

## Studies in the liverwort genus *Fossombronina* (Metzgeriales) from southern Africa. 6. New species from Lesotho, Swaziland and Mpumalanga and new records from Lesotho

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### ABSTRACT

Two new species of *Fossombronina* are described: *F. angulifolia* Perold from Lesotho and *F. swaziensis* Perold from Swaziland and Mpumalanga. *F. angulifolia* is characterised by erect or semi-erect, 2–4-lobed, angular leaves, by mostly incompletely reticulate spores and by rather short elaters. *F. swaziensis* can be recognised by large, rounded or sometimes shallowly notched leaves, which are rather stiff and bi- to multistratose basally, by quite large perigonal bracts in the male plants and by spores which have irregular areolae containing tubercular inclusions.

### 1. *Fossombronina angulifolia* Perold, sp. nov.

Plantae repentes aggregatae. Folia subimbricata vel subcontigua, superne plerumque bilobata, lobis angularibus vadosis vel profundis. Rhizoidea purpurea. Forsan dioicae; plantas masculas non vidi. Pseudoperianthium nonnihil brevius foliis contiguis, superne in 5 lobis irregularibus divisum. Sporae 27.5–45.0 µm diametro, superficie distali lamellis 10 vel 11 irregularibus ramosis et anastomosantibus, interdum areolas formantibus; superficie proximali plerumque sine nota triradiata, cum cristis pluribus pertenuibus irregularibus granulatis. Elateres 52.5–90.0 µm longi, bis vel ter spirales, 7.5–10.0 µm lati, interdum apices versus contracti.

TYPE.—Lesotho, 2927 (Maseru): 7.5 km west of Roma along main tarred road and then south on dirt road toward Korokoro, across river, on hillside above maize-field, on soil between rocks, (–BC), S.M. Perold & M. Koekemoer 3711 (PRE, holo.). Same locality, S.M. Perold & M. Koekemoer 3712a (PRE, para.).

Plants smallish to medium-sized, creeping, in crowded, overlying stands, green, margins of some young leaves tinged with red, upper part of older leaves frequently dry and turning yellow, proximally becoming colourless, occasionally several small, deep pink leaves closely clasping basal part of stem; shoots mostly simple, 8.0–12.0 mm long, 1.2–1.4 mm high, ± 1.9 mm wide, rarely once furcate toward apex, sometimes with ventrolateral innovations. Stems prostrate, green, in cross section apically (Figure 1Q), ± 310 µm (11 cell rows) high, ± 350 µm wide, basally (Figure 1R), ± 250 × 330 µm, plano-convex. Rhizoids purple, 15.0–17.5 µm wide. Leaves (Figure 1A–N) slightly overlapping to almost contiguous, erect to semi-erect (Figure 2A, B), obliquely inserted succubously, sinuous above and mostly 2-lobed, rarely 3- or 4-lobed, with shallow or deep angular lobes, dissimilar or similar in size and shape, lateral sides of leaves ± parallel or not, distally smaller, gradually

enlarging proximally, (975–)1225–1450 × (500–)875–1375 µm, margins with 6–8, generally one-celled slime papillae at angulations as well as elsewhere, closer together at 'trailing' edge. Leaf cells (Figure 1O) thin-walled, at upper margins subquadrate to rectangular across, 20.0–25.0 × 27.5–57.5 µm, at lateral margins short- to long-rectangular, 30.0–92.5 × 12.5–27.5 µm; upper laminal cells (4–)5- or 6-sided or polygonal, 35.0–47.5 × 27.5–50.0 µm; middle laminal cells 50.0–57.5 × 30.0–40.0 µm; basal cells 50.0–62.5 × 37.5–50.0 µm. Oil bodies hyaline (Figure 1P), slightly granular, 9–18 per cell, round, oval or irregularly shaped, 3–6 µm diam.; chloroplasts numerous, ± 5 µm diam.

?Dioicous; no male plants seen, only females. Archegonia dorsally scattered along stem, naked (Figure 2C), few becoming fertilised. Pseudoperianths (Figure 2D–F) single, ± 1500 µm long (Figure 1U), ± 250 µm shorter than adjacent leaves, divided above into 5 irregular lobes (Figure 1V), up to 1685 µm wide across mouth, with 15 or 16 spinous processes topped by a slime papilla; cells comparable in shape and size to those of leaves, except for those in basal part, which are larger, 75.0–125.0 × 27.5–35.0 µm. Capsule globose, ± 600 µm diam., capsule wall bistratose, cells in inner layer irregularly shaped, variable in size, 30.0–50.0 × 25.0–32.5 µm, each cell wall with 1–3 nodular (Figure 1S) and very rare semi-annular thickenings. Seta delicate, ± 1.4 mm long, in cross section (Figure 1T) 200 × 150 µm, 8 cells across. Spores light brown, hemispherical or occasionally ± oval-shaped in outline, (27.5–)32.5–45.0 µm diam., including low spines projecting around periphery (Figure 3C); distal face convex, with 10 or 11 irregular lamellae across it (Figure 3A, B), branching and anastomosing, sometimes forming areolae, 5.0–12.5 × 5.0 µm, walls slightly raised at corners, surface between lamellae finely granular (Figure 3D); proximal face (Figure 3E) mostly lacking distinct triradiate mark, with numerous very fine, irregular ridges liberally sprinkled with granules, around periphery many fine spines, shorter than 2.5 µm. Elaters (Figure 3F) yellow-brown, (52.5–)60.0–70.0 (–90.0) µm long, often 3-spiral and uniformly up to 10 µm wide or tapering slightly toward tips, sometimes 2-spiral, 7.5–10.0 µm wide, tips 5.0 µm wide.

