

Studies in the genus *Riccia* (Marchantiales) from southern Africa. 10. Two new white-scaled species of the group 'Squamatae': *R. argenteolimbata* and *R. albornata*

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Keywords: Marchantiales, new species, nothopolyploidy, *Riccia*, southern Africa, taxonomy

ABSTRACT

Two new white-scaled species, *R. argenteolimbata* and *R. albornata* have been isolated by one of us (Volk). *R. argenteolimbata* has a compact thallus with stiff, regular scales and apolar spores, whereas *R. albornata* has a somewhat more spongy structure of the thallus, large, frilly, hyaline scales and polar spores.

UITTREKSEL

Twee nuwe spesies met wit skubbe, *R. argenteolimbata* en *R. albornata* is deur een van ons (Volk), geïsoleer. *R. argenteolimbata* het 'n kompakte tallus, met stywe, ewe-groot skubbe en apolêre spore, terwyl *R. albornata* 'n ietwat meer sponsrige tallus-bou, groot, gekartelde, hialiene skubbe en polêre spore het.

1. *Riccia argenteolimbata* Volk & Perold, sp. nov.

Thallus dioicus, perennis, parvus, in vivo glaucescens-opacus, in sicco albidus; squamis argenteis quasi limbatis, inde nomen. *Frons* usque ad 7 mm longa, 0,7–1,2(–2,0) mm lata, 0,6–0,9 mm crassa, 1–1,5(–2)-plo latior quam crassa, asymmetrice furcata, lobis extremis brevibus, obovato-ligulatis, subacutis, marginibus acutis, lateribus costae rectis; pagina superior subplana, longe sulcata. *Squamae* rigidae, dense imbricatae, semiorbiculatae, integerrimae, marginem frondis minutim superantes, calce incrustatae, albae vel plusminusve subfuscae. *Sporae* apolares, subglobosae, sine ala, 80–120(–130) μ m diametro, rufo-brunee, ornamentatione reticulata, 12–15 (–16) foveolis in diametro. *Chromosomatum numerus* n = 8; 9; 16; 20; 24.

TYPES.—SWA/Namibia, 2116 (Okahandja): Marienhof (Dunroamin) (OK 289) (–BD), alt. 1 550 m, schluffreicher, stark kalkhaltiger, grauer Boden der 'Vlakte', zeitweise durchfeuchtet, pH 7,8, 1974.03.28, *Volk 00910* (M, holo.). 2217 (Windhoek): Hatsamas (WIN 92) (–DC), alt. 1 870 m, ebene Treppenstufen im Blaukalk, staubiger, schluffreicher, kalkhaltiger Boden, pH 7,8, mit *Oropetium capense*, 1974.01.31, *Volk 00762* (M, para.).

Thallus dioicous (Figure 1A, B), perennial, gregarious or single and scattered, rarely in rosettes; mostly asymmetrically bi- or trifurcate, branches medium to widely divergent, obovate-ligulate (Figures 1A, B; 2A), 2–7 mm long, 0,7–1,2(–2,0) mm broad, 0,6–0,9 mm thick, 1–1,5(–2) times broader than thick, segments short, apex wedge-shaped (Figure 2B); sulcus conspicuous and long (Figure 1A, B, E), its sides convex, becoming flatter proximally (Figure 1H1–3), dorsally dull greenish grey,

not shiny, sometimes brown along the margin; margins acute, flanks steep, dark-coloured, covered by silvery grey scales, hence the specific epithet; ventral surface rounded, green or reddish brown, apically with arched, narrow, brown bands across (Figure 1G); when dry, dorsally greyish white, margins lip-like tightly inflexed and flanks densely covered by regularly arranged, appressed, stiff scales (Figure 1C). *Anatomy of thallus*: dorsal epithelium bistratose, upper layer of cells rarely intact, but when intact, inflated, $\pm 20\text{--}35 \times 30\text{--}40 \mu\text{m}$, capped with deposits of calcium, (Figure 1I), soon collapsed, forming so-called 'ring'-cells, which appear thick-walled (Figures 1J, centre; 2C, D), the lateral walls double and raised; second layer of epithelial cells without chloroplasts, short-rectangular, $25\text{--}37 \times 22\text{--}32 \mu\text{m}$, upper transverse and lateral walls thicker, the latter gradually thinning out below (Figure 1I); from above, dorsal cells arranged in regular, honeycomb pattern, air pores mostly triangular and quadrangular, small, (Figures 1J, 2D); assimilation tissue (chlorenchyma) compact, about $\frac{1}{2}$ the thickness of thallus, cells rectangular, $40\text{--}50 \times \pm 32 \mu\text{m}$, in columns of about 8–10 cells, enclosing very narrow, usually 4-sided air canals; storage tissue almost $\frac{1}{2}$ the thickness of thallus. Rhizoids 12–23 μm wide, mostly smooth. *Scales* generally only marginally, sometimes entirely white, base silvery mauve becoming dark grey-brown more proximally (Figure 1B, C, E, F, K), closely imbricate, stiff, $600\text{--}800 \times \pm 500 \mu\text{m}$, projecting about 100 μm above thallus margin (Figure 2E, F), rounded, edge smooth, cell surfaces heavily encrusted with calcareous deposits (Figure 1L); in body of scale, cells $50\text{--}90 \times 25\text{--}30 \mu\text{m}$, hexagonal or nearly isodiametric, corners angled, cell walls appear thick; at margins cells smaller, quadrate to brick-shaped, $\pm 22 \times 27 \mu\text{m}$. *Antheridia* with short, hyaline necks. *Archegonia* with dark purple necks. *Sporangia* usually single, bulging slightly dorsally, each containing 200–450 spores, rarely sporulating. *Spores* 80–120 (–130) μm in diameter, reddish brown to almost black, semi-opaque to opaque; globular to subglobular, apolar, wing and triradiate mark absent (Figure 3A, B), periphery tuberculate (Figure 3D, E), ornamentation reticu-

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MS. received: 1988.02.01.

