

Taxonomic Results of the BRYOTROP Expedition to Zaire and Rwanda

7. Ricciaceae

S.M. Perold

National Botanical Institute, Private Bag X101, Pretoria, Republic of South Africa

Abstract. Four *Riccia* species, namely *R. lanceolata*, *R. okahandjana*, *R. stricta* and *R. vulcanicola* of the hepatic family Ricciaceae (order Marchantiales) from Rwanda and Zaïre are described and illustrated in this report. *Riccia lanceolata* and *R. stricta* are new records for Rwanda.

RICCIACEAE Reichenbach (Marchantiales)

Plants thalloid, small to large, scattered or in gregarious patches or in rosettes, green; terricolous, rarely aquatic. Branches 2 or 3 times dichotomously furcate, linear to obovate; apex truncate to rounded, emarginate. Groove median along dorsal face. Thallus margins acute to obtuse, glabrous or occasionally ciliated. Flanks sloping obliquely or steep; ventral face rounded to flat. Scales small to large, rarely absent, generally imbricate, lateral or ventral, hyaline or variously coloured, purple, red or black.

Dorsal covering an epithelium of hyaline, echlorophyllose cells in 1 or 2 strata with air pores numerous, small, regular spaces; or else, dorsal covering an epidermis, chlorophyllose, generally unistratose with air pores fewer, simple, delimited stomata, scattered, and often becoming cavernous. Assimilation tissue compact, cell

columns enclosing narrow vertical air canals; or spongy, with mostly unistratose cell plates enclosing wide polyhedral air chambers; storage tissue occupying ventral ½ or less of thallus; rhizoids long, unicellular, smooth or tuberculate, arising from ventral epidermis.

Monoicous or dioicous. Gametangia acropetally arranged, embedded, only necks projecting, single, median along groove or scattered. Sporangia without stalk or foot, enclosed by venter wall, soon disintegrating to liberate spores, elaters absent. Spores generally large, separating at maturity, rarely remaining coherent in tetrads, triangular-globular or subglobular, ornamentation mostly reticulate, often specific.

The family, classified in the Marchantiales, comprises two genera: firstly, the species-rich genus *Riccia* with up to about 200 species worldwide, and secondly, the monotypic, cosmopolitan genus *Ricciocarpos*.

Abbreviations::

* New record for Rwanda viz. Zaire

KB: Kahuzi-Biega (Zaire)

Ka: Karisimbi (Rwanda)

Ny: Nyungwe Forest (Rwanda)

Ak: Akagera region (Rwanda)

Ki: Kigali region (Rwanda)

100-171, number of collecting site.

For locality data and a description see the contribution by E. Fischer on the vegetation of the study area in this volume (Tropical Bryology 8: 13-37, 1993). The specimens are deposited at the Botanical Museum Berlin (B) as well as in the herbarium of the author (except for unicates).

RICCIA L.

Riccia L. Species Plantarum: 1138 (1753); Steph. (1898: 314); Sim (1926: 8); Müller (1951-1958: 416); S. Arnell (1963: 13); Hässel (1962: 208); Na-Thalang (1980: 71); Jovet-Ast (1986: 291). Lectotype species: *R. glauca* L., fide Hässel in Opera Lilloana 7: 208 (1962).

The species dealt with in this report belong to two different subgenera: *Riccia* and *Ricciella* (A. Braun) Reichenb. The latter is here represented by both its sections: section *Ricciella* and section *Spongodes* Nees.

KEY TO THE SPECIES OF RICCIA IN THIS REPORT

1a. Thalli covered by a dorsal epithelium of echlorophyllose cells in one or rarely in two strata; air pores numerous, small and regular intercellular spaces; assimilation tissue compact, in vertical rows of chlorophyllose cells separated by mostly very narrow interstitial air canals; scales small to large; habitat often xeric, sometimes mesic (Subgenus *Riccia*):

2a. Thalli glaucous green to green; scales deep violet with hyaline edges extending to thallus margins but never inflexed over them; spores distinctly polar, winged, proximal face with well-defined triradiate mark, facets and distal face often with incomplete areolae....1. *R. lanceolata*

2b. Thalli bluish green; scales prominent, black, projecting above thallus margins, and inflexed over dorsal face, dry; spores not distinctly polar, wingless, lacking triradiate mark, densely papillate.....2. *R. okahandjana*

1b. Thalli covered by a dorsal epidermis of thin-walled, chlorophyllose cells; air pores mostly clearly delimited, often ringed by smaller cells, well-spaced, fewer, frequently becoming cavernous; assimilation tissue loosely arranged, spongy, unistratose cell plates enclosing large polyhedral air chambers; scales small and evanescent; habitat mostly mesic, rarely xeric or aquatic (Subgenus *Ricciella*):

3a. Thalli not in rosettes; branches linear, strap-shaped or 'ribbon-like'; never cavernous; sporangia in a row, oblique and markedly bulging ventrally; distal spore face with areolar walls wide and prominent, proximal face with thick triradiate mark3. *R. stricta* (section *Ricciella*)

3b. Thalli in partial rosettes; branches not linear; becoming cavernous proximally; sporangia numerous, crowded, bulging dorsally and ventrally; areolar walls on both spore faces and triradiate mark on proximal face thin.....4. *R. vulcanicola* (section *Spongodes*)

Subgenus *Riccia*

Thalli small to large; terricolous. Groove deep or shallow. Scales mostly large, lateral, rarely ventral, rounded, variously pigmented or hyaline, extending to, or projecting above thallus margins, scale margins entire, rarely denticulate or crenate.

Dorsal epithelium hyaline, in one or more strata, air pores small spaces, numerous, regular. Assimilation tissue compact, with mostly narrow interstitial vertical air canals.

Spores large, (65-)80-120 μm in diameter; tetrads separating at maturity, triangular-globular or subglobose, variously ornamented.

