The genera *Sporormiella* and *Sporormia* in east Africa[1]

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Four new coprophilous species of *Sporormiella* are described and illustrated: ***S. macropulchella*** from Canada, Kenya, Tanzania, and U.S.A.; ***S. obliqua*** from Canada, Kenya, Tanzania, Uganda, and U.S.A.; ***S. similis*** from Canada, Kenya, Tanzania, and U.S.A.; and ***S. tenuispora*** from Kenya, Tanzania, and U.S.A. Many additional records are reported for 18 previously described species, several of which are redescribed from axenic cultures. New records are provided for two of the known species of *Sporormia*.

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Quatre nouvelles espèces coprophiles de *Sporormiella* sont décrites et illustrées: ***S. macropulchella***, provenant du Canada, du Kenya, de la Tanzanie et des Etats-Unis; ***S. obliqua***, du Canada, du Kenya, de la Tanzanie, de l'Ouganda et des Etats-Unis; ***S. similis***, du Canada, du Kenya, de la Tanzanie et des Etats-Unis; et ***S. tenuispora***, du Kenya, de la Tanzanie et des U.S.A. Plusieurs mentions additionnelles sont rapportées pour 18 espèces décrites antérieurement. Plusieurs de ces espèces sont redécrites et illustrées à partir de cultures axéniques. De nouvelles mentions sont rapportées pour deux des espèces connues de *Sporormia*.

[Traduit par le journal]

Introduction

The genera *Sporormiella* with over 70 coprophilous species and *Sporormia* with 3 species are classified in the Sporormiaceae Munk. *Sporormiella* is well represented in both tropical and temperate regions, while *Sporormia* prefers warmer and drier climates. The history and taxonomic concept of the genus *Sporormiella* has been studied by Ellis and Everhart (1892), Griffiths (1901), Clements and Shear (1931), Cain (1934), Munk (1957), Ahmed and Asad (1967), and Ahmed and Cain (1972). *Sporormia* was erected by de Notaris (1849) and more recently has been treated by Breton and Faurel (1964), Ahmed and Asad (1967), and Ahmed and Cain (1972).

The ascospores in *Sporormiella* develop in bitunicate, stipitate, nonamyloid, eight-spored asci. These characteristic spores are transversely septate and generally have a constant number of cells, which may be from 4 to 16. In a few species, the number of cells is variable. Each ascospore has a distinct, hyaline, light-refractive gelatinous sheath, and each cell of the ascospore has a longitudinal, oblique, or transverse germ slit. *Sporormia* differs from *Sporormiella* in possessing a pseudothecium (sensu Luttrell) without a neck and ascospores united in a compact bundle within the ascus. The ascospores have many cells which are variable in number and lack germ slits.

Four new and 18 previously described species of *Sporormiella* are reported in this publication, along with additional records for two species of *Sporormia*. These taxa either appeared on dung incubated for 3 to 8 weeks in moist chambers at room temperature, as described by Cain (1934), or were found on dry dung which was examined prior to setting up a moist chamber. In some instances, the organism was isolated in pure culture.

The descriptions which follow are based on specimens found on natural substrata and from isolates grown in pure culture. The term pseudothecium is used for the ascocarps. See Cain and Luck-Allen (1969) for a discussion concerning the use of this term. The pseudothecia were mounted either in distilled water, lactophenol with cotton blue, India-ink, or Gurr's mounting medium plus lactofuchsin (Carmichael 1955). The methods and terminology used in this investigation are those of Ahmed and Cain (1972). The material was collected by R. F. Cain, H. D. Griffin, and J. C. Krug in Kenya, Tanzania, and Uganda during July and August 1966. Each field collection was given a serial number. To this, a separate letter was added for each of the species found on that collection. These collections all begin with "66." To save space in the text, only the collection number is given. The complete data may be obtained by referring to the

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table which follows. For the new taxa, some North American specimens are also cited with the collection data. The specimens are all deposited in the Cryptogamic Herbarium, University of Toronto (TRTC).

List of collections

Kenya

66.146. Aberdare Mts., Kamae, 0°50′ S, 36°37′ E, elevation 8800 ft, on buffalo dung, 6 July 1966
66.261. Same as 66.146 except on dung of unidentified herbivore
66.289. Aberdare Mts., Kimakia, 0°46′ S, 36°45′ E, elevation 8000 ft, on dung of duiker or buck, 8 July 1966
66.305. Nairobi National Park, 1°22′ S, 36°52′ E, elevation 5200 ft, on dung of unidentified herbivore, 10 July 1966
66.306. Same as 66.305 except on wildebeest dung
66.307. Same as 66.305 except on dung of unidentified herbivore
66.308. Same as 66.305 except on antelope dung
66.309. Same as 66.305 except on giraffe dung
66.310. Same as 66.305 except on antelope dung
66.381. Mt. Kenya, Castle, 0°23′ S, 37°18′ E, elevation 6900 ft, on elephant dung, 11 July 1966
66.493. Mt. Kenya, Naro Moru Track, 0°10′ S, 37°12′ E, elevation 9000 ft, on buffalo dung, 13 July 1966
66.494. Same as 66.493 except on elephant dung
66.598. Mt. Kenya, Naro Moru Track, 0°10′ S, 37°14′ E, elevation 11 000 ft, on antelope dung, 13 July 1966
66.609. Same as 66.598 except on dung of unidentified herbivore
66.610. Same as 66.598 except on buffalo dung
66.639. Mt. Kenya, Timau Track, 0°5′ S, 37°20′ E, elevation 13 000 ft, on carnivore dung, 14 July 1966
66.640. Same as 66.639 except on eland dung
66.641. Mt. Kenya, Timau Track, 0°0′ S, 37°19′ E, elevation 11 000 ft, on cow dung, 14 July 1966
66.659. Mt. Kenya, Timau Track, 0°5′ S, 37°20′ E, elevation 13 000 ft, on rock hyrax dung, 14 July 1966
66.660, 66.667, 66.682, 66.685, 66.686, 66.692, Same as 66.659
66.1287. Kajiado, 1°52′ S, 36°48′ E, elevation 5600 ft, on cow dung, 9 August 1966
66.1408. Machakos, E of Wamunyu, 1°25′ S, 37°36′ E, elevation 4200 ft, on cow dung, 22 August 1966
66.1428. Mtito Andei, 2°42′ S, 38°12′ E, elevation 2700 ft, on zebra dung, 23 August 1966
66.1429. Same as 66.1428 except on elephant dung
66.1431. SE of Voi, 3°28′ S, 38°40′ E, elevation 1500 ft, on cow dung, 23 August 1966
66.1437. 40 mi NW of Mombasa, 3°45′ S, 39°12′ E, elevation 1000 ft, on cow dung, 23 August 1966
66.1541. Aberdare National Park, 0°26′ S, 36°44′ E, elevation 10 000 ft, on elephant dung, 4 September 1966
66.1543. Same as 66.1541 except on antelope dung
66.1763. Amboseli, 01 Tukai Lodge, 2°40′ S, 37°17′ E, elevation 3900 ft, on zebra dung, 17 August 1966
66.1765. Same as 66.1763 except on antelope dung

Kenya (continued)

66.1766. Lake Amboseli, 2°33′ S, 37°10′ E, elevation 4000 ft, on dung of unidentified herbivore, 18 August 1966
66.1768. Same as 66.1766 except on zebra dung
66.1769. Same as 66.1766 except on elephant dung
66.1770. Same as 66.1766 except on cow dung
66.1771. Same as 66.1766 except on zebra dung
66.1773. Same as 66.1766 except on cow dung
66.1775. Same as 66.1766
66.1776. Same as 66.1766 except on antelope dung
66.1777. Same as 66.1766 except on rabbit dung
66.1778. Same as 66.1766 except on antelope dung
66.1779. Same as 66.1766
66.1780. Same as 66.1766 except on buffalo dung
66.1781. W of Lake Amboseli, 2°32′ S, 37°0′ E, elevation 4800 ft, on cow dung, 18 August 1966