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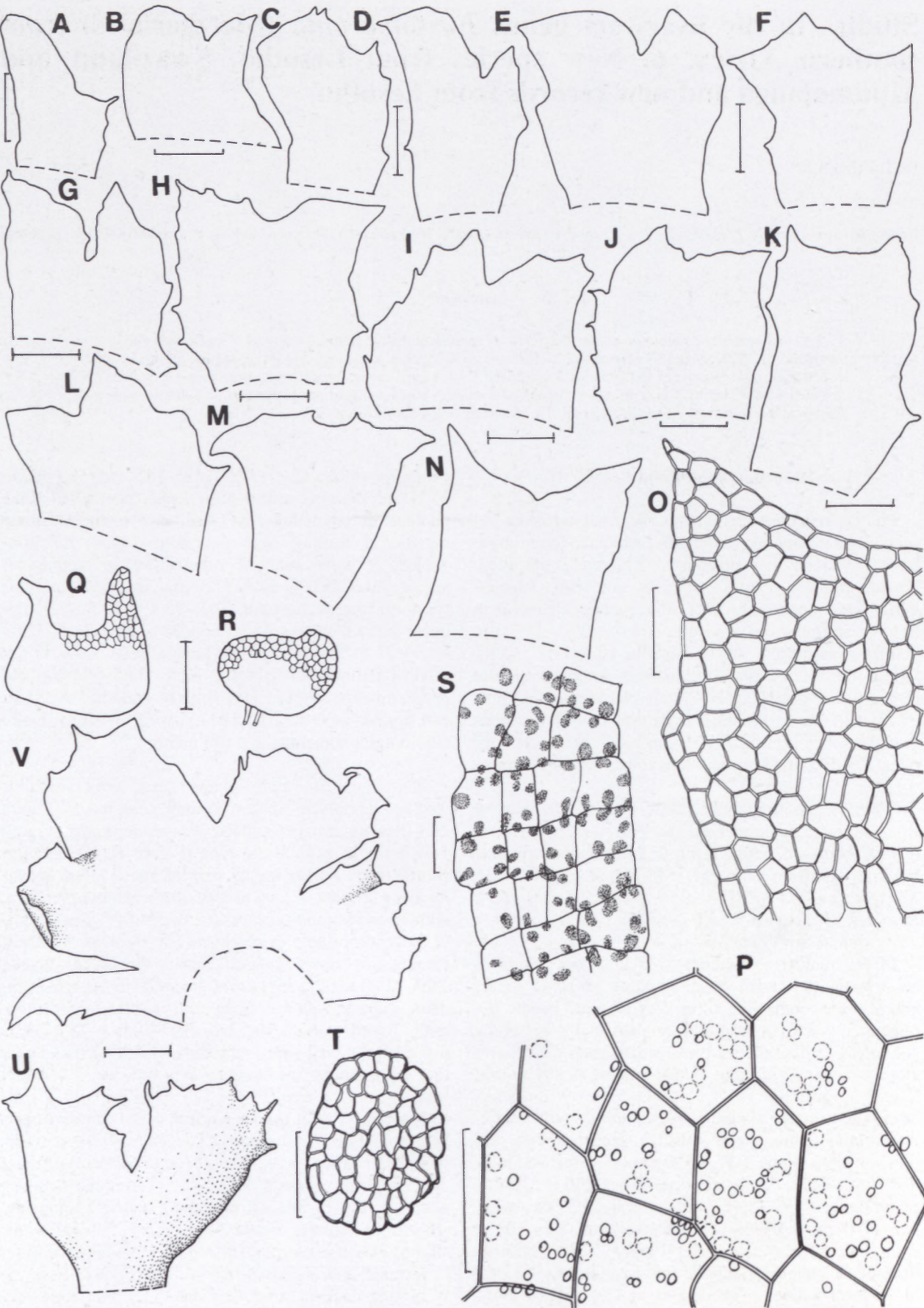


FIGURE 1.—*Fossombronía angulifolia*. A–N, leaves; O, detail of leaf margin; P, median leaf cells with oil bodies (solid lines) and chloroplasts (dotted lines); Q, c/s of stem apex; R, c/s of stem base; S, cells in capsule wall; T, c/s of seta; U, pseudoperianth from side; V, opened pseudoperianth. A–V, S.M. Perold & M. Koekemoer 3711. Scale bars: A–N, U, V, 500 µm; O, T, 100 µm; P, S, 50 µm; Q, R, 250 µm. Artist: G. Condy.



