

***GLOMUS NANOLUMEN* (ENDOGONACEAE),
A NEW SPECIES FROM HAWAII**

R. E. KOSKE

*Department of Botany, University of Rhode Island,
Kingston, Rhode Island 02881*

AND

J. N. GEMMA

National Tropical Botanical Garden, P.O. Box 340, Lawai, Kauai, Hawaii 96765

Collections of soil from around roots of plants growing on sand dunes on the northwestern coast of Kauai, Hawaii, contained spores of an undescribed species of *Glomus*. Spores were recovered from soil by wet-sieving or sucrose centrifugation (Walker *et al.*, 1982). Descriptions and observations reported in this study are from specimens mounted in a polyvinyl alcohol mounting medium (Koske and Tessier, 1983). Wall descriptions and terminology follow those suggested by Walker (1983). Measurements are based on the analysis of *ca* 200 spores. Holotypes have been deposited in the herbarium at Oregon State University (OSC), and isotypes have been deposited at the Farlow Herbarium (FH), the Bernice P. Bishop Museum, the herbarium of the National Tropical Botanical Garden, and at Kew (K).

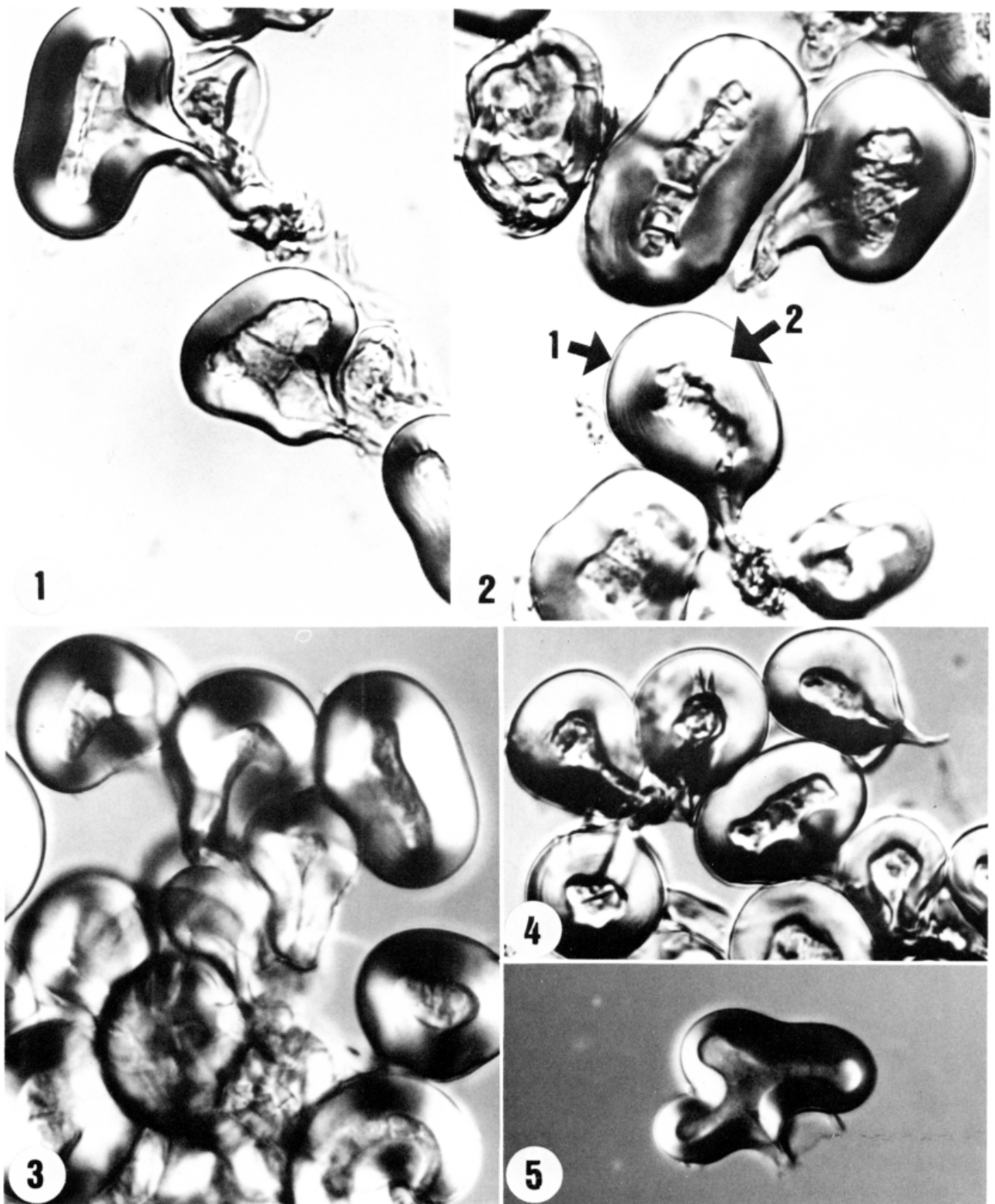
Glomus nanolumen* Koske & Gemma, *sp. nov.