Tanzania

66.1015. Kifaru, Himo-Mombo Road, 3°32′ S, 37°35′ E, elevation 3000 ft, on cow dung, 12 August 1966
66.1061. Mt. Kilimanjaro, N of Lyamungu, 3°10′ S, 37°17′ E, elevation 6000 ft, on elephant dung, 11 August 1966
66.1093. Ngurdoto Crater, 3°15′ S, 36°55′ E, elevation 3000 ft, on elephant dung, 10 August 1966
66.1291. Mt. Meru, Arusha, 3°16′ S, 36°45′ E, elevation 7000 ft, on cow dung, 9 August 1966
66.1292. 30 mi N of Arusha, S of Longido, 2°55′ S, 36°43′ E, elevation 4800 ft, on cow dung, 9 August 1966
66.1294. Same as 66.1292 except on zebra dung
66.1700. Ngurdoto Crater, 3°15′ S, 36°55′ E, elevation 3000 ft, on buffalo dung, 10 August 1966
66.1710. N of Same, South Pare Mts., 4°2′ S, 37°42′ E, elevation 3000 ft, on antelope dung, 12 August 1966
66.1719. Usambara Mts., N of Lushoto, Kijucha Ngwelo Hill, 4°46′ S, 38°18′ E, elevation 5500 ft, rock hyrax dung, 14 August 1966
66.1726. Kihurio, 4°28′ S, 38°5′ E, elevation 1600 ft, on cow dung, 14 August 1966
66.1729. Mt. Kilimanjaro, above Kifinika, 3°10′ S, 37°29′ E, elevation 10 500 ft, on dung of unidentified herbivore
66.1731. Same as 66.1729
66.1787. Serengeti National Park, Seronera, 2°21′ S, 34°55′ E, elevation 5000 ft, on antelope dung, 28 August 1966
66.1790. Same as 66.1787
66.1794. Same as 66.1787 except on zebra dung
66.1795. Same as 66.1794
66.2379. Same as 66.1729 except on carnivore dung
66.2380. Same as 66.1729
66.3137. Same as 66.1061 except on rock hyrax dung
66.3377. Same as 66.1292
66.3442. Same as 66.1719 except on dung of unidentified herbivore

Uganda

66.2166. Queen Elizabeth National Park, Mweya Lodge, 0°12′ S, 29°53′ E, elevation 3000 ft, on elephant dung, 27 July 1966
66.3286. Queen Elizabeth National Park, Lake George Flats, 0°5′ N, 30°5′ E, elevation 3000 ft, on buffalo dung, 27 July 1966
66.3287, 66.3288. Same as 66.3286 except on antelope dung

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Descriptions

Sporormiella macropulchella Khan & Cain, sp. nov. Figs.1–5

Pseudotheciis 255–285 μm in diametro, sparsis vel interdum laxe aggregatis, immersis vel semiimmersis, subglobosis vel ovatis, glabris, olivaceo-brunneis vel atro-brunneis; peridio membranaceo, pseudoparenchymatico, atro-brunneo. Ascis 135–175 × 14–17 μm, octosporis, cylindraceo-clavatis, iodo non caerulescentibus, superne rotundatis, inferne in stipitem 6–15 μm longum attenuatis. Pseudoparaphysibus 2–3 μm crassis, numerosis, filiformibus, hyalinis, septatis, non ramosis. Ascosporis 24–32 × 7.5–9 μm, obliquis uniseriatis, interdum irregularis biseriatis, quattuor-cellularibus, cylindraceo-fusiformibus, primum hyalinis vel olivaceis, demum atro-brunneis, transverse septatis, modice vel profunde constrictis; articulis postremo vix secedentibus; articulis terminalibus longioribus et leviter attenuatis; stria germinationis obliqua, interdum diagonali; vagina mucosa hyalina angusta.

HOLOTYPUS: In fimo vaccino (*Bos taurus*), Kenya: Lake Amboseli, 2°33′ S, 37°10′ E, elevation 4000 ft, 18 August 1966. *Cain*, *Griffin* et *Krug*, TRTC 66.1770h. In Cryptogamic Herbarium, University of Toronto.

ETYMOLOGY: Latin, *macro* = long and *pulchellus* = beautiful, referring to the ascospores which differ in size and appearance from the ascospores of *Sporormiella pulchella* (Hansen) Ahmed and Cain.

Pseudothecia 255–285 μm diameter, scattered or occasionally loosely aggregated, immersed to semiimmersed, subglobose to ovoid, glabrous, olivaceous brown to dark brown; neck very small, black, papilliform, glabrous; peridium pseudoparenchymatous in surface view, membranaceous, dark brown by transmitted light. Asci 135–175 × 14–17 μm, eight spored, cylindrical-clavate, nonamyloid, rounded above, narrowed below into a 6–15 μm long stipe. Pseudoparaphyses 2–3 μm diameter, abundant, filiform, unbranched, hyaline, septate, fascicled and mixed with the asci. Ascospores 24–32 × 7.5–9 μm, obliquely uniseriate, occasionally irregularly biseriate, four-celled, fusiform-cylindrical, hyaline to light olivaceous when young, becoming dark brown at maturity, transversely septate, moderately to deeply constricted at each septum, segments not easily separable at maturity; terminal cells longer, slightly tapering, conical; germ slit oblique, occasionally diagonal; gelatinous sheath hyaline and narrow. Conidia unknown.

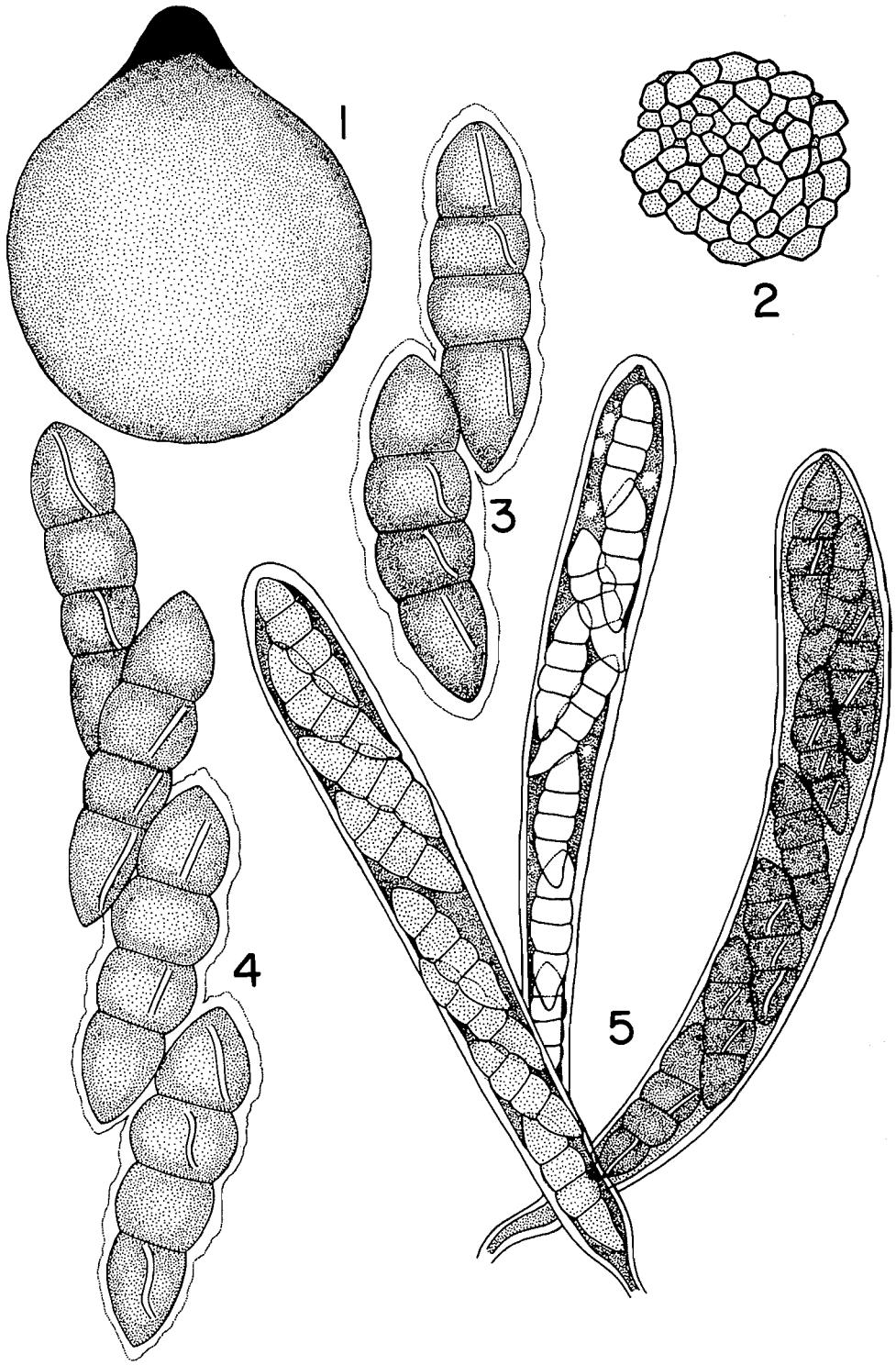
HABITAT: On buffalo, cow, deer, marmot, porcupine, pronghorn, rabbit, sheep, and wapiti dung.