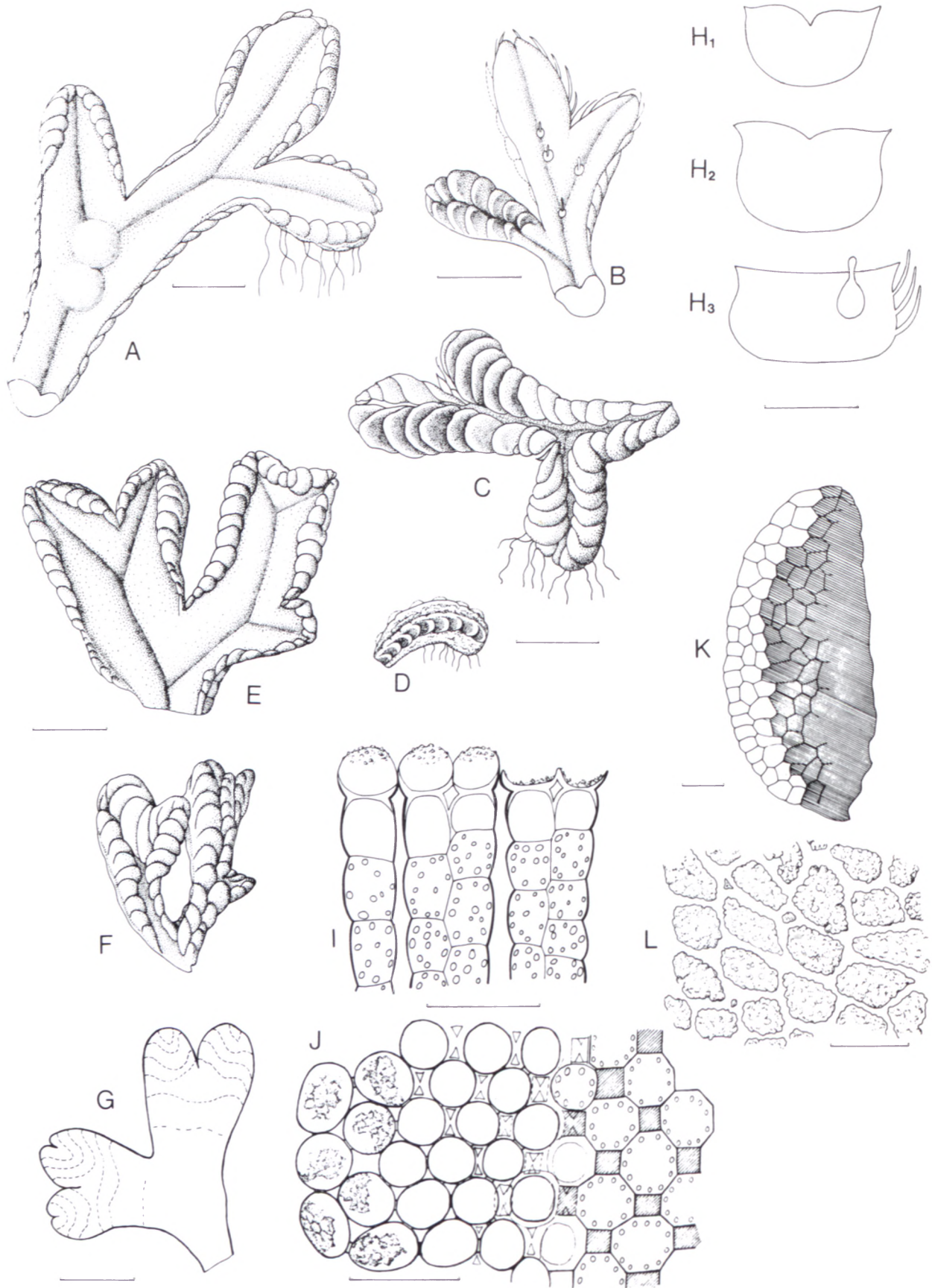


FIGURE 1.—*Riccia argenteolimbata*. Morphology and anatomy. A, female thallus with two sporangia, turgid; B, male thallus with antheridial necks, turgid; C, as B, dry, scales with dark bases; D, bulbil; E, turgid, scales white; F, same specimen as E, dry; G, transverse bands on ventral surface; H1–3, transverse sections from apex to base; I, part of section with deposits on turgid and collapsed epithelial cells, ('ring' cells with thickened walls); J, horizontal section at different levels: left, top of epithelium with triangular air pores; centre, base of (epithelial cells); right, chlorenchyma with four-sided air canals; K, scale; L, calcium deposits on outer surface of scale; (A–L by Volk). A, E, G, *Volk 00910*; B, D, H3, *Volk 00765*; H1, *Volk 84-713*; H2, I–L, *Volk 881a*. Scale bars: A–H = 1 mm; I, J, L = 50 μ m; K = 100 μ m.

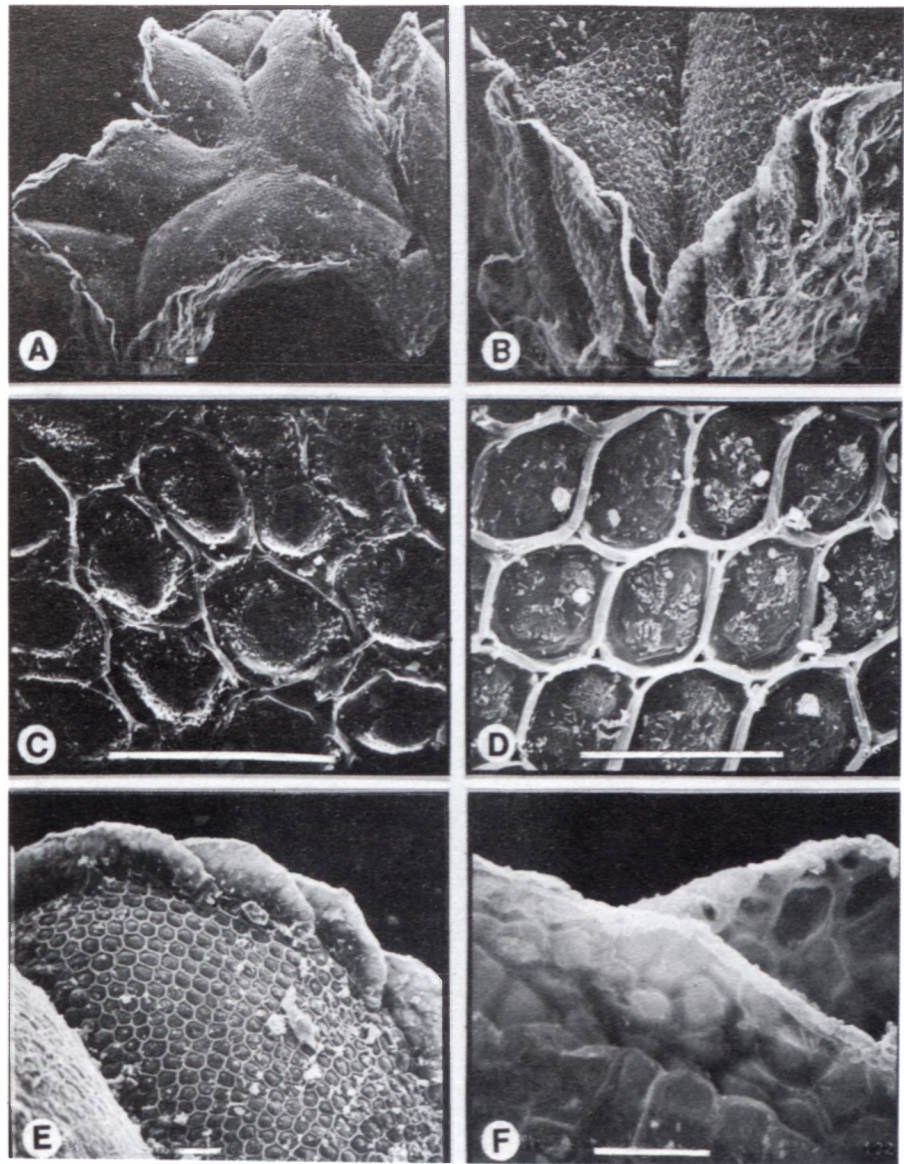


FIGURE 2.—*Riccia argenteolimbata*. Morphology and anatomy. A, dorsal view of dichotomous branch; B, wedge-shaped apex and groove; C, dorsal cells with only a few not collapsed; D, dorsal cells collapsed, showing cell walls and small pores; E, stiff scales at thallus margin; F, more enlarged view of marginal dorsal cells and scales. (SEM micrographs by Perold). (A–F, S.M. Perold 772). Scale bars on A–F = 100 μ m.

late with 12–15(–16) round to angular areolae across diameter (Figure 3C, D), 3–7 μ m wide, ridges thick (Figure 3A, F), raised at nodes into conical or truncate processes (Figure 3E). *Chromosome numbers* $n = 8$; 9; 16; 20; 24 (Figure 4A, B, C, D).

