

***Buergenerula spartinae* sp. nov., an Ascomycete from salt marsh cordgrass,  
*Spartina alterniflora***

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Comparisons between the marine wood-inhabiting Ascomycete *Sphaerulina pedicellata* Johnson and a similar species from *Spartina* spp. demonstrate that the two fungi are not identical. The species from *Spartina*, described as *Buergenerula spartinae* sp. nov., is compared with the type species of the genus, *B. bisepitata* (Rostrup) Sydow. *Buergenerula spartinae* is characterized by hyphopodia, periphyses, pseudoparaphyses, unitunicate, thick-walled asci with a non-amyloid, ring-like apical apparatus, and clavate, three-septate, hyaline ascospores. *Sphaerulina pedicellata* is considered a doubtful species.

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La comparaison entre l'Ascomycète marin lignicole *Sphaerulina pedicellata* Johnson et une espèce semblable provenant de *Spartina* spp. montre que ces champignons ne sont pas identiques. L'espèce provenant de *Spartina*, décrite ici comme *Buergenerula spartinae* sp. nov., est comparée avec l'espèce-type du genre *B. bisepitata* (Rostrup) Sydow. *Buergenerula spartinae* est caractérisée par des hyphopodes, des périphyses, des pseudoparaphyses, des asques unituniqués à paroi épaisse et à anneau apical non-amyloïde, et des ascospores claviformes, tri-septées, hyalines. *Sphaerulina pedicellata* est regardée comme espèce douteuse.

Marine mycologists since 1962 have been assigning a clavate-spored Ascomycete collected on salt marsh cordgrass, *Spartina alterniflora* Loisel., and *Spartina* sp. to *Sphaerulina pedicellata* Johnson. This fungus was originally described by Johnson (1956) from a submerged pine panel, and other workers have reported it from driftwood, submerged wood (Johnson and Sparrow 1961; Jones 1962; Cavaliere 1966a, 1966b), and an unspecified substrate<sup>1</sup> (Cavaliere 1968). *Sphaerulina pedicellata* has also been reported from *Spartina alterniflora* (Webber 1970; Gessner *et al.* 1972; Gessner and Goos 1973a, 1973b; Goos and Gessner 1975; Gessner 1976) and from *Spartina* sp. (Jones 1962) from salt marshes in the U.S.A. and Great Britain. After studying the fungus on *Spartina alterniflora* and the two available collections from wood (Jones 1962; Cavaliere 1968), we feel that the *Spartina* fungus *Buergenerula spartinae* Kohlmeyer et Gessner sp. nov. is distinctly different from the species originally described from wood, and a comparison between the two species follows.

Material from single-ascospore cultures and

field collections of *Spartina alterniflora* was examined as well as the collections of Jones (1962) from driftwood and Cavaliere (1968) from wood in Iceland. The type material of *Sph. pedicellata* could not be obtained and evidently does not exist; therefore, it could not be compared with *B. spartinae* and is considered a doubtful species because critical characters of ascocarp and ascus morphology are unknown. The collections on wood from Iceland (Cavaliere, nos. 189, 231, 251, 296) appear to be different from both *B. spartinae* and *Sph. pedicellata* since the ascospores are smaller (25–32 × 8–9 μm). The fungus identified by Cavaliere (1966b) as *Sph. pedicellata* also appears to differ from *B. spartinae*. The fungus collected by Jones (1962) had similar ascospores and asci (slide Herb. IMI 81681), but the ascocarps could not be compared because the original collection had been destroyed in a fire (E. B. G. Jones, personal communication). Besides spore shape and size, the ascus apical apparatus and ascocarp morphology including the centrum must be considered in identifying *B. spartinae*.

The fungus on *Spartina alterniflora*, *B. spartinae*, differs from *Sph. pedicellata* in a

<sup>1</sup>Examined by us and found to be wood.

number of ways. *Buergenerula spartinae* produces light to dark runner hyphae bearing lobed hyphopodia in culture and on culms of *Spartina alterniflora* beneath the leaf sheath (Gessner *et al.* 1972; Goos and Gessner 1975). These have not been described for *Sph. pedicellata* from wood.