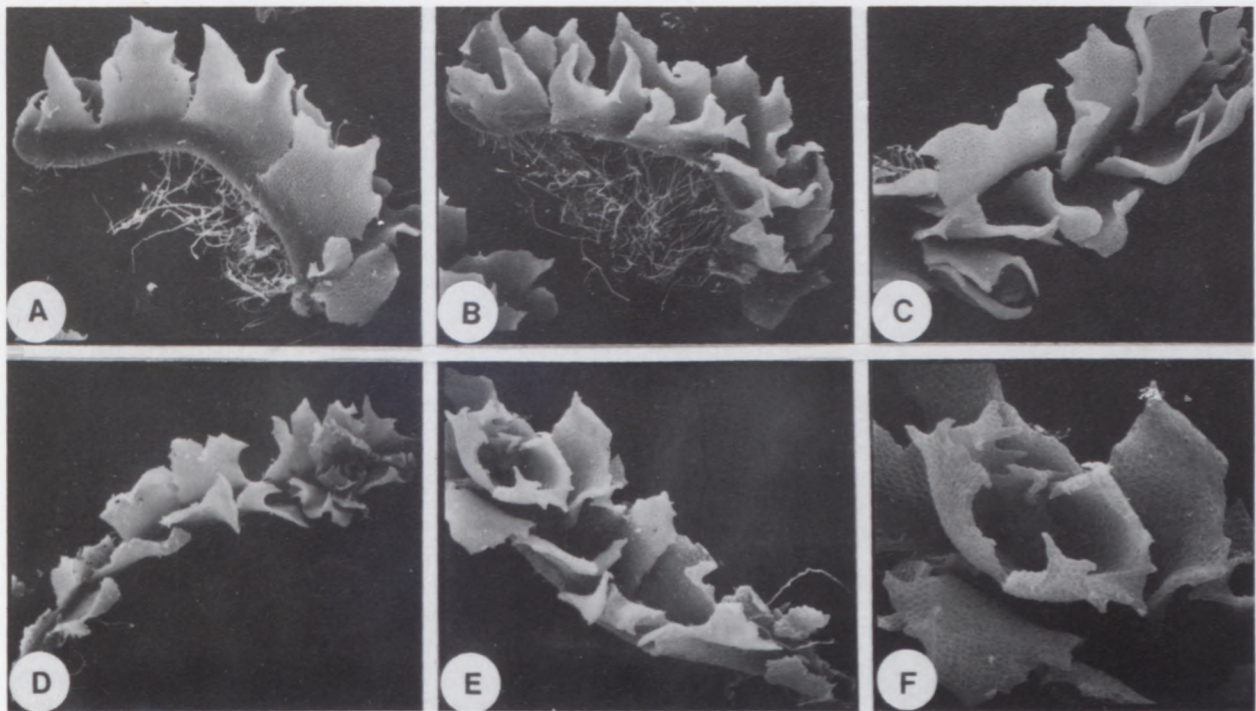


FIGURE 2.—*Fossombronina angulifolia*. A, arched terminal segment of thallus and leaves from side; B, shoot and leaves partly from side; C, archegonia seen from above; D, pseudoperianth (in culture stem continued growth beyond pseudoperianth); E, different shoot with pseudoperianth; F, close-up of pseudoperianth. A–F, S.M. Perold & M. Koekemoer 3711. A,  $\times 15.7$ ; B,  $\times 14.2$ ; C, E,  $\times 19.7$ ; D,  $\times 11$ ; F,  $\times 37.6$ .

*Fossombronina angulifolia* is known only from the type locality in the Mountain Kingdom of Lesotho (Figure 4) which receives rain in summer and occasional snowfalls in winter. The two specimens referred to here were collected in autumn after a season of good rains. Part of the holotype specimen had to be kept in cultivation for almost two months to allow the spores in several capsules to ripen. No plants with antheridia were observed, despite thorough

searching. Mosses growing together with this new species are *Bartramia hampeana* C.Müll., *Bryum canariense* Brid., *Pseudoleskeopsis* cf. *claviramea* (C.Müll.) Thér., *Gigaspermum repens* (Hook.) Lindb. as well as the liverwort, *Targionia hypophylla* L. The soil is derived from weathered sandstone and is finely to somewhat coarsely granular. The vegetation type is Afromontane Grassland (Low & Rebelo 1996). Some of the angular two-lobed

