Bothalia 19,1: 9–16 (1989)

Studies in the genus *Riccia* (Marchantiales) from southern Africa. 11. *Riccia montana* and *R. alboporosa*, a further two new white-scaled species of the group 'Squamatae'

S. M. PEROLD*

Keywords: air pores, anatomy, calcium salts, distribution, endemic, rare, reticulation, scales, spore ornamentation

ABSTRACT

Another two new endemic species of the subgenus *Riccia*, section *Riccia*, group 'Squamatae', are described: *R.* **montana** and *R.* **alboporosa**. The distribution of *R.* **montana** is apparently restricted to high altitudes in the Drakensberg and Witteberg Mountain ranges. The species is characterized by ligulate branches, finely spongy dorsal surface and hyaline to white, calcium-encrusted scales. *R.* **alboporosa** is found in Namaqualand, but it is rare. It can be recognized by the distinctly porous appearance of the dorsal surface due to the presence of large, ± regularly spaced air pores, which are encircled by six or seven radially arranged, wedge-shaped cells that become white on drying, hence the specific epithet.

UITTREKSEL

Nog twee nuwe endemiese spesies van die subgenus *Riccia*, seksie *Riccia*, groep 'Squamatae', word beskryf: *R.* **montana** en *R.* **alboporosa**. Die verspreiding van *R.* **montana** is blykbaar beperk tot hooggeleë gebiede in die Drakensberg- en Witteberggebiede. Die spesie word gekenmerk deur lintvormige vertakkings, fyn, sponserige dorsale oppervlak en hialiene tot wit, kalkbedekte skubbe. *R.* **alboporosa** kom voor in Namakwaland maar dit is skaars. Dit kan erken word aan die duidelik poreuse voorkoms van die dorsale oppervlak, veroorsaak deur groot, ± reëlmatig verspreide lugporieë wat omsluit word deur 'n ring van ses of sewe radiaal gerangskikte, wig-vormige selle wat wit word met uitdroging, vandaar die spesifieke epiteton.

1. **Riccia montana** *Perold*, sp. nov.

Thallus dioicus, perennis; subviridis vel viridis, in sicco albidus vel flavidus; subtiliter spongiosus; marginibus reflexis vel inflexis saepe labia duo secus ramos formantibus. *Frons* usque ad 8 mm longa, (1,5–) 1,7–2,0 (–2,5) mm lata, 0,6–0,75 mm crassa, 2,5–3-plo latiora quam crassa, lobis ligulatis, dorsaliter profunde sulcatis. *Squamae* apicem versus undulatae, mox ad latera appressae, vix margines thalli superantes, hyalinae vel calcii depositis tectae. *Sporae* 70,0–85,0 μm diametro, alis ± 5 μm latis, grosse reticulatae, 7–8 areolis trans diametrum, parietibus areolarum crassis. *Chromosomatum numerus* n = 9.

TYPE.—Cape Province, 3027 (Lady Grey): Witteberg Mountains, basalt cliffs at top of Jouberts Pass, 10 km E of Lady Grey, eastern aspect, alpine heath-grassland (–CB), *Van Rooy 2712* (PRE, holo.), with *Bryum alpinum* Huds. ex With.

Thallus dioicous (Figure 1A, B), perennial, gregarious, not in rosettes, medium-sized; branches apically symmetrically or asymmetrically furcate, frequently with short lateral branching more proximally, medium to widely divergent, up to 8 mm long, segments 3–5 mm long, (1,5–)1,7–2,0(–2,5) mm wide, 0,6–0,75 mm thick, i.e. ± 2½ to 3 times wider than thick, ligulate, apex rounded to subacute, emarginate, deeply grooved on dorsal surface (Figure 2A), proximally ± flat to slightly concave (Figure 1D1–6); dorsally light green to green, finely spongy and glistening; margins acute, flanks almost vertical distally to sloping somewhat obliquely outward and upward proximally, green; ventral surface rounded, green; when dry, dorsally white to yellowish, margins inflexed or more usually reflexed along the edges (Figure 1C), generally forming two lips in proximal parts of branches. *Anatomy:* dorsal epithelium unistratose, hyaline, bulging upper walls of cells covered with fine deposit of calcium salts (Figure 2C), 20–30 × 35×50 μm, cell width somewhat irregular, sometimes single cells spanning 1½–2(–3) subdorsal cells (Figure 1E), soon collapsing; air pores often only partly aligned with air canals below (Figures 1F, 2C), large, 20–45 μm across, wider towards thallus margins, (3–) 4–5(–6)-sided (Figure 2D); assimilation tissue (chlorenchyma) consisting of vertical columns of 6–10 cells, ± 50–65 × (37–)42–50 μm, air canals in between assimilation cell columns ± 50 (–65) μm wide (Figure 1E, G); storage tissue occupying lower ½ or more of the thickness of thallus, cells tightly packed. Rhizoids hyaline, some smooth, others tuberculate, up to 25 μm wide, arising from ventral epidermis of thallus and base of scales. *Scales* wavy at apex, soon appressed to flanks, imbricate, hyaline or whitened with calcium deposits, sometimes flecked with red toward base, hardly exceeding thallus margins (Figures 1H; 2B), 850 × 500 μm, cells in body of scale 4–6-sided, 50–85(–90) × ± 40 μm, smaller at margin, ± 30 × 50 μm, cell walls mostly bulging. *Antheridia* with hyaline or white necks ± 160 μm long, projecting from small, shallow pits on either side of dorsal groove (Figure 1A). *Archegonia* purple-necked, scattered along groove in female plants. *Sporangia* proximal, single or 2 adjacent, each containing about 450 spores, large, ± 750 μm wide, bulging conspicuously dorsally (Figure 1B), overlying thal-

* Botanical Research Institute, Department of Agriculture and Water Supply, Private Bag X101, Pretoria 0001, RSA.