The ascocarps of *B. spartinae* are 300–450  $\mu\text{m}$  in diameter (Fig. 1) while those of *Sph. pedicellata* can be much broader (up to 720  $\mu\text{m}$ ), according to Johnson and Sparrow (1961). The fruiting body of *B. spartinae* is light to dark brown and, in general, uniformly colored. *Sphaerulina pedicellata* produces a perithecium which is black above and brown below (Johnson 1956). Periphyses are present in *B. spartinae* (Fig. 2). They were not included in the original description of *Sph. pedicellata* but later were found by Cavaliere (1966b) in collections supposedly in agreement with this species.

The peridium of *B. spartinae* consists of two layers. The outer layer has thick, flat, brown cells with narrow lumina and an inner layer of ellipsoidal, thin-walled, hyaline to brown cells with large lumina (Figs. 3 and 5). The cells of the peridium form a textura angularis and are filled with oil globules. The venter wall of *Sph. pedicellata* from wood is two-layered with small, spherical, thin-walled cells merging gradually toward the centrum with thin-walled, ellipsoidal or rectangular cells (Cavaliere 1966b). A second wall stratification pattern was also reported by Cavaliere (1966b) in the same fungus. He found outer layers of thick-walled, spherical or broadly ellipsoidal cells with small lumina merging gradually with inner layers of thinner-walled, ellipsoidal cells with larger cavities.

Filamentous structures, apparently originating from the upper tissues of the centrum, suggestive of pseudoparaphyses (or apical paraphyses?) develop before the asci in *B. spartinae* (Figs. 3, 4, and 10). *Sphaerulina pedicellata* is aparaphysate, according to Johnson (1956). A description of the centrum was not given in the

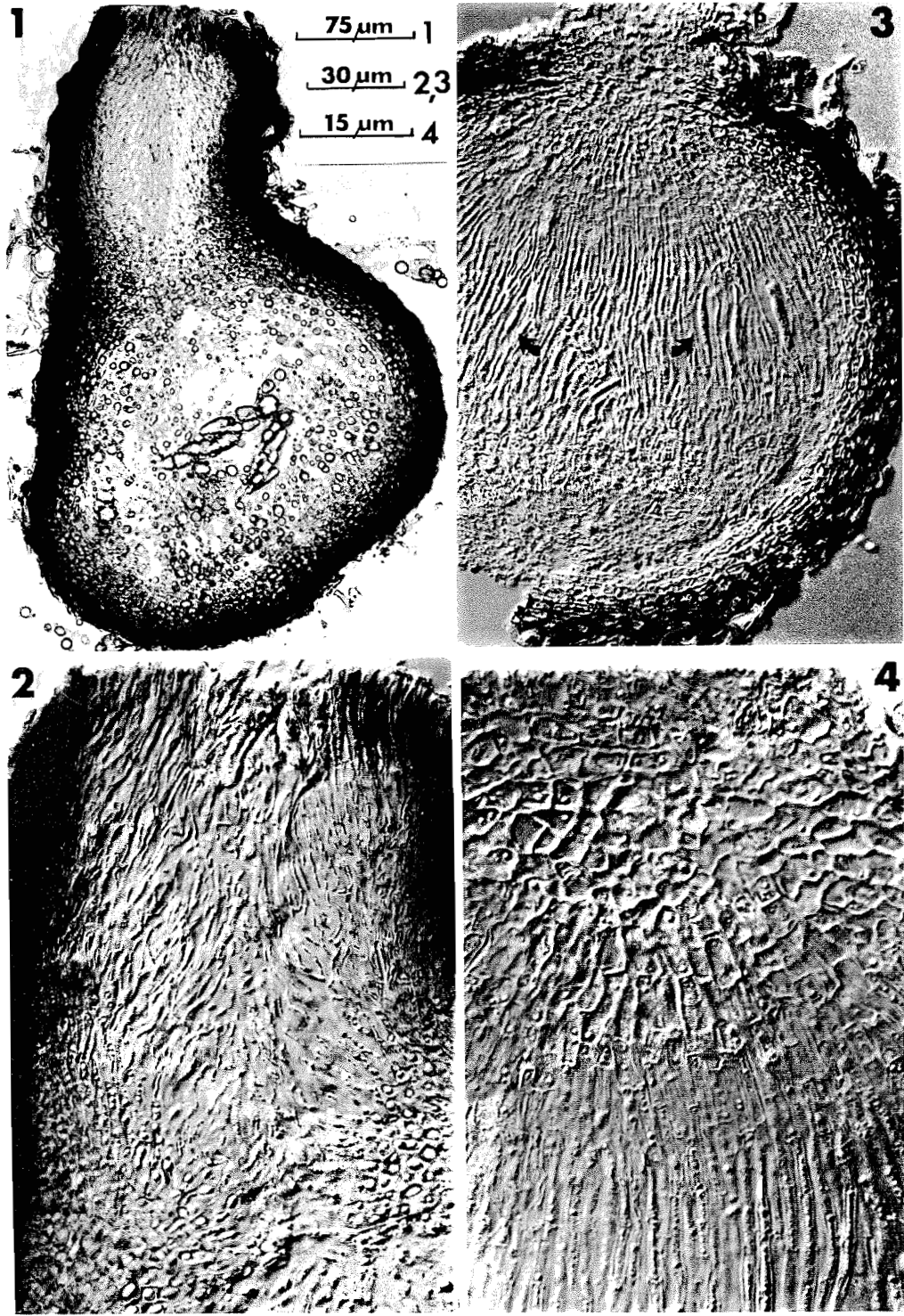
type description. It has been suggested, however, that *Sph. pedicellata* is pseudothecial (Cavaliere 1966b).