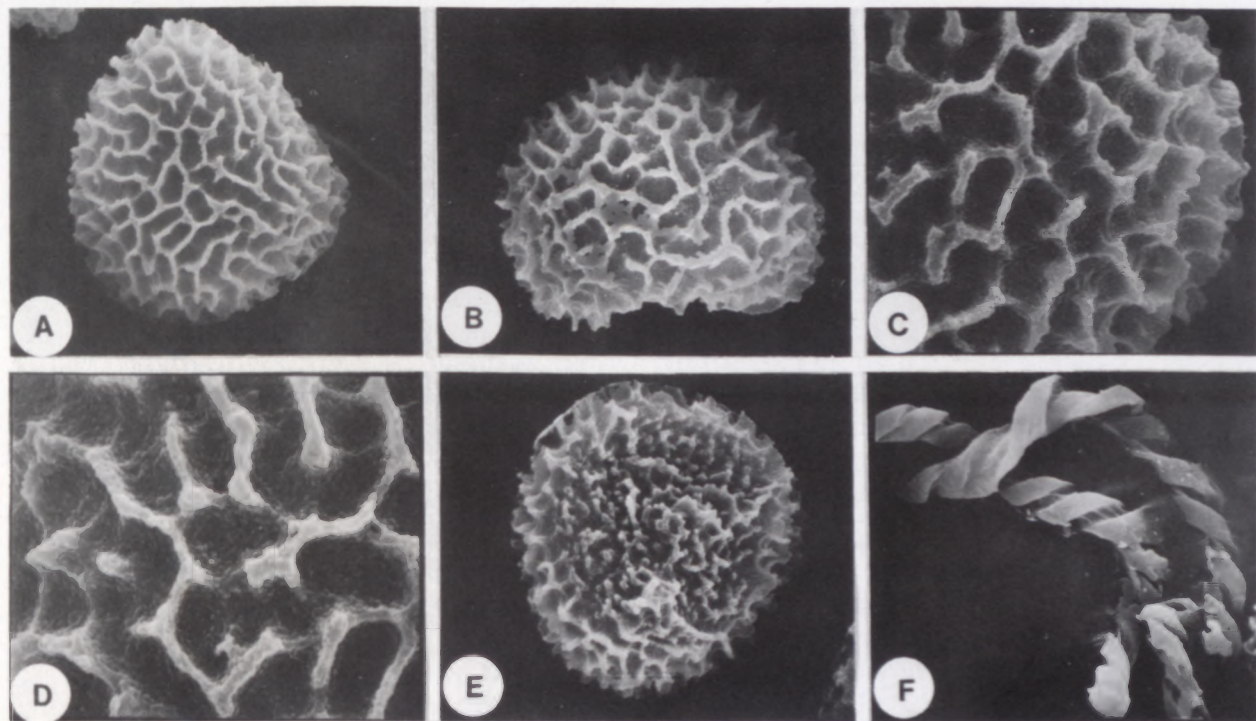


FIGURE 3.—*Fossombronina angulifolia*. Spores and elaters. A, distal face; B, side view of distal face; C, detail of areolae at margin of distal face; D, surface between lamellae on distal face; E, proximal face; F, elaters. A–F, S.M. Perold & M. Koekemoer 3711. A,  $\times 1094$ ; B,  $\times 1200$ ; C,  $\times 2589$ ; D,  $\times 3533$ ; E,  $\times 1120$ ; F,  $\times 753$ .



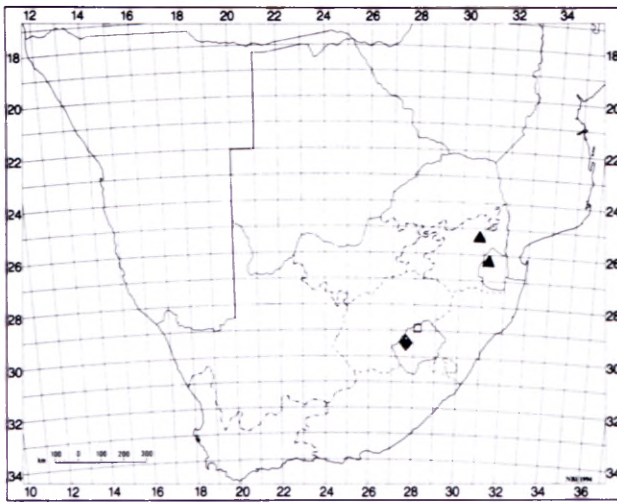


FIGURE 4.—The distribution of *F. angulifolia*, ●; and *F. swaziensis*, ▲; and some new records of *F. gemmifera*, ◇; and *F. glenii*, □, in Lesotho, Mpumalanga and Swaziland.

leaves in *F. angulifolia* are rather similar to those found in *F. spinifolia* Steph. (Perold 1997b), but the spores in the two species differ in their ornamentation, with those in *F. spinifolia* having fewer and coarser ridges and some spinous processes in between.

## 2. *Fossombronina swaziensis* Perold, sp. nov.

Plantae repentes aggregatae. *Folia* superne concava vel inflexa, late patescentia, marginibus superioribus lateralibusque rotundatis, basin versus bis vel multistratosa. *Rhizoidea* purpurea. Dioicae. *Antheridia* dorsaliter biseriata in caule, bracteis perigynalibus concavis 1- vel 3-lobatis obiecta. *Pseudoperianthium* plerumque supra folia reflexa eminens; campanulatum; pedicellatum; ore subpectinato, undulato. *Sporae* 47.5–55.0  $\mu\text{m}$  diametro, superficie distali lamellis 8 vel 9 rectis vel subcurvatis, parallelis vel radiatis, irregulariter interconnexis areolas imperfectas formantibus, unaquaeque tubercula 1 vel 2(3) continens; superficie proximali sine nota triradiata, cum papillis vel spiculis humilibus, congestis, perirregularibus, centro maioribus, circum peripheriam usque ad 21 spinulis humilibus perisporio non connexis. *Elaters* 80–150  $\mu\text{m}$  longi, bis vel medio ter, apices versus bis, spirales, 10–15  $\mu\text{m}$  lati, plerumque apices versus contracti.