Ms. received: 1988.04.24.

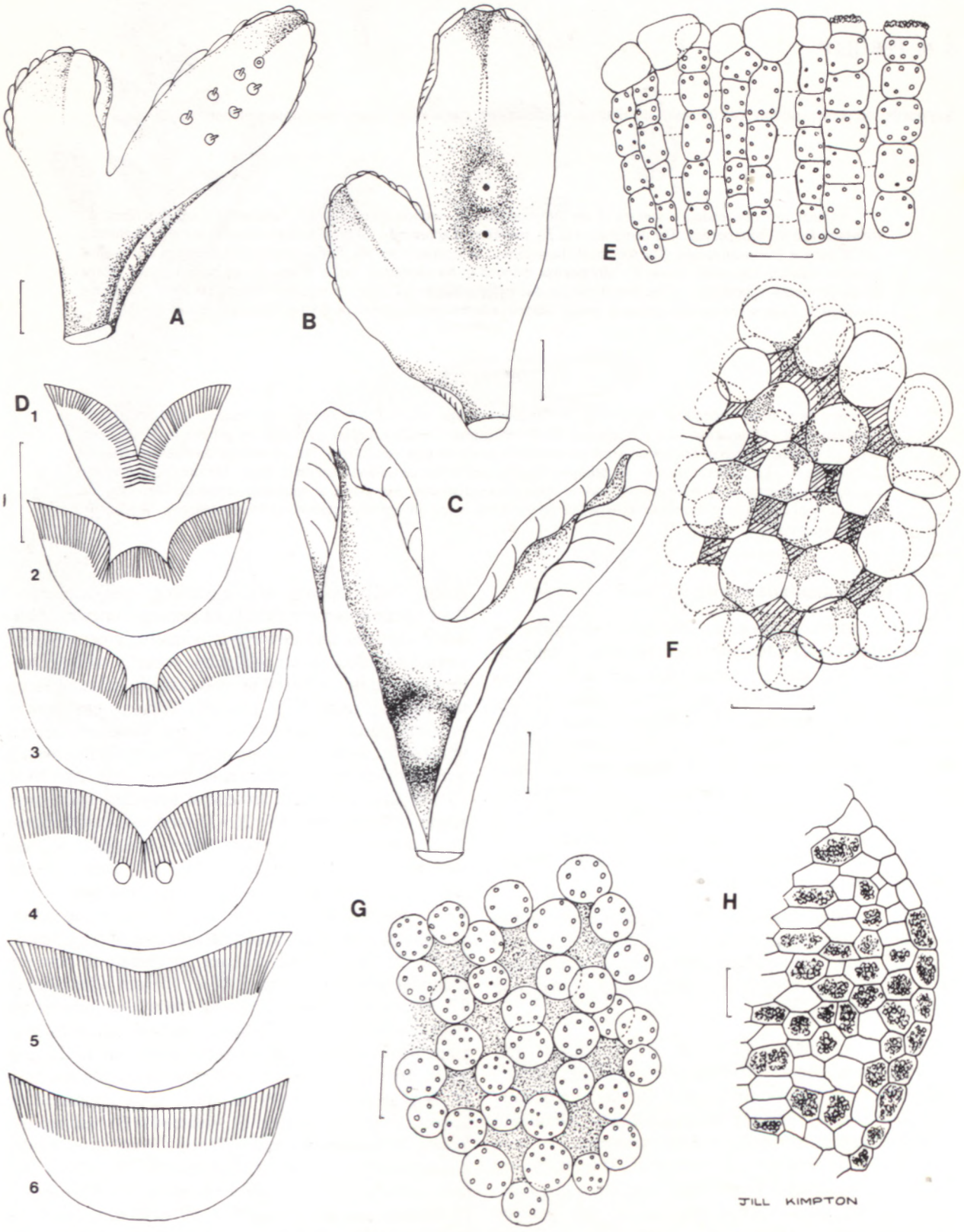

FIGURE 1.—*Riccia montana*. Structure of thallus and scales. A, fresh male thallus; B, fresh female thallus with sporangia; C, dry female thallus; D1–6, transverse sections of thallus branch at different distances from apex to basal parts; E, transverse section through dorsal epithelium and chlorenchyma; F, epithelial cells (solid lines), and air pores (hatched lines) from above, with subdorsal cells (broken lines) and air canals (stippled); G, horizontal section through chlorenchyma, with air canals stippled; H, scale. A–C, *Van Rooy 3046*; D1–6, *Van Rooy 2712*; E, *Oliver 8354*; F, G, *Perold 31*; H, *Van Rooy 2718*. A–H drawn by J. Kimpton. Scale bar on A–D = 1 mm; E–G = 50 μm; H = 100 μm.

