperfectus modo *Scopulariopsis* productus; conidiophorae simplices vel ramosae, raro in synnematibus aggregatae, hyalinae vel brunneae, 10–80 × 3.0–3.5 μ; annellophorae solitariae vel gregareae, cylindraceae, ad basas inflatae, 6–12 × 2.0–3.0 μ; annellosporae ovoideae vel clavatae, ad basa truncatae, griseobrunneae, laeves, unicellares, 4.5–9.0 × 3.0–4.5 μ, catenulatae.

HOLOTYPUS: in fimo *Loxodontae africanae*, Mweya Lodge, Queen Elizabeth National Park, Uganda, 27 July 1966, *Cain, Griffin & Krug*, TRTC 66.2166*g*. In Cryptogamic Herbarium, University of Toronto.

ETYMOLOGY: Greek, *pachys* = thick, and *pleura* = side, referring to the thick ascocarp peridium.

Homothallic; *colonies* on yeast–cellulose medium (see above) attaining a diameter of 3.5–4.0 cm in 19 days at room temperature, velvety

to somewhat cottony, producing irregular growth rings, grey in areas of abundant conidial production, brown in sterile areas; reverse light violet-brown to brown; *mycelium* 1.5–3.5 μ in diameter, thin, with hyphae sparsely septate, frequently anastomosing, hyaline to light brown, producing darker and more abundantly septate mycelium deep within the medium; *ascocarp initials* produced abundantly in areas of conidial production, at first coiled and unbranched but soon becoming compact and contorted as a result of profuse branching, usually involving the neighboring hyphae to some extent; *ascocarps* 195–315 μ in diameter, immersed to superficial, globose, black, opaque, covered with numerous white hairs when young and thus appearing somewhat *Chaetomium*-like, glabrous in age, nonostiolate, slightly amyloid in Melzer's solution when young; *ascocarp peridium* 37–46 μ thick, consisting of three distinct tissue layers; peridial cells of the outer layer 3.5–5.0 μ in diameter, pseudoparenchymatous in surface view, rounded in cross section, thick-walled, brown, one or two cells deep in cross section; peridial cells of the middle layer thinner walled and lighter brown than the outer layer, 3.5–14 μ in diameter, five to eight cells deep in cross section; peridial cells of the inner layer 3.5–12 × 1.5–3.5 μ, thin-walled, hyaline to pale brownish, flattened in cross section, nearly isodiametric in surface view, indefinite in thickness, light bluish-green in Melzer's solution; *asci* 7–14 μ in



FIGS. 39–46. *Kernia pachypleura*. Fig. 39. Ascocarp initials (× 1500). Fig. 40. Cross section of peridium (× 650). Fig. 41. Peridium surface (× 650). Fig. 42. Asci (× 1500). Fig. 43. Ascospores (× 1500). Fig. 44. Conidiophores (× 1500). Fig. 45. Synnema (× 1500). Fig. 46. Conidia (× 1500).

diameter, irregularly disposed, ovoid to globose, eight-spored, evanescent, nonstipitate; *ascospores* 4.5–7.0 × 3.5–5.0 μ, ellipsoidal, light brown to honey-colored by transmitted light, light brown to orange brown in dry mass, orange brown to rust-colored in wet mass, thin-walled, smooth, with a germ pore at each end, with a prominent de Bary bubble, reddish orange in Melzer's solution when young; *conidial stage* a *Scopulariopsis*; *conidiophores* arising from the aerial or substrate mycelium, simple or branched, occasionally united to form synnemata, hyaline to brown, either bearing annellophores directly at the apex or repeatedly and very compactly branching to form a dense penicillus, 10–80 × 3.0–3.5 μ or if terminating a hyphal branch then indefinite in length; *annellophores* 6–12 × 2.0–3.0 μ, borne singly on the vegetative mycelium or more commonly in clusters of two to seven at the apex of conidiophores or metulae, nearly cylindrical to somewhat swollen, flaring at the apices, *annellospores* 4.2–9.0 × 3.0–4.2 μ, narrowly to broadly ovoid to clavate, truncate at the base, broadly rounded at the apices, occasionally pointed, nearly hyaline by transmitted light, grey to brownish in mass, smooth, adhering in chains and forming compact columns.