TYPE.—Swaziland, 2631 (Mbabane): Hhohho Dist., Forbes Reef, Umbuluzi River at Forbes Reef Store, on clay soil of steep streambank in wattle forest, (–AA), *H.F. Glen* 3130 (PRE, holo.). Same locality, *H.F. Glen* 3127 (PRE, para.).

Plants medium-sized to fairly large, creeping, in crowded stands; shoots with proximal parts seemingly from previous year, greyish brown, dead, or else growth interrupted by dry conditions, at apex fresh, green, mostly simple, 8–10 mm long,  $\pm 2$  mm high, 4 mm wide (up to 4.5 mm wide at pseudoperianth). *Stems* prostrate, green, occasionally peripheral cell walls in some areas of dorsal surface reddish, ventrally purple, in cross section apically  $\pm 400$   $\mu\text{m}$  (10 or 11 cell rows) high,  $\pm 700$   $\mu\text{m}$  wide in male plants (Figure 5N), becoming increasingly

fleshy, at  $\pm$  midlength, 600  $\mu\text{m}$  (16 cell rows) high, 900  $\mu\text{m}$  wide, tapering toward base (Figure 5O), 250  $\times$  340  $\mu\text{m}$ , plano-convex; female stems in cross section apically  $\pm 350 \times 550$   $\mu\text{m}$  (Figure 5P). *Rhizoids* purple, 17.5–27.5  $\mu\text{m}$  wide. *Leaves* apically smaller, concave to inflexed above, becoming widely spreading, inserted succubously, upper and lateral margins rounded, occasionally shallowly notched, often rather stiff, basally bi- to multistratose (Figure 6C), sometimes up to  $\pm$  midlength in a wide median arch (Figure 5F), proximally increasing in size, in male plants (Figure 5A–F) 1250–2000  $\times$  1500–2125  $\mu\text{m}$ , somewhat larger in female plants (Figure 5G–K), shorter than wide, 1500–2150  $\times$  2625–3000  $\mu\text{m}$ , margins at intervals with 6–8 one-celled, papillae (Figure 6B),  $\pm 22.5 \times 12.5$   $\mu\text{m}$ , sessile or at lower ‘trailing’ edge raised on (1)–2–4 basal cells. *Leaf cells* thin-walled, not appreciably different in male and female plants, at upper margins (Figure 5L) subquadrate to rectangular across, 25.0–42.5  $\times$  50.0–82.5  $\mu\text{m}$ , at lateral margins long-rectangular, 62.5–97.5  $\times$  25.0–30.0  $\mu\text{m}$ ; upper laminal cells 5- or 6-sided, 40.0–57.5  $\times$  27.5–55.0  $\mu\text{m}$ ; middle laminal cells 50.0–87.5  $\times$  30.0–62.5  $\mu\text{m}$ ; basal cells 60.0–97.5  $\times$  55.0–70.0  $\mu\text{m}$ . *Oil bodies* disintegrated, remains executing Brownian movement on wetting; chloroplasts granular, up to 5  $\mu\text{m}$  diam. (Figure 5M).

Dioicous. *Antheridia* dorsal on stem, often in 2 rows, short-stalked,  $\pm 250$   $\mu\text{m}$  wide, shielded by concave perigynal bracts (Figures 5Q–S; 6D), single, 600–650  $\times$  300–350  $\mu\text{m}$ , or double, sometimes 3 lobes laterally fused together, up to 480  $\times$  850  $\mu\text{m}$ , each one topped by a papilla which is usually raised on a basal cell, marginal cells 50–75  $\times$  45–50  $\mu\text{m}$ , cells in interior 70.0–112.5  $\times$  37.5–42.5  $\mu\text{m}$ . *Archegonia* naked, in a well-spaced dorsal row. *Pseudoperianth* (Figures 5U, V; 6E, F)  $\pm 2$  mm proximal to apex, campanulate, raised on stalk up to 1000  $\mu\text{m}$  long, mostly projecting above reflexed leaves, 1875–2250  $\mu\text{m}$  long, 2750–2875  $\mu\text{m}$  wide across mouth, sometimes partly slit along side, margin slightly scalloped, undulating, very few or no papillae seen, toward base with 2 irregularly thickened lateral outgrowths or wings; cells not appreciably different in shape and size from those in leaves. *Capsules* globose,  $\pm 1000$   $\mu\text{m}$  diam., wall bistratose, cells of inner layer irregularly shaped, 30.0–37.5  $\times$  25.0–30.0  $\mu\text{m}$ , each cell wall with 1–3 dark brown nodular and some semi-annular thickenings (Figure 5T). *Seta*  $\pm 2.5$  mm long, 200  $\mu\text{m}$  diam., 9 cell rows across. *Spores* light brown to darker brown, 47.5–55.0  $\mu\text{m}$  diam., including lamellae projecting around periphery, hemispherical; distal face (Figure 7A–C) convex, ornamentation irregularly lamellate and incompletely reticulate, with 8 or 9 straight or slightly curved parallel or radiating lamellae, their uneven crests running across face, up to 3  $\mu\text{m}$  high, 5.0–7.5  $\mu\text{m}$  apart, irregularly interconnected forming mostly incomplete areolae of variable size and shape, each one containing 1 or 2 (3) tubercles (Figure 7D) with very faint ridges radiating from their bases; proximal face (Figure 7E) slightly concave, lacking triradiate mark, with low, crowded, highly irregular small papillae or spicules, becoming larger toward centre and linking up with one another, around spore periphery up to 21 low ‘spines’, which are the ‘ends’ of the lamellae from the distal face extending over the sides and not connected by a perispore. *Elaters* (Figure 7F) light brown, 80–150  $\mu\text{m}$  long, 10–15  $\mu\text{m}$