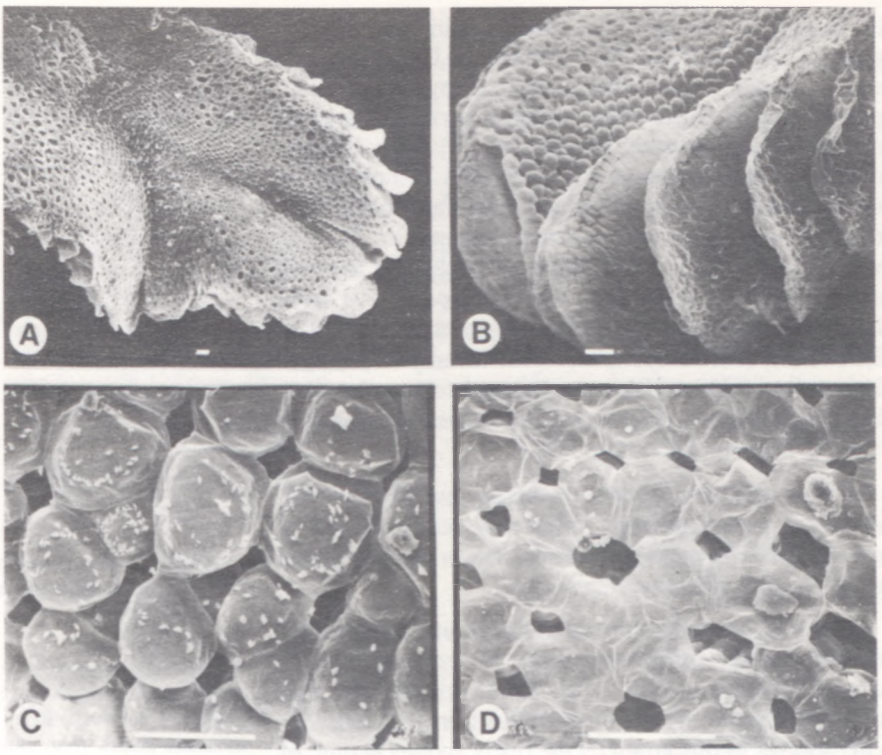

FIGURE 2.—*Riccia montana*. Structure of thallus and cells. A, dorsal view of thallus, apically grooved; B, scales at apical margin; C, intact dorsal cells with calcium deposits, air pores; C, collapsed dorsal cells with wide air pores. A–D, *Oliver 8354*, SEM micrographs. Scale bar = 50 μm. All SEM and LM micrographs by S. M. Perold.