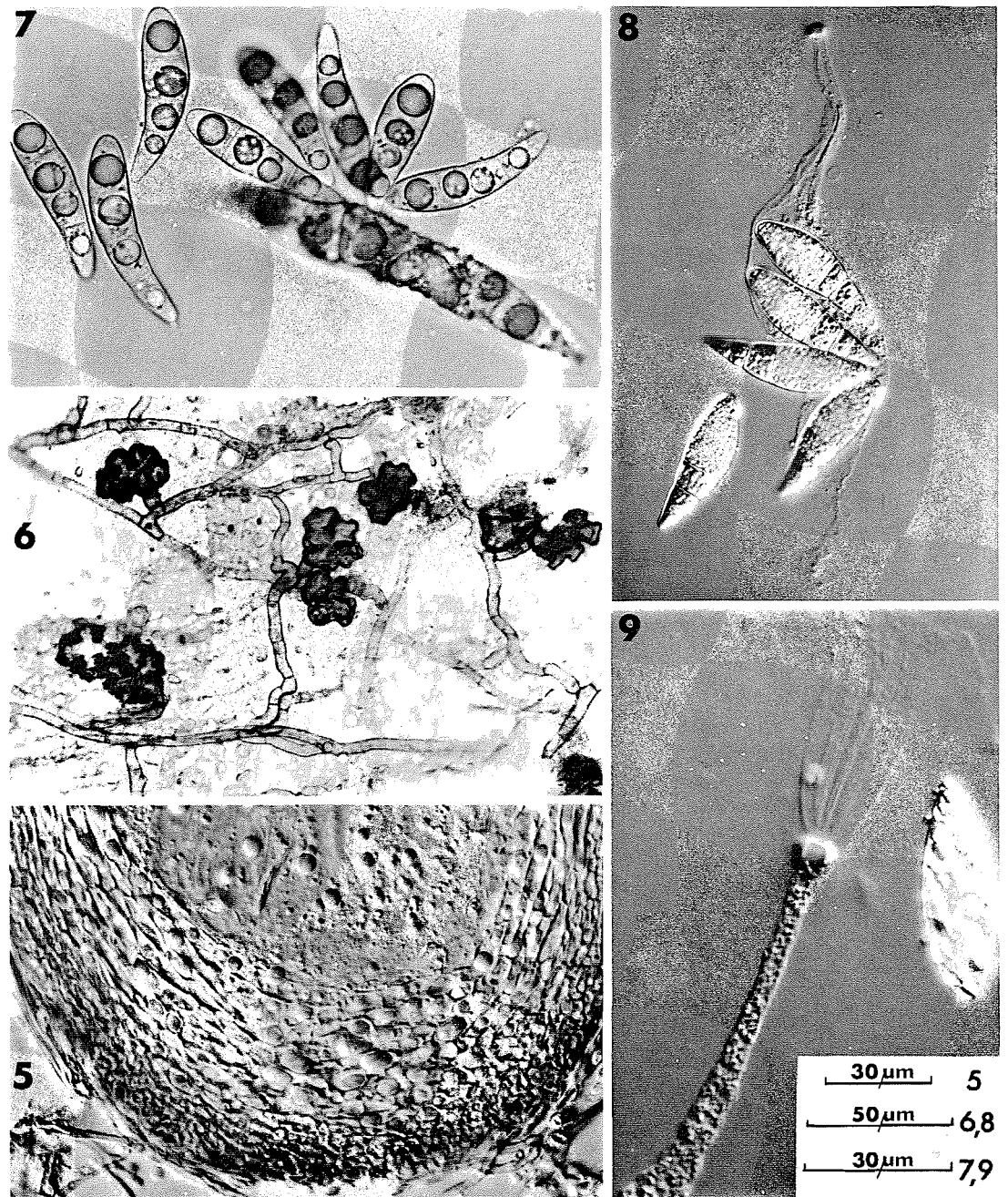
The ascus of *B. spartinae* is unitunicate, thick-walled, and persistent (Figs. 10 and 12). Asci of *Sph. pedicellata* are reported to be thin-walled (not mentioned if unitunicate or bitunicate) with an apical thickening and occasionally deliquescent (Johnson 1956). A mycosphaerellaceous affinity was suggested because of the apical thickenings of *Sph. pedicellata* (Johnson and Sparrow 1961). The fungus from *Spartina* has no relationship to the Loculoascomycete genus *Mycosphaerella*. The ascus of *B. spartinae* has a complex apical structure with a refractive ring, which becomes visible in Nomarski differential interference-contrast (Figs. 10–12) or in Melzer's reagent, but is not amyloid. The ring stains medium blue in Shaeffer's blue-black ink, indicating a chitinoid reaction (Luttrell, personal communication; Chaudfaud 1969).