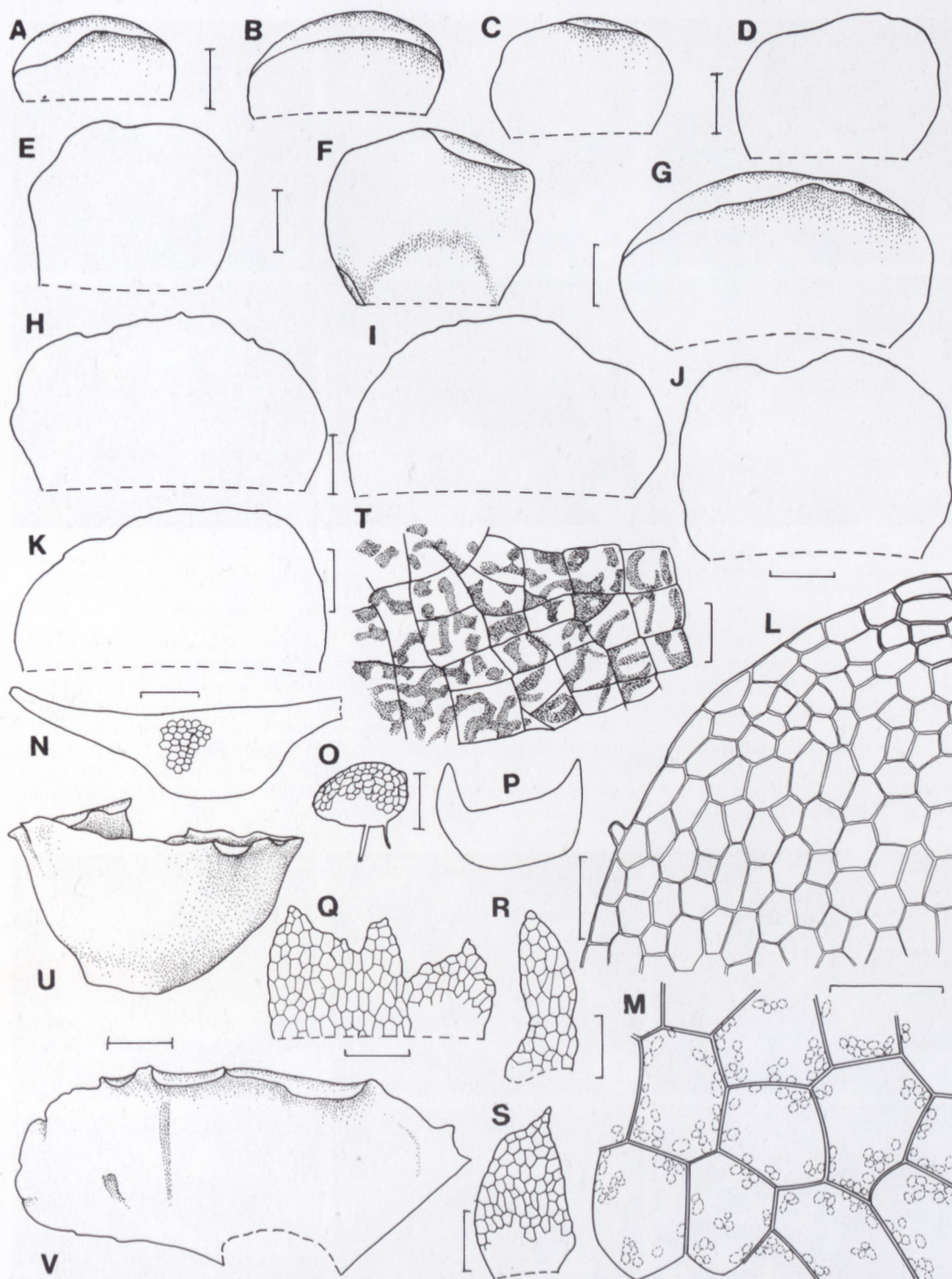


FIGURE 5.—*Fossombronina swaziensis*. A–F, male leaves; G–K, female leaves; L, detail of leaf margin; M, median leaf cells with chloroplasts (dotted lines), oil bodies disintegrated; N, c/s of apical part of male stem; O, c/s of basal part of male stem; P, c/s of apical part of female stem; Q–S, bracts; U, pseudoperianth from side; V, opened pseudoperianth. A–F, L–O, Q–V, H.F. Glen 3130; G–K, P, H.F. Glen 3127. Scale bars: A–K, U, V, 500 µm; L, 100 µm; M, T, 50 µm; N–P, Q–S, 250 µm. Artist: G. Condy.



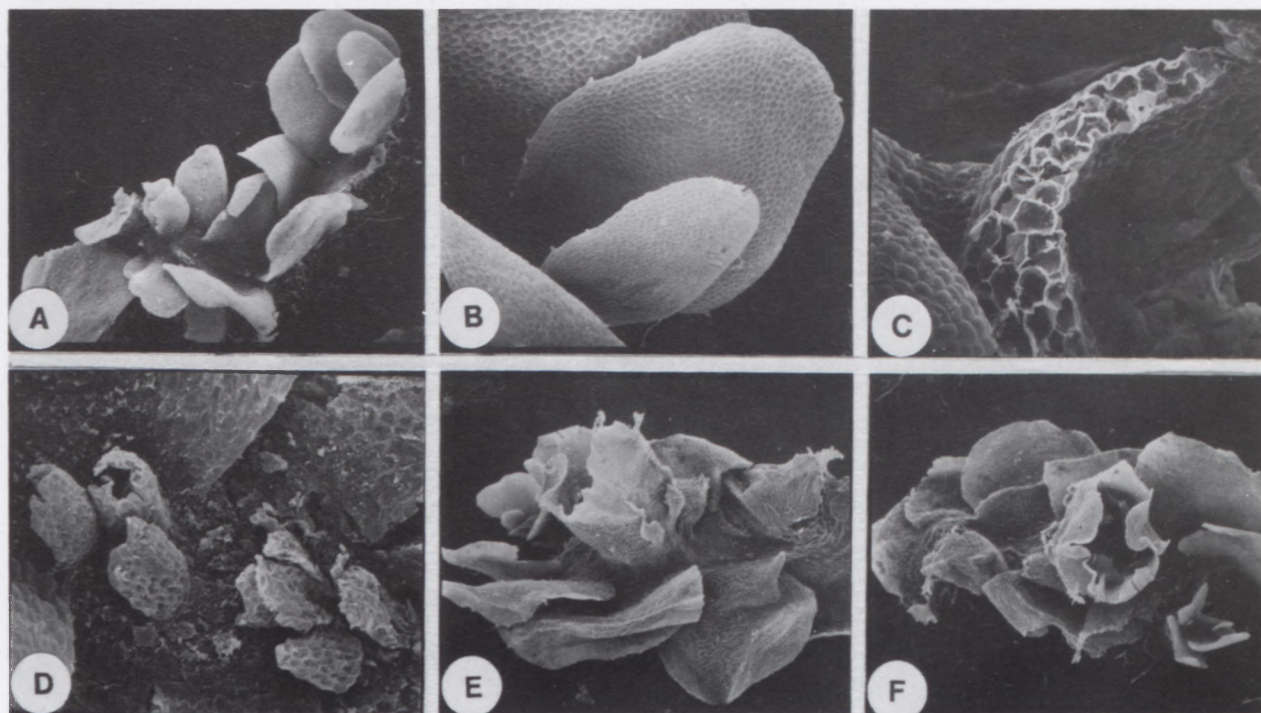


FIGURE 6.—*Fossombronina swaziensis*. A, simple stem toward apex; B, apical leaves in close-up; C, leaf base showing cell layers; D, perigonial bracts; E, pseudoperianth from side; F, pseudoperianth from above. A–C, E, F, H.F. Glen 3127; D, H.F. Glen 3130. A,  $\times 9$ ; B,  $\times 29$ ; C,  $\times 83$ ; D,  $\times 19$ ; E,  $\times 11$ ; F,  $\times 10.5$ .

wide in centre, mostly tapering to tips and ending in a loop, 5  $\mu\text{m}$  wide, sometimes not tapering, ends blunt,  $\pm 12.5 \mu\text{m}$  wide, bispiral or centrally trispiral and then bispiral toward ends.

*Fossombronina swaziensis* is known from the two type collections growing on clayey soil on the banks of the Umbuluzi River in a wattle forest at Forbes Reef Store (Figure 4), Hhohho District, Swaziland, with vegetation

type North-Eastern Mountain Grassland (Low & Rebelo 1996), receiving  $>1000 \text{ mm}$  rain annually. A third sporulating specimen was recently collected on the banks of Sterkspruit, De Kuilen, east of Lydenberg in Mpumalanga. The species can be recognised by its wide, rounded leaves, sometimes slightly inflexed above, by quite large perigonial bracts in male plants and by spores which have one to several tubercular processes in the complete or incomplete areolae. This ornamentation is