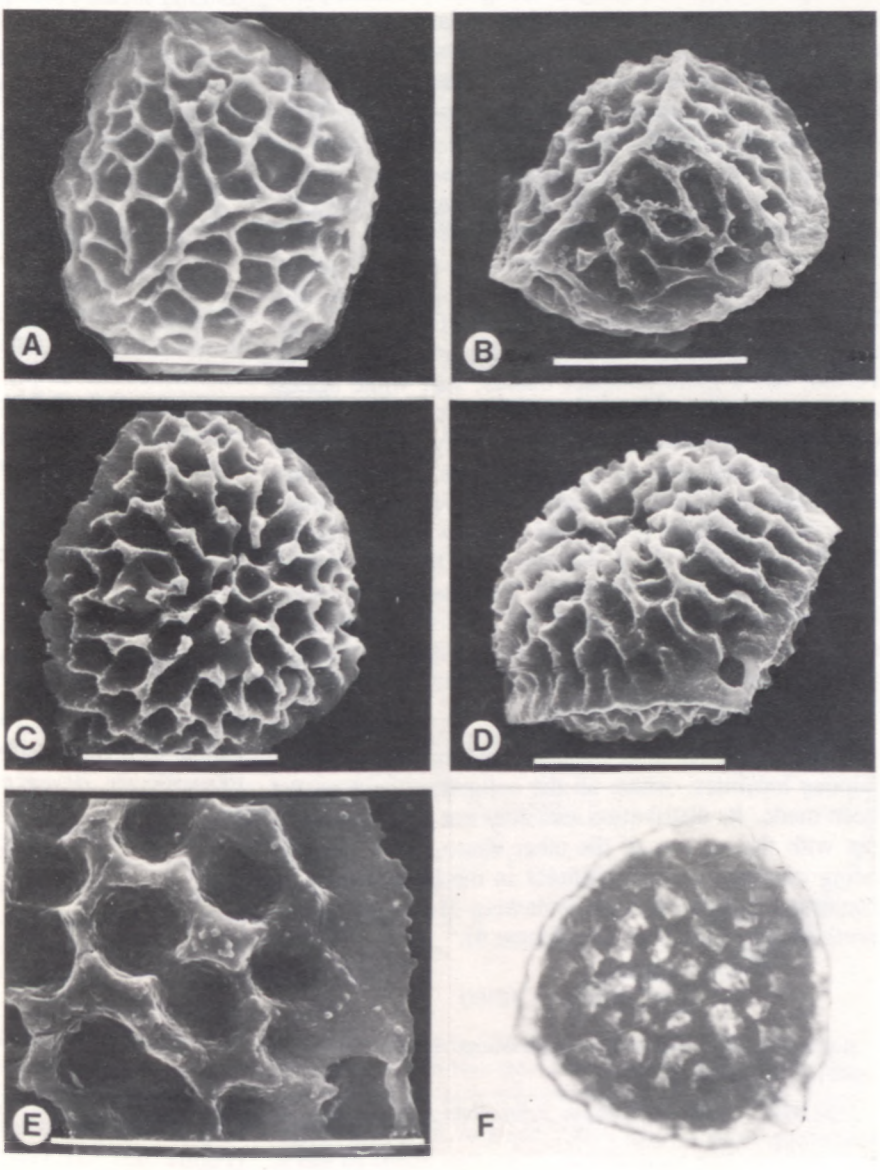

FIGURE 3.—*Riccia montana*. Spores. A, proximal face; B, proximal face viewed from side; C, distal face; D, distal face, side view; E, areolae, wing and pore on distal face, much enlarged; F, distal face. A, C, D, F, *Van Rooy 2712*; B, *Glen 1728*; E, *Van Rooy 2718*. A–E, SEM micrographs; F, LM micrograph. Scale bar = 50 μm; diameter of spore on F = ± 100 μm.

lus tissue not turning white, but shrinking and disintegrating. *Spores* (70,0−)75,0−80,0(−85,0) μm in diameter, brown, semi-transparent, triangular-globular, polar, wing ± 5 μm wide, wider at perforated angles, margin somewhat wavy (Figure 3A, C), finely eroded, crenulate, ornamentation on both faces completely or incompletely coarsely reticulate; distal face with 7 or 8 rounded to angular areolae across diameter, ± 7,5 μm wide (Figure 3C, F), walls thick and high, ± 5 μm tall, extending partly onto wing, with raised papillae at areolar nodes; proximal face with triradiate mark distinct to less clearly defined, areolae often incomplete, irregularly ridged (Figure 3B), or with complete, angular areolae, raised at nodes (Figure 3A). *Chromosome number* n = 9 (T. Bornefeld pers. comm.).

Riccia montana grows on black, humus-rich soil, overlying rocky outcrops, often near seepages, and in association with moss species e.g. *Bryum alpinum* Huds. ex With. and with other *Riccia* spp.

In the white-scaled species of the group 'Squamatae', section *Riccia*, subgenus *Riccia*, *R. montana* and *R. argenteolimbata* (Volk *et al.* 1988) are the only two dioicous species. *R. montana* differs from the other *Riccia* species in this group by the finely spongy texture of the dorsal surface of the thallus, by the ligulate branches with lip-like, reflexed margins along the proximal parts when dry, by the coarsely reticulate, polar spores and by its distribution which is restricted to the eastern mountain ranges. It is somewhat similar to the other white-scaled species, *R. albolimbata* S. Arnell, *R. albornata* Volk & Perold, *R. argenteolimbata* Volk & Perold, and *R. alboporosa* sp. nov. in the group 'Squamatae', but it never turns chalk-white over the sporangia as does *R. albolimbata*. *R. albolimbata* and *R. albornata* generally have much larger, wavy, hyaline (or white) scales that extend above the thallus margins and broad, not ligulate branches. The ornamentation of their spores is also markedly different. *R. argenteolimbata* Volk & Perold, has a more compact thallus, stiff white scales and apolar spores, whereas *R. alboporosa* has a more coarsely spongy thallus, is dorsally puffy when dry and thickly covered with calcium salts, has inconspicuous scales and more finely reticulate polar spores. *R. montana* was originally recognized as a new species by the late Prof. E. A. C. L. E. Schelpe of BOL, from one of his gatherings at the Sentinel, Drakensberg in 1946. Unfortunately the spores were not fully mature, but recently, more collections of the same species with mature sporangia have been made, also in mountainous regions 2 000−3 000 m above sea level.

The specific epithet, *montana*, refers to the mountainous localities, where all the collections have so far been made. Its distribution area does not appear to overlap with that of any of the other white-scaled species, being confined to high altitudes in the Drakensberg of Natal and Lesotho and the Witteberg Mountains of the north-eastern Cape Province (Figure 4).

SPECIMENS EXAMINED

NATAL.—2828 (Bethlehem): Drakensberg, Sentinel, 9 500 ft (−CB), *Schelpe s.n.* (BOL).

LESOTHO.—2828 (Bethlehem): 6 km from Oxbow Lodge to Mokhotlong, basalt outcrops (−DC), *Van Rooy 3045, 3046* (PRE); 2927 (Maseru): Blue Mountain Pass, 19 km from Maseru on road to Thaba Tseka, calcrete soil on seepage bank (−BC), *J. M. Perold 31* (PRE); 2929 (Underberg): Sani River bank, ± 7 km from Sani Top, along road to Mokhotlong (−CA), *Van Rooy 3446* (PRE); Sani Top, mountain slopes W of Border Post (−CB), *Van Rooy, 3540, 3566* (PRE); Sani flats, 2 km from Sani Border Post to Mokhotlong (−CB), *Van Rooy 3702* (PRE); Sehlabathebe Nat. Park, on black gritty soil bordering stream, 2 300−2 500 m (−CC), *Jacot Guillarmod, Getliffe & Mzamane 60* (PRE).