Riccia argenteolimbata is one of eight southern African *Riccia* species for which several karyotypes are known. Four of the six karyotypes of *R. argenteolimbata* (Figure 4A–D) are given in their original arrangement and sorted according to chromosome types (Bornefeld 1984). The karyotype with $n = 8$ (Figure 4A) represents the basic set in the genus *Riccia* and is common to the majority of the species. The karyotype with $n = 9$ possesses one additional B_1 chromosome; that with $n = 16$ has two B_1 , two C_1 and four D_1 chromosomes. As is evident from Figure 4B and 4C, the triploid karyotypes of *R. argenteolimbata* are not achieved by threefold multiplication of the basic set, but by differential multiplication of the diverse chromosome types. For this phenomenon, which is unique to *Riccia*, the term 'nothopolyploidy' was earlier suggested (Bornefeld 1984). The decreasing size of homologous chromosomes does not occur by chance; it is also found in the other genera of the Marchantiales and becomes more noticeable as the number of homologous chromosomes increases (Borne-

feld & Grillenberger 1987). The same degree of nothopolyploidy, represented by two different chromosome patterns within one species, occurs in *R. argenteolimbata* (Figure 4B, C) and in *R. albolimbata* (Bornefeld unpublished). The karyotype with $n = 20$ (Figure 4D) seems to have developed from the one with $n = 24$ (Figure 4C) by the loss of the four D_1 chromosomes. The loss of a group of homologous chromosomes has also been observed in *Targionia lorbeeriana* (Bornefeld 1987). Further investigations may yield still other karyotypes of *R. argenteolimbata*. Because of the variability of chromosome numbers in some *Riccia* species, this character does not seem to be suitable for the definition of a species.

Chromosome numbers (Number of counts in brackets)

- $n = 8$: Volk 86-930 pp (3), Volk 86-934 (5), S.M. Perold 772 (3)
 $n = 9$: Volk 86-930 pp (4), Volk 86-934 (3)
 $n = 16$: S.M. Perold 727 (2)
 $n = 20$: Volk 81-164/165 (4)
 $n = 24$: with one A chromosome: Volk 81-164/165 (8), Volk 81-170 (2), Volk 81-172 (3), Volk 86-922 (2); with two A chromosomes: Volk 81-204 pp (2); Volk 00912 (5)

Riccia argenteolimbata Volk & Perold, sp. nov., differs from the other *Riccia* species with white scales by being dioicous, by the compact texture of the thallus, the closely imbricate, stiff, white or greyish white scales, often with darker coloured bases, and by the globular or subglobular, apolar spores.

Among the Volk specimens 881, 883 and 11906, which Arnell (1957) identified as *R. albosquamata*, thalli of *R. argenteolimbata* are also present; however, his description of *R. albosquamata*, as well as the type specimen Volk 452, and most definitely its triangular-globular, polar spores, do not correspond with *R. argenteolimbata* (Perold in press). Arnell appears to have been uncertain about the distinguishing characters of the white-scaled species and misidentified them several times.

R. argenteolimbata is found at altitudes of 1000–2000 m above sea level, in summer rainfall areas with an annual precipitation of at least 200 mm. It prefers a sunny position, is calciphilous and often grows on greyish turf soils with a high dust content, overlying lime-rich beds, calcrete, crystalline limestone, or dolomite, or on alluvium on steep river banks. These soils may become periodically waterlogged for short intervals when it rains. Soil pH values are high: of 96 samples tested, 36% fell between 7,0 and 7,4; 39% between 7,5 and 7,9 and

25% above 7,9 (Volk). The species is often associated with *R. trichocarpa*, *R. albolimbata*, *R. atropurpurea*, Cyanophyceae and with crustaceous lichens. It has so far been found only in Zambebian areas occupied by the Sudano-Zambebian floral element (Volk 1966), in the northern parts of SWA/Namibia and a few localities in Botswana, north-western and south-western Transvaal, central Orange Free State and northern Cape Province (Figure 5). In some recent collections, e.g. Volk 85-775 and 86-930, very small plants are mixed with plants of normal size. The difference in size seems to be genetically determined, as it persists in cultivation experiments and the small specimens may represent a different subspecies.

During the dry season from April onwards, *R. argenteolimbata* tends to form bulbils or turions for perennation and dispersal (Figure 1D) (Volk 1984); these are very loosely attached to the soil, brown material accumulates in the walls of the peripheral cells, which then form a resistant covering, the assimilation columns shorten and fatty oils appear in the storage tissue.

SPECIMENS EXAMINED

S.W.A./NAMIBIA.—1815 (Okahakana): Etosha, Bitterwater (–CC), Volk 01389 (M). 1816 (Namutoni): Olifantsbad (–AA), Volk 81-174 (M, PRE); Etosha, Okerfontein