SPECIMENS EXAMINED: CANADA: Ontario: Algoma Dist., Twp. 196, Mississagi Road, on porcupine dung, *Cain*, TRTC 36871. Nipissing Dist.: Lake Timagami, on porcupine dung, *Cain*, TRTC 36039; Bear Island, on rabbit dung, *Cain*, TRTC 5392; portage from Gull Lake to Watson Lake, on porcupine dung, *Cain*, TRTC 36972; Algonquin Prov. Park, Macualay Road, on dung of unidentified herbivore, *Cain*, TRTC 46378, Sproule Road, on deer dung, *Cain*, TRTC 46379. Alberta: near Columbia Ice Field, 120 mi N of Banff townsite on marmot dung, *Malloch*, TRTC 48140. British Columbia: Yoho National Park, on deer dung, *Cain*, TRTC 39732. U.S.A.: South Dakota: Hyde Co., Highmore, on cow dung, *Carter*, (NY, TRTC 39805). Custer Co., Wind Cave National Park, on cow dung, *Cain*, TRTC 46560. Pennington Co., S of Rapid city, on cow dung, *Cain*, TRTC 46769. Wyoming: Bighorn Co.: Upper Shell Canyon, on pronghorn dung, *Luck-Allen*, TRTC 42102, on sheep dung, *Cain*, TRTC 43402. Albany Co.: Nash Fork, W of Centennial, on wapiti dung, *Cain*, TRTC 43451. KENYA: TRTC 66.641a, 66.1770h (TYPE), 66.1780y. TANZANIA: TRTC 1726a.

Sporormiella macropulchella resembles *S. pulchella* but can be distinguished by its larger ascospores, longer and broader asci, and tapering conical shape of the terminal cell, especially the lower one. In two collections from the U.S.A., TRTC 42102 and 43451, the ascospores are slightly larger and biseriate but retain the very characteristic appearance of *S. macropulchella*. Although these spores measure (29–)30–35 × 7–9.5 μm, it is preferable for the present to retain these collections in *S. macropulchella* rather than erecting a new species.

Sporormiella oblique Khan & Cain, sp.nov. Figs. 6–14

Pseudotheciis 280–500 × 150–350 μm, sparsis vel aggregatis, immersis vel semi-immersis, piriformibus vel subglobosis, glabris, atro-brunneis vel paene nigris; collo 85–110 × 42–45 μm, mediocriter longo, cylindraceo, glabro, atro-brunneo vel nigro; peridio 18–25 μm crasso, membranaceo vel semicoriaceo, pseudoparenchymatico, atro-brunneo, bistratoso. Ascis (110–)120–146(–162) × (8.5–)10–12(–13) μm, octosporis, cylindraceis, numerosis, iodo non caerulescentibus, superne rotundatis, inferne in stipitem 18–30 μm longum. Pseudoparaphysibus 1.5–3.5 μm crassis, numerosis, filiformibus, hyalinis, septatis, non ramosis. Ascosporis 22–28(–32) × 3.5–5.5 μm, superne duobus vel tribus stichis, inferne uniseriatis, quattuor-cellularibus, cylindraceis vel sub-cylindraceis, hyalinis vel olivaceis, demum atro-brunneis et opacis,



FIGS. 1–5. *Sporormiella macropulchella* (TYPE). Fig. 1. Pseudothecium. × 200. Fig. 2. Peridial surface. × 650. Figs. 3 and 4. Mature ascospores with hyaline sheath. × 1800. Fig. 5. Young ascus with hyaline ascospores and mature asci with light to dark brown ascospores. × 800.

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transverse septatis vel saepe oblique septatis, modice et profunde constrictis; articulis postremo secendentibus; articulis terminalibus longioribus et attenuatis; stria germinationis obliqua vel parallelioro; vagina mucosa 1.5–3.5 μm crassa, hyalina.

HOLOTYPUS: In fimo vaccino (*Bos taurus*), Tanzania: 30 mi N of Arusha, S of Longido, 2°55′ S, 36°43′ E, elevation 4800 ft, 9 August 1966, *Cain*, *Griffin* et *Krug*, TRTC 66.3377f. In Cryptogamic Herbarium, University of Toronto.

ETYMOLOGY: Latin, *obliquus* = oblique or slanting, referring to the oblique septa and germ slits in the ascospores.

Pseudothecia 280–500 × 150–350 μm, scattered to aggregated, immersed to semiimmersed with the neck projecting above the substrate, pyriform to subglobose, dark brown to nearly black by reflected light; neck 85–110 × 42–45 μm, moderately long, cylindrical, glabrous, dark brown to black; peridium 18–25 μm thick, pseudoparenchymatous in surface view, membranaceous to semicoriaceous, dark brown by transmitted light, two layered, with each layer two to four cells wide; outer peridial cells 3.5–12 × 2–4 μm, angular, thick walled and dark brown, merging into an inner peridial layer; inner peridial cells 7–15 × 1.5–3 μm, narrow, elongated, thin walled, hyaline, and evanescent, occasionally persisting. Asci (110–)120–146(–162) × (8.5–)10–12(–13) μm, eight-spored, cylindrical, abundant, nonamyloid, nondextrinoid, broadly rounded above and tapering below into a 18- to 30-μm-long stipe. Pseudoparaphyses 1.5–3.5 μm diameter, fairly abundant, fascicled and mixed with the asci, filiform, septate, hyaline, unbranched, occasionally guttulate when young, usually longer than the asci. Ascospores 22–28(–32) × 3.5–5.5 μm, two or three seriate above, uniseriate below, four-celled, cylindrical to subcylindrical, hyaline at first, becoming olivaceous brown to dark brown and finally opaque, transversely septate or very often with oblique septa, constriction at each septum moderately broad and deep, segments separable at maturity; the terminal cells slightly longer and more tapering than the midcells, upper terminal cells 6–6.5 × 4–4.6 μm, midcells 5–6.5 × 4–5(–5.5) μm, lower terminal cells 6–7(–7.5) × 3.5–4.5 μm; germ slit oblique or occasionally parallel; gelatinous sheath hyaline, 1.5–4 μm broad, staining black with India-ink.

Spermogonia in most collections associated with the pseudothecia, 12–20 μm in diameter; pyriform to subglobose, dark brown by reflected light, glabrous; spermatia 2–3.5 × 1–2 μm, abundant, smooth, hyaline, one-celled, ellipsoidal, biguttulate.

HABITAT: On antelope, buffalo, cow, moose, rabbit, and wildebeest dung.

SPECIMENS EXAMINED: CANADA: Ontario: Muskoka Dist.: Gravenhurst, on rabbit dung, *Cain*, TRTC 5317. Thunder Bay Dist.: Black River, on moose dung, *Cain* et al., TRTC 37526. U.S.A.: Wyoming: Carbon Co., Brush Creek, Ryan Park, on rabbit dung, *Cain*, TRTC 43447. KENYA: TRTC 66.306b, 66.307h, 66.308c, 66.310f, 66.1287f, 66.1431f. TANZANIA: 66.1790ℓ, 66.3377f (TYPE).