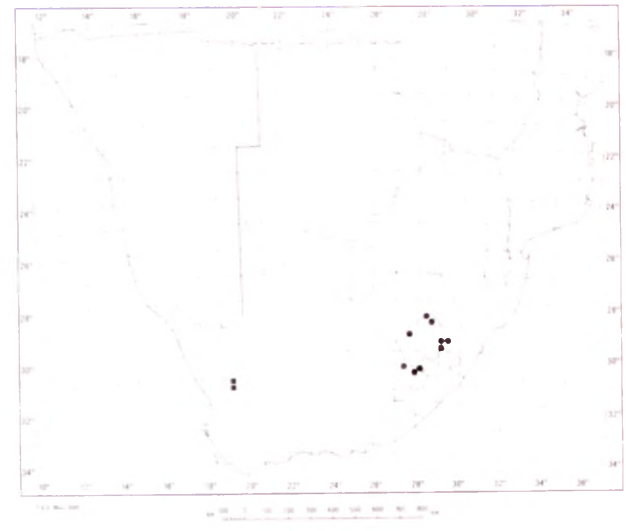

FIGURE 4.—Map showing distribution of *R. montana*, ● and *R. alboporosa*, ■ in southern Africa.

CAPE.—3027 (Lady Grey): Witteberg Mountains, basalt cliffs at top of Jouberts Pass, 10 km E of Lady Grey (−CB), *Van Rooy 2718* (PRE); ibid. *Van Rooy 2712* (see type); Ben MacDhui, above Rhodes, wet loamy plateau S of main peak, very short grassland (−DD), *Oliver 8354* (PRE). 3028 (Matatiel): 20 km from Rhodes, up Naudesnek towards Maclear (−CA/CC), *Glen 1728* (PRE).

2. **Riccia alboporosa** *Perold*, sp. nov.

Thallus monoicus, perennis, in vivo flavido-viridis, dense calcii depositis tectus, poribus magnis regularibus; in sicco albidus, inflatus, marginibus solum apicaliter inflexis. *Frons* usque ad 7,0 mm longa, 1,8−3,5(−4,0) mm lata, 0,8−1,2 mm crassa, 2−3-plo latior quam crassa, obtuse cuneata vel late ovata, sulco dorsali lato. *Squamae* inconspicuae, aegre ad margines thalli extensae, calcio tectae. *Sporae* 75,0−88,0 μm diametro, polares, ala ± 5 μm lata, tenue reticulata, 11−13 areolis trans diametrum superficiei distalis. *Chromosomatum numerus* n = 10.

TYPE.—Cape Province, 3119 (Calvinia): NE of Nieuwoudtville, Groothoek, at Soetlandsfontein River (−AD), *Oliver 8854* (PRE, holo.), on sandy/clay flats alongside river, in rock crevices and on ledges, associated with *Riccia albornata* Volk & Perold and small moss species, *Bryum argenteum* Hedw.

Thallus monoicous, perennial, gregarious or single, not in rosettes; once (Figure 5A) or twice symmetrically or occasionally asymmetrically furcate (Figure 5B), branches medium to widely divergent, bluntly wedge-shaped to broadly ovate (Figure 6A), up to 7 mm long, 1,8−3,5 (−4,0) mm wide and 0,8−1,2 mm thick, i.e. 2−3 times wider than thick; apex rounded, emarginate; dorsally bright yellowish green with ± regularly spaced, large, conspicuous air pores encircled by lighter coloured cells; apically deeply grooved by wide sulcus (Figure 6B), proximally somewhat concave to nearly flat (Figure 5D1−5); ventrally green, gently rounded; flanks