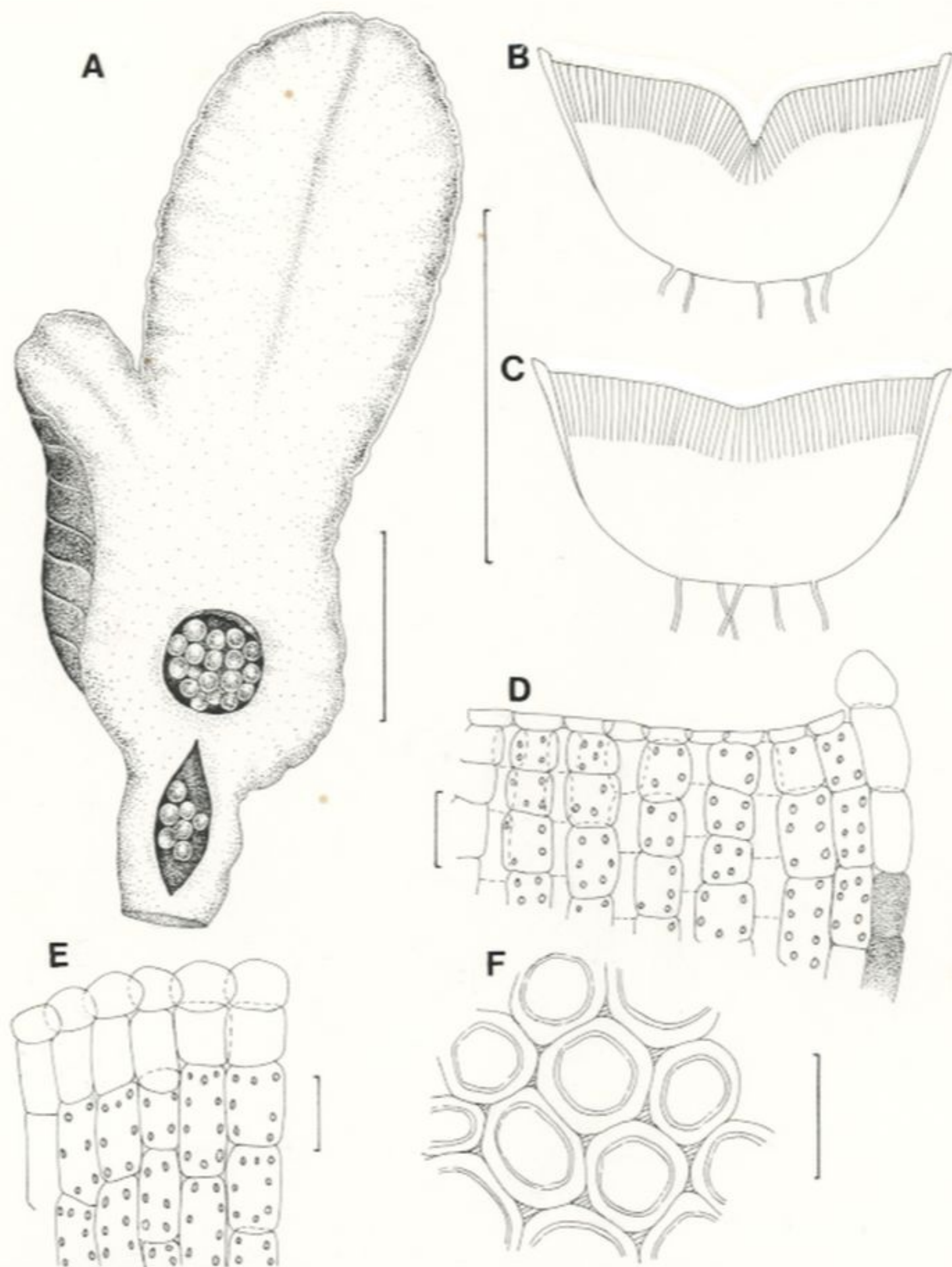


Figure 1. *Riccia lanceolata*. A, thallus branches seen from above; B,C, transverse sections of thallus branch near apex and toward base respectively. D, collapsed dorsal cells and assimilation tissue toward margin, with scale attached, in transverse section; E, intact dorsal cells and assimilation tissue toward groove, in transverse section; F, dorsal cells from above. A-F, *Frahm 6524*. Scale bars on A-C = 1mm; D-F = 50 μ m.

1. **Riccia lanceolata* Steph. in Hedwigia 27: 110 (1888); *ibid.* (1898: 34); Jones (1957: 218). Type: Dahomey: Canné, *F. Newton 6* (G, holo.)

Plants medium-sized, in crowded, gregarious or overlapping patches, rarely in irregular rosettes or scattered; glaucous green to bright green, with narrow white or sometimes violet band on inner side of hyaline, undulating margins; when dry, dorsally pale green to whitish, margins raised to incurved and occasionally clasped together apically, exposing purple flanks, sometimes appearing vertically 'striped', due to hyaline margins of scales. Branches simple, to once or twice dichotomously furcate, closely to moderately divergent, rarely asymmetrically branched, with one long and one short, almost parallel lobe; broadly ovate or \pm linear, 4.0-8.5 mm long, (1.0-1.5-2.5 mm wide, 0.7-1.0 mm thick and in section (1½-2)22½(-3) times wider than thick; apex obtusely rounded to somewhat tapered, shortly emarginate. Groove apically narrow and deep, becoming shallower, but persisting to \pm midlength of dorsal face. Thallus margins acute, slightly raised, hyaline, wavy. Flanks distally vertical, proximally sloping steeply upward and outward, basally reddish purple to deep violet, at margins hyaline or white; ventral face rounded, entirely purple or green with purple blotches. Scales fragile, closely adherent to flanks, imbricate, rounded, 400 x 500 μ m, projecting up to 90 μ m above thallus margins, with hyaline border of 2-4 cell rows above purple base, cells in body of scale long hexagonal, 50-65(-85) x 37 μ m, marginally smaller, isodiametric or short-rectangular.

Dorsal epithelium unistratose, hyaline, cells globose to rounded above, 27.5-37.5 x 32.5-37.5 μ m, soon collapsed and cup-shaped, sub-dorsal cells 30.0-62.5 x 27.5-37.5 μ m, mostly echlorophyllose, walls uniformly thin; air pores triangular. Assimilation tissue 320-375(400) μ m thick, less than ½ the thickness of thallus, consisting of vertical columns of 6 or 7 rectangular cells 40-60 x 27-37 μ m, enclosing 4-sided air canals, \pm 15 μ m wide; storage tissue occupying ventral part of thallus, cells angular or rounded, closely packed together, 35.0-62.5 μ m wide.

Monoicous. Antheridia with inconspicuous hyaline necks, projecting \pm 80 μ m, in a row along dorsal groove. Archegonia with purple necks and hyaline tips, total length 300 μ m, of which 200 μ m projecting above dorsal surface. Sporangia 3 or 4 proximally in a central row, each containing 115-125 spores, overlying tissue turning white and disintegrating, leaving sporangia exposed in longitudinal hollow. Spores (87.5-) 92.5-100.0(-105.0) μ m in diameter, triangular-globular, polar, reddish-brown, semi-transparent; wing faintly granular, 5 μ m wide, marginal angles not perforated, margin roughened to finely crenulate; ornamentation mostly incompletely reticulate on both spore faces: distal face convex, areolae incomplete and generally not extending to margin, (5)6-8 across, (10-)12-22 μ m wide, central walls up to 5 μ m high, raised at nodes, outer walls low and often absent; proximal face with triradiate mark distinct; facets mostly with poorly developed areolar walls, only disconnected low walls or nearly smooth. Chromosome number: $n = 16$ (Bornefeld 1987).

Riccia lanceolata can be distinguished from the other *Riccia* species with wavy, hyaline margins, namely *R. atropurpurea*, *R. nigerica* and *R. radicata*, by its medium-sized thalli (it is more robust than *R. atropurpurea* and *R. radicata*, but smaller than *R. nigerica*); by its winged spores, the ornamentation of which is rarely completely reticulate, by the bright green colour of living plants, the dorsal cells lacking any fine deposit of salts as is usually found in *R. atropurpurea*; and by its 'striped' flanks. (Note: in the type specimen, *Newton 6*, the spore ornamentation is variable, the areolar walls being poorly to well-defined.)

Habitat. *Riccia lanceolata* was found on soil in a bog in the area reported on. Otherwise it grows on shallow soil overlying granite or ironstone, often between grasses.