Sporormiella obliqua resembles *S. dakotensis* (Griff.) Ahmed and Cain. In the former, the asci are longer and broader, the ascospores often have oblique septa, the ascospore segments are not easily separable at maturity, the germ slits are distinctly oblique, and there is a moderately broad, hyaline, gelatinous sheath surrounding the ascospores. In *S. dakotensis*, the germ slit is parallel and the gelatinous sheath is narrow. *Sporormiella obliqua* can be differentiated from *S. subtilis* Ahmed and Cain by its comparatively slender and narrower asci and the characteristic shape of the ascospores which have moderately deep constrictions at the septa. On account of the oblique septa in the ascospores, *S. obliqua* most closely resembles *S. muskokensis* (Cain) Ahmed and Cain but differs from it in the shape and size of the ascospores as well as the type of germ slit.

Sporormiella obliqua also resembles *S. inaequalis* Ahmed and Asad, but the ascospores in the former are more slender and very often possess oblique septa. In the Wyoming collection TRTC 43447, the ascospores are slightly broader and longer, 28–33 × 5.5–6.5 μm, but the gross morphological appearance is the same as in *S. obliqua*.

Numerous attempts have been made to obtain *S. obliqua* in pure culture but no fertile pseudothecia were produced. Colonies on V8 agar and Weitzman and Silva-Hutner's (1967) media attaining 5 cm diameter in 1 week at 25°C, appearing purple to reddish pink, smooth, azonate to slightly zonate, sometimes with concentric rings, velvety to felty, reverse light pink. Mycelium hyaline, septate, 1.5–3.0 μm diameter, anastomosing freely. Spermogonia maturing after 3 weeks; spermatia 2–3.5 × 1.5–2 μm, abundant, hyaline, smooth, one celled, ellipsoidal, with two guttules in each spermatium.

Sporormiella similis Khan & Cain, sp. nov.

Figs. 15–24

Pseudotheciis 210–350 × 170–260 μm, subglobosis vel piriformibus, immersis usque semiimmersis, sparsis vel aggregatis, atro-brunneis vel paene nigris, glabris, ostiolatis; collo 40–75 ×

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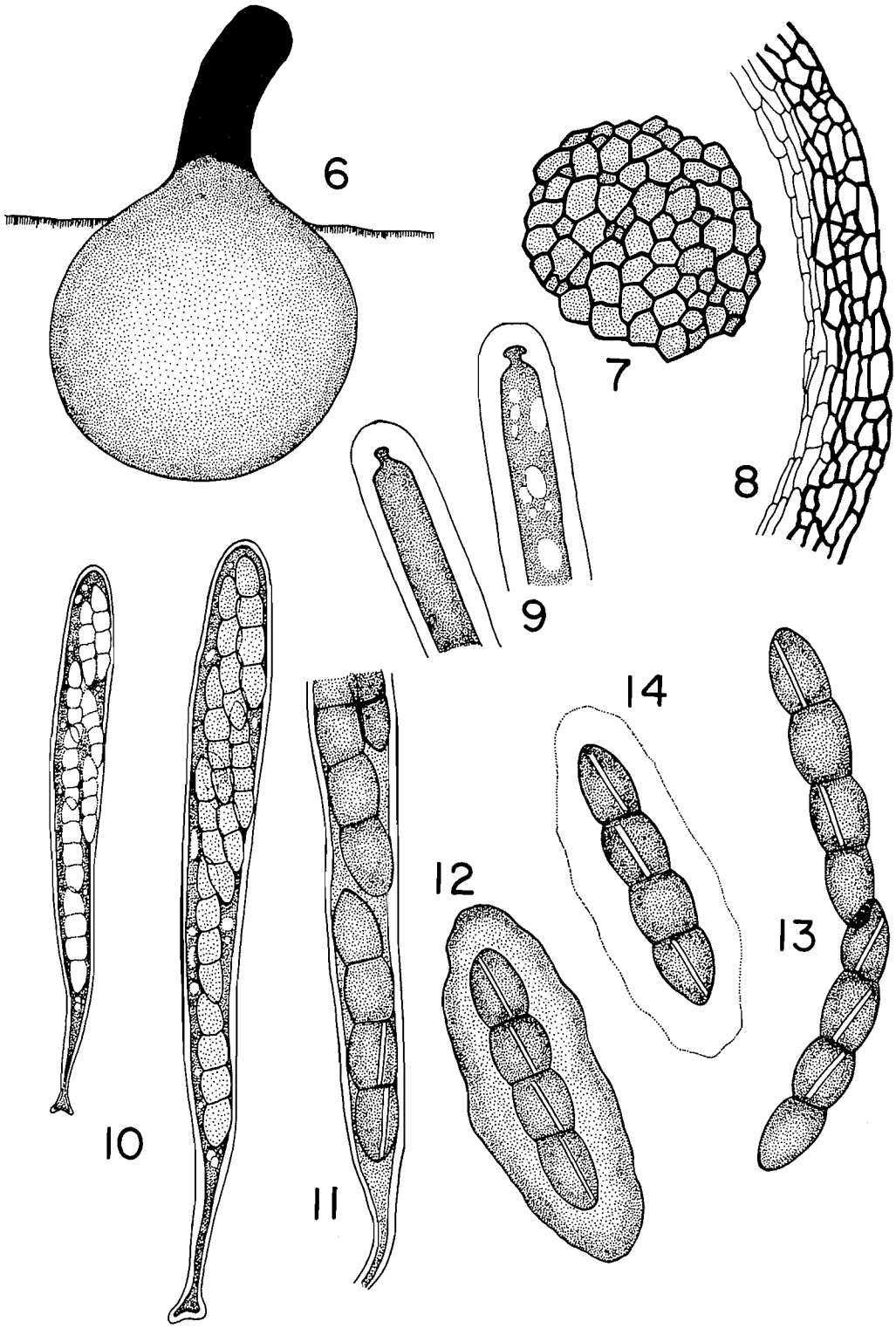

FIGS. 6–14. *Sporormiella obliqua* (TYPE). Fig. 6. Pseudothecium. × 150. Fig. 7. Peridial surface. × 500. Fig. 8. Peridial cross section. × 750. Fig. 9. Very young asci. × 1000. Fig. 10. Young ascus with hyaline ascospores and mature ascus with light brown ascospores. × 750. Fig. 11. Part of a mature ascus with dark brown mature ascospores. × 1400. Fig. 12. Mature ascospore showing the hyaline sheath stained black with India-ink. × 1600. Fig. 13. Ascospores drawn without sheath. × 1600. Fig. 14. Ascospore with hyaline sheath. × 1600.

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30–65 μm, parvo, papilliformi, laevi; ostiolo orbiculato, indistincto; peridio 24–30 μm crasso, membranaceo vel semi-coriaceo, atro-brunneo, pseudoparenchymatico, glabro, tristratoso. Ascis (140–)150–185(–215) × 24–27(–28) μm, octosporis, stipitatis, cylindraceo-clavatis, iodo non caerulescentibus, superne late rotundatis, inferne attenuatis, breve stipitatis. Pseudoparaphysibus 2.5–4 μm crassis, filiformibus, numerosis, septatis. Ascosporis 42–50(–52) × 9–9.5(–10) μm, quattuorcellularibus, cylindraceis, duobus-seriatis, rarouno-seriatis, primum hyalinis vel olivaceo-brunneis, demum atro-brunneis, transverse septatis, late et leviter constrictis; articulis prope similibus; stria germinationis obliqua; vagina mucosa 5–8 μm crassa, hyalina.

HOLOTYPUS: In fimo leporino, Kenya: Lake Amboseli, 2°33′ S, 37°10′ E, elevation 4000 ft, 18 August 1966, *Cain*, *Griffin* et *Krug*, TRTC 66.1777a. In Cryptogamic Herbarium, University of Toronto.

ETYMOLOGY: Latin, *similis* = like, referring to the similarity with *Sporormiella australis* (Speg.) Ahmed and Cain and *S. intermedia* (Auersw.) Ahmed and Cain.