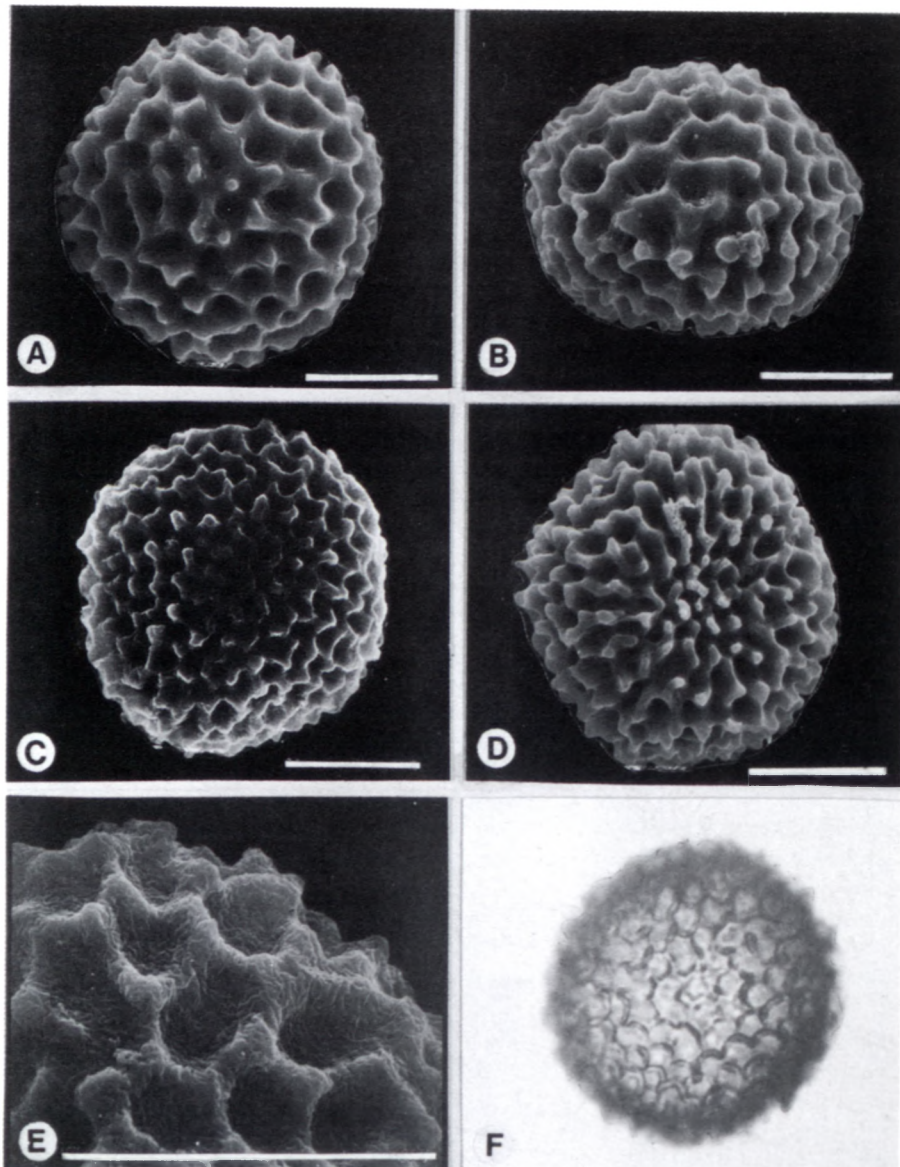


FIGURE 3.—*Riccia argenteolimbata*. Spores. A, ?proximal face; B, side view; C, ?distal face; D, ?distal face, with crowding of truncate papillae at areolar nodes in centre; E, more enlarged view of areolae; F, ?distal face. [A–E, SEM micrographs; F, LM (light microscope) micrograph by Perold.] (A, B, D, Volk 85-775b; C, E, F, Volk 84-713.) Scale bars on A–E = 50 μm ; diameter of spore on F, \pm 100 μm .

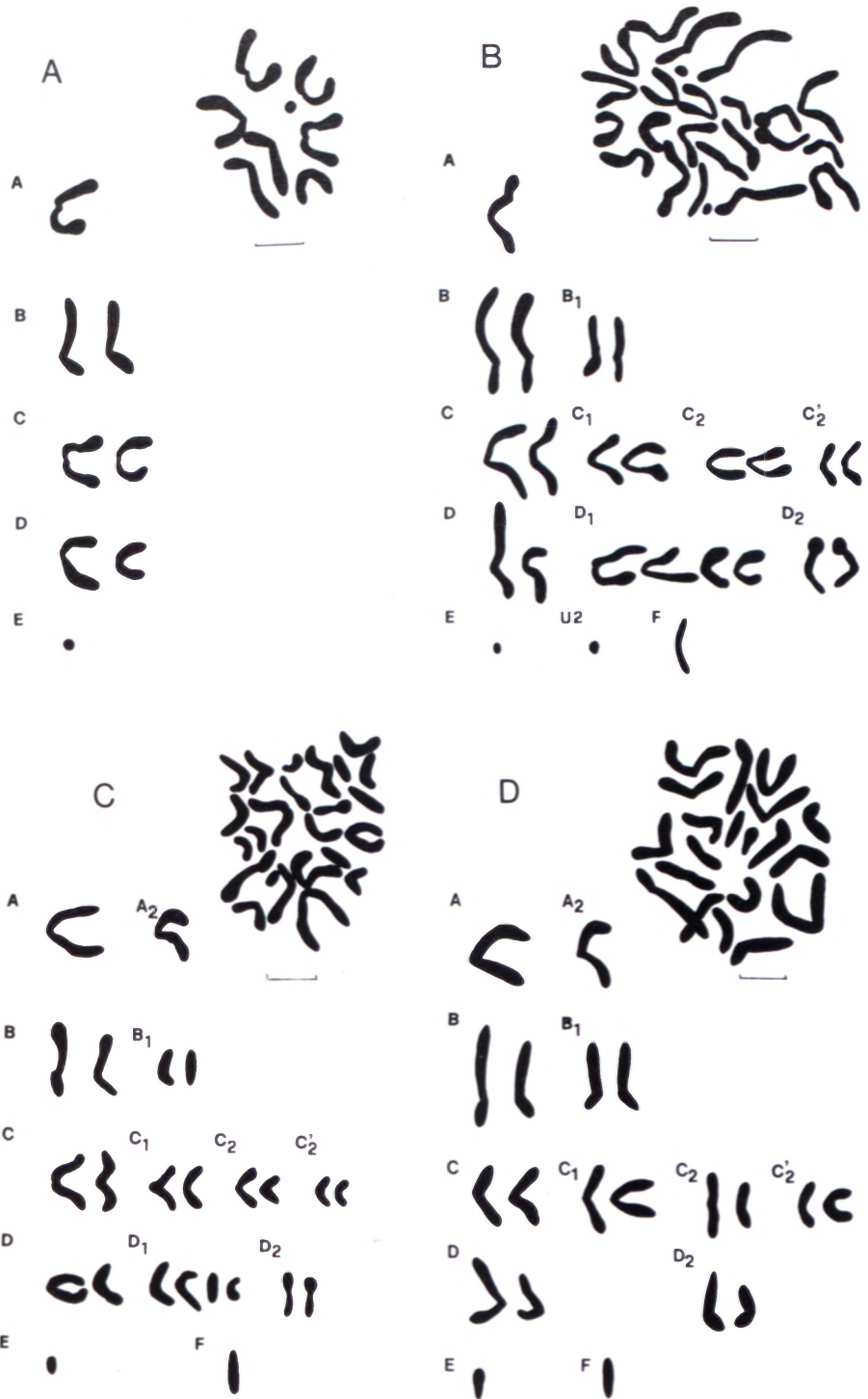


FIGURE 4.—*Riccia argenteolim-bata*. Karyotypes. A, karyotype with $n = 8$ and chromosome formula where A, BB, CC, DD, E represent the basic set in the genus *Riccia*; B, nothotriploid set with one A chromosome and U2 chromosome (this karyotype seems to be the most widespread one) ex Bornefeld 1984 (by courtesy of J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, Berlin-Stuttgart, FRG); C, nothotriploid set with two A chromosomes and lacking U2 chromosome; D, karyotype with $n = 20$ resembles that of 2C, but the four D_1 chromosomes have been lost (the sequence from A to D possibly corresponds to an evolutionary line). (A–D by Bornefeld) (A, *S.M. Perold* 772; B, *Volk* 81-172 p.p.; C, *Volk* 81-204 p.p.; D, *Volk* 81-164/165.) Scale bar: A–D = 1 μm .