The ascospores of *B. spartinae* are clavate, curved, and usually three- and occasionally four-septate (Figs. 7 and 8). *Sphaerulina pedicellata* has three- to five-septate ascospores which are elongate-ovoid to elongate-pyriform, one end cell being attenuated and curved (Johnson 1956). Ascospores in the material of *Sph. pedicellata* from wood examined by Cavaliere (1966b) differed from the type description of the species in that the ascospores were tapered but lacked the diagnostic, attenuated, curved end cell. Therefore, this collection may be different from *Sph. pedicellata*.

In summary, the fungus described by Johnson (1956) from wood as *S. pedicellata* has some general similarities to *B. spartinae*, but critical characters of the ascocarp and centrum cannot be compared in the absence of type material. Reports of *S. pedicellata* during the past 20 years were evidently based on the size and shape of ascospores since type material was absent. *Sphaerulina pedicellata* Johnson, therefore, should be rejected according to Article 69 of the

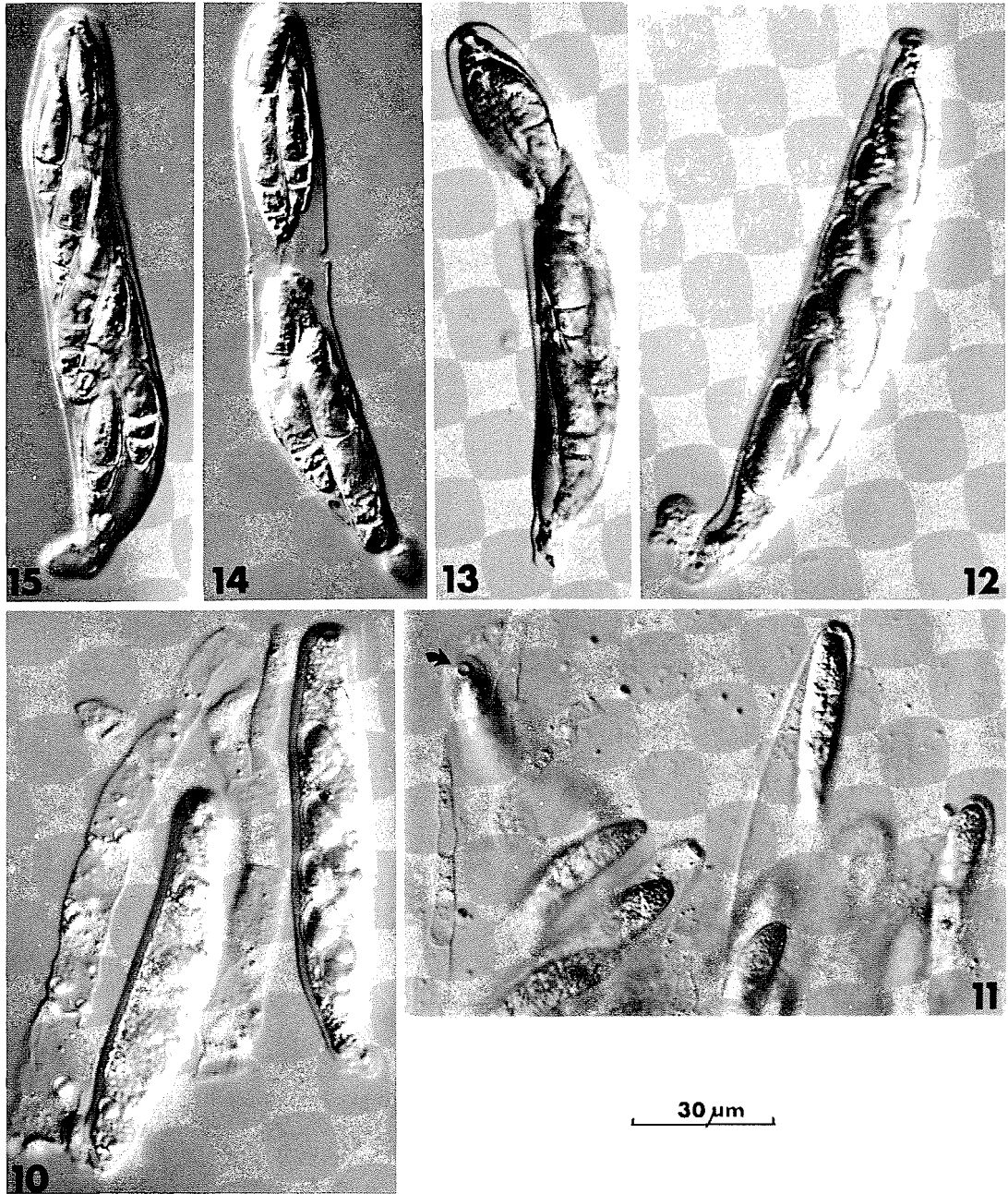
Figs. 1–4. *Buergenerula spartinae*. Fig. 1. Longitudinal section (L.s.) (16  $\mu\text{m}$ ) through mature ascocarp; note large number of oil droplets. Fig. 2. L.s. (16  $\mu\text{m}$ ) through neck of ascocarp; ostiolar canal filled with periphyses. Fig. 3. L.s. (12  $\mu\text{m}$ ) through young ascocarp with pseudoparaphyses and immature asci (arrows); the neck will develop from the apical pseudoparenchyma (P). Fig. 4. L.s. (12  $\mu\text{m}$ ) through apical region of immature ascocarp, showing attachment of pseudoparaphyses to the pseudoparenchyma. Figure 1 is in bright-field, the others are in Nomarski differential interference-contrast. Figures 1 and 2 are from Herb. J.K. No. 3498; Figs. 2 and 3 are from Herb. J.K. No. 3503.