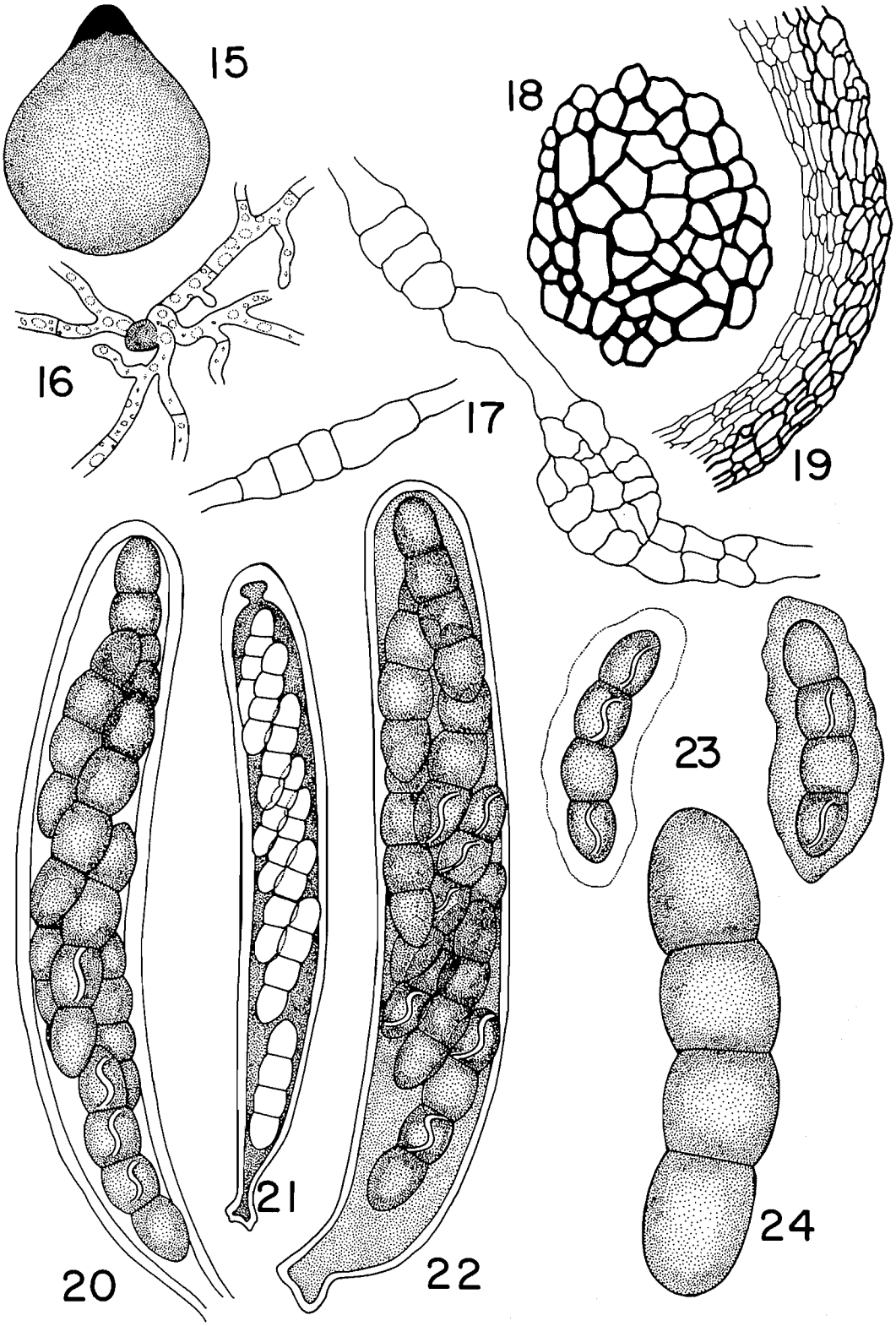
Colonies on V8 agar and Weitzman and Silva-Hutner's (1967) media attaining 6–7 cm diameter in 3 weeks at 25°C, appressed to somewhat granular, pale white in the beginning, then becoming grey to somewhat black when old, dark grey to black where pseudothecia abundant, often showing a tendency to sectoring, reverse colourless to light grey; hyphae 1.5–7.0 μm diameter, hyaline, rarely grey or brown, thin walled, remotely to fairly closely septate, branching and frequently anastomosing; pseudothecial initials appearing within a week, consisting of a single intercalary cell, which continually divides in several planes to form a large pseudoparenchymatous mass which eventually forms the pseudothecium. Pseudothecia 210–350 × 170–260 μm, subglobose to pyriform, immersed to semiimmersed when young, superficial when old, solitary to clustered in small groups, dark brown to nearly black by reflected light, smooth, glabrous, ostiolate; neck 40–75 × 35–65 μm, small, papilliform, projecting above the substrate, smooth, glabrous; ostiole indistinct; peridium 24–30 μm thick, membranaceous to semicoriaceous, dark brown by reflected light, pseudoparenchymatous in surface view, three layered; outer peridial cells 7–15 × 4.5–10 μm, angular, thick walled, dark brown; median peridial cells 9–16(–20) × 4–5.5 μm, elongated and somewhat flattened, thick walled, hyaline to light brown; inner peridial cells 10–21 × 2–3.5 μm, elongated, thin walled, hyaline and evanescent, occasionally persisting. Asci (140–)150–185(–215) × 24–27(–28) μm, eight-spored, cylindrical-clavate, stipitate, nonamyloid, broadly rounded above, gradually to abruptly tapering into a short stipe. Pseudoparaphyses 2.5–4 μm diameter, abundant, filiform, septate, longer than the asci and mixed with them. Ascospores 42–50(–52) × 8–9.5(–10) μm, four-celled, biseriate, rarely uniseriate, cylindrical, hyaline to olivaceous brown when young, finally becoming dark brown to opaque at maturity, transversely septate, constriction at septa broad and shallow; middle cells about equal in length and broader than terminal cells; terminal ones longer, slightly more cylindrical with rounded apices; germ slit strongly oblique, somewhat S shaped; gelatinous sheath hyaline, blackened with India ink, 5–8 μm broad. Conidia not observed in axenic cultures.

HABITAT: On antelope, buffalo, cow, elephant, marmot, pronghorn, rabbit, rock hyrax, and zebra dung.

SPECIMENS EXAMINED: CANADA: Alberta, near Columbia Ice Field, 120 mi N of Banff townsite, on marmot dung, *Malloch*, TRTC 48142. U.S.A.: Wyoming: Niobrara Co., N of Lusk, on sheep dung, *Cain*, TRTC 42935. Carbon Co., Brush Creek, on pronghorn dung, *Cain*, TRTC 43448. KENYA: TRTC 66.307p, 66.682a, 66.1763s, 66.1765c, 66.1773c, 66.1775k, 66.1777a (TYPE), 66.1779d, 66.1780z. TANZANIA: TRTC 66.1093i, 66.1700b, 66.3377t.

Sporormiella similis is related to *S. australis* and *S. intermedia*. It possesses asci and ascospores which are intermediate in size and shape between these two species. *Sporormiella similis* seems to resemble *S. intermedia* more closely than *S. australis*. It possesses larger asci and ascospores than *S. australis* but not as large as those of *S. intermedia*. The lower limit in ascospore measurements approaches the upper limit of *S. australis*, namely 42–45 × 8.5 μm.

FIG. 15–24. *Sporormiella similis* (TYPE). Fig. 15. Pseudothecium. × 150. Fig. 16. Germinating ascospore. × 500. Fig. 17. Pseudothecial initials. × 750. Fig. 18. Peridial surface. × 500. Fig. 19. Peridial cross section. × 500. Fig. 20. Mature ascus with dark brown ascospores. × 800. Fig. 21. Young ascus with hyaline ascospores. × 400. Fig. 22. Mature ascus and ascospores, ascus ending abruptly in a short stipe. × 800. Fig. 23. Ascospores with hyaline sheath, one stained black with India-ink. × 800. Fig. 24. Mature ascospore. × 1800.



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In TRTC 66.3377t, the ascospores measure 46–50 × 8.5–9.0 μm, while in 66.1700b, the ascospores measure 41.5–45.5 × 8.5–9.5 μm. Therefore, *S. similis* occupies a taxonomic position between *S. australis* and *S. intermedia*.