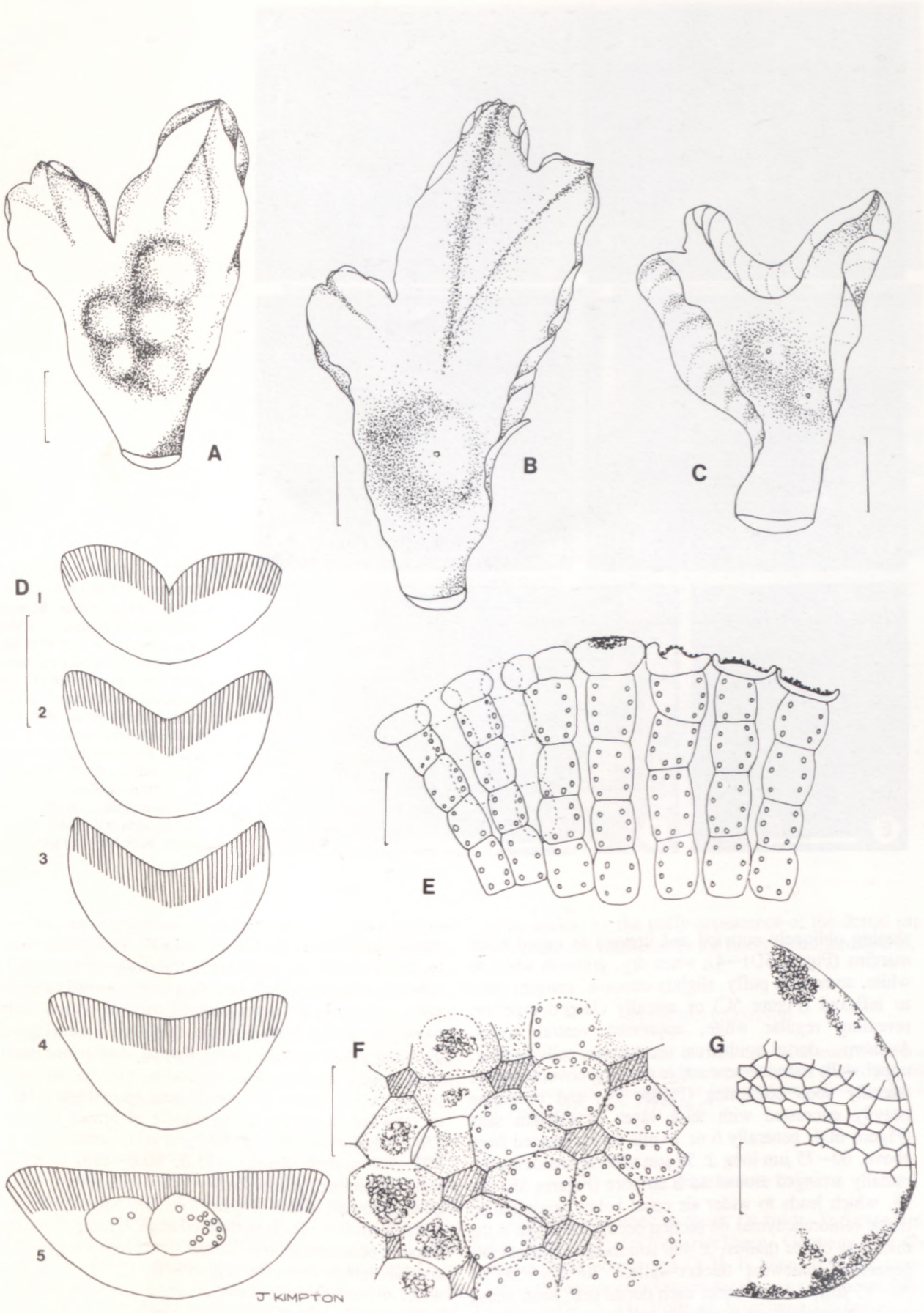

FIGURE 5.—*Riccia alboporosa*. Structure of thallus and scales. A, B, fresh thalli; C, dry thallus; D1–5, transverse sections of thallus branch at different distances from apex to basal parts; E, transverse section through dorsal epithelium and chlorenchyma; F, epithelial cells (solid lines) and air pores (hatched) from above, with subdorsal cells (broken lines) and air canals (stippled); G, scale. A, B, E, *S. M. Perold 1775*; C, D, E, G, *Oliver 8854*. A–G drawn by J. Kimpton. Scale bar on A–D = 1 mm; E, F, = 50 μm; G = 100 μm.