(–DD), *Volk* 81-164 (M, PRE). 1915 (Okaukuejo): Etosha between Okaukuejo and Okandehoe (–AA), *E. Retief* 1422a (PRE); Etosha, Sprokieswoud (–BA), *Volk* 81-172 (M); Okaukuejo (–BB), *Volk* 00912, 81-204 (M). 1916 (Gobaub): Etosha, Gemsbokvlakte (–AA), *E. Retief* 1493a (PRE); *Smook* 5118 (PRE); OU 449 (–AC), *Volk* 5116 (M); Halali (–BA), *Smook* 5138 (PRE); Elandsdraai (–CA), *Volk* 81-170 (M); GR 412 (–CB), *Volk* 00749 (M); OU 179 (–CD), *Volk* 00975 (M); GR 398 (–DB), *Volk* 00744 (M); OU 359 (–DC), *Volk* 81-177a (M). 1917 (Tsumeb): Otjikoto Lake (–AB), *Smook* 5159 (PRE); *Volk* 81-156 (M, PRE); GR 45 (–DB), *Volk* 81-151b (M, PRE); GR 154 (–DC), *Volk* 00454 (M). 1918 (Grootfontein): GR 729 (–AC), *Volk* 81-146 (M, PRE); *Volk* 84-705 (M). 2014 (Welwitschia): OU 419 (–BA), *Volk* 5137 (M). 2016 (Otjiwarongo): OU 193 (–AA), *Volk* 00977 (M); OU 132 (–AA), *Volk* 5135 (M); Outjo Dist., 20 km W of Khorixas (–AA), *Long & Rae* 921 (E); OU 187 (–BA), *Volk* 86-860 p.p. (M); OTJ 23 (–CA), *Volk* 00462 (M); OTJ 97 (–CC), *Volk* 84-713 (M). 2017 (Waterberg): GR 98 (–AA), *Hoffmann* PRE-CH 4514 (PRE); *Volk* 00453, 84-692, 84-721, 85-773, 85-775, 86-930, 86-933, 86-934

(M); OTJ 147 (–CA), *Volk* 881 p.p., 883 p.p. (M, PRE). 2116 (Okahandja): OM 46 (–AA), *Gibbs Russell & Smook* 5240 (PRE); OM 37 (–AA), *Volk* 85-853 (M); OK 240 (–BD), *Volk* 00910 (M); OK 34/44 (–CA), *Volk* 11906 p.p. (M); OK 22 (–DA), *Volk* 5170 (M); OK 252 (–DA), *Volk* 00469 (M). 2117 (Otjosondu): OK 105 (–DB), *Volk* 6169 (M). 2118 (Steinhausen): OK 107 (–DB), *Volk* 86-922 (M); OK 113 (–DB), *Volk* 6212a (M); GO 252 (–DB), *Volk* 00507 (M). 2217 (Windhoek): Avis Dam (–CA), *Volk* 00752 (M); Rietfontein (–CD), *Volk* 81-265 p.p. (PRE); WIN 92 (–DC), *Volk* 00591, 00761, 00762, 00764, 00765 (M). 2316 (Nauchas): Windhoek Dist., Gamsberg Mountains, 130 km SW of Windhoek (–AD), *Long & Rae* 946 (E); WIN 46 (–BA), *Volk* 81-200 (M). 2317 (Rehoboth): GIB 113 (–BB), *Volk* 01291 (M). 2416 (Maltahöhe): MAL 19 (–BB), *Volk* 6386, 6439, 6860 (M); MAL 91 (–BD), *Volk* 6856 (M); 2417 (Mariental): GIB 6 (–BA), *Volk* 5268 (M). 2418 (Stamriet): Gochas, Auob River (–DD), *Hardy* 6586a (PRE).

BOTSWANA.—1921 (Aha Hills): Ngamiland Dist., Aha Hills, hill on N side near E end of range (–CC), *Long & Rae* 834,

842 (E). 2123 (Pink Pan); Central Kalahari Game Res., Deception Pan (-BD), *Henderson 659* (PRE).

TRANSVAAL.—2228 (Maasboom): Alldays, 55 km W of, on road to Swartwater (-DA), *S.M. Perold 766, 767, 769, 772* (PRE); Gregory Halt, 19 km NW of Alldays, near bridge (-DB), *S.M. Perold 737* p.p. (PRE); opposite Bulkop Store, on calccrete (-DC), *S.M. Perold 793* p.p., *794* (PRE). 2327 (Ellisras): Farm Franschhoek, 29 NW of Villa Nova (-BD), *Smook 4231* (PRE). 2329 (Pietersburg): Vivo, 15 km N of (-AB), *S.M. Perold 727, 728* (PRE). 2428 (Nylstroom): between Groenvallei and Roedtan, Farm Zoetkoppies (-BB), *S.M. Perold 339* p.p. (PRE). 2725 (Bloemhof): Farm Leeufontein, 10 km W of Wolmaransstad (-BB), *A.E. van Wyk 5753* p.p. (PRE).

O.F.S.—2825 (Boshof): Farm Goede Hoop (-CA), *Volk 81-204* p.p., *81-210* p.p. (M, PRE). 2827 (Senekal): 5 km S of turnoff to Willem Pretorius Wildtuin (-AC), *S.M. Perold 957* (PRE). 2926 (Bloemfontein): nr Eagle's Nest, Bloemfontein (-AA), *Potts 7003B-E* (BLFU).

CAPE.—2922 (Prieska): Farm Erfrust, N bank of Orange River, between Prieska and Koegasbrug (-BC), *Smook 4487* (PRE).

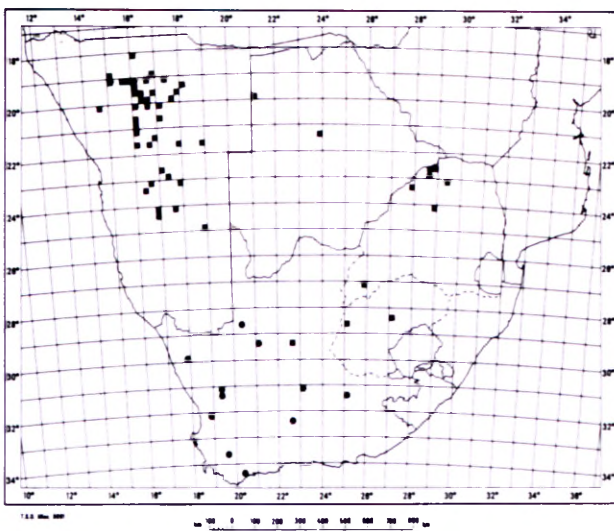


FIGURE 5.—Distribution map of *R. argenteolimbata*, ■, and *R. albornata*, ●, in southern Africa.

2. *Riccia albornata* Volk & Perold, sp. nov.

Thallus monoicus, mediocris, viridis; in sicco albidus, nitidus. *Frons* usque ad 12 mm longa, 1,5–2,0(–4,0) mm lata, 1,0–2,0 mm crassa, triplo latior quam crassa, bi- vel trifurcata; lobis terminalibus brevibus, valde divergentibus, late ligulatis, apice rotundato emarginato, in partibus junioribus profunde acuteque sulcatis; cellulae dorsales epithelii grandes, ad 60 μ m diametro, saepe duas columnas chlorophylloferas obtegentes; chlorenchyma dimidio crassitudinis thalli, canalaeriferae ad 80 μ m latae ab 6 columnis chlorophyllosis circumcinctae; costa subplana, lateribus oblique in margines acutes excurrentibus, viridibus vel purpureis. *Squamae* magnae, crispatae, calce incrustatae, vel hyalinae, marginem frondis excedentes, dense imbricatae, basi saepe coloratae. *Sporae* polares, \pm 100 μ m diametro, alatae, \pm irregulariter reticulatae, foveolis 2,5 μ m latis, saepe imperfectis. *Ricciae albolimbatae* similis, sed ornamentatione sporarum et conformatione epithelii et chlorenchymatis differt. *Chromosomatum numerus* $n = 15$.

TYPE.—Cape Province, 2921 (Kenhardt): \pm 10 km westl. Kenhardt, an der Strasse nach Kakamas (-AC),

alt. 970 m, grobsandiger, schluffreicher, rotbrauner Granitzersatz am Fuss von Batholithen, pH 7,1, mit *R. okahandjana* S. Arnell und Moosen, 1981.01.15, *Volk 81-081* (M, holotype).

Thallus monoicus (Figures 6A, 7B), perennial, in crowded gregarious patches, not in rosettes; branches simple or bi- to trifurcate, symmetric or asymmetric, usually widely divergent, oblong, (4–)5–9(–12) mm long, 1,5–2,0(–4,0) mm broad, 1,0–2,0 mm thick, 1,2–2,5 or more times broader than thick; apex rounded, obtuse, emarginate, sulcus deep apically (Figures 6A; 7A, B, C), gradually becoming shallow and wide, flattening out proximally (Figure 6B1–4); dorsally green, shiny, older surfaces and edges yellowish or whitish green; margins acute, slightly attenuate, flanks sloping obliquely outward, violet or green; ventral surface flat to rounded, green; when dry, greyish white and margins inflexed with large, frilly, hyaline or lime-encrusted, white scales covering most of dorsal surface.

Anatomy of thallus: dorsal epithelial cells globose or mammillate (Figures 6C; 7C, D), 30–40(–50) \times 40–60 μ m, often spanning two columns of assimilation cells beneath (Figure 6C, D, centre), surface occasionally lightly dusted with fine calcium carbonate deposits (Figure 7F), towards margins and in older parts cells frequently collapsed (Figure 7E); air pores narrowly rectangular or wider near the margins and 5 or 6-sided, positioned over wide, mostly 6-sided air canals, up to 80 μ m wide (Figure 6D); assimilation tissue (chlorenchyma) about $\frac{1}{2}$ the thickness of thallus, cells short-rectangular, 40–50 \times \pm 30 μ m wide, in columns of 6–8(–10) cells; storage tissue about $\frac{1}{2}$ the thickness of thallus, cells \pm 50 μ m wide. Rhizoids mostly smooth, some tuberculate, \pm 20 μ m wide. *Scales* imbricate, rounded, margin smooth, projecting \pm 50–100 μ m above margin of thallus, those at apex hyaline, more proximal ones white, sometimes with reddish purple bases, large, up to 1 250 \times 750 μ m, cells occasionally lime-encrusted, walls thick, 4–6-sided, 75–85(–100) \times 35–50 μ m in body of scale; brick-shaped, \pm 35 \times 60 μ m wide (Figure 6E) in margin. *Antheridia* with prominent hyaline necks projecting along midline. *Archeogonia* with purple necks scattered singly along either side of midline. *Sporangia* containing \pm 300 spores each, covering tissue with large pores, disintegrating when ripe and leaving capsules exposed in hollow. *Spores* large, (85–) 95–105(–115) μ m in diameter, straw-coloured or yellow to brown, semi-transparent to opaque; triangular-globular, polar, with wing up to 5 μ m wide (Figure 8A, B), notched or perforated at angles, margin finely crenulate, distal face \pm reticulate with 14–16(–20) small, deep areolae across the diameter, about 2,5 μ m wide (Figure 8C, D, F); areolar walls \pm 2,5 μ m thick, raised into processes at the nodes (Figure 8E) and frequently anastomosing to form short convoluted ridges (Figure 8C, D); proximal face with triradiate mark distinct, about 30–40 small areolae on each of 3 facets (Figure 8A). *Chromosome number* $n = 15$ (Figure 6F).

This unusual haploid set with 15 chromosomes (Figure 6F) is known only in *R. albornata* (*Volk 81-081* — 15 counts); *Volk 84-667* p.p. — 4 counts). The chromosome formula of this set contains, in addition to the basic set, 2B₁, 2C₁ and 3D₁ chromosomes.

Vegetatively *R. albornata* is not easily distinguished from *R. albolimbata*, but it never grows in rosettes, the