Sporormiella tenuispora Khan & Cain, sp. nov. Figs. 25–31

Pseudotheciis 255–425 μm in diametro, sparsis vel aggregatis, immersis vel semi-immersis, interdum superficialibus, subglobosis vel piriformibus, glabris, atro-brunneis vel paene nigris; collo 200–340 × 85–136 μm, longiore, nigris, glabris; peridio membranaceo, pseudoparenchymatico, glabro, atro-brunneo vel nigro, bistratoso. Ascis 180–220 × 16–25 μm, octosporis, cylindraceis, iodo non caerulescentibus, superne rotundatis, inferne in stipitem 6–15 μm longum attenuatis. Pseudoparaphysibus filiformibus, hyalinis, septatis, non ramosis. Ascosporis 46–52 × (7–)8.5–10.5 μm, quattuor-cellularibus, superne duobus vel tribus seriatis, inferne uno-seriatis, fusiformis-cylindraceis, primum hyalinis vel olivaceo-brunneo, deinde atro-brunneis, demum opacis, transverse septatis, modice profunde constrictis; articulis maturitate confirmata non separabilis; articulis non similibus; articulis terminalibus 12–13.5 × 7–8.5 μm, longioribus et leviter attenuatis; articulis mediis 10.5–11.5(–12) × 8.5–10.5 μm, breve et latis; stria germinationis parallelo; vagina mucosa, hyaline et angusta.

HOLOTYPUS: In fimo vaccino (*Bos taurus*), Kenya: Lake Amboseli, 2°33′ S, 37°10′ E, elevation 4000 ft, 18 August 1966, *Cain*, *Griffin* et *Krug*, TRTC 66.1770x. In Cryptogamic Herbarium, University of Toronto.

ETYMOLOGY: Latin, *tenuis* = slender, referring to the slender asci and ascospores in comparison with *Sporormiella grandispora* (Speg.) Ahmed and Cain.

Pseudothecia 255–425 μm diameter, scattered or aggregated, immersed to semiimmersed, occasionally superficial, subglobose to pyriform, glabrous, dark brown to nearly black by reflected light; neck 200–340 × 85–136 μm, black, moderately long, glabrous, protruding above the substrate; peridium membranaceous, pseudoparenchymatous in surface view, glabrous, dark brown to black by reflected light, two layered; outer peridial cells angular, thick walled, dark brown; inner peridial cells elongated, thin walled, hyaline, mostly evanescent, occasionally persisting, merging with the outer layer. Asci 180–220 × 16–25 μm, eight-spored, cylindrical, nonamyloid, rounded above and gradually tapering below into a 6 to 15 μm long stipe. Pseudoparaphyses filiform, hyaline, septate, unbranched, longer than the asci, fascicled, and mixed with them. Ascospores 46–52 × (7.0–)8.5–10.5 μm, four-celled, two or three seriate above and uniseriate below, fusiform-cylindrical, hyaline at first, then becoming olivaceous brown to dark brown and finally opaque, transversely septate, constriction at the septa moderately deep; segments not easily separable at maturity; cells unequal in size and shape; terminal cells 12–13.5 × 7–8.5 μm, longer than the midcells and slightly narrower towards the ends; midcells 10.5–11.5(–12) × 8.5–10.5 μm, broader and shorter than the terminal cells; germ slit parallel; gelatinous sheath hyaline and narrow. Conidia unknown.

HABITAT: On cow dung.

SPECIMENS EXAMINED: CANADA: Ontario: Peel Co., SW of Palgrave, on rabbit dung, *Cain*, TRTC 38817. York Co., Nashville, on cow dung, *Cain*, TRTC 39217. U.S.A.: Utah: Duchesne Co., Duchesne, on rabbit dung, *Cain*, TRTC 44837. KENYA: TRTC 66.1770x (TYPE). TANZANIA: TRTC 66.1726w.

Sporormiella tenuispora resembles *S. grandispora* but can be differentiated by the characteristically narrower asci and ascospores of the former.

New Records of *Sporormiella*

Sporormiella australis (Speg.) Ahmed & Cain, Can. J. Bot. 50: 434. 1972.

In the material examined, the asci were more or less clavate to subcylindrical measuring 110–160 × 20–27(–30) μm, ascospores 32–47 × 6.5–8.5(–9.0) μm, four celled, obliquely biseriate. *Sporormiella australis* resembles *S. similis* to which the affinity is evident in some collections. For instance, in TRTC 66.1765, the asci measure 144–160 × 25–27 μm and the ascospores are 43–48 × 8–8.5 μm; in TRTC 66.1763k, the asci taper gradually into a short stipe and the ascospores measure 42–47 × 7.5–8.5 μm.

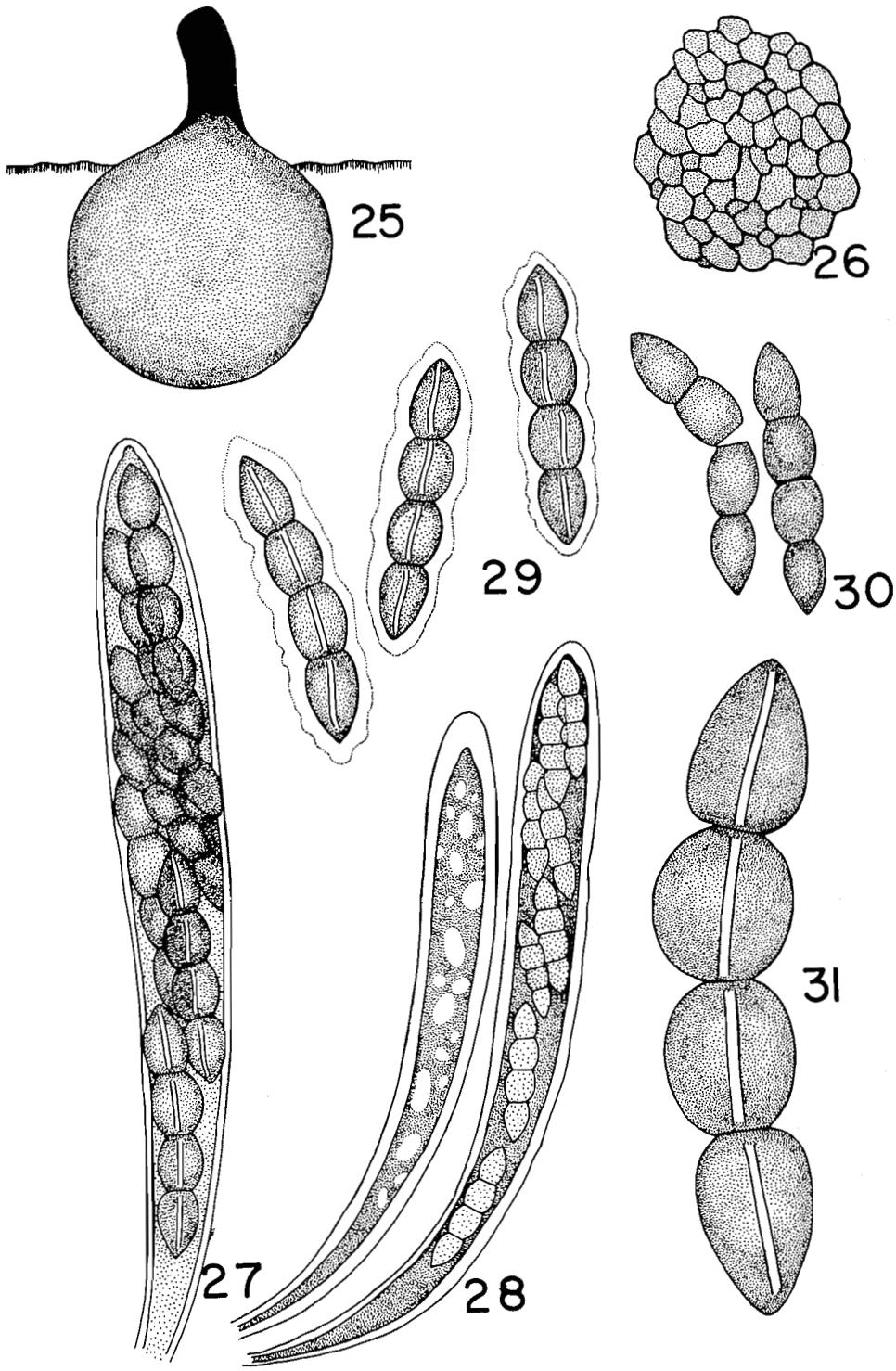
SPECIMENS EXAMINED: KENYA: TRTC 66.261d, 66.307k, 66.640d, 66.667d, 66.685c, 66.692a, 66.1541c, 66.1543f, 66.1763k, 66.1765c, 66.1773c, 66.1775d. TANZANIA: TRTC 66.2379c, 66.3377s.