Altitudinal range. 2330 m

General distribution. *Riccia lanceolata* is known from Benin (= Dahomey), Nigeria and Uganda (Jones 1957), Ghana (Jones & Harrington 1983), Ivory Coast (leg. *Porembski*), Malawi (leg. *Petrol*), Tanzania (leg. *Pócs*), Zambia (leg. *Bing-*

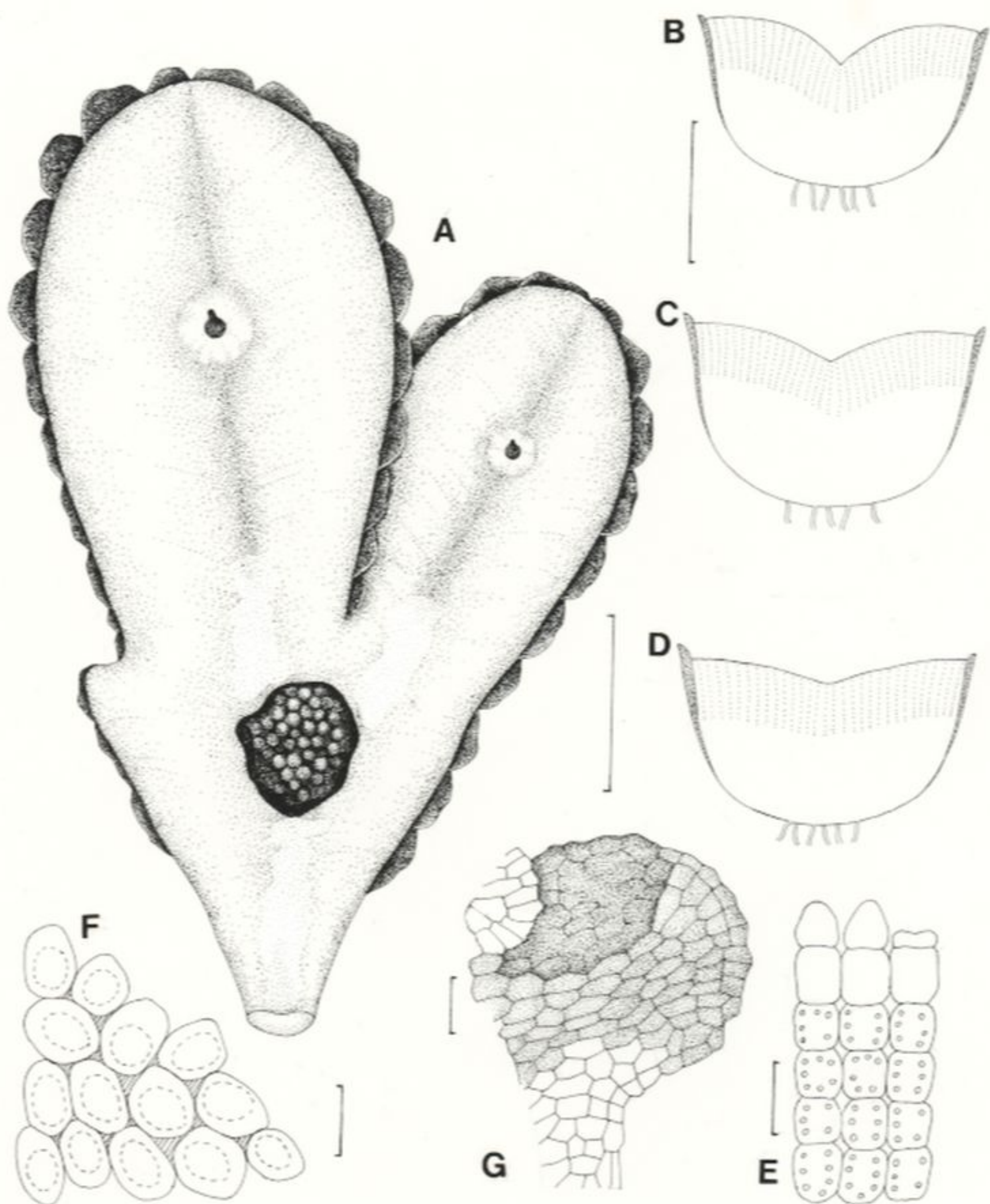


Figure 2. *Riccia okahandjana*. A, thallus braches seen from above; B-D, transverse sections of thallus branch from apex toward base; E, dorsal cells and assimilation tissue in transverse section; F, dorsal cells from above; G, ventral scale. A-G, *Frahm 9023*. Scale bars on A-D = 1 mm; E,F = 50 μ m; G = 100 μ m.

ham) and now from Rwanda.

Illustrations. Figures 1AE; 5A,B.

Specimen examined. Ny: 115, *Frahm 6524*.

2. **Riccia okahandjana* S. Arnell in *Mitteilungen der botanischen Staatssammlung München* 16: 268 (1957); S. Arnell (1963: 32). Type: Namibia: Bez. Otjiwarongo: Okosongomingo, *Volk 11944* (PRE-CH4233) (M; PRE, lecto.), selected by Perold, Ph.D thesis, Pretoria University 1991).

Plants medium-sized, in crowded gregarious patches or in rosettes 15-30 mm across; green to bluish green, sometimes blotched with violet, black scales projecting vertically above margins; when dry, dorsally yellowish green, mostly hidden by tightly inflexed sides covered with shiny black scales. branches simple or once or twice to several times symmetrically or asymmetrically furcate, narrowly to moderately divergent; linear to ligulate or narrowly ovate, 5.0-8.0 (-10.0) mm long, (1.2-)1.5-1.8 mm wide, 0.8-1.0 mm thick and in section 1½ times to twice wider than thick; apex rounded, shortly emarginate. Groove narrow and deep apically, shallow and wider proximally, disappearing toward base. Thallus margins subacute to acute. Flanks steep, covered by black scales; ventral face gently rounded to almost flat, green or with purple bands across. Scales conspicuous, imbricate, 400-600 x 350-450 µm, projecting 100-250 µm above thallus margins, rounded to oblong, shiny black, often hyaline toward base and partly covering the next more apical scale, giving flanks a somewhat 'striped' appearance when dry, cells in body of scale oblong-hexagonal, 65 x 30 µm, walls mostly straight to slightly sinuous, margin crenate and cells smaller, 25-37 x 25 µm.

Dorsal epithelium bistratose, upper layer intact only when young, cells conical or somewhat elongated and sometimes slightly constricted in the middle, dumbbell-shaped, hyaline, 22-40 x 20-25 µm, soon collapsing; second layer of cells also without chloroplasts, 32-45 x 32-50 µm; air

pores mostly triangular, small. Assimilation tissue 350 µm thick, 1/3 to almost ½ the thickness of thallus, cells quadrangular to short-rectangular, 25-37 x 22-25 µm, in columns of 6 or 7(8), enclosing narrow, 4-sided air canals; storage tissue occupying ventral part of thallus, cells up to 50 µm wide, rounded, irregularly arranged.

Monoicous. Antheridia with hyaline necks, in 1 or 2 rows along dorsal groove. Archegonia with purple necks projecting 80-100 µm, scattered singly along median part of thallus. Sporangia single or 2(3) serially arranged, each with about 150 spores, causing slight bulging of overlying dorsal tissue, which gradually disintegrates, leaving clean-edged, deep, round hollows filled with spores. Spores 92-110(-120) µm in diameter, triangularglobular, polar, straw-coloured or golden brown, semi-transparent; wingless, perforated at marginal angles, margin crenulate; ornamentation densely papillate, the same on both faces, papillae blunt, smooth, rounded, up to 5 µm high and 7.5 µm wide, discrete or several joined together to form short vermiculate ridges, separated by narrow grooves or obscuring small round areolae; distal face convex; proximal face without distinct apex or triradiate mark, but with flattening of 3 facets, caused by earlier pressure from sibling spores. Chromosome number: n = 8 (Bornefeld 1984; 1989).

Riccia okahandjana can be distinguished most readily from other *Riccia* species with shiny black scales, that also occur in tropical Africa, by its light brown papillate spores. Its thalli are generally smaller than those of *R. congoana* and of *R. angolensis*; on transverse section, *R. okahandjana* has steep, not sloping, flanks and its scales are vertically arranged when the thallus is turgid. In dry plants, the inflexed margins and flanks covered by black scales, often have more soil particles clinging to the scales than in *R. angolensis*, but they are not nearly 'buried' as in *R. congoana*.

Habitat. *Riccia okahandjana* was found on riverine sandy soil in the area reported on. Otherwise it grows on shallow soil overlying granite, quartzite, basalt or sandstone or on

clayey soil.

Altitudinal range. Not known.

General distribution. *Riccia okahandjana* is common and widespread, occurring throughout tropical Africa, namely Angola (leg. *Welwitsch*), Zimbabwe (leg. *Le Brun*), Malawi (leg. *Perold*), Mocambique (leg. *Sérgio*), and Tanzania (leg. *Pócs et al.*) as well as in southern Africa, except for the winter rainfall areas of the southwestern and southern Cape Province. It was recently also reported from the Arabian Peninsula (Frey & Kürschner 1988).

Illustrations. Figures 2AG; 5C,D.

Specimen examined. Zaïre, Prov. Kivu, Virunga Nat. Park, beside Rutshuru River at Mata Moto hot springs, leg. *Frahm 9023*.

Subgenus *Ricciella*

Ricciella (A. Braun) Reichenb., *Der Deutsche Botaniker. Das Herbarienbuch*: 23 (1841), (fide Grolle (1983: 426). Lectotype species: *R. fluitans* L.).

=*Spongodes* (Nees) Volk in *Mitteilungen der Botanischen Staatssammlung München* 19: 456 (1983). Type species: not designated.

Thalli smallish to large; terricolous, rarely aquatic. Scales small, ventral, mostly evanescent.

Dorsal epidermis chlorophyllose; air pores scattered, soon enlarging, often becoming cavernous. Assimilation tissue with large, polyhedral to irregular air chambers.

Sporangia immersed or bulging ventrally; vertical or rarely oblique. Spores smallish to medium-sized to large; tetrads separating at maturity.

Section *Ricciella*

Ricciella (A. Braun, *pro gen.*) *Bisch.* in *Nova Acta Academiae Caesareae Leopoldino-Caroli-*

nae Germanicae Naturae Curiosorum 17: 1068 (1835). Lectotype species: *R. fluitans* L. fide Grolle (1976: 248).

Thalli smallish to rather large; terricolous or aquatic. Branches linear, quite firm or lax, 1015 mm long, sparingly furcate. Scales very small to small, ventral, mostly only toward apex, single or split, without central appendage.

Dorsal epidermis chlorophyllose, air pores small, surrounded by smaller companion cells, not becoming cavernous. Assimilation tissue with polyhedral air chambers enclosed by unistratose walls.

Sporangia bulging and opening ventrally; vertical or oblique. Spores smallish, areolar walls thick or partly thick.

3. * *Riccia stricta* (Lindenb.) Perold in *Bothalia* 22: 197-206 (1990). Type: Cape, Philipstown, ad arborum truncos (!?), *Ecklon* s.n. (BM, lecto!).

R. fluitans L. var. ? *stricta* Gott. *et al.*, *Synopsis hepaticarum*: 610 (1846). Type: Cape, Philipstown, *Ecklon* (BM!).

R. stricta A.V. Duthie ined. fide S. Arnell: 37 (1963)

? *Ricciella stricta* (Gott. *et al.*) Trev. in *Memorie de Reale Istituto Lombardo Ser.* 3,4: 62 (1877).

Plants small to medium-sized, in dense, tangled masses; bright green, often with purple streaks along margins of thalli; when dry, flattened to almost unchanged, but groove more pronounced and longer, light green. Branches repeatedly symmetrically or asymmetrically furcate, moderately to widely divergent; linear or strap-shaped, 15.0-20.0 mm long, segments 5.0 mm or more long, (0.3-)0.5-0.8(-1.2) mm wide, 0.25-0.35(-0.5) mm thick and in section 13(-14) times wider than thick; apex slightly narrowed and somewhat tapering, occasionally bulbous. Groove only visible at apex in living plants. Thallus

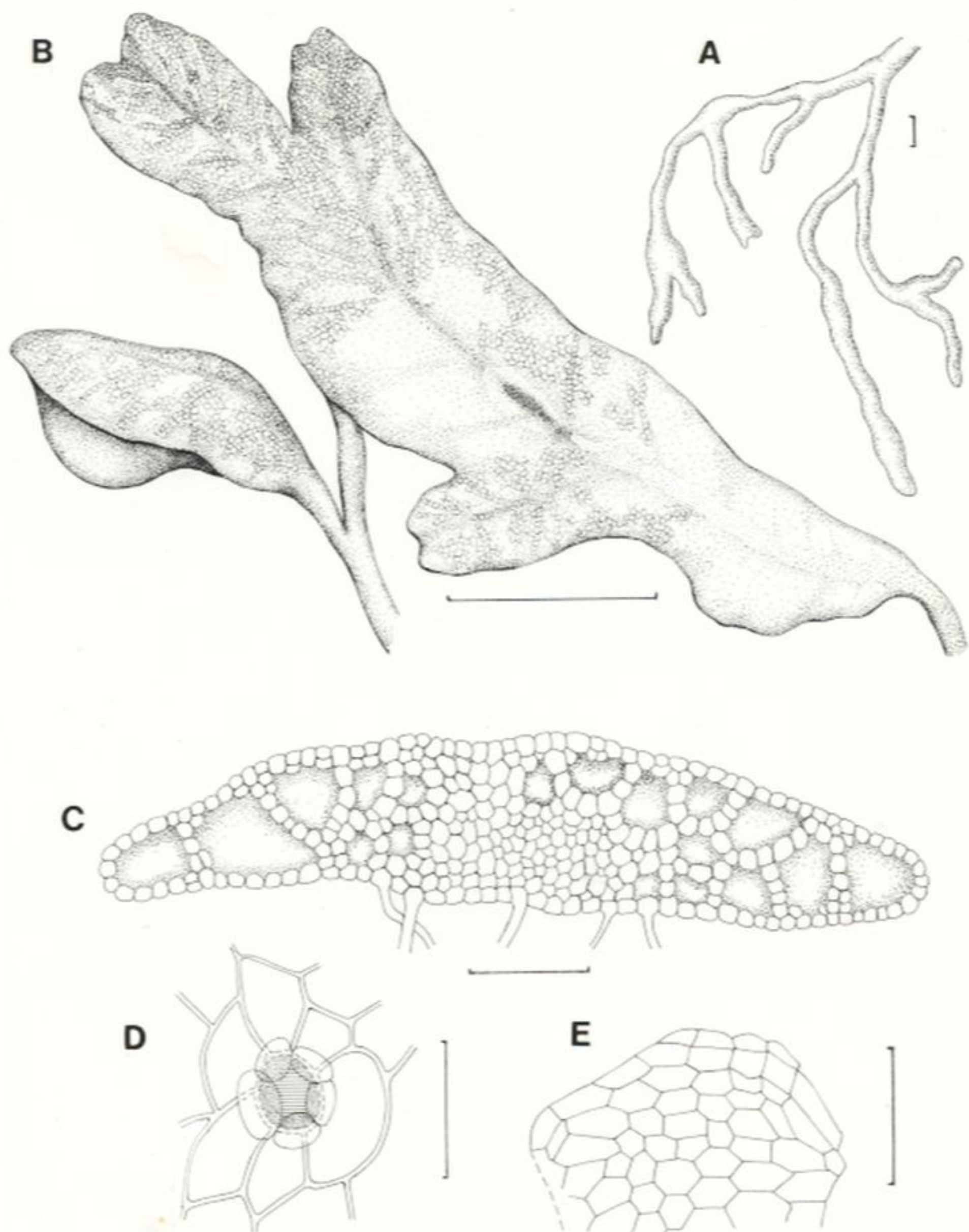


Figure 3. *Riccia stricta*. A, habit; B, branches with dorsal epidermal cells and bounding cells of air chambers partly drawn in; ventrally bulging sporangium shown on the left; C, transverse section through thallus; D, air pore (cross-hatched), with thin-walled companion cells and thicker-walled epidermal cells; E, single scale. A-E, *Pócs 6460*. Scale bars on A,B = 1 mm; C = 200 μm ; D = 50 μm ; E = 100 μm .

margins rounded, obtuse to subacute. Flanks vertical to sloping obliquely to almost flat; ventral face gently rounded to flat, green. Scales under apex and spaced at short or rather longer intervals along ventral face of terminal segment, apically single, soon splitting into two halves, obtusely triangular, concave, hyaline, occasionally somewhat purple, small, up to 250-500 x 150-400 μm , cells 4- or 5(6)-sided, isodiametric, 50-65 μm wide, 1 or 2 rows toward apex wider than long.

Dorsal epidermis forming a more or less flat, not domed, cover over elongated air chambers, cells longhexagonal, 42-65 x 25 μm , smaller and isodiametric at margins, ± 25 μm , air pores small, up to 17 μm wide, surrounded by ring of 5 or 6 smaller companion cells, partly overlying slightly thicker-walled epidermal cells and sometimes raised. Assimilation tissue 100-500 μm thick, less than $\frac{1}{2}$, to most of thickness of thallus, air chambers in 1 or 2 layers medianly, uniseriate laterally, up to 65 μm wide, enclosed by chlorophyllose plates, one cell thick, cells isodiametric, 25-40 μm ; storage tissue occupying ventral part of thallus, cells rounded, ± 25 μm wide.

Monoicous. Antheridia near apex and more proximally, single at intervals medianly along branches, necks forwardly placed, hyaline, conspicuous, 150-200 μm long, at the base surrounded by low, hyaline, conical cells, 37-50 x 30 μm . Archegonia median, up to 3 per segment, serially arranged, sometimes interspersed between antheridia, obliquely orientated, neck purple, long, sloping at an angle toward, and opening into shallow, apically directed furrow, the 'blind' end fringed with erect, hyaline, conical cells. Sporangia at generally wider and always thicker sites along thallus, oblique and protruding conspicuously ventrally, subspherical, up to 600 μm wide, abundantly supplied with rhizoids, containing ± 270 spores each. Spores (50-)62-70(-75) μm in diameter, triangular-globular, polar, light brown, semi-transparent; wing thick, 7.5 μm wide, wider at perforated or notched marginal angles, with a row of fine granules along edge, margin crenulate; ornamentation reticulate, different on 2 spore faces: distal face highly convex, with (4-)5-6 large, deep areolae across dia-

meter of spore, 17-20 μm wide, in centre a pillar or boss, from which several low ridges radiate outward, sometimes forming a network, areolar walls rounded, 34 μm wide and up to 7.5 μm high, sometimes sparsely granulate; proximal face with triradiate mark very prominent, up to 5 μm high, as wide (or wider) toward marginal angles at join with wing, each facet with 6-10 areolae, some incomplete, often subdivided by faint radiating ridges, wall thin, raised at nodes. Chromosome number: $n = 8$ (Bornefeld 1989).

Species in the *R. fluitans*-complex, to which *R. stricta* belongs, are very variable and notoriously difficult to distinguish from one another, ideally requiring cultivation under similar conditions (Berrie 1964). Nevertheless, *R. stricta* can generally be recognized by the mostly smooth dorsal surface of the thallus, through which the large air chambers are faintly to fairly clearly visible, by small ventral scales and by smallish spores with large, thick-walled areolae containing a central boss on the distal face and, on the proximal face, a prominent triradiate mark. It frequently sporulates, whereas *R. fluitans* L. *sensu stricto* very rarely does.

Much of the tropical African material identified as *R. fluitans* or *R. fluitans sensu lato* undoubtedly belongs to *R. stricta*. Arnell (1956) reported it from Masai Province in Kenya, and Stephani from Usambara as *R. fluitans* (Stephani in Brunnthaler 1913). Jones (1957) found that the spores of two of his African collections (655 and 826) named *R. fluitans sensu lato*, differed from those of European material and Bizot *et al.* (1978) concluded the same for material from Kilimanjaro. The spores illustrated by Jones (1985) (*Forster* 55 from Kampala, Uganda, and *Jones* 826 from Luki, Zaïre) show a pronounced triradiate mark on the proximal face and thick areolar walls on the distal face, strongly reminiscent of those of *R. stricta*. Vanden Berghen (1972) who examined some African collections of the complex (*Symoens* 12436, 12774, *Schmitz* 7305 and *Jean Louis* 4410—all in BR) expressed the opinion that '*R. stricta* A.V. Duthie in S. Arnell (1963) Hep. South Afr., p. 37, est peut-être identique au taxon reconnu au Shaba'.

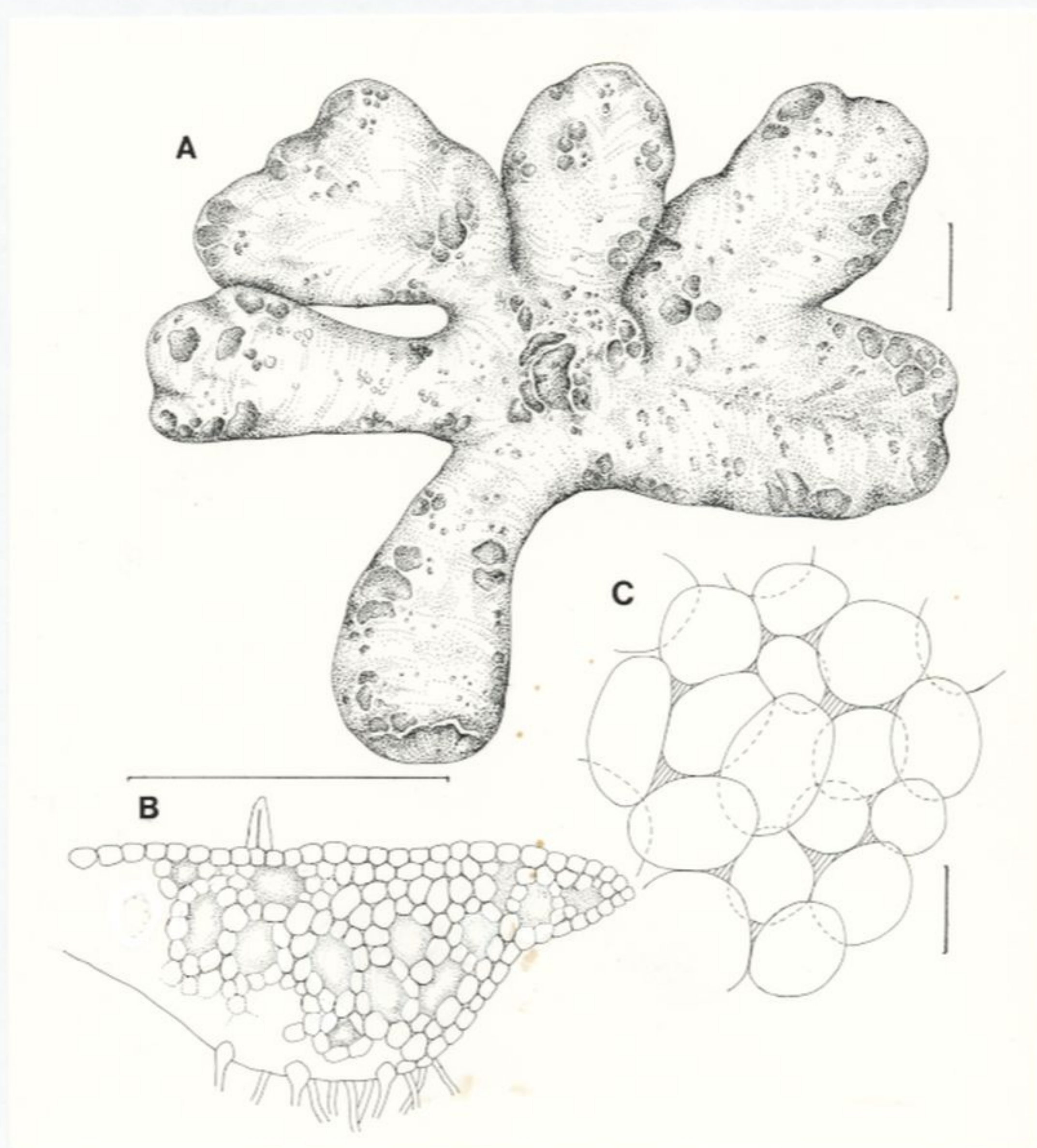


Figure 4. *Riccia vulcanicola*. A, thallus in partial rosette; B, transverse section of branch; C, dorsal cells from above. A-C, Pócs 8068. Scale bars on A,B = 1 mm; C = 50 μ m.

Schmitz 7305 and *Jean Louis 4410* were also examined by me and their spores studied with LM and SEM. In both, the triradiate mark is pronounced and the areolar walls on the distal face are thickened; these collections should, accordingly, be assigned to *R. stricta*. (For a comparison of characters of *R. stricta* and *R. fluitans sensu stricto*, see Perold (1990)).

Habitat. *Riccia stricta* is either terrestrial, growing on damp soil in roadside ditches, near waterfalls or in swamps, or can be aquatic when it floats on, or is submerged in water.

Altitudinal range. In the area reported on, it is found at altitudes between 1600 m and 2400 m.

Illustrations. Figures 3AE; 5E,F.

General distribution. *Riccia stricta* is known from central, eastern and southern Africa. It is widely distributed in the summer rainfall areas especially, and is one of the most commonly collected *Riccia* species.

Specimens examined. Ny: 104, *Fischer 6201**; 109, *Fischer 6388**; 112, *Pócs 6460**; 113, *Pócs 6466**; 153, *Pócs 7990**; 153, *Pócs 8012*; 153, *Pócs 8020 c**. KB: 144, *Frahm 7576*.

* = specimens with ripe spores

Section *Spongodes*

Spongodes Nees, *Naturgeschichte der Europäischen Lebermoose* 4: 391 (1838). Lectotype species: *R. crystallina* L. emend. Raddi fide Grolle: 248 (1976).

Thalli medium-sized to large, rarely heterothallic with small male gametophytes; terricolous. Scales small, ventral, evanescent.

Dorsal epidermis chlorophyllose; air pores soon large, cavernous. Assimilation tissue with large polyhedral air chambers.

Sporangia mostly immersed, sometimes bulging somewhat ventrally or dorsally or both. Spores medium-sized to large; separating at maturity.

4. *Riccia vulcanicola* E. Fischer, *Tropical Bryology* 8: 70 (1993). Type: Rwanda Pref. Ruhengeri, between Mt. Karisimbi and Bisoke, *Pócs 8068* (EGR, holo-!)

Plants medium-sized, isolated or crowded and in overlying, incomplete, partial rosettes, 8-13 mm across; glaucous green to green, not or finely pitted apically, only toward base becoming somewhat spongy; when dry, yellowish green, finely spongy, margins not inflexed. Branches 2 or 3 times dichotomously furcate, shortly to more deeply divided, closely to moderately divergent; obcuneate to oblong or irregular, up to 5 mm long, 23 mm wide, 0.5 mm thick, in section 4-6 times wider than thick; apex rounded, truncate or slightly emarginate. Groove only present at apex, shallow. Thallus margins rounded, obtuse. Flanks sloping obliquely to almost horizontal; ventral face flat. Scales tiny, evanescent.

Dorsal epidermis with cells hyaline, globose, 42.5-45.0 x 55.0-75.0(-82.5) μm , mostly collapsed; walls of air chambers hardly visible from above, air pores apically small, soon widening as air chambers enlarge, eventually leaving some quite exposed. Assimilation tissue occupying most of thickness of thallus, air chambers apically narrow, 125 μm wide toward base, polygonal, bounded by one-layered plates of chlorophyllose cells; storage tissue confined to a few ventral layers of cells; rhizoids mostly smooth, 15.0-27.5 μm wide, rarely tuberculate, 17.5 μm wide.

Monoicous. Antheridia apically scattered, necks colourless, up to 250 μm long. Archegonia in several rows along lobes, necks purple-brown, 150 μm long. Sporangia numerous, bulging dorsally and ventrally, crowded, 650 μm wide, containing \pm 850 spores each. Spores 62.5-70.0 μm in diameter, triangular-globular, polar, light brown, semi-transparent; wing thin, 10 μm wide, slightly wider at perforated marginal angles, margin crenulate to eroded; ornamentation reticulate, similar on the 2 spore faces: distal face convex, with 4 or 5(6) large areolae across diameter of spore, 12.5-17.5 μm wide, some with a central boss, from which 13 low ridges radiate outward, areolar walls thin, 5.0-7.5 μm high, edges crenate, not extending onto wing; proxi-

mal face with triradiate mark distinct, thin, 2.5-5.0 μm high, not extending across wing, each facet with 5 or 6 areolae, outer walls sometimes poorly developed or absent, otherwise 2.5 μm high, edges crenate. Chromosome number: n not known.

Morphologically the thalli of this new species are similar to those of *R. crystallina*, but *R. vulcanicola* is distinguished from it by its yellow-green colour and incomplete rosettes. The spore ornamentation is distinct from that of *R. crystallina* in that there are fewer and larger areolae with thin, high walls, not raised into bifid or trifid processes at the nodes.