FIGS. 5-9. *Buergenerula spartinae*. Fig. 5. Longitudinal section (16  $\mu$ m) through asocarp wall. Fig. 6. Hyphae with hyphopodia from the surface of *Spartina alterniflora*. Fig. 7. Ascospores. Fig. 8. Torn ascus with mature ascospores; apical apparatus above. Fig. 9. Immature ascus and ascospore; wall (above) pulled away from the cytoplasm with granular inclusions; apical apparatus in between. Figures 6 and 7 are in bright-field, the others are in Nomarski differential interference-contrast. Figures 5 and 6 are from Herb. J.K. No. 3498; Fig. 7 is from Herb. J.K. No. 3706; and Figs. 8 and 9 are from Herb. Gessner, Connecticut.





FIGS. 10-12. *Buergenerula spartinae*. Fig. 10. Immature asci and fragments of pseudoparaphyses. Fig. 11. Asci with apical apparatuses, apical (arrow) and side views; pseudoparaphysis to the left. Fig. 12. Immature, thick-walled ascus with apical apparatus. FIGS. 13-15. *Buergenerula biseptata*. Fig. 13. Ascus, showing apical apparatus. Fig. 14. Mature, unitunicate ascus, ruptured by force in the middle, showing the thick wall which is strongly refractive on the outside. Fig. 15. Mature, thick-walled ascus. All figures are in Nomarski differential interference-contrast. Figures 10 and 12 are from Herb. J.K. No. 3498; Fig. 11 is from Herb. J.K. No. 3685; and Figs. 13-15 are from Herb. DAOM 130787.

International Code of Botanical Nomenclature since without type material and an adequate description of taxonomically important structures (ascus tip and centrum) it would remain a 'long-persistent source of error.'

*Buergenerula spartinae* appears to be a parasitic fungus on *Spartina* spp. since it produces runner hyphae with hyphopodia and black streaks on the leaves of the host where the ascocarps are produced. It is common on *S. alterniflora* (Gessner and Goos 1973b) and seems to occur in both living and dead tissues. Numerous collections have been made by J. J. Kohlmeyer and other workers (Brooks, personal communication) in areas where *B. spartinae* is found abundantly on *S. alterniflora*, and it has not been found to occur on intertidal or submerged wood. Based on these findings, we consider *B. spartinae* to be different from *Sph. pedicellata* and a new species.

***Buergenerula spartinae* Kohlmeyer et Gessner sp. nov.**

*Hyphae* 2.5–8  $\mu\text{m}$  diam, ramosis et anastomosantibus, septatis, pachydermaticis, albis, olivaceis, atro-brunneis vel nigris; hyphopodia 14–37  $\mu\text{m}$  diam, olivacea, atro-brunnea vel nigra formantibus. *Ascocarpiis* 300–475  $\mu\text{m}$  altis (papillis exclusis), 200–450  $\mu\text{m}$  diam, subglobosis ad obpyriformibus, ostiolatis, papillatis, coriaceis, dilute brunneis vel fuscis, solitariis, immersis, saepe in cavernulis aeriis vel inter culmum et vaginam folii crescentibus. *Peridiis* 30–60  $\mu\text{m}$  crassis, bistratis; strato externo 8–16  $\mu\text{m}$  crasso, 3 ad 5 stratis cellularum planarum, brunnearum luminis angustis, compositis; strato interno 20–30  $\mu\text{m}$  crasso, 8 ad 10 stratis cellularum, ellipsoidearum, leptodermarum, hyalinarum ad dilute brunnearum luminis grandibus, compositis; cellulis peridiorum texturam angularem formantibus, globulis olei impletis. *Papillis* vel collis 100–280  $\mu\text{m}$  altis, 120–180  $\mu\text{m}$  diam, apicalibus vel leviter lateralibus, cylindricis vel conicis; peridio cellulis elongatis, luminibus parvis, versus ostiolum in periphysibus transientibus; periphysibus filiformibus, sinuosis, centrīs angustis refractivisque, stratis externis gelatinosis tectis. *Pseudoparaphysibus* (vel paraphysibus apicalibus?) 8–10  $\mu\text{m}$  diam, filamentosis, simplicibus vel ramosis, leptodermis, septatis, ad septa leniter constrictis, ante ascos crescentibus, primo ad apicem basemque affixis,