Sporormiella capybarae (Speg.) Ahmed & Cain, Can. J. Bot. 50: 436. 1972.

In TRTC 66.1770dd, the ascospores measure 48–56 × 8.5–10 μm and are more slender and more tapering than in typical collections so that the terminal cells appear conical.

SPECIMENS EXAMINED: KENYA: TRTC 66.1770dd, 66.1780o.

Sporormiella dubia Ahmed & Cain, Can. J. Bot. 50: 440. 1972.



FIGS. 25–31. *Sporormiella tenuispora* (TYPE). Fig. 25. Pseudothecium. × 100. Fig. 26. Peridial surface. × 500. Fig. 27. Mature ascus with dark brown ascospores. × 700. Fig. 28. Young asci, one with light brown ascospores. × 600. Fig. 29. Mature ascospores with hyaline sheath. × 800. Fig. 80. Mature ascospores separable at midseptum. × 800. Fig. 31. Mature ascospore. × 1800.

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The east African specimens were found to be slightly different in ascospore measurements than in typical collections. In TRTC 66.641f, the asci measure 100–135 × 18–22 μm, while in TRTC 66.1763r, they measure 140–165 × 16–18 μm, and the ascospores 42–49 × 8–10 μm; in TRTC 66.1780x, the ascospores are more tapering and slender, measuring 44–46 × 6–8 μm. However, these discrepancies are not sufficient to separate such collections from *S. dubia*.

SPECIMENS EXAMINED: KENYA: TRTC 66.309d, 66.493a, 66.609a, 66.641f, 66.1763r, 66.1770x, 66.1780x.

Sporormiella herculea (Ellis & Ev.) Ahmed & Cain, Can. J. Bot. 50: 442. 1972.

There are some noteworthy differences in the specimens from east Africa. They differ in ascus measurements and the number of ascospore segments. The asci are (295–)340–400 × (35–)42–52 μm. The ascospores are (100–)126–154 × (12–)15–17 μm and only 10–12 celled; 14 to 16-celled ascospores found in North American collections were not observed. Specimens of *S. herculea* from Kenya and Tanzania show certain differences when compared with those from North America, Mexico, and Brazil, as reported by Ahmed and Cain (1972). The ascospores in specimens of *S. herculea* from Canada and U.S.A. are 9–16 celled, (95–)100–160(–170) × 15–18(–20) μm; from Mexico and Brazil, 7–12 celled, (87–)90–125(–140) × 15–18 μm; from east Africa, 10–12 celled, (100–)120–152 × (12–)15–17 μm.

Furthermore, in the east African specimens, the basal cell of the ascospores is longer and narrower than most of the other cells. The average measurement of the basal cell is 20 × 12.5 μm, while the other cells (except the third and fourth from the upper end) measure 12–13.5 × 15–17 μm.

The third upper cell (or fourth upper cell in some spores) is very much enlarged, measuring 17–21 × 21–30 μm. In all specimens, the germ slit is always transverse and a narrow gelatinous sheath surrounds each ascospore.

SPECIMENS EXAMINED: KENYA: TRTC 66.1770j. TANZANIA: TRTC 66.1093h.

Sporormiella intermedia (Auersw.) Ahmed & Cain in Kobayasi et al. Bull. Natl. Sci. Mus. Tokyo, 12: 339. 1969.

SPECIMENS EXAMINED: KENYA: TRTC 66.310d, 66.667e, 66.1763s, 66.1765d, 66.1780k. TANZANIA: TRTC 66.3377g.

Sporormiella inaequalis Ahmed & Asad, Sydowia, 21: 291. 1967.

SPECIMENS EXAMINED: PAKISTAN: Karachi, goat dung, *Wasif*, TRTC 46504. TANZANIA: TRTC 66.1726u, 66.3377xx.

Sporormiella isomera Ahmed & Cain, Can. J. Bot. 50: 445. 1972.

Colonies on V8 agar and Weitzman and Silva-Hutner's (1967) media attaining 6–7 cm diameter in 2–3 weeks at 25°C, cottony to woolly in the beginning, later becoming granular, appressed, azonate, olivaceous grey to dark grey or brown, reverse grey to slightly blackish, fruiting bodies abundant, occasionally in concentric rings, often showing a tendency to sectoring, sterile white sectors alternating with dark fertile ones; aerial hyphae 1.5–3.5 μm diameter, hyaline to light grey, regularly septate; substrate hyphae 2.5–7.0 μm diameter, dark grey to light brown, somewhat thick walled, and frequently anastomosing; pseudothecial initials consisting of a single intercalary cell which continually divides in several planes to form a large pseudoparenchymatous mass which eventually forms the pseudothecium. Pseudothecia 200–275 × 150–170 μm, pyriform to subglobose, immersed to semiimmersed, scattered to aggregated, dark brown to black by reflected light, smooth, glabrous, ostiolate; neck up to 60 μm in length, small, papilliform to somewhat cylindrical, glabrous; ostiole circular and indistinct; peridium 22–25 μm thick, membranaceous to semicoriaceous, dark brown by transmitted light, pseudoparenchymatous in surface view, two layered in cross section; outer peridial cells 3.5–15 × 3–5 μm, angular, thick walled, dark brown, in radial section two to five cells thick; inner peridial cells 10–16.5 × 2.5–3.5 μm, elongated and flattened, thin walled, hyaline, evanescent at maturity, occasionally persisting. Asci 125–180 × 13–16 μm, eight-spored, long cylindrical to cylindrical-clavate, nonamyloid, broadly rounded above and gradually tapering below into a 12- to 20-μm-long stipe. Pseudoparaphyses filiform, septate, hyaline, occasionally branched, longer than the asci and mixed with them. Ascospores (27–)30–35 × 4.5–6(–6.5) μm, four-celled, biseriate, cylindrical, hyaline to olivaceous brown when young, becoming dark brown to opaque at maturity, transversely septate, constrictions at the septa moderately deep, occasionally shallow, terminal cells slightly different from the midcells; upper terminal cell 8–8.5(–9.0) × 5–5.5 μm, cylindrical with rounded apex; the midcells 7–8 × 5–6.5 μm, broader and truncated at the ends; the lower terminal cells 9–9.5(–10.5) × 4.5–5.5 μm, cylindrical and tapering towards the ends; germ slit oblique to parallel with a kink near the middle; gelatinous

sheath hyaline, about 3.5–8 μm broad. Conidia not observed in axenic cultures.

SPECIMENS EXAMINED: KENYA: TRTC 66.307r, 66.309e, 66.310k, 66.494b, 66.639c, 66.1429c, 66.1763d, 66.1769g. TANZANIA: TRTC 66.1061ℓ, 66.1093k, 66.1719a, 66.1729a, 66.2380d, 66.3137a.

When these collections of *S. isomera* were compared with collections from Canada, particularly the TYPE TRTC 36241, slight differences were noticed in the asci and ascospores. The ascospore segments in east African collections are more or less unequal in shape and size, the lower terminal cell being more tapering than the rest of the segments; the germ slit is almost oblique but occasionally parallel, with a kink near the middle. On the basis of such slight differences, it is hard to separate these collections from *S. isomera*. Accordingly, all these collections from east Africa have been referred to *S. isomera*.

Sporormiella kansensis (Griff.) Ahmed & Cain, Can. J. Bot. 50: 445. 1972.