FIGS. 1–10

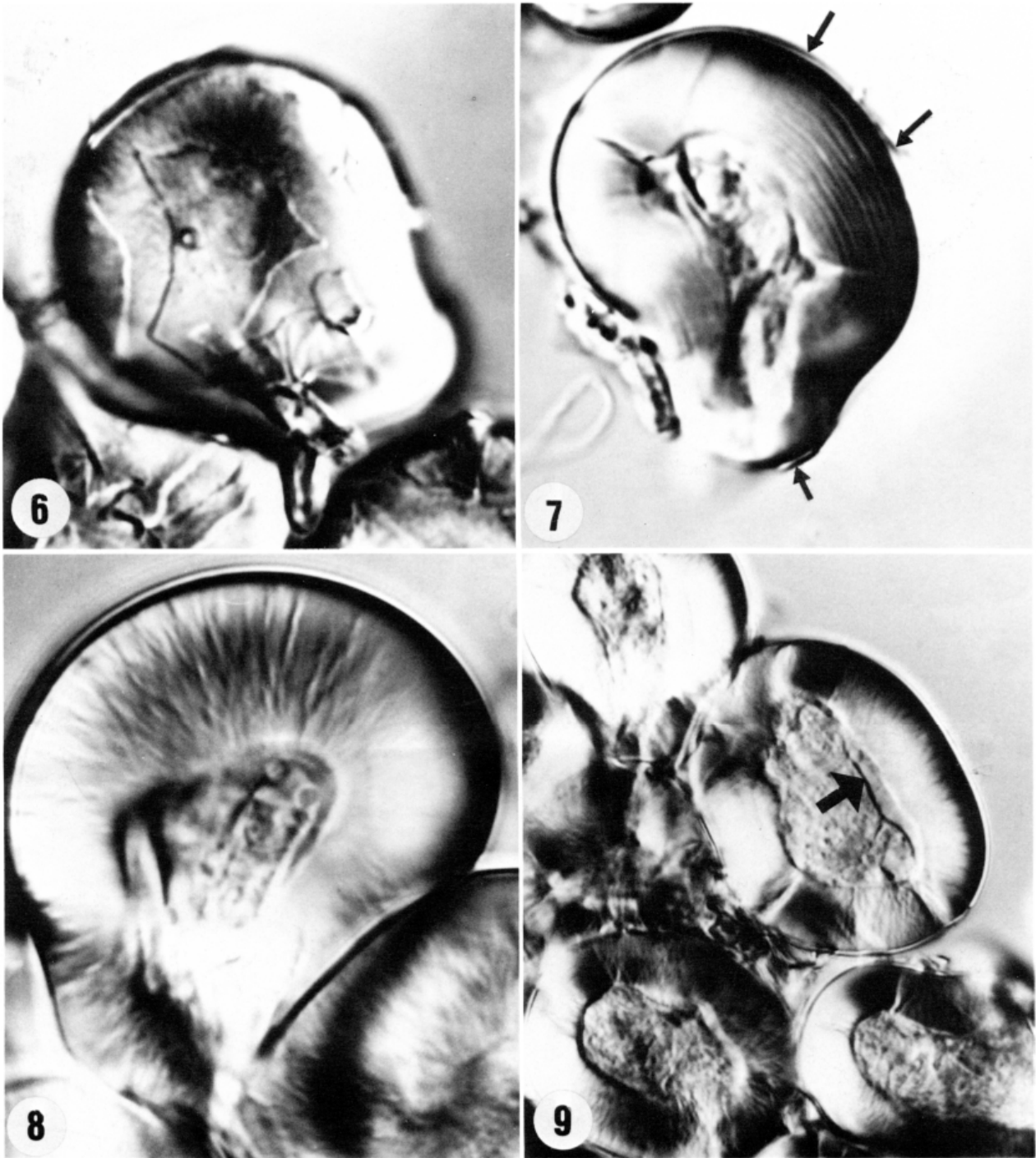
Sporae singulae vel in sporocarpis in solo efformatae, luteae, armeniacaе, vel roseolae, translucentes, lu-