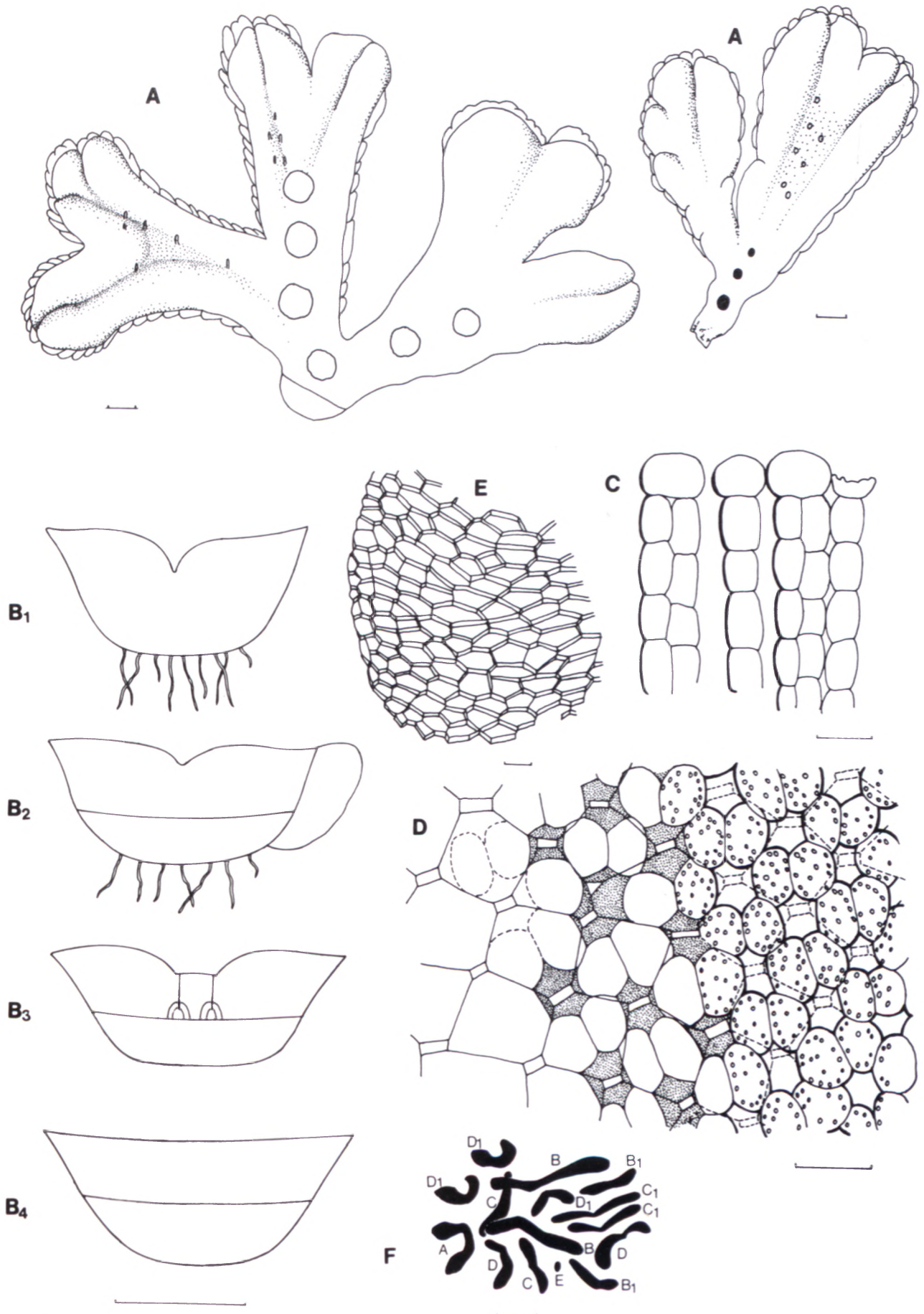


FIGURE 6.—*Riccia albornata*. Morphology and anatomy. A, fresh thalli with sporangia, archegonial and antheridial necks; B₁–4, transverse sections of branch at different distances from apex to proximal part; C, enlargement of transverse section through dorsal epithelium (showing wide cells) and through assimilation tissue; D, horizontal section at different levels: left, air pores and epithelial cells; in centre, position of air pores over air canals with epithelial cells extending over columns of chlorenchyma; right, chlorenchyma with air canals; E, scale; F, chromosomes. (A–E by Volk; F by Bornefeld) (A–D, F, Volk 81-081; E, Volk 84-667). Scale bars: A, B = 1 mm; C, D = 50 μm; E = 100 μm; F = 1 μm.

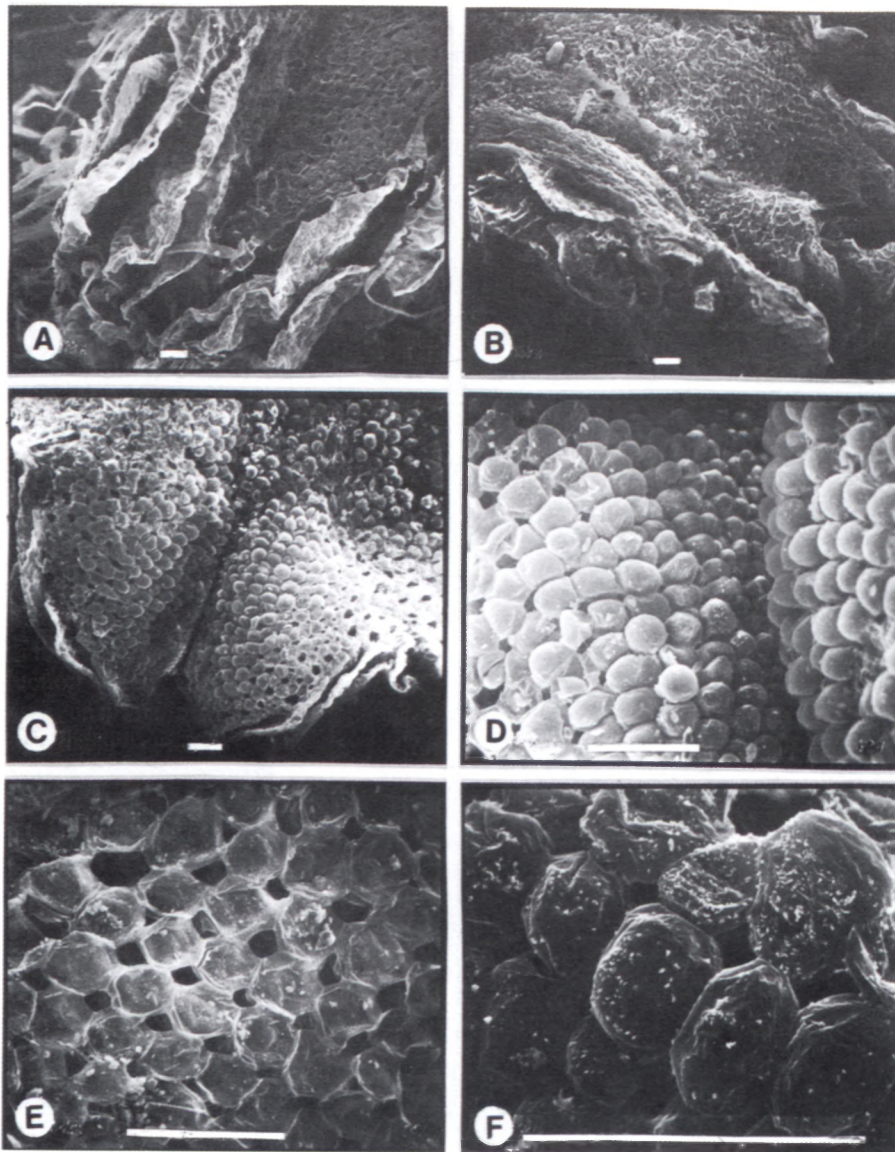


FIGURE 7. — *Riccia albornata*. Morphology and anatomy. A, dorsal view of apex and groove with partly inflexed margins and large scales; B, archegonial and antheridial necks; C, dorsal cells in groove; D, more enlarged view of dorsal cells at groove; E, dorsal cells and air pores toward margin; F, dorsal cells with deposits (SEM micrographs by Perold). (A, B, E, F, *Oliver 8854a*; C, D, *Morley CH4525*.) Scale bars on A–F = 100 μ m.

hyaline scales are larger and frillier, the dorsal epithelial cells are also larger, the air canals wider and generally enclosed by six columns of cells and the spore ornamentation is markedly different with numerous small, irregular areolae and convoluted ridges on both faces. The distribution areas of the two species do not appear to overlap either, except for two localities in the central Cape.