Colonies in V8 agar medium attaining 6 cm diameter in 3 weeks at 25°C, light pink, cottony to felty, azonate to zonate, fruiting bodies produced in concentric rings, reverse light pink, margin smooth, pigmentation centrally restricted; aerial hyphae 1.5–3 μm diameter, hyaline, regularly septate, and anastomosing; substrate hyphae 3–8 μm diameter, thick walled, frequently anastomosing; pseudothecial initials consisting of a single intercalary cell which continually divides in several planes to form a large pseudoparenchymatous mass which eventually forms the pseudothecium. Pseudothecia 385–550 × 300–400 μm, immersed to semiimmersed, scattered or aggregated, subglobose to pyriform, glabrous, dark brown to black by reflected light; neck up to 215 μm diameter, black, glabrous; ostiole circular and indistinct; peridium 25–35 μm thick, membranaceous to semicoriaceous, dark brown by transmitted light, pseudoparenchymatous in surface view, two layered in cross section; outer peridial cells 4–11 × 2–3.5 μm, angular, thick walled, dark brown, in radial section two to four cells thick; inner peridial cells angular, thin walled, elongated, hyaline, evanescent, occasionally persisting, size extremely variable, forming a layer up to 25 μm thick. Asci 210–250 × 30–35 μm, eight-spored, cylindrical-clavate, stipitate, nonamyloid, broadly rounded above, broadest part above the middle, contracted below into a 30- to 35 μm long stipe. Pseudoparaphyses 2–3.5 μm diameter, abundant, filiform, regularly to remotely septate, hyaline, often branched, longer than the asci and mixed with them. Ascospores (62–)65–70(–74) × 10–11.5(–12.5) μm, two or three seriate, four celled, cylindrical, rounded at their ends, hyaline when young, ranging through yellow to brown, finally dark brown and opaque at maturity; transversely septate, constriction at the septa broad and deep; segments easily separable at all septa but more frequently at the middle one; all cells about equal in length; terminal cells more slender than the midcells; midcells 16–17.5 × 10.5–12 μm; terminal cells 17–19(–21) × 9–11 μm; germ slit parallel to oblique; gelatinous sheath hyaline and moderately broad. Conidia not observed in axenic cultures.

SPECIMEN EXAMINED: KENYA: TRTC 66.1778d.

In the east African collection, which has been isolated in pure culture, the ascospores are shorter than in other TRTC collections but this difference is not sufficient to justify erecting a separate species at this time.

Sporormiella longispora (Cain) Ahmed & Cain, Can. J. Bot. 50: 447. 1972.

SPECIMEN EXAMINED: KENYA: TRTC 66.309c.

Sporormiella longisporopsis Ahmed & Cain, Can. J. Bot. 50: 448. 1972.

SPECIMEN EXAMINED: KENYA: TRTC 66.1763c.

Sporormiella megalospora (Auersw.) Ahmed & Cain, Can. J. Bot. 50: 449. 1972.

Ascospores are 65–74 × 14–17 μm and slightly smaller than the ascospores in Canadian specimens (70–85 × 15.5–18 μm) but agree with those from the United States and Mexico.

SPECIMEN EXAMINED: KENYA: TRTC 66.667j.

Sporormiella minima (Auersw.) Ahmed & Cain, Can. J. Bot. 50: 449. 1972.

Sporormiella minima appears to be a fairly common species in east Africa; a large number of collections of this species were examined.

Ascospores of east African collections are shorter than those from North American collections but the width is the same. The germ slit is parallel with a kink near the middle and the gelatinous sheath is hyaline and narrow. The difference in ascospore length is not sufficient to warrant describing a separate species. The ascospores germinate without difficulty on V8 agar and Weitzman and Silva-Hutner's (1967) media at 25°C. For a discussion of various factors influencing ascospore germination, growth, and pseudothecial production in *S. minima*, see Asina *et al.* (1977*a*, 1977*b*).

SPECIMENS EXAMINED: KENYA: TRTC 66.146c, 66.261c, 66.289e, 66.305a, 66.307m, 66.309i, 66.310e, 66.381i, 66.493n, 66.598d, 66.609b, 66.610a, 66.659b, 66.692c, 66.1287ℓ,

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66.1408i, 66.1428e, 66.1431ℓ, 66.1437c, 66.1543e, 66.1765g, 66.1766a, 66.1768t, 66.1771c, 66.1776c. TANZANIA: TRTC 66.1015a, 66.1061c, 66.1093g, 66.1291d, 66.1294c, 66.1700c, 66.1710b, 66.1726s, 66.1731a, 66.1790e, 66.1794a, 66.1795e, 66.2380e, 66.3377p. UGANDA: TRTC 66.2166i, 66.3286h, 66.3287b, 66.3288a.

Sporormiella minimoides Ahmed & Cain, Can. J. Bot. 50: 450. 1972.

SPECIMENS EXAMINED: KENYA: TRTC 66.307q. TANZANIA: TRTC 66.3377o, 66.3442a.

Sporormiella muskokensis (Cain) Ahmed & Cain, Can. J. Bot. 50: 451. 1972.

SPECIMEN EXAMINED: KENYA: TRTC 66.667i.

Sporormiella pilosa (Cain) Ahmed & Cain, Can. J. Bot. 50: 454. 1972.

In material from Kenya, the pseudothecia are devoid of hairs in the upper part and on the necks. The presence of pseudothecial hairs is considered a very diagnostic characteristic of this species. However, the glabrous nature of pseudothecia in this collection may be due to an excess of moisture in the moist chamber, where they were developed in the laboratory at room temperature.

The ascospores measure (56–)60–70 × 10.5–13 μm. In comparison with material from North America, the ascospores are more slender, the terminal cells are more tapering, and the germ slit is oblique to diagonal.

SPECIMEN EXAMINED: KENYA: TRTC 66.1763u.

Sporormiella subtilis Ahmed & Cain, Can. J. Bot. 50: 459. 1972.

SPECIMEN EXAMINED: KENYA: TRTC 66.640c.

Sporormiella teretispora Ahmed & Cain, Can. J. Bot. 50: 460. 1972.

SPECIMENS EXAMINED: KENYA: TRTC 66.667f. TANZANIA: TRTC 66.2379a.

Sporormiella tetramera Ahmed & Cain, Can. J. Bot. 50: 464. 1972.

The ascospores measure 25–35 × 5.5–7(–7.5) μm, which is slightly smaller than in North American collections. The basal cell is much longer than the remaining cells and prominently narrowed at the end. The germ slit is curved and S-shaped or nearly parallel to oblique. In some ascospores, the septum has a kink near the middle.

SPECIMENS EXAMINED: KENYA: TRTC 66.309b, 66.1770f, 66.1780h. TANZANIA: TRTC 66.1726c, 66.3377w.

New Records of *Sporormia*

Sporormia fimetaria de Not., Mem. R. Accad. Torino, II, 10: 342. 1849.

Sporormia fimetaria is characterized by smaller pseudothecia and asci than the other two species of *Sporormia*. The ascospores are 16 to 20 celled and measure 50–57(–60) × 3.5–4.5(–5.5) μm. They lie parallel and are firmly united into a cylindrical truncate mass in the centre of the ascus.

SPECIMENS EXAMINED: KENYA: TRTC 66.1287k, 66.1431j, 66.1437f, 66.1765e, 66.1768n, 66.1770w, 66.1773b, 66.1775e, 66.1779a, 66.1780i, 66.1781b. TANZANIA: TRTC 66.1787b, 66.3377y. UGANDA: TRTC 66.3288d.

Sporormia fimicola Ahmed & Asad, Sydowia, 21: 291. 1967.

Sporormia fimicola differs from *S. fimetaria* in possessing larger pseudothecia, asci, and ascospores. In the former, the ascospores measure 85–116 × 5.0–6.5 μm and each ascospore is 16 celled. *Sporormia fimicola* seems to be restricted in its distribution as it was encountered in only two collections from east Africa. The only previous record is from its type locality, Karachi, Pakistan.

SPECIMENS EXAMINED: KENYA: TRTC 66.1770a. TANZANIA: TRTC 66.1292e, 66.1726h.

Acknowledgment

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