Habitat. *Riccia vulcanicola* was collected on soil along a trail on a southern slope of Mt. Visoke in secondary *Hagenia-Dombeya* forest.

Altitudinal range. 2700-3000 m.

General distribution. So far, this new species is only known from the type specimen and two collections listed below.

Illustrations. Figures 4AC; 6A,B

Specimens examined. **Ka:** 158, *Pócs* 8068, 8073

Acknowledgements

I wish to thank J.-P. Frahm for sending me the collections for examination; also the curators of BM, BR and G for the loan of specimens. My thanks to the photographer at NBI, Mrs A. Romanowski, for developing and printing the SEM micrographs of the spores, as well as to the artist, Ms Anne Pienaar, for the drawings.

Literature cited

- Arnell, S. 1956. Hepaticae collected by O. Hedberg *et al.* Arkiv för Botanik 3: 555-556.
- Arnell, S. 1957. Hepaticae collected in South-West Africa by Prof. Dr. O.H. Volk. Mitteilungen der Botanischen Staatssammlung München 16: 262-272.
- Arnell, S. 1963. Hepaticae of South Africa. pp. 441. Swedish Natural Science Council, Stockholm.
- Berrle, G.K. 1964. Experimental studies on polyploidy in liverworts. 1. The *Riccia fluitans* complex. The Bryologist 67: 146-152.
- Bischoff, W. 1835. Bemerkungen über die Lebermoose, vorzüglich aus den Gruppen der Marchantieen und Riccieen. Nova Acta Academiae Caesareae Leopoldino-Carolinae Germanicae Naturae Curiosorum 17: 911-1018.
- Bizot, M., Friis, L., Lewinsky, J. & Pócs, T. 1978. East African bryophytes IV. Danish collections. Lindbergia 4: 259-284.
- Bornefeld, T. 1987. The natural system of the Marchantiales based upon cytogenetical and morphological evidence. Nova Hedwigia 45: 41-52.
- Bornefeld, T. 1989. The *Riccia* species of S- and SW-Africa. Chromosome numbers and composition of the chromosome sets. Nova Hedwigia 48: 371-382.
- Brunthaler, J. 1913. Ergebnisse einer botanischen Forschungsreise nach Deutsch-Ostafrika und Süd-Afrika (Kapland, Natal und Rhodesia). Teil 1, p. 14 (Hepaticae bearbeitet von F. Stephani). Denkschriften der kaiserlichen Akademie der Wissenschaften, Mathematisch-Naturwissenschaftlichen Klasse 88: 7-24.
- Fischer, E. 1993. Taxonomic Results of the BRYOTROP Expedition to Zaire and Rwanda 8. *Riccia vulcanicola* E. Fischer (subgenus Ricciella, Sectio Caverosae), a new species from the Virunga Volcanoes, Rwanda. Tropical Bryology 8: 69-74.
- Frey, W. & Kürschner, H. 1988. Bryophytes of the Arabian Peninsula and Socotra. Studies in Arabian bryophytes 12. Nova Hedwigia 46: 37-120.
- Gottsche, C.M., Lindenberg, J.B.G. & Nees ab Esenbeck, C.G. 1844-1847. Synopsis Hepaticarum. pp. 835. Hamburg, Meissner. Reprinted 1967, Cramer, Lehre.
- Grolle, R. 1976. Verzeichnis der Lebermoose Europas und benachbarter Gebiete. Feddes Repertorium 87: 171-279.
- Grolle, R. 1983. Hepatics of Europe including the Azores: an annotated list of species with synonyms from the recent literature. Journal of Bryology 12: 403-459.
- Hässel de Menéndez, G.G. 1963. Estudio de las Anthocerotales y Marchantiales de la Argentina. Opera Lilloana 7: 1297.
- Jones, E.W. 1957. African Hepatics XIII. The Ricciaceae in Tropical Africa. Transactions of the British Bryological Society 3: 208-227.
- Jones, E.W. 1985. African Hepatics XXXV. Some new or little-known species and some noteworthy records. Journal of Bryology 13: 497-508.
- Jones, E.W. & Harrington, A.J. 1983. The hepatics of Sierra Leone and Ghana. Bulletin of the British Museum (Natural History), (Botany) 11: 215-289.
- Jovet-Ast, S. 1986. La *Riccia* de la Région Méditerranéenne.