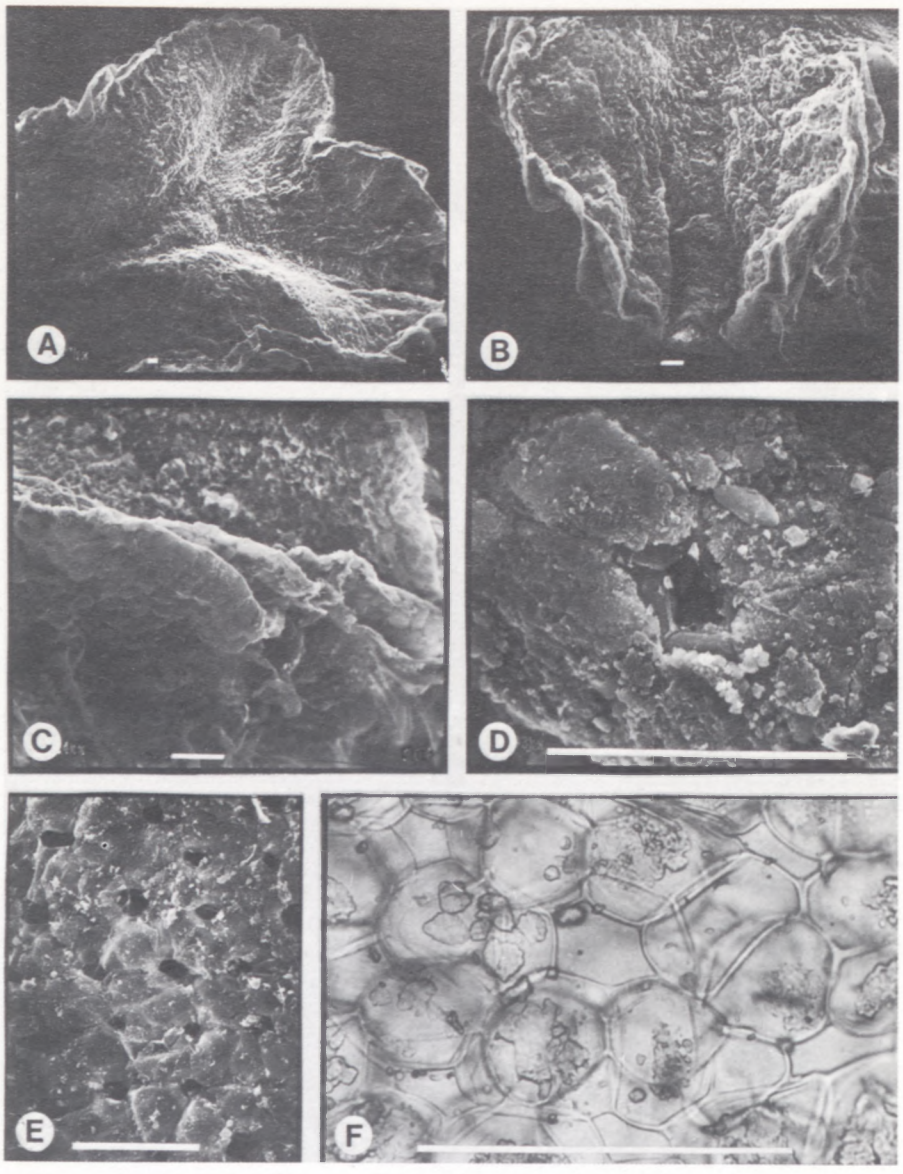

FIGURE 6.—*Riccia alboporosa*. Structure of thallus and cells. A, dorsal view of thallus; B, wide dorsal groove at apex; C, scales near apex; D, air pore with surrounding cells heavily encrusted with calcium crystals; E, air pores and dorsal cells; F, dorsal cells (lightly dusted with calcium crystals) encircling air pores, air canals and subdorsal cells faintly visible beneath. A–C, E, *S. M. Perold 1775*; D, F, *Oliver 8854*. A–E, SEM micrographs; F, LM micrograph. Scale bar = 50 μm.

sloping obliquely outward and upward to raised blunt margins (Figure 5D1–4); when dry, greenish white to white, somewhat puffy, slightly concave, margins erect to inflexed (Figure 5C) or apically clasped together, revealing regular white, appressed ventral scales. *Anatomy:* dorsal epithelium unistratose, cells hyaline, upper walls rounded near and in dorsal groove, but more laterally soon collapsing (Figure 5E) and becoming heavily encrusted with thick layer of calcium salts (Figure 6D), generally 6 or 7 cells wedge-shaped from above, 60–75 μm long ± 50 μm wide at broadest part, radially arranged around each air pore (Figures 5F; 6E, F), which leads to wider air canal below; assimilation tissue (chlorenchyma) on section occupying about ½ the thickness of the thallus, ± 400 μm thick, topmost cells generally somewhat thicker-walled, 20–25(–35) × 30–35 μm, often 2 under each dorsal cell, soon losing their chloroplasts as overlying cell layer collapses; air canals 50–80 μm wide (Figure 5D), enclosed by columns of rectangular cells ± 50 × 37–45 μm; storage tissue occupying lower ½ of thickness of thallus, cells 50–75 μm wide. Rhizoids hyaline, some smooth, others tuberculate, up to ± 25 μm wide, very long, arising from ventral epidermal cells and base of scales. *Scales* mostly inconspicuous, 550 × 350 μm, hardly extending to thallus margins, appressed, imbricate (Figure 6C), rounded, smooth-edged, heavily encrusted with calcium salts, especially on exposed distal parts of scales, cells mostly 6-sided in body of scale, ± 85 × 37 μm (Figure 5G), marginally smaller, brick-shaped. *Antheridia* with hyaline necks, scattered along groove. *Archegonia* with purple necks. *Sporangia* single near base (Figure 5B), or crowded in groups along middle of branch (Figure 5A), bulging dorsally, ± 800 μm wide, containing ± 400–500 spores. *Spores* (75,0) 80,0–85,0 (–88,0) μm in diameter, yellow-brown, semi-transparent, triangular-globular, polar (Figure 7A, E), wing ± 5 μm wide, slightly wider at perforated angles, margin mostly smooth; ornamentation reticulate: distal face with 11–13 areolae across diameter (Figure 7B, C, F), ± 5 μm wide, toward centre somewhat larger and with thicker, higher walls, ridges extending onto wing, radial ones generally more pronounced than those across (Figure 7D), slightly raised at nodes; proximal face with triradiate mark ± distinct (Figure 7A, E), each facet with up to ± 50 small, round areolae ± 3 μm wide, some adjacent ones confluent, ridges low (Figure 7A, E). *Chromosome number* n = 10 (Bornefeld pers. comm.).

