

## Studies in the liverwort genus *Fossombronia* (Metzgeriales) from southern Africa. 9. A new species from Mpumalanga and KwaZulu-Natal, with notes on other species

S.M. PEROLD\*

**Keywords:** *Fossombronia*, *F. renateae*, liverworts, Metzgeriales, new species, southern Africa, tropical Africa

### ABSTRACT

A new species of *Fossombronia*, *F. renateae*, from Mpumalanga and KwaZulu-Natal in southern Africa is described. It is distinguished by its reflexed, undulating leaves and often stipitate pseudoperianth with a highly convoluted mouth, as well as by completely or incompletely reticulate spores and usually by short, blunt elaters with two spirals which often form rings or coils. Notes are provided on two unnamed species from Mpumalanga which cannot be fully described as yet, since ripe spores are not available for study. Brief references are made to some tropical African species.

### *Fossombronia renateae* Perold, sp. nov.

Plantae repentes, dense congestae vel cum muscis intercrecentes. *Folia* late patentia, undulata, oblonga vel breviora quam lata, supra leve lobata. Dioicae. *Antheridia* in plantis masculis bracteis obiecta. *Pseudoperianthium* campanulatum; ore perirregulariter lobato et maxime convoluto. *Sporae* 37.5–47.5  $\mu\text{m}$  diametro, cum 8 vel 9 cristis irregularibus, aliquando anastomosantibus, aliquot areolas formantibus. *Elateres* plerumque bis spirales, annulares vel spirales, 25–75  $\times$  12.5–17.5  $\mu\text{m}$ .

TYPE.—Mpumalanga, 2530 (Lydenburg): Lone Creek Falls, on soil, at margin of pond below falls, (–BB), Perold & Koekemoer 4073 (PRE, holo.).

Plants smallish to medium-sized to rather large, creeping, in dense, crowded stands or intimately to loosely intergrown with mosses, green; shoots often simple, in male plants 5–13  $\times$  3–4 mm, 1.3–2.5 mm high; in female plants 9–15  $\times$  3.5–4.0 mm, 1.6–2.5 mm high, sometimes furcate or with short, lateral branches near apex and/or toward base. *Stems* prostrate, in some populations distally markedly fleshy, tapering proximally, in living material from above, hardly distinct from adjoining leaf bases, sometimes faintly longitudinally striate, in cross section plano-convex, in male plants at apex (Figure 1L) up to 600  $\mu\text{m}$  (12–14 cell rows) high,  $\pm$  630  $\mu\text{m}$  wide, at base (Figure 1M)  $\pm$  570  $\times$  540  $\mu\text{m}$ ; in female plants at apex (Figure 1N) up to 680  $\mu\text{m}$  (15 cell rows) high,  $\pm$  1000  $\mu\text{m}$  wide, at base (Figure 1O)  $\pm$  420  $\times$  700  $\mu\text{m}$ . *Rhizoids* purple, 12.5–25.0  $\mu\text{m}$  wide. *Leaves* overlapping by about  $\frac{1}{3}$  of their width, spreading widely, undulating, succubously inserted, often slightly decurrent, apically smaller, soon becoming larger, oblong or shorter than wide, shallowly lobed above; in male plants (Figure 1A–F) 1200–2500  $\times$  1300–2375  $\mu\text{m}$ ; in female plants mostly larger (Figure 1G–I), 1250–2500  $\times$  1350–3500  $\mu\text{m}$ , sometimes narrower above or below;

margins with up to 13 well-spaced, sessile papillae, but sometimes fewer, only 2 toward leaf base, occasionally raised on a basal cell. *Leaf cells* thin-walled, in male plants not appreciably different from those of female plants, at upper margins (Figure 1J) rectangular across, occasionally isodiametric, 25.0–37.5  $\times$  27.5–52.5  $\mu\text{m}$ , at lateral margins long-rectangular, 50.0–87.5  $\times$  15.0–22.5  $\mu\text{m}$ ; upper laminal cells 5- or 6-sided, 35.0–52.5  $\times$  27.5–37.5  $\mu\text{m}$ ; middle laminal cells 47.5–75.0  $\times$  32.5–45.0  $\mu\text{m}$ ; basal cells 75.0–107.5  $\times$  42.5–62.5  $\mu\text{m}$ . *Oil bodies* few (Figure 1K), only 4–6 per cell, 5  $\mu\text{m}$  diam., or a little larger, round, but some slightly irregular and with a central indentation; chloroplasts numerous, mostly rounded,  $\pm$  5  $\mu\text{m}$  diam.

Dioicous. *Antheridia* dorsal on stem, in 1 or 2 crowded rows, short-stalked, globose, distal ones often larger, 220–270  $\mu\text{m}$  diam., white, proximal ones smaller,  $\pm$  160  $\mu\text{m}$  diam., yellow, each shielded by a perigonial bract (Figures 1P–S; 2A, B), 460–580  $\times$  200–380  $\mu\text{m}$ , sometimes 2 adjacent ones joined together and then 2- or 3-lobed, mostly with apical processes topped by a papilla, marginal cells  $\pm$  rectangular, 40–75  $\times$  27.5–40.0  $\mu\text{m}$ , inner cells usually 5-sided, 65.0–87.5  $\times$  22–35  $\mu\text{m}$ . *Archegonia* in 1 or 2 rows dorsally along stem (Figure 2C), distally and proximally, naked, sometimes 2 per branch, at intervals or 2 adjacent or even 3 in a cluster, becoming fertilised. *Pseudoperianth* (Figures 1T, U; 2D–F) campanulate, about as tall as leaves, raised on a short stalk, then widely flaring above, up to 1625  $\mu\text{m}$  long,  $\pm$  3500  $\mu\text{m}$  wide across mouth, very irregularly lobed and highly convoluted, lobes 300–400  $\times$  400–450  $\mu\text{m}$ , with papillae at angulations, some sessile, others raised on a basal cell; cells comparable in shape and size to those of leaves, except for basal ones which are larger, 100.0–112.5  $\times$  37.5–45.0  $\mu\text{m}$ . *Capsules* globose,  $\pm$  750  $\mu\text{m}$  diam., walls bistratose, cells in inner layer irregularly shaped (Figure 1V), subquadrate, long-rectangular or triangular, 25–50  $\times$  27.5–40.0  $\mu\text{m}$ , each cell wall with 1 or 2 dark brown, nodular and sometimes semi-annular thickenings. *Seta* 1.1–2.5 mm long, in cross section (Figure 1W) 200–300  $\mu\text{m}$  diam., 8 cells across. *Spores* light brown, hemispherical, 37.5–47.5  $\mu\text{m}$  diam., including

\* National Botanical Institute, Private Bag X101, 0001 Pretoria.  
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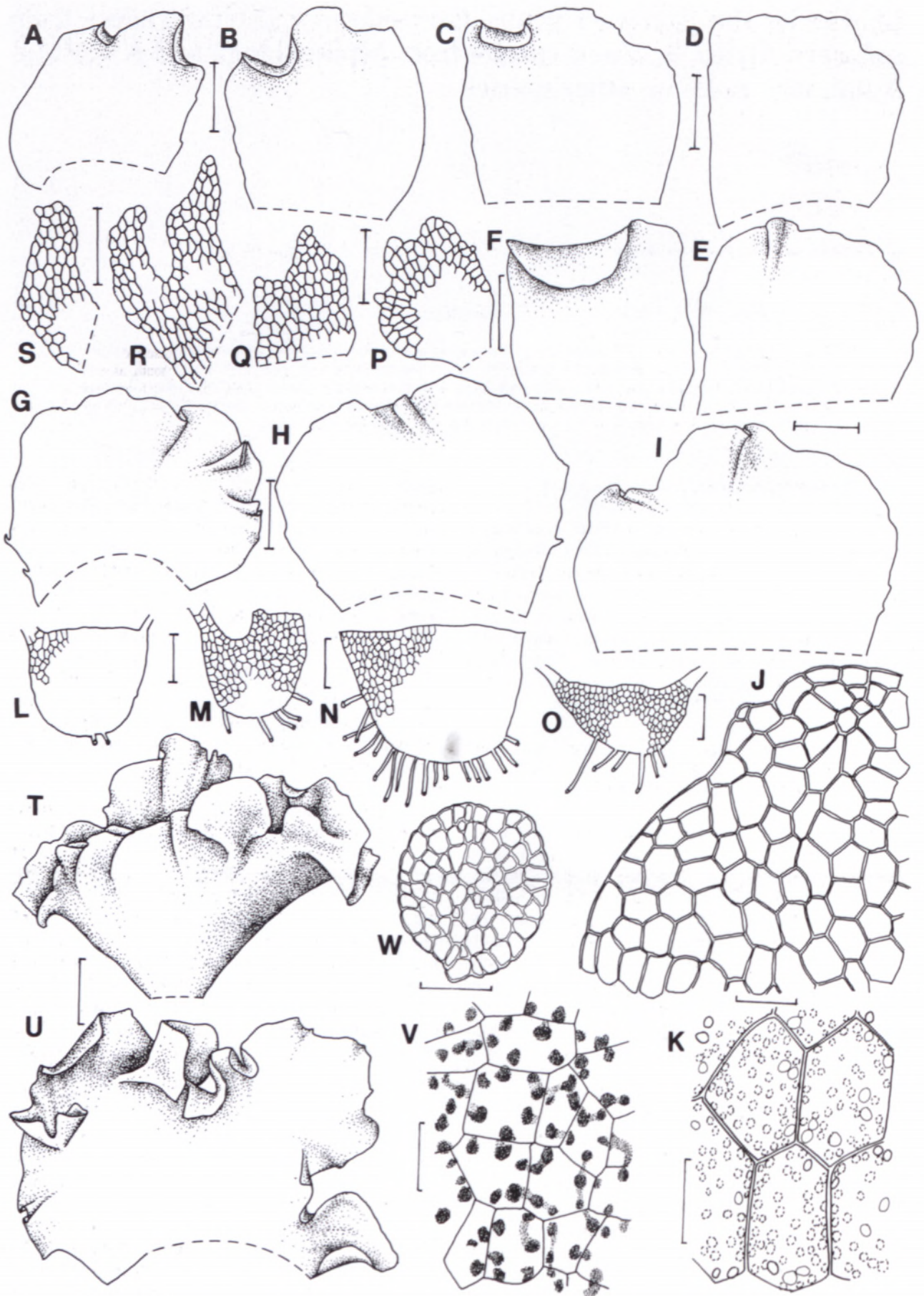


FIGURE 1.—*Fossombronia renateae*. A–F, male leaves; G–I, female leaves; J, upper leaf margin; K, median leaf cells with oil bodies (solid lines) and chloroplasts (dotted lines); L, c/s male stem base; M, c/s male stem apex; N, c/s female stem apex; O, c/s female stem base; P–S, perigonal bracts; T, pseudoperianth from side; U, opened pseudoperianth; V, cells in inner capsule wall; W, c/s seta. A–F, K–M, P–S, Perold & Koekemoer 4071; G–I, N, O, Perold & Koekemoer 4073; J, Lübenau-Nestle SA265; T, U, Lübenau-Nestle SA264 p.p.; V, Doidge CH3564; W, Perold & Koekemoer 4078. Scale bars: A–I, T, U, 500 µm; J, W, 100 µm; K, V, 50 µm; L–S, 250 µm. Artist: G. Condy.

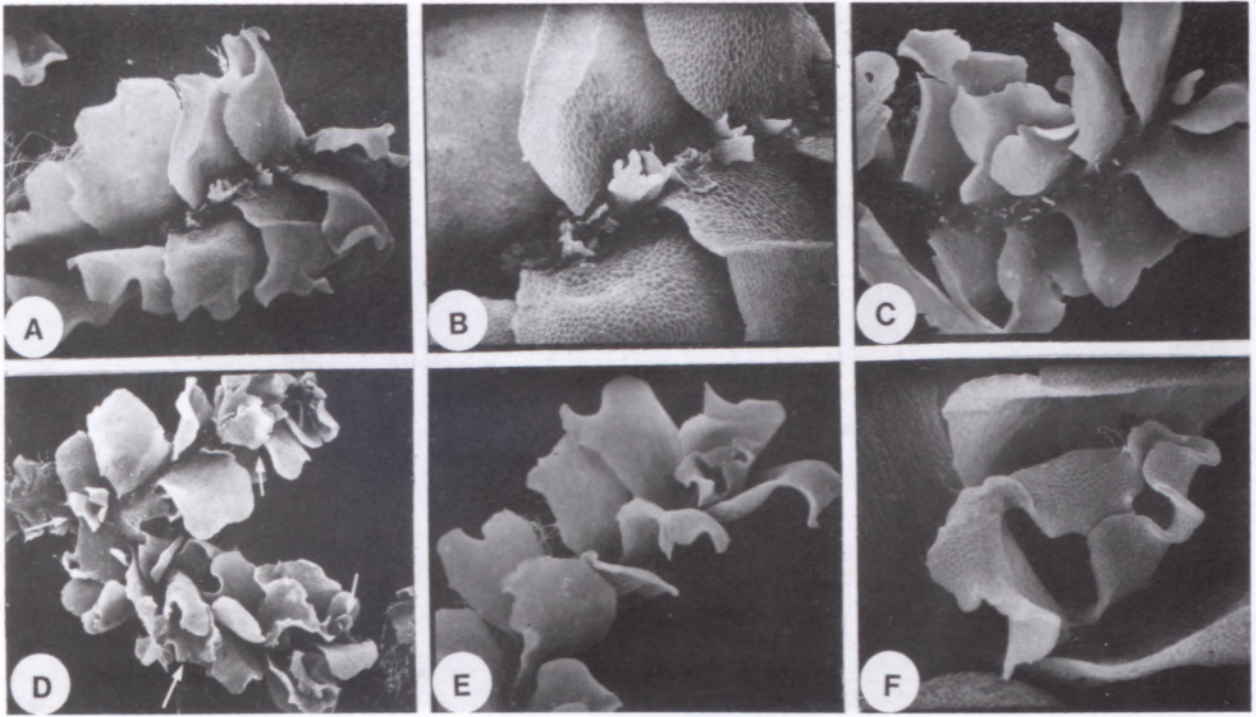


FIGURE 2.—*Fossombronia renatae*. A, male plant with perigonial bracts; B, close-up of perigonial bracts; C, female plant with archegonia; D, female plant with pseudoperianths (indicated by arrows); E, female plant with pseudoperianth near apex of branch; F, close-up of pseudoperianth. A, B, E, F, Perold & Koekemoer 4071; C, Perold & Koekemoer 4073; D, Lübenau-Nestle SA265. A,  $\times 8.7$ ; B,  $\times 20$ ; C, D,  $\times 8$ ; E,  $\times 8$ ; F,  $\times 25.6$ .

ridges projecting at margin; distal face (Figure 3A–D) convex, with a tendency to form 8 or 9 well-marked areolae across face, 5.0–7.5  $\mu\text{m}$  wide, occasionally ridges running parallel to each other or else in different directions, interconnected by faint or distinct cross walls or anastomosing and forming incomplete areolae, sometimes with small inclusions, surrounding ridges 2.5–4.0

$\mu\text{m}$  high, crenulate above; proximal face (Figure 3E) lacking triradiate mark, mostly flat, covered with coarse, very irregular spicules or spikes, 20 or 21 'spines' projecting up to 2.5  $\mu\text{m}$  high around spore periphery and completely or somewhat incompletely joined by a  $\pm 5 \mu\text{m}$  wide, membranous wing or perispore, its margin crenulate. *Elaters* in most populations relatively few, with 2