HABITAT: on dung of African elephant, Uganda.

SPECIMEN EXAMINED: UGANDA: Queen Elizabeth National Park: Mweya Lodge, on elephant dung, 27 July 1966, *Cain, Griffin & Krug*, HOLOTYPE TRTC 66.2166*g*.

Cultures derived from TRTC 66.2166*g* have been deposited with ATCC, CBS, and IMI.

K. pachypleura is most similar to *K. nitida*, from which it differs in having globose, thicker walled ascocarps which lack appendages. It has been found only once.

Excluded Species

Kernia bartlettii (Massee & Salmon) Benjamin. El Aliso, 3: 344. 1956.

Type material for *K. bartlettii* was not available for study but we have had a culture available from Pakistan (TRTC 45706) that fits the original description and illustrations closely. In addition, we have examined dried material from Canada and Germany.

Detailed cultural studies in our laboratory of TRTC 45706 by Miss Kanti Jain have revealed that this species is ostiolate. Although obscured by the terminal hairs at maturity, the ostiole is evident in the early stages of development. Because ostiolate species are not included in *Kernia* it is necessary to transfer it to another genus. It appears to fit most easily in the genus *Lophotrichus* Benjamin, especially in respect to mycelial, colony, ascocarps, asci, and ascospores. As with other species of *Lophotrichus*, *K. bartlettii* grows faster than *Kernia* species, produces elongated asci and larger ascospores with prominent germ pores, and lacks an annellophore conidial state.

K. bartlettii appears to be identical with *L. brevirostratis* Ames and represents an older name for that species, hence the following new combination must be made.

Lophotrichus bartlettii (Massee & Salmon) Malloch & Cain, comb. nov.
=*Magnusia bartlettii* Massee & Salmon, Ann. Bot. 15: 333. 1901.
≡*Kernia bartlettii* (Massee & Salmon) Benjamin. El Aliso, 3: 344. 1956.
≡*Kernia bartlettii* (Massee & Salmon) Tandon & Bilgrami. Lloydia, 24: 168. 1961.
=*Lophotrichus brevirostratis* Ames. Monograph of the Chaetomiaceae, p. 52. 1961 (1963).

Kernia furcotricha Tandon & Bilgrami. Lloydia, 24: 168. 1961.

The scattered, spiralled ascocarp appendages, cylindrical asci, and brown ascospores suggest that *K. furcotricha* does not belong in *Kernia*. Cylindrical asci are unknown in the Microascaceae and are probably inconsistent with the developmental type. The habitat on dead leaves is also unknown in this family. It may represent a species of *Chaetomidium*.

Kernia spirotricha (Benjamin) Benjamin. El Aliso, 3: 344. 1956.

We have obtained the type culture of *K. spirotricha* from the Centraalbureau voor Schimmelcultures and have studied it in detail. Except for the clustered ascocarp appendages it has no relationship to species of *Kernia* or any of the Microascaceae. The asci, contrary to earlier reports, appear to be arranged uniformly on the inner wall of the ascocarp and radiate inward. The ascospores are dark brown and have a single germ pore. We believe that *K. spirotricha* fits the present concepts of the Chaetomiaceae and should be transferred to the genus *Chaetomidium* as

Chaetomidium spirotrichum (Benjamin) Malloch & Cain, comb. nov.

BASIONYM: *Magnusia spirotricha* Benjamin. El Aliso, 3: 199. 1956.

Acknowledgments

We thank Dr. B. Boivin for correcting the Latin. Thanks are extended to the Curators of various herbaria from which collections were obtained for this study.

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