centes, pyriformes, ovoideae, vel irregulares, (24–)30(–52) × (20–)4(–63) μm. Tunica sporarum parietibus duobus. Paries 1 aureo-brunneus, 0.5–1 μm crassus. Paries 2 lamellatus, luteolus, (4–)9(–20) μm crassus. Lumen sporarum nanum, ad hypham sustentantum canale (1–2(–4) μm lato connexum. Basis sporae infundibuliformis, (2–)6(–25) μm longa, a (4–)9(–20) μm lata ad corpus principale sporae ad 3–6 μm lata ad affectionem hyphae contracta.

Sporocarps formed in soil, subglobose to irregular, 90–520 μm diam, composed of *ca* 5–40 loosely to tightly packed spores and sporogenous hyphae. Spores subglobose, pyriform, ovoid to irregular, (24–)30(–52) × (20–)34(–63) μm, produced singly or in sporocarps; translucent, sparkling; yellow, reddish-yellow or rose pink in color with reflected light. *Spore wall structure* (murograph, FIG. 10) of two walls (1–2) in one group (A). Outer unit wall (1) golden yellow-brown in transmitted light, 0.5–1 μm thick. Wall 2 laminated, pale yellow, nearly hyaline in transmitted light in crushed spores, (4–)9(–20) μm thick. Spore lumen small, connecting to sporogenous hyphae through an open channel 1–2(–4) μm wide. *Spore*



FIGS. 1-5. Spores of *Glomus nanolumen*. 1. Irregularly shaped spores with thick walls and small lumens, $\times 690$. 2. Spores with septa in lumen. Walls 1 and 2 are indicated with arrows, $\times 710$. 3. Small lumina in spores and bright refringence of spore walls in transmitted light, $\times 710$. 4. Crushed sporocarp. Note tapered subtending hyphae, $\times 590$. 5. Irregularly shaped spore with uneven thickening of wall 2, $\times 500$.



FIGS. 6-9. Spores of *Glomus nanolumen*. 6. Crushed spore showing outer unit wall (wall 1) separating from inner, laminated wall (wall 2), $\times 1250$. 7. Multiple laminations of wall 2 are readily visible in this spore as are fragments of wall 1 (arrows). Note uneven thickness of wall 2, $\times 1160$. 8. Crushed spore showing radial fracture lines in wall 2, $\times 1740$. 9. Innermost lamination (arrow) of wall 2 separated from other laminations, $\times 740$.

base funnel-shaped, (2-)6(-25) μm long, tapered from (4-)9(-20) μm broad at main spore body to 3-6 μm broad at junction with subtending hypha. Neither wall reacting with Melzer's solution.

DISTRIBUTION AND HABITAT: Known only from calcareous sand dunes on Kauai, Hawaii.

MYCORRHIZAL ASSOCIATIONS: Associated in the field with roots of *Scaevola sericea* Vahl. and *Ipomoea stolonifera* (Cyrill.) J. F. Gmel.

ETYMOLOGY: Latin, *nanus*, referring to the unusually small size of the spore interior, and *lumen*, the cavity within the spore.

COLLECTIONS EXAMINED: TYPE: HAWAII, KAUAI CO., Polihale State Park, among roots of *Scaevola sericea*

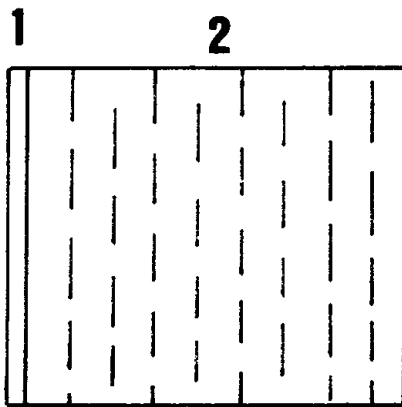


FIG. 10. Murograph of spore wall structure of *Glomus nanolumen*. The unit wall (wall 1) is adherent to the thick, laminated wall (wall 2).