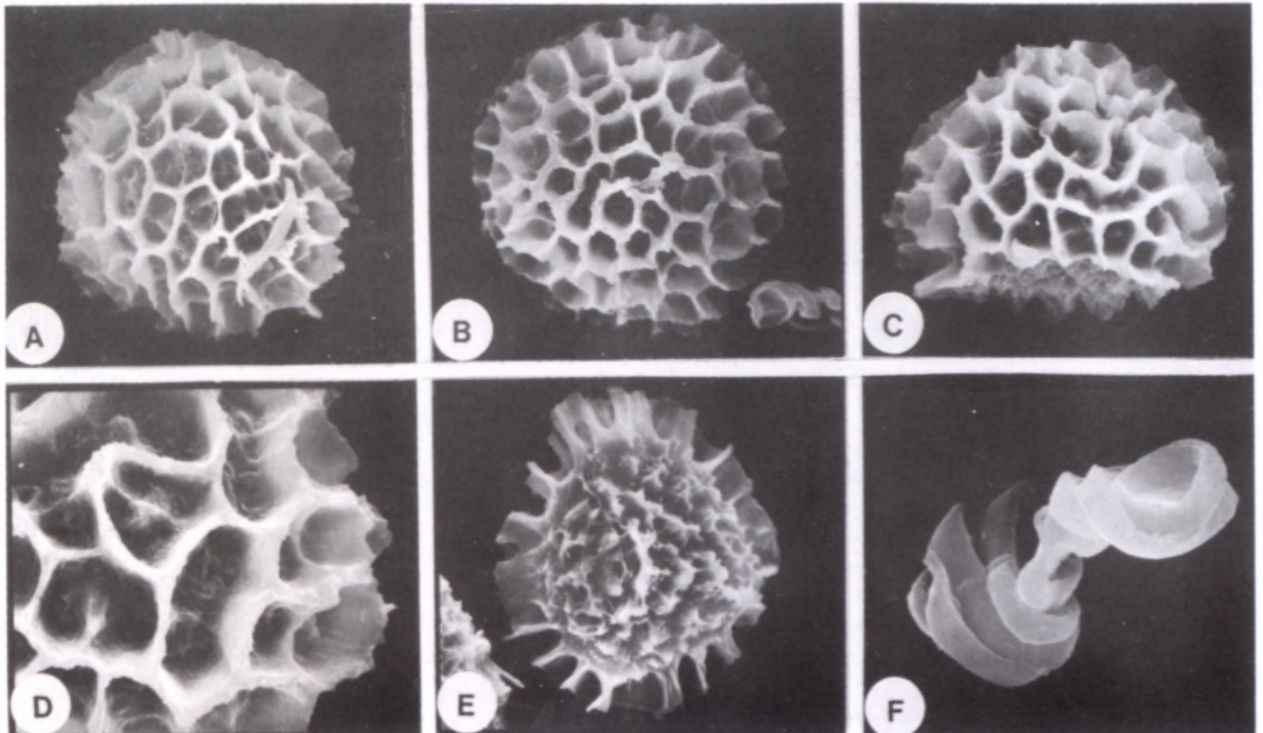


FIGURE 3.—*Fossombronia renatae*. A–E, spores; F, elater. A, B, distal face; C, side view of distal face; D, detail of part of distal face; E, proximal face. A, Perold & Koekemoer 4073; B–E, Lübenau-Nestle SA265; F, Lübenau-Nestle SA264 p.p. A,  $\times 1046$ ; B,  $\times 908$ ; C,  $\times 881$ ; D, F,  $\times 1744$ ; E,  $\times 752$ .

spirals (rarely with 3 spirals partly), light brown or greenish, often in rings or coils (Figure 3F), rather short and stout, blunt at both ends, or  $\pm$  wedge-shaped,  $25\text{--}75 \times 12.5\text{--}17.5 \mu\text{m}$ , sometimes sticking to spores.

*Fossombronia renatae* is so far known from only two localities, both in the Afromontane, summer rainfall region of southern Africa, from Lone Creek Falls, near Sabie in Mpumalanga and Xumeni Forest Reserve, near Donnybrook in KwaZulu-Natal (Figure 4), but it must surely be more widespread. At Lone Creek Falls, the plants grow on soil between rocks and are kept moist by spray from the falls. Unfortunately, there are no details about the substrate and conditions on the label of the Doidge collection from Xumeni Forest Reserve. *Bryum alpinum* Huds. ex With. and *Funaria limbata* (C.Müll.) Broth. are mosses that grow together with the Lone Creek plants.

This newly isolated species has been named *F. renatae* in honour of Dr Renate Lübenau-Nestle of Kempten, Germany, who collected it when on a visit to South Africa in 1992 and kindly lent her specimens to PRE for examination. In 1998, accompanied by Ms M. Koekemoer, curator of PRE herbarium, I visited Lone Creek Falls (and the vicinity) three times. In April we failed to find fertile specimens of this species, but in June we were successful, although the material only had a few dehisced capsules retained from the previous season, and fortunately still with some unshed spores. These spores and elaters are closely similar to those of the Lübenau-Nestle specimens. Samples of the fresh collections with young capsules were cultivated for two months (until August) before ripe spores were obtained. Many of these spores were malformed, but the ornamentation was fairly similar to that of the earlier collections. The elaters, however, were more numerous, usually with 2 (rarely 3) darker and thicker spirals,  $45\text{--}110$  ( $-132.5$ )  $\times 10.0\text{--}17.5 \mu\text{m}$ ; only a few elaters were identical to the Lübenau-Nestle and Doidge ones.

Scott & Pike (1988) refer to the elaters of *F. caldonica* Steph. as 'bispiral, with the spirals breaking down into rings' (translated by them from Latin). They found similar elaters in *F. papillata* (and several other species), where capsules with elaters of this sort and capsules with normal elaters occurred in the same colony. Accordingly, they considered the production of such elaters a mere abnormality not worthy of specific recognition. However, in a genus where there are so few reliable taxonomic characters to discriminate between species, I would hesitate to discard this one entirely.

The plants collected by Perold & Koekemoer are decidedly more robust and the stems fleshier than in the earlier collections. The species can be distinguished by its undulating leaves, by its often stipitate pseudoperianths, of which the mouth is highly convoluted, by completely or incompletely reticulate spores and generally by short and relatively wide elaters, the two spirals often forming rings or coils.

*Fossombronia capensis* S.W.Arnell from the winter rainfall area in the southern Cape, also has short and stout elaters, usually with loose, pale-coloured spirals (Perold 1997a), but in spore ornamentation it differs completely from *F. renatae*.

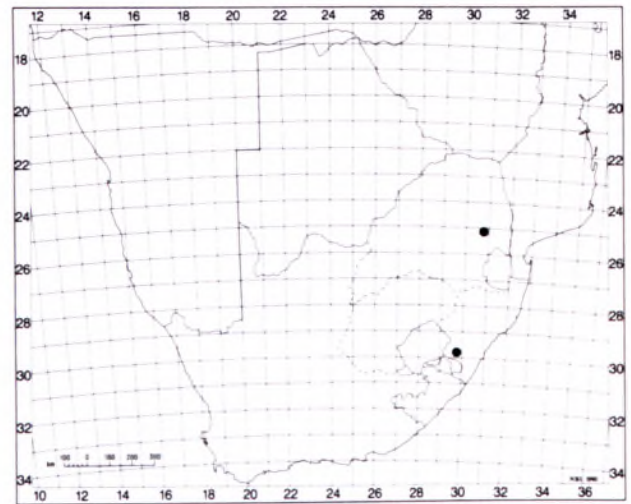


FIGURE 4.—The distribution of *Fossombronia renatae* in southern Africa.

#### NOTES ON TWO UNNAMED SPECIES FROM MPUMALANGA

A new, unnamed species was found beside the Malieveld River, 9 km East of Sabie on the road to Hazyview, Mpumalanga. It has been collected three times, Perold & Koekemoer 3573, 4053, 4082, in the past few years. This species grows on the concrete supports of the bridge, just above or at the water level, as well as on the soil of the streambank. Unfortunately, ripe spores have not yet been obtained and it cannot be described at this stage.

This species can be recognised by almost entire, rounded, slightly concave and rather stiff, imbricate leaves,  $1250\text{--}1750 \times 1500\text{--}2000 \mu\text{m}$ . They overlap by  $\pm 1/3$  of their width and are not decurrently inserted on the stem. The shoots are up to 19 mm long, including the apical branches which are 5–7 mm long. The pseudoperianth is cupulate, also rather stiff and the margin is undulating. The perigonal bracts shielding the antheridia in the male plants, are conspicuous.

Another species of *Fossombronia* collected at Lone Creek Falls, Perold & Koekemoer 4059, 4060, is very large, with up to 50 mm long shoots. It is an erect-growing, bottle-green, aquatic plant. Its leaves are subquadrate to rectangular,  $2800\text{--}3375 \times 2725\text{--}3200 \mu\text{m}$ , and only very slightly decurrent at the 'trailing' edge, rather stiff, 4-stratose at the base and bistratose up to  $\pm$  midlength. Unfortunately, only specimens with archegonia were found, and the plants kept in cultivation deteriorated rapidly. It cannot, therefore, be described at this stage, but it is still worth mentioning, in case fruiting material turns up later.

Several more, large, aquatic specimens, without spores have been collected elsewhere in southern Africa. It would appear that fertilisation of these plants in quite rapidly flowing streams, seldom takes place.

#### NOTES ON SOME TROPICAL AFRICAN SPECIES

It is unlikely that the above-mentioned plants belong to *F. pulvinata*, a sterile species described by Stephani

(1911, 1917) from Rwanda, leg. *Mildbraed 22182* (G!). The leaves of *F. pulvinata*, in contrast to the above-mentioned South African plants, are strongly decurrent, much wider than long ('7 mm lata, medio 4 mm longa') and rather lax. Scott & Pike (1988) think that this species may be *F. australis*.

Jones (1990) reports *Noteroclada porphyrorhiza* (Nees) Steph. with purple rhizoids, as once recorded from Kilimanjaro. The pseudoperianth is said to be laterally compressed and bilabiate, but spores are not mentioned. This species had previously been transferred to *Fossombronia porphyrorhiza* (Nees) Prosk. by Proskauer (1955). I have not seen this specimen and am unable to comment on it. I have, however, examined a sterile specimen from Lydenburg, *Wilms 024671*(G), which had been referred to *Fossombronia* (= *Androcryphia*) *porphyrorhiza* Nees. This plant has surely been misidentified, as the type species is from South America, which Scott & Pike (1988) think may also be *F. australis*.