globulis olei impletis. *Ascis* 120–190  $\times$  18–20  $\mu\text{m}$ , octosporis, cylindricis ad subfusiformibus, breve pedunculatis vel non pedunculatis, unitunicatis, pachydermis ad apices; corpore apicali, ellipsoideo, annulari, circa 4  $\mu\text{m}$  diam; ad basem ascocarpi evolutis, inter pseudoparaphyses crescentibus. *Ascosporis* 37–66  $\times$  9.5–14  $\mu\text{m}$ , biseriatis, clavatis, latis ad apices, ad basibus gradatim decrescentibus, vulgo curvatis, tri- (rariter quadri-) septatis, ad septa non vel leniter constrictis, hyalinis. *Hospites*: *Spartina alterniflora* Loisel. and *Spartina* sp. *Distributio*: Oceanus Atlanticus: Argentina (Buenos Aires), Canada (New Brunswick), Britannia (England), U.S.A. (Maine, New Hampshire, Rhode Island, Connecticut, New Jersey, Virginia, North Carolina, Florida, South Carolina).

*Hyphae* 2.5–8  $\mu\text{m}$  in diam, branching and anastomosing, septate, thick-walled, white to olive-green, dark brown or black, forming olive-green to dark brown or black lobed hyphopodia, 14–37  $\mu\text{m}$  in diam (Fig. 6). *Ascocarps* 300–475  $\mu\text{m}$  high (excluding the necks), 200–450  $\mu\text{m}$  in diam, subglobose to obpyriform, ostiolate, papillate, coriaceous, light or dark brown, solitary, immersed, often developing in air chambers of the host tissue or between culm and leaf sheath (Fig. 1). *Peridium* 30–60  $\mu\text{m}$  thick, two-layered; outer layer 8–16  $\mu\text{m}$  thick, composed of three to five layers of flat, brown cells with narrow lumina; inner layer 20–30  $\mu\text{m}$  thick, composed of 8–10 layers of ellipsoidal, thin-walled, hyaline to light brown cells with large lumina; cells of both layers forming a textura angularis, filled with oil globules (Figs. 1, 3, and 5). *Papillae* or *necks* 100–280  $\mu\text{m}$  high, 120–180  $\mu\text{m}$  in diam, apical or slightly lateral, cylindrical or conical; peridium composed of elongate cells with small lumina, merging towards the ostiolar canal into periphyses; periphyses filiform, wavy, with a narrow, refractive core, surrounded by a gelatinous outer layer (Fig. 2). *Pseudoparaphyses* (or apical paraphyses?) 8–10  $\mu\text{m}$  in diam, filamentous, simple or branched, thin-walled, septate, slightly constricted at the septa, developing before the asci, at first attached at both the tip and bottom, filled with oil globules (Figs. 3, 4, 10, and 11). *Asci* 120–190  $\times$  18–20  $\mu\text{m}$ , eight-spored, cylindrical to subfusiform, short pedunculate or non-pedunculate, unitunicate, thick-walled, with an ellipsoidal, ring-like apical apparatus, about 4  $\mu\text{m}$

in diam (Figs. 8–12), developing at the base of the ascocarp venter and growing up between the pseudoparaphyses (Fig. 3); in squash mounts of some specimens the ascus wall appeared to separate into two layers leaving a core filled with small globules on one side and a thicker, homogenous sheath on the other with the apical apparatus in between (Fig. 9); although this separation is an artifact, it seems to indicate that the wall has more than one layer. However, it should be emphasized that the asci are not bitunicate. *Ascospores* 37–66 × 9.5–14 μm, biserial, clavate, thick at the apex, tapering at the base, mostly curved, three- (rarely four-) septate, not or slightly constricted at the septa, hyaline (Figs. 7 and 8). Structures suggestive of conidiophores (or spermatophores?) bearing microconidia (or spermatia?) are found on the mycelium of *B. spartinae* in cultures grown on corn meal agar (Difco) prepared with seawater. The stalked structures are branched, up to 20 μm long, and form laterally from the somatic hyphae. Each bears a small, phialide-like projection from which curved cells about 2 μm wide and 5 μm long are borne. *Hosts*: *Spartina alterniflora* Loisel. and *Spartina* sp. *Distribution*: Atlantic Ocean: Argentina (Buenos Aires), Canada (New Brunswick), Great Britain (England), U.S.A. (Maine, New Hampshire, Rhode Island, Connecticut, New Jersey, Virginia, North Carolina, South Carolina, Florida). *Etymology*: Named after the host genus *Spartina*.