(KG 649, 24 Nov. 1987); other collection: Polihale State Park (KG 648, 24 Nov. 1987).

Glomus nanolumen is readily distinguished from other *Glomus* species by its relatively thick spore wall, greatly reduced lumen, small spore size, and luminescent appearance of spores in transmitted light. Spore lumen diameter is nearly always less than 50% of the spore diameter and in some specimens only 20% because of the amount of thickening of wall 2.

Wall 1 of spores of *G. nanolumen* generally adheres to wall 2 and is best seen in specimens that have been forcibly crushed (FIG. 6). The darker color and brittleness of wall 1 distinguish it from the laminations of wall 2.

The laminations of wall 2 of spores are most evident in slightly crushed specimens (FIG. 7). This wall appears to have a somewhat gelatinous texture and is moderately flexible in contrast to the brittle, laminated walls of other *Glomus* species [e.g., *G. mosseae* Gerd. & Trappe, *G. intraradices* Schenck & Smith, *G. fasciculatum* (Thaxter) Gerd. & Trappe]. When spores of *G. nanolumen* are forcibly crushed, numerous radial fracture lines appear in wall 2 (FIGS. 8, 9), but the wall does not break into separate pieces. The thickness of the laminated wall (wall 2) of spores is uneven, with the difference between the thickest and the thinnest areas of the wall of an individual spore ranging from 3–10 μm . This results in the shape of the lumen being more irregular than the outline of the spore itself (FIGS. 1–5, 6, 7). The unusual features of the laminated wall of *G. nanolumen* suggest that the concept of the laminated wall (Walker, 1983) may require

redefinition, possibly including two categories, brittle and flexible.

The innermost lamination of wall 2 is distinct in some spores and may separate slightly from the other laminations in well-crushed spores (FIG. 9). In general appearance, this lamination is similar to the innermost lamination of spores of *Gigaspora* species. In the latter, it has been interpreted as a separate wall (the "germinal" wall) (Spain *et al.*, 1989). The lumina of many spores of *G. nanolumen* appear to be traversed by one to six septa-like structures (FIG. 2). Whether these are true septa that compartmentalize cytoplasm could not be determined by light microscopy. If they are septa, *G. nanolumen* would be the only member of the Endogonales with multicellular spores.

Spores of *G. nanolumen* are produced in tight clusters, superficially similar to the sporocarps of *Sclerocystis rubiformis* Gerd. & Trappe. However, in *G. nanolumen* spores are not formed around a central plexus but instead are produced at all levels of the cluster, as in *G. aggregatum* Schenck & Smith. No peridium is present and there are few hyphae in the sporocarps.

The thick-walled, tapered hyphal attachment of spores of *G. nanolumen* is easily broken from the thin-walled parent hypha a short distance below the point of attachment (FIGS. 1, 3–5).

ACKNOWLEDGMENTS

We thank J. Morton and P. Olexia for their suggestions, E. Lew for assistance in collecting, and J. Trappe for reviewing the manuscript and preparing the Latin diagnosis.

Key Words: *Glomus*, vesicular-arbuscular mycorrhizae, sand dunes, Hawaii

LITERATURE CITED

- Koske, R. E., and B. Tessier. 1983. A convenient, permanent slide mounting medium. *Mycol. Soc. Amer. Newsletter* 34(2): 59.
- Spain, J. L., E. Sieverding, and N. C. Schenck. 1989. *Gigaspora ramisporophora*: a new species with novel sporophores from Brazil. *Mycotaxon* 29: 667–677.
- Walker, C. 1983. Taxonomic concepts in the Endogonaceae: spore wall characteristics in species descriptions. *Mycotaxon* 18: 445–455.
- , C. W. Mize, and H. S. McNabb. 1982. Populations of endogonaceous fungi at two locations in central Iowa. *Canad. J. Bot.* 60: 2518–2529.