R. argenteolimbata is generally a smaller plant, with regular, stiff white scales, a mat, glaucous grey dorsal surface and apolar spores; it is also dioicous.

R. albornata is a rare endemic species infrequently collected at altitudes of 500–1 500 m above sea level. It appears to be confined to those regions of the Cape Province (Figure 5) which are influenced by, or generally receive sparse winter rains of at least 125 mm per annum. Generally it grows on reddish brown or light brown, coarse, gravelly soil, derived from granite or quartzite, on koppies or on slopes, in full sun or in light shade of small shrubs or thorn trees. The soil pH values are 7,0–8,0 (Volk). It is sometimes associated with other *Riccia* spp., e.g. *R. okahandjana* S. Arnell and with mosses, e.g. *Desmatodon convolutus* (Brid.) Grout and *Funaria* spp.

SPECIMENS EXAMINED

CAPE.—2820 (Kakamas): Aughrabies Nat. Park, Oranjestrom (–CB), *Volk 84-667* (M, PRE). 2917 (Hondeklipbaai):

36 km S of Springbok, on road to Kamieskroon (–DD), *S.M. Perold 1445* (PRE). 2921 (Kenhardt): 10 km W of Kenhardt (–AC), *Volk 81-081* (M, PRE). 3119 (Calvinia): E of Slagberg, midway between Nieuwoudtville and Loeriesfontein, Farm Koringhuis (–AB), *S.M. Perold 1800, 1801* (PRE); NE of Nieuwoudtville, Groothoek, on Soetlandsrivier (–AD), *Oliver 8854a* (PRE). 3123 (Victoria West): Farm Rietpoort, 34 km N of Victoria West, on slope (–AA), *Smook 6961* (PRE); Farm Kalkfontein, 48 km NE of Victoria West, on flat gravel plain (–AA), *Smook 6990* (PRE). 3125 (Steynsburg): White Ridge (–AC), *Duthie 5149* (BOL). 3218 (Clanwilliam): Bidouw, Farm Mertenhof (–BB), *Oliver 1463* (BOL). 3222 (Beaufort West): Beaufort West, on small koppie (–BC), *Steyn 5487* (BOL). 3319 (Worcester): Rabiesberg, Farm Doringkloof (–DA), *Morley CH4525* (PRE); Nuy (–DA), *Morley 362* (PRE). 3420 (Bredasdorp): De Hoop, in pass on road from Wydgeleë to De Hoop (–AD), *Fellingham 746a* (PRE).

ACKNOWLEDGEMENTS

Sincere thanks are due to the Curators of Botanische Staatssammlung, München and Bolus Herbarium, University of Cape Town, for the loan of specimens and to the many people who kindly collected specimens for us, especially Botanical Research Institute staff members, Dr G.E. Gibbs Russell, Messrs D. Hardy, E.G.H. Oliver, Mrs L. Fish (née Smook), Misses E. Retief, L. Henderson and M. Morley as well as to the Hoffmann family, Farm Oros, SWA/Namibia.

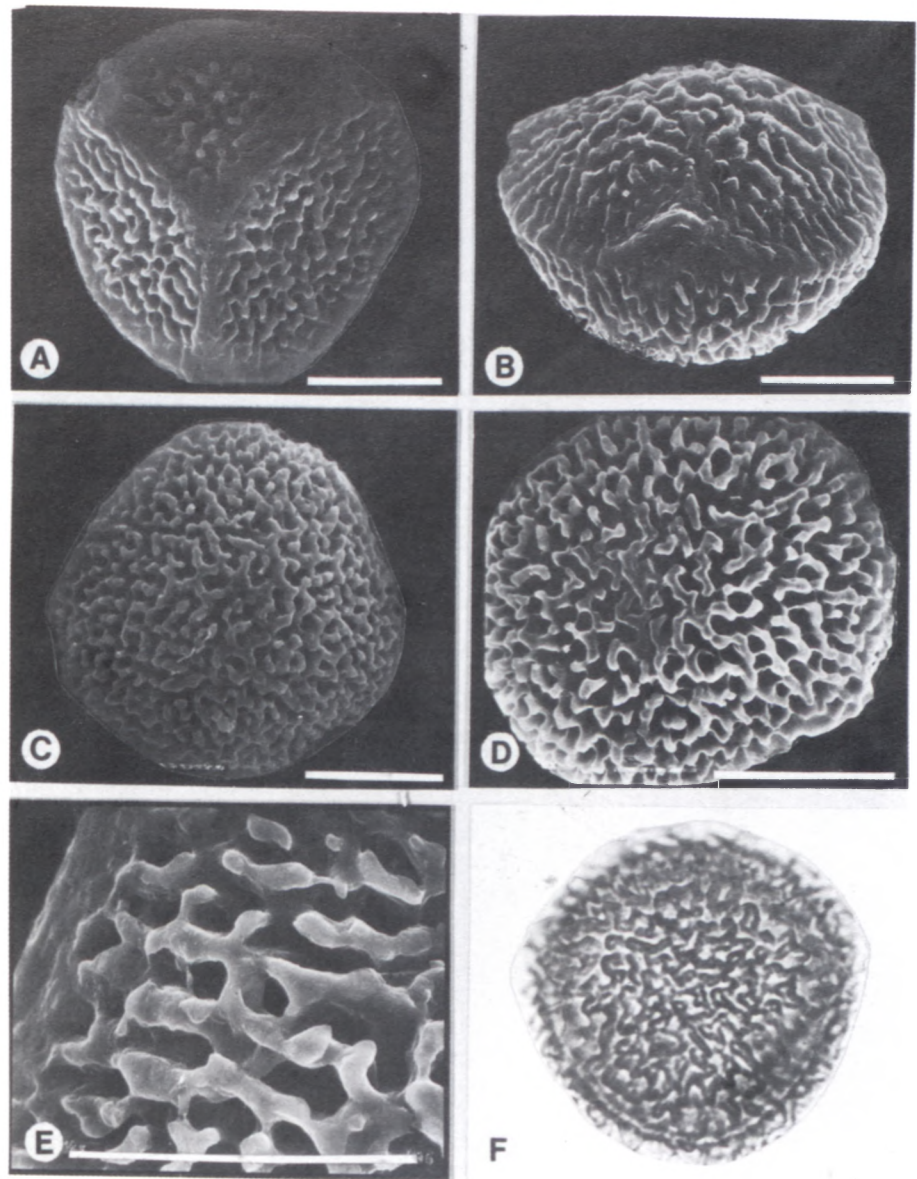


FIGURE 8.—*Riccia albornata*. Spores. A, proximal face; B, side view of proximal face; C, D, F, distal face; E, more enlarged view of areolae near margin on distal side. (A–E, SEM micrographs; F, LM (light microscope) micrograph by Perold.) (A–D, *Oliver 5149*; E, F, *Volk 84-667*.) Scale bars on A–E = 50 μm ; diameter of spore on F, $\pm 100 \mu\text{m}$.

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