**MATERIAL EXAMINED**: In old leaf sheaths of *Spartina alterniflora*, mouth of Rio Salado at Rio La Plata, Prov. Buenos Aires, Argentina, 17 Oct. 1973, salinity 5.5‰, leg. et det. J. Kohlmeyer (Herb. J.K. No. 3498; *Holotype*: NY, slide nos. 1–5 and dried specimen; same data, *Isotype*: IMS, slide nos. 6–10 and dried specimen). *Paratypes*: Same site and data as above (Herb. J.K. No. 3503, NY and IMS); in leaves of *Spartina* sp., Eel River near Dalhousie, New Brunswick, Canada, 27 June 1973, leg. et det. J. Kohlmeyer (Herb. J.K. No. 3378, IMS); in old leaf of *S. cf. pectinata* Link, Petitcodiac River, Hopewell Cape, New Brunswick, Canada, 28 June 1973, salinity 20‰, leg. et det. J. Kohlmeyer (Herb. J.K. No. 3380, IMS); in leaves and leaf sheaths of *S. alterniflora*, Housatonic River, Stratford, Connecticut, 10 Sept. 1975, leg. et det. R. V. Gessner (Herb. J.K. No. 3688, IMS); in *S. alterniflora*, Hoophole Creek on Bogue

Banks, Carteret County, North Carolina, 9 Aug. 1970, leg. et det. J. Kohlmeyer (Herb. J.K. No. 3706, IMS); in dead, submerged leaf of *S. alterniflora*, Broad Creek, Carteret County, North Carolina, 1 Oct. 1975, salinity 1–32‰ (between Sept. 6 and Dec. 10, 1975), leg. J. Kohlmeyer, det. T. L. Herbert (Herb. J.K. No. 3680, IMS); in washed-up, dead stalks of *Spartina* sp., Broad River at Highway 170, west of Beaufort, Beaufort County, South Carolina, 11 May 1974, leg. et det. J. Kohlmeyer (Herb. J.K. No. 3700, IMS).

Drs. M. E. Barr, K. A. Pirozynski, and R. A. Shoemaker (personal communications) suggested a relationship between the *Spartina* fungus and the genus *Buergenerula* Sydow. We examined the type species of the genus, *B. biseptata* (Rostrup) Sydow<sup>2</sup> (Müller 1950), and concur with their opinion. The general ascocarp morphology is identical in *B. spartinae* and *B. biseptata*. Both species have coriaceous, papillate ascocarps with pseudoparaphyses attached at the top to a pseudoparenchyma of small, subglobose, thin-walled, hyaline cells. Asci in both species are mostly cylindrical, thick-walled, unitunicate, persistent, and provided with a non-amyloid apical apparatus that stains faintly blue in ink (Figs. 13–15). Differences between the species are as follows: hyphopodia, long periphyses, thick ascocarp walls, clavate, three-septate ascospores, and marine occurrence in *B. spartinae*; hyphopodia absent, short periphysoid cells; thin ascocarp walls; elliptic-fusiform, two-septate ascospores; and terrestrial occurrence in *B. biseptata*. In view of the agreeing characters, the differences appear minor and do not seem to justify a generic separation of the two species. The genus *Buergenerula* is being placed in the Physosporrellaceae of the Phyllochorales by Dr. M. E. Barr (personal communication). *Buergenerula spartinae* has similarities to genera in the Amphispheariaceae, which may have cylindrical asci with an apical apparatus composed of a chitinous pulvinus and an annulus which may be amyloid or non-amyloid (Barr 1975).

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<sup>2</sup>Material on *Carex riparia* Curt., Isaszeg, Hungary, leg. S. Tóth, 17 Mar. 1956, DAOM No. 130787, comm. K. A. Pirozynski.

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