Another *Fossombronia* species described from tropical Africa on Mt Kilimanjaro in Kenya, is *F. grandis* Steph., leg. *Volkens 1226* (G18524) holotype (G!). It is a large plant, as the specific epithet is intended to convey. The shoots are 20 mm long and simple, the leaves large and broadly rounded, the margins with some short, longitudinal folds. Stephani (1900) reported the spores of this dioicous species to be 34 µm diam.; my measurements are 32.5–37.5 µm diam. The distal face is coarsely reticulate, with rather thin, 2.5–5.0 µm high ridges delimiting 4 or 5(–6) angular areolae, 7.5–10.0 µm wide, across the diameter and with ± 12 spinous projections connected by a perispore, at the periphery; the proximal face is generally concave in the centre, with fine, irregular, sinuating ridges, sometimes forming small areolae, partly or completely surrounded and often a little obscured by several large, angular areolae, seemingly 'folded' inward from the outer row on the distal face. The elaters are 242–280 × 7.5 µm and often 2-spiral. I have also examined a specimen, *Adam & Jager 9211/X* from Mt Elgon National Park, which was kindly lent by Dr Chuah-Petiot. It, and a sterile specimen, *Pócs 9214/AC* had been assigned to *F. grandis* by Prof. T. Pócs. Chuah-Petiot (1995) reports *F. grandis* (*Pócs 9236/AA*) from Naro Moru. A specimen, *Hedberg 1747h* (BOL) from Mount Kenya (at the stream below Tyndall glacier), was determined by Arnell (1956) as *F. grandis*. It is sterile and the determination is doubtful.

The spore ornamentation in *F. grandis* is so closely similar to that of *F. angulosa* (Dicks.) Raddi, [said to be a salt-tolerant (Smith 1990), mediterranean-atlantic species (Jovet-Ast 1946)], and also large as well as dioicous, that I am surprised no one else has remarked on it. Scott & Pike (1988) regard both *F. angulosa* and *F. grandis* as good species and do not comment on the spore ornamentation. I found the leaves in *F. angulosa* to be mostly longer than wide and shortly lobed above. In *F. grandis* the leaves are generally wider than long, the apex rounded and, at the base, several cell layers thick, the latter also found to be the case in *F. angulosa*. In both species the pseudoperianths are stipitate. Despite the similarities between these two species, it seems phytogeographically unlikely that *F. grandis* would be conspecific with

*F. angulosa*. Moreover, I have examined only two sporulating specimens of *F. grandis*, the type specimen and the Adam & Jager collection, which makes me hesitate to place this species in synonymy under *F. angulosa*.

Krauss (1846) collected a specimen of the so-called *F. angulosa* from southern Africa 'in rupibus rivulorum natalensium', but this has not been confirmed and is thought to have been a misidentification of the commonly occurring *F. crispa* Nees (= *F. zeyheri* Steph.) (Perold 1997b, c).

#### SPECIMENS EXAMINED

Held at PRE, unless otherwise stated. Species listed in alphabetical order.

##### *F. angulosa* (duplicates in PRE)

*T. Arts* (Portugal and Madeira) 15519, 15567, 15605, 15732, 15778, 15912, 16277, 16329, 19815, 19819, 19883, 19921, 19929, 20003, 20190. *Bryhn NH31448*. *Curnow CH656*. *Piquet CH536B*.

##### *F. grandis*

*Adam & Jager 9211/X*. *Pócs* (sterile) 9214/AC (University of Nairobi). *Hedberg* (sterile) 1747h (BOL). *Volkens 1226* (= G18524) (G).

##### Lone Creek specimens (very large)

*Perold & Koekemoer 4059, 4060*.

##### Malieveld specimens

*Perold & Koekemoer 3573, 4053, 4082*.

##### *F. porphyrorhiza*

*Wilms 024671* (G), incorrectly referred here.

##### *F. pulvinata*

*Mildbraed 22182* (G).

##### *F. renateae*

*Doide CH3564*. *Lübenau-Nestle SA264* p.p., SA265 (Herbarium Lübenau). *Perold & Koekemoer 4073* (holotype), 4074, 4076, 4078.

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