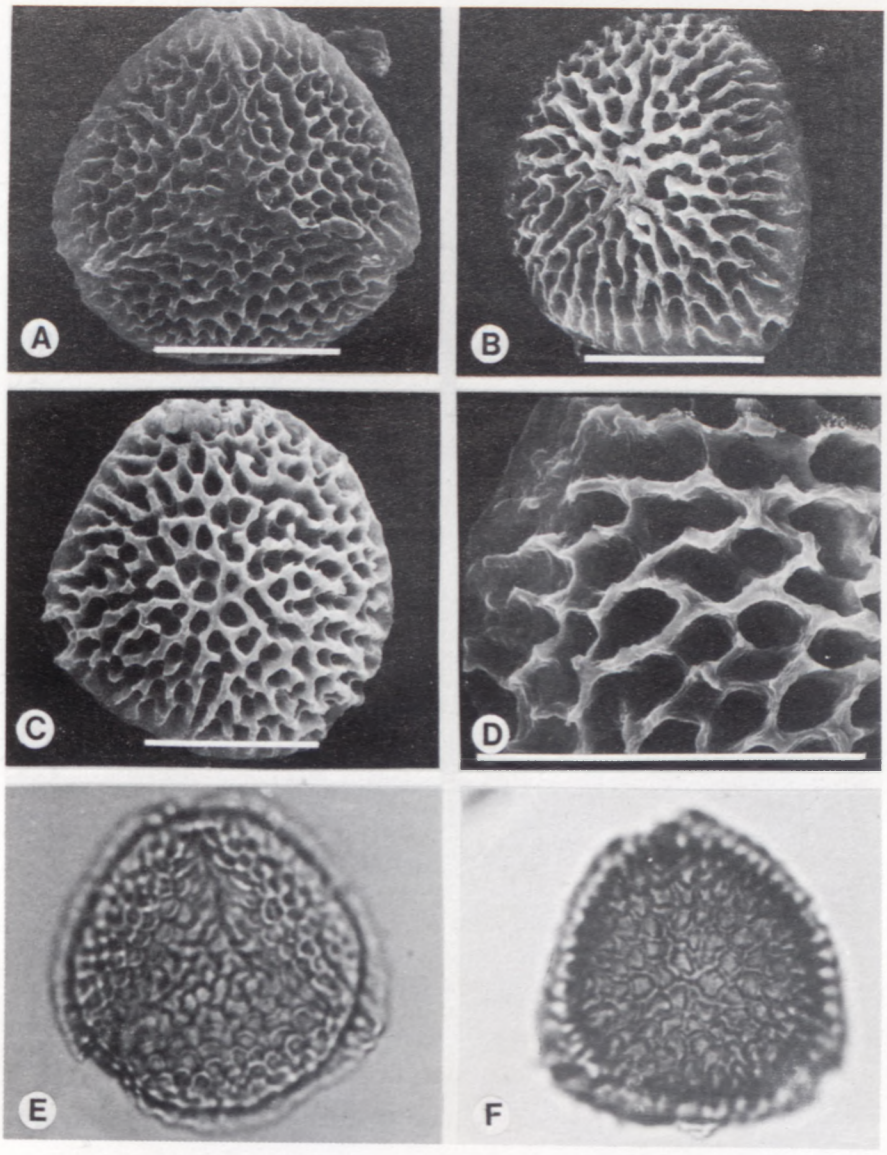

FIGURE 7.—*Riccia alboporosa*. Spores. A, E, proximal face; B, C, F, distal face; D, enlarged view of areolae and margin on distal face. A–F, *Oliver 8849*. A–D, SEM micrographs; E, F, LM micrographs. Scale bar = 50 μm; diameter of spore on E, F = ± 100 μm.

Riccia alboporosa is known from only two localities in the drier area of the north-west Cape Province, with an annual winter rainfall of less than 200 mm at altitudes of 750–850 m above sea level. It grows on fine yellow-brown, sandy or slightly brackish soil overlying tillite rocks, in association with other *Riccia* species, e.g. *R. albornata* Volk & Perold and with the small moss species *Bryum argenteum* Hedw. and with *Aloina bifrons* (De Not.) Delgadillo.

It is easily recognized by a feature alluded to in the specific epithet: the thallus has numerous large, widely but ± regularly spaced air pores encircled by dorsal epithelial cells, part of which form the roof over the air canals and on drying, rapidly become white, before the remainder of these cells, supported by subdorsal cells, do. The dorsal surface becomes heavily encrusted with calcium salts, which, in field-grown specimens, must be removed with dilute hydrochloric acid, before the cell outlines can be distinguished. As seen from above, each hyaline dorsal cell is in contact with an air pore, which necessitates placing this species in the subgenus *Riccia* (Volk 1983), although the air canals are wider than is generally encountered in this subgenus. It differs from the other white-scaled species by the inconspicuousness of its scales, by the puffy appearance of the dorsal surface in the dry plant and by the finely reticulated spores.

SPECIMENS EXAMINED

CAPE.—3119 (Calvinia): S of Loeriesfontein, Skietnes Kloof, E of Slagberg, rocky ledges, facing South (–AB), *Oliver 8849* (PRE); NE of Nieuwoudtville, Groothoek, at Soetlandsfontein River (–AD), *S. M. Perold 1772, 1775, 2317* (PRE).

ACKNOWLEDGEMENTS

The author wishes to thank Dr habil. T. Bornefeld, Am Reelein 1, D8706, Höchberg, Germany, for the chromosome counts and Dr H. F. Glen, BRI, for translating the diagnoses. Sincere thanks are also due to: Prof. (emer.) Dr O. H. Volk of Würzburg University for advice during preparation of the first draft of the text; the late Prof. E. A. Schelpe for the loan of his specimen; Messrs E. G. H. Oliver, Stellenbosch Botanical Unit, J. van Rooy, BRI and J. Perold, Department of Agriculture and Water Affairs, for collecting specimens, often in difficult terrain.

REFERENCES

ARNELL, S. 1957. Hepaticae collected in South West Africa by Prof. Dr O. H. Volk. *Mitteilungen aus der Botanischen Staatssammlung, München* 16: 262–272.

ARNELL, S. 1963. *Hepaticae of South Africa*. pp. 411. Swedish National Scientific Research Council, Stockholm.

BORNEFELD, T. 1984. Chromosomenanalyse der Gattung *Riccia* von Süd- und SW-Afrika und allgemeine Bemerkungen zur Zytogenetik der Lebermoose. *Nova Hedwigia* 40: 313–328.

PEROLD, S. M. 1989. Studies in the genus *Riccia* (Marchantiales) from southern Africa. 12. *Riccia albolimbata* and the status of *R. albosquamata*, white-scaled species originally described by Arnell. *Bothalia* 19: 17–25.

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

VOLK, O. H., PEROLD, S. M. & BORNEFELD, T. 1988. Studies in the genus *Riccia* (Marchantiales) from southern Africa. 10. Two new white-scaled species of the group 'Squamatae': *R. argenteolimbata* and *R. albornata*. *Bothalia* 18: 155–163.