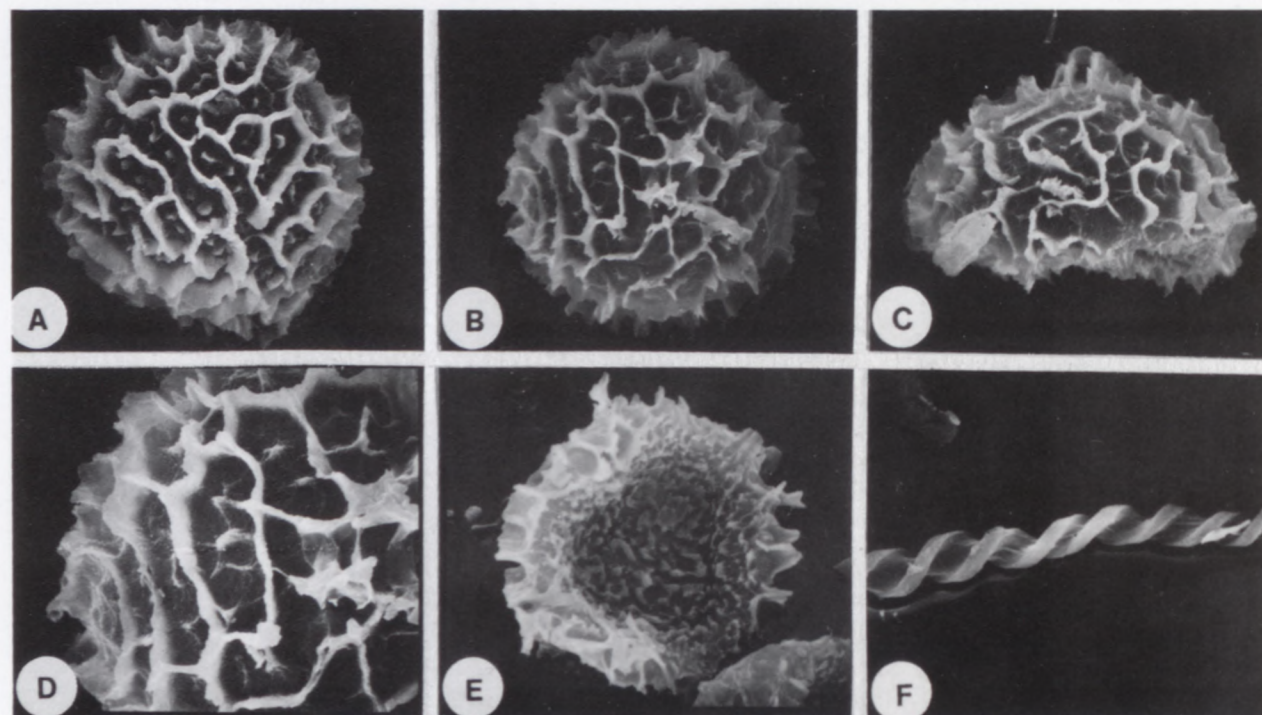


FIGURE 7.—*Fossombronina swaziensis*. Spores and elater. A, B, distal face; C, side view of distal face; D, detail of areolae on distal face; E, proximal face; F, elater. A, H.F. Glen 3127; B–F, H.F. Glen 3130. A,  $\times 715$ ; B,  $\times 795$ ; C,  $\times 780$ ; D,  $\times 1400$ ; E,  $\times 811$ ; F,  $\times 681$ .



somewhat similar to that seen in *F. straussiana* (Perold 1997a), but there the rhizoids are hyaline, not purple as in *F. swaziensis*. The latter is also a larger plant, with  $\pm$  entire, nonconvoluted leaves and discrete perigonal bracts subtending the antheridia. *F. swaziensis* may be far more common than the only two sporulating specimens from Forbes Reef and the single one from De Kuilen suggest, but all the other collections lack spores which are needed to confirm the determinations. This new species is also rather similar in general appearance to robust forms of *F. crispa* which, however, has reticulate spore ornamentation with the areolae lacking inclusions (Perold 1997c). The multistratose leaf bases in *F. swaziensis* may be due to the growing conditions, as Scott & Pike (1988) surmised the case to be in *F. crassifolia* Spruce, where this also occurs.

#### SPECIMENS EXAMINED

Held at PRE. Bracketed numbers after citation of collectors' names and collecting numbers refer to the species described in the text in alphabetical order, namely: *F. angulifolia* (1) and *F. swaziensis* (2).

*Glen* 3127 (2) (paratype), 3130 (2) (holotype).

*Perold & Koekemoer* 3711 (1) (holotype), 3712a (1) (paratype), 4064 (2).

#### NEW RECORDS OF *FOSSOMBRONIA* SPECIES IN LESOTHO (HELD AT PRE)

*F. gemmifera* Perold (Perold 1997a: 19). LESOTHO, 2927: (–BC), *Perold & Koekemoer* 3733.

*F. glenii* Perold (Perold 1997a: 20). LESOTHO, 2828: (–CC), *Perold & Koekemoer* 3737, 3739. 2927: (–BA), *Perold & Koekemoer* 3736. 2927: (–BC), *Perold & Koekemoer* 3713, 3719.

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