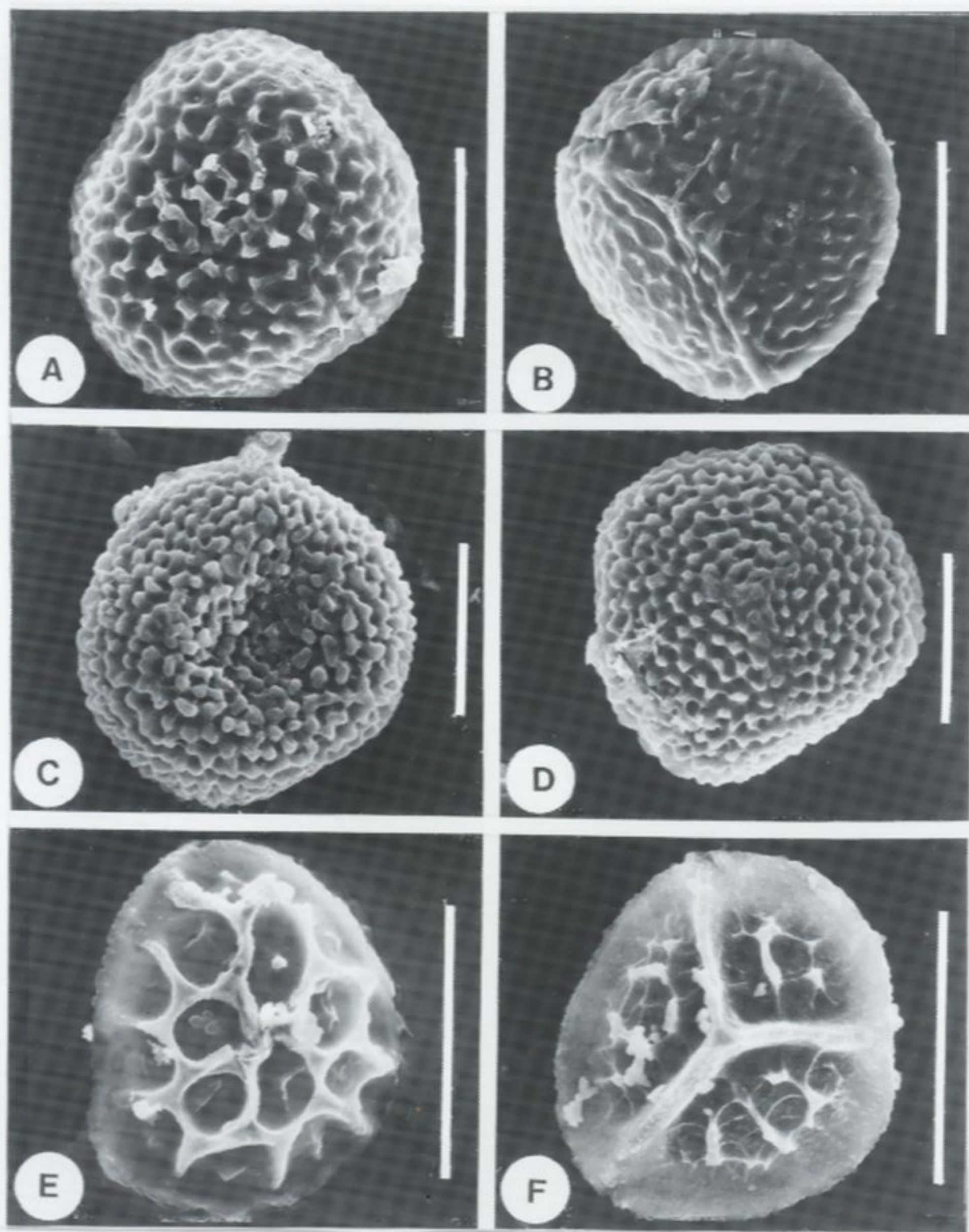


Figure 5. SEM micrographs of spores. A,B, *R. lanceolata* distal and proximal faces respectively; C,D, *R. okahandjana* distal and proximal faces respectively; E,F, *R. stricta* distal and proximal faces respectively. A,B, *Frahm 6524*; C,D, *Frahm 9023*; E,F *Frahm 6388*. Scale bars on A-F = 50 µm.

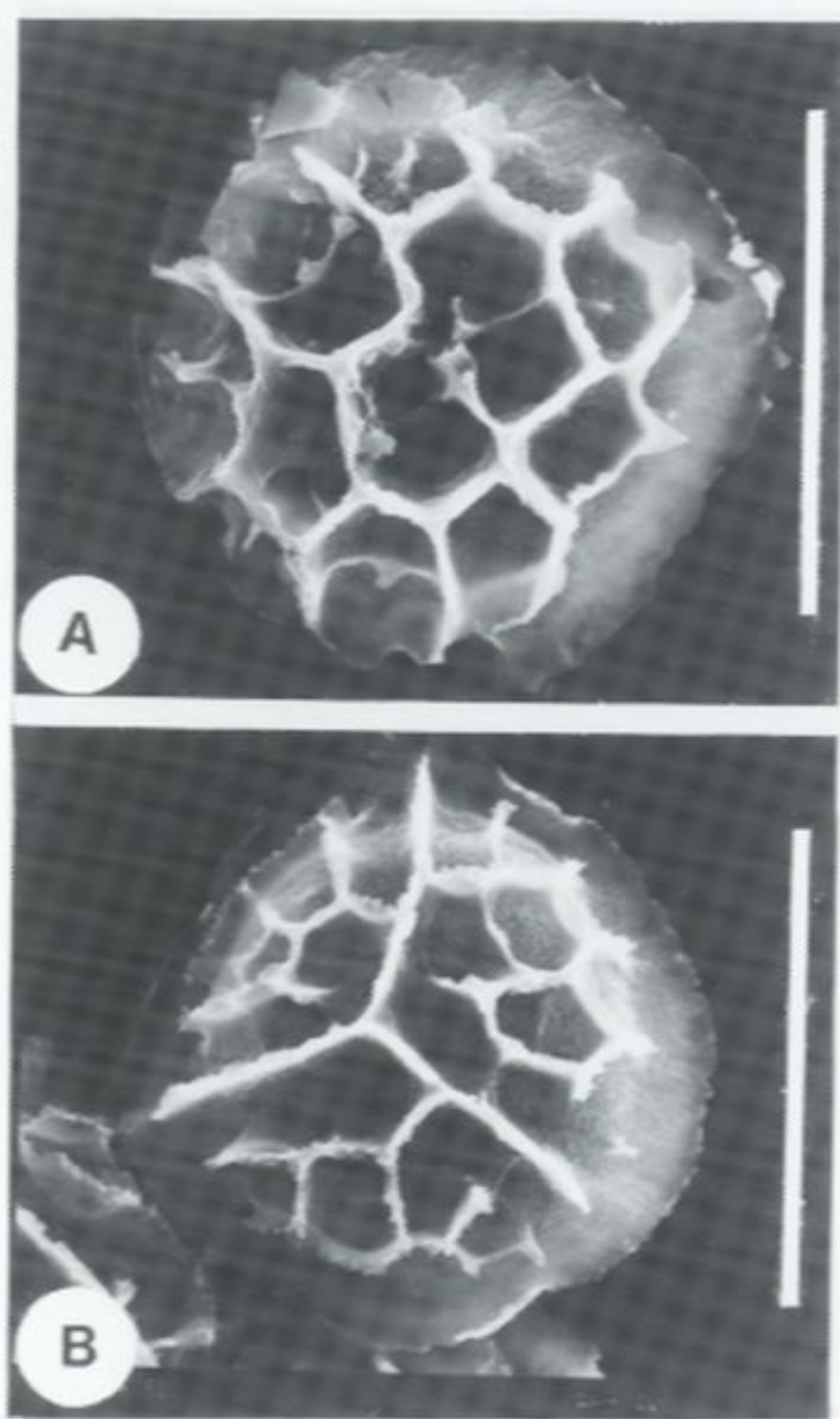


Figure 6. SEM micrographs of spores. A,B, *R. vulcanicola* distal and proximal faces respectively. A, Pócs 8073; B, Pócs 8068. Scale bars on A,B = 50 μ m.

Cryptogamie, Bryologique et Lichénologique 7: 283-431.

Linnaeus, C. 1753. Species Plantarum. pp. 1200. Bradbury & Evans.

Müller, K. 1951/1958. Die Lebermoose Europas, in Rabenhorsts Kryptogamenflora 6: 416-471.

Na-Thalang, O. 1980. A revision of the genus *Riccia* (Hepaticae) in Australia. Brunonia 3: 61-140.

Nees ab Esenbeck, C.G. 1838. Naturgeschichte der Europäischen Lebermoose 4: 389-444.

Perold, S.M. 1990. Studies in the genus *Riccia* (Marchantiales) from southern Africa. 21. *R. stricta* stat. nov. and *R. purpurascens*, subgenus *Ricciella*. Bothalia 20: 197-206.

Perold, S.M. 1991. Taxonomic revision of the Ricciaceae Reichenb. (Marchantiales: Hepaticae) in southern Africa. Ph.D. thesis. University of Pretoria.

Reichenbach, H.G.L. 1841. Der Deutsche Botaniker. Das Herbarienbuch. pp. 213. Dresden & Leipzig.

Sim, T.R. 1926. The Bryophyta of South Africa. Transactions of the Royal Society of South Africa 15: 14-75.

Stephanl, S. 1888. Hepaticae africanae. d) Aus verschiedenen Theilen des westlichen Afrikas. Hedwigia 27: 110-111.

Trevisan de Saint-Leon, V. 1877. Schema di una nuova Classificazione delle Epatiche. Memorie del Reale Istituto Lombardo di Scienze e Lettere Ser. 3,4: 383-451.

Vanden Berghen, C. 1972. Hépatiques et Anthocérotes. Résultats scientifiques de l'exploration hydrobiologique du Bassin Lac Bangweolo & Luapula 8: 1-202.

Volk, O.H. 1983. Vorschlag für eine Neugliederung der Gattung *Riccia* L. Mitteilungen der Botanischen Staatssammlung München 19: 453-465.