

Studies in the genus *Riccia* (Marchantiales) from southern Africa. 1. Two new species of the section *Pilifer*: *R. duthieae* and *R. alatospora*

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Keywords: dorsal epithelium, Duthie, *Riccia* species, section *Pilifer*, sporangia, spores, thallus

ABSTRACT

Riccia duthieae Volk & Perold and *R. alatospora* Volk & Perold, two new species endemic to southern Africa, are described. Both species belong to the section *Pilifer* Volk (1983), which is characterized by the dorsal epithelium of the thalli consisting of loose pillars of colourless cells.

***Riccia duthieae* Volk & Perold, sp. nov. sectionis *Pilifer*.**

Dioica, perennis, in sicco subalbida, in tumido viridis, mediocris, gregaria vel semirosulata. *Frons* 1 ad 8 mm longa, ad 5 mm lata, 1,0 mm crassa, furcata furcis ovato-ligulatis, emarginatis, ad apicem solum sulcatis, in partibus adultae convexis, in sicco concavis, marginibus subacutis, parvopapillata, costa sensim producta plano-convexa, lateribus sub apice recte, aliter oblique adscendentibus vel explanatis; pro parte colorata. *Squamae* magnae, altitudine frondis haud superantes, hyalinae, tenerae basi interdum picti, cellulis parietibus rectis constructa. *Frondis sectio transversalis*, superficies frondis strato pilifero (epithelium) dense obtecta, pili conici, liberi, hyalini, 120-160-220 μm longi, basaliter 40-70-105 μm , apicaliter 25-40-60 μm lati, tri- (raro quadro-) cellulati, infra cellulis auxiliaris unicellularis interdum ornatis; stratum aeriferum (chlorenchyma) 2-4/10 altitudine, lamellis suberectis, 8-10 cellulis altis, unicellularis crassis, canales aeriferi amplii quadro- ad octogoni formantes aedificatum. *Ostiola mascula* hyalina ad 0,5 mm longe prominentia. *Sporangia* parum protuberantes, cum 400 ad 600 spora parvae. *Sporae* 60-70 μm in diametro, polarae, anguste crenato-alatae, cinnamoneae, subtriangulares, superficies exterior sporarum laxe reticulatim ornata, 3-7 areolis grandibus, 10-15-25 μm latae, cristae crassis, saepe reticulatis secundariis incompletis vel ad papillae reductis, saepe ab areolae minores circumdata; superficies interior distincte tri-radiata, dense parvo-areolata vel lamellis ad lineas interruptas papillive reductis. Chromosomata $n = 8$ (Bornefeld).

Endemica Africae australis. *Riccia parvo-areolata*, *R. albovestita* similis, sed diversus ab ornamentatio sporarum et aedificationem epithelii.

TYPE. — Cape, 3224 (Graaff Reinet): Aberdeen, next to road R57, 2 km north-east of junction with R61, at shallow edges of vleis temporarily damp or occasionally inundated (-AC), 1981.04.11, *Volk*

81-273 (M, holo; PRE), associated with *Marsilia burchellii*, *Eragrostis homomala*, *Chloris virgata*, *Crassula* spp. and with thick layers of Cyanophyceae, or on bare ground. Soil clayey loam, pH 6,9.

Dioecious, perennial, often in large, densely crowded gregarious patches or in incomplete rosettes 1-4 cm across. *Thallus* arises from narrow ribbon-like base, becoming wider towards apex, simple or furcate, segments 1-8 mm long, 0,5-5 mm broad, about 1 mm thick (Figs 1.1-1.5 & 2.1); mostly short and broad, shape oblong-obcordate; emarginate at apex, shortly sulcate; when dry (Fig. 1.2, 1.3) lateral margins inflexed over sulcus, otherwise dorsal surface plane to concave, greenish-white, felt-like, without obvious rows of cells or openings to air canals, margins somewhat thickened; ventral surface pale green, flanks and bases of ventral scales occasionally flecked with shiny reddish black blotches (reddish yellow in chloral hydrate), when fresh or moistened, dorsal surface pale creamy green, velvety, convex. *Scales* large and conspicuous, spreading (Fig. 1.3) or closely adherent to flanks of thallus margin, except for apical scales, cells 5-6 sided with thin straight walls, sizes up to 95 \times 40 μm ; at scale margin cells smaller, nearly isodiametric (Fig. 1.8). *Cross section of thallus* 1,5 to 3 (-4) times broader than high, margins acute to rounded, flanks steep near apex, otherwise sloping outwards, ventral surface almost flat (Fig. 1.10); epithelium about 1/10, assimilation tissue (chlorenchyma) 2-4/10; storage tissue 4-5/10 the thickness of thallus; dorsal surface densely covered by hair-like cell pillars (Table 1, Fig. 1.9) consisting of loose, colourless cells of varying lengths 120-160-220 μm ; each pillar with 3 (or

TABLE 1. — *Riccia duthieae*, measurements on cross section (cultivated plants of Volk 81/273)

Breadth of thallus	: 0,5-2,4-5 mm
Height (thickness)	: 0,8-1,1-1,4 mm
Thickness of epithelium	: 150-190-245 μm ca 2/10 thickness of thallus
Thickness of chlorenchyma:	120-390-480 μm ca 3-4/10 thickness of thallus
Thickness of storage tissue:	320-510-800 μm ca 4-5/10 thickness of thallus

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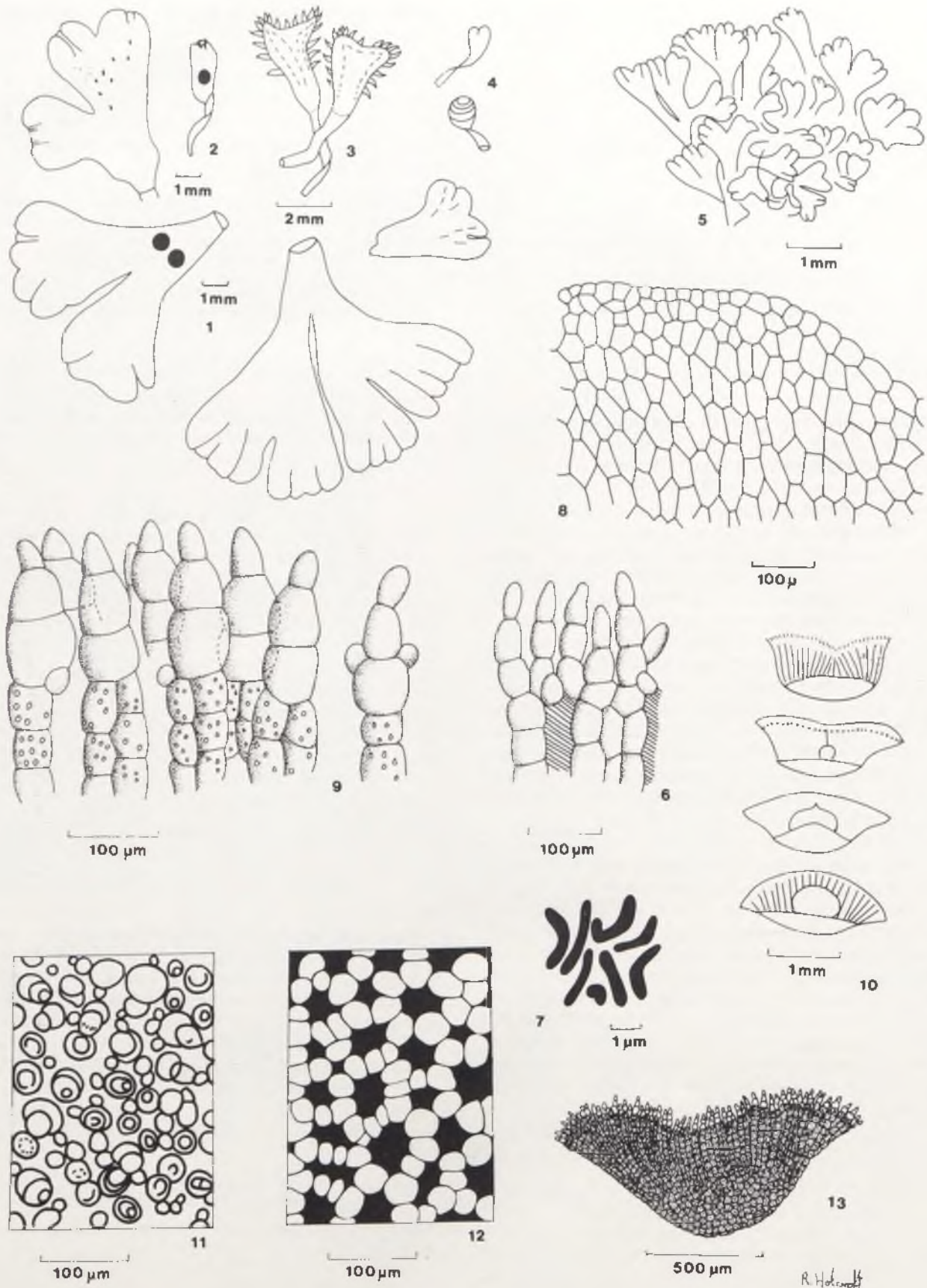


FIG. 1. — *Riccia duthieae* (O. H. Volk 81/273, M; PRE). Structure of the thallus. 1, fresh thalli; 2, 3, dry thalli; 4, 5, thalli in dense colonies; 6, unicellular outgrowths at bases of pillars; 7, chromosomes; 8, ventral scale; 9, epithelium; 10, cross sections of thallus at various distances from apex; 11, cell pillar tips from above; 12, air canals in horizontal section; 13, detailed cross section of thallus. (1–6, 8–12 by O. H. Volk; 7 by T. Bornefeld; 13 by R. Holcroft.) Scale bar 1, 2, 4, 5, 10 = 1 mm; 3 = 2 mm; 6, 8, 9, 11, 12 = 100 μ m; 7 = 1 μ m; 13 = 500 μ m.

very occasionally 4) thin-walled cells 25–40–60 μm long with shorter conical cells at blunt tip, width of basal cells 40–70–105 μm (Table 2); at bases of pillars occasional unicellular globular outgrowths which reduce air spaces over pores (Fig. 1.6); viewed from above pillar tips irregularly arranged (Fig. 1.11); assimilation tissue (chlorenchyma) consisting of 8–10 cells in columns or plates 1–3 cells broad and 1 cell thick, enclosing 4–8-sided air canals (Fig. 1.12), which slant slightly forwards and widen upwards; storage tissue with longitudinally elongated, thin-walled cells containing rich supplies of fatty oils in perennating tips of thalli; epidermis of ventral surface has flattened cells, bearing smooth and tuberculate rhizoids. *Antheridia* numerous with colourless ostioles, up to 0,5 mm long; *archegonia* scattered in the middle along length of thallus. *Sporangia* slightly bulging, up to 0,7 mm in size, with red-brown neck and colourless tip, 175 μm long, containing 400–600 spores each. *Spores* small (50–) 60–70 (–80), average size 62 μm , colour cinnamon brown, opaque, shape triangular-globular, polar, with wing 3–5 μm wide. (Figs 2.5–2.7 & 3.1, 3.3); ornamentation on distal (outer) face: in centre 3–5 large prominent areolae measuring 10–15–25 μm across, these areolae often with reduced blind-ending secondary ridges, 'crack' viz Arnell, and sometimes with only a central knob; marginally surrounded by smaller areolae with thicker, incomplete ridges; however, surrounding ridges sometimes thin and complete (Figs 2.5–2.7 & 3.3, 3.4); at edge ridges often extend across narrow wing (Fig. 2.7); wing finely and irregularly crenulate, slightly projecting at angles of spore, with notch leading to pore (Fig. 3.5) in spore wall (Fig. 2.6); facets of proximal (inner) face sharply delimited by triradiate mark and covered with fine network (up to 5 μm) of low, toothed ridges, often only partly complete or reduced to simple projections and stipplings (Fig. 3.1, 3.2). Chromosome number $n = 8$ (Bornefeld) (Fig. 1.7).

When covered in mud, or when growing in dense colonies, thin, narrow, diverging and runner-like branches, which ascend obliquely forwards are formed. Branches either enlarge into broader thalli or else become transformed into nearly globular perennial bulbils as follows: proximal parts of thalli, flanks and 2–4 cell layers of chlorenchyma underneath epithelium lose their contents, cell walls become impregnated with red-black pigment and form covering layer 100–150 μm thick (Fig. 1.4). On dry-

ing, thallus shrinks and scar-like pits are left behind in soil surface.

This species is named in honour of Dr Augusta Vera Duthie (1881–1963) who, at Stellenbosch, became the first South African trained botanist to be appointed as a university lecturer in this country (Gunn & Codd, 1981). Her collections and publications with Garside (Duthie & Garside, 1936, 1939) are very valuable contributions to the knowledge of South African Riccias.

This new species belongs to the South African endemic section *Pilifer* Volk (1983) and bears a close resemblance to *R. albovestita* Volk (1981) and *R. parvo-areolata* Volk & Perold (1984) which, however, differ from *R. duthieae* by having 4- (or rarely 5-) celled epithelial pillars and different spore ornamentation.

TRANSVAAL. — 2629 (Bethal): 5 km W of Kriel (–AB), March 1984, *Perold* 342 (PRE).

CAPE. — 3224 (Graaff-Reinet): Aberdeen (–AC), April 1981 *Volk* 81/272; Feb. 1984 *Volk* 84/646 (PRE, M). 3319 (Worcester): Robertson (–DD), *Duthie* 5182 (BOL); *Duthie* 5193 (BOL). 3326 (Grahamstown): between Ulster & Mooi River (–BA), Dec. 1981 *Smook* 4036 (PRE).

In a letter dated 10 June 1929, Duthie sent material of *Riccia* [AVD 5004 (BOL) = CH 1007 (PRE)] from Stellenbosch Flats, accompanied by clear drawings, to T.R. Sim, stating that it could perhaps be *R. coronata* Sim, or that it was close to it. Sim however, thought differently and suggested in his reply of 15 June 1929, that it was a new species and that she should describe the plant as *R. duthieae* Sim MSS (correspondence at PRE). This was not done and a description was never published. However, in a pencilled note found with this specimen at BOL, she named it '*R. alatospora*' (described below). According to Duthie's drawings and confirmed by our investigations, AVD 5004 (BOL) = CH 1007 (PRE) differs from *R. duthieae*, *Volk* 81/273, by the former being smaller and having inconspicuous ventral scales and by its larger, very broadly winged (15 μm wide) spores, with otherwise somewhat similar ornamentation (see below).

Arnell (1963: 21 & 22) mistakenly published the above-mentioned drawings by Duthie under *R. coronata* Sim (type specimen *Sim* 8730 had been lost), where the thallus according to Sim's description (1926:9) has 'one epidermal upper layer of similar but hyaline cells,' and not short 3-celled pillars as depicted by Duthie in her notes on *R. alatospora*.

TABLE 2. — *R. duthieae*, size (in μm) of the cells of the epithelium and its other parts on cross section (cultivated plants of *Volk* 81/273)

	Average size		Length: Breadth	Variation in size	
	Length	Breadth		Length	Breadth
Terminal cell	43	37	1,2:1	30–60	25–60
2	53	51	1,0:1	30–75	30–75
Basal cell	60	72	0,8:1	35–95	40–105
Basal cell if 4 cells in pillar	46	76	0,6:1	35–60	45–95
Total length	150			120–240	
Chlorenchyma	56	60	0,9:1		
	50	60	0,8:1		

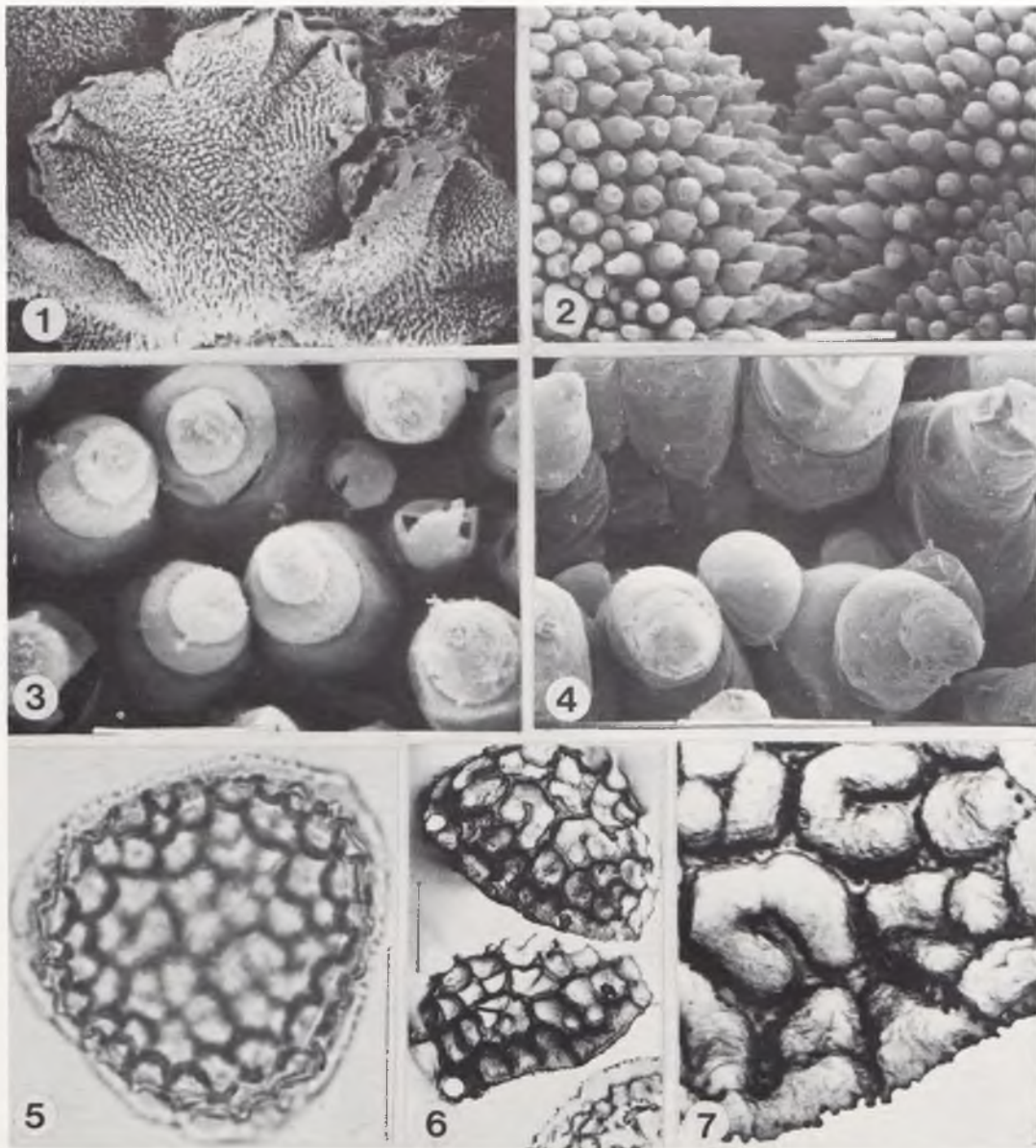


FIG. 2. — *Riccia duthieae* (O. H. Volk 81/273, M; PRE). Thallus, epithelium and spores. 1, thallus; 2-4, terminal cells of the epithelium; 5, 6, distal face of spore; 7, distal face and margin of spore. (1-4 SEM micrographs by O. H. Volk; 5, L.M. photograph by S. M. Perold; 6, 7, L.M. photographs by O. H. Volk.) Scale bar = 50 μ m.

Sim wrote further that *R. coronata* has 'near the margin of the thallus, one line of long white mammillate cells, erect or inflexed (which) gives a crown-like appearance.'

***Riccia alatospora* Volk et Perold, sp. nov.** sectionis *Piliferae*, *R. duthieae* Volk et Perold simile, sed habitu frondorum pusilliorum, sporis majoris (90-100 μ m) alis sporarum conspicuis plusquam 10 μ m latis (indum nomen) et interdum perforatis, squamae inconspicuae speciebus austro-africanis differt. Endemica Africae australis.

TYPE. — Cape, 3318 (Cape Town): Stellenbosch, Platklip, on moist sand in hollows on granite outcrop (-DD), June 1929 *Duthie 5004* (BOL), *CH 1007* (PRE).

Dioecious, perennial, in crowded gregarious patches, plants often overlying each other. *Thallus*

small, single or shortly furcate, arising from narrow base becoming wider towards apex, segments up to 5 mm long, 0,85-3 mm broad and 0,6-1,2 mm thick, shape obcuneate to obovate, apex obtuse and emarginate (Figs 4.1 & 5.1); when dry apex and distal sides inflexed over sulcus, which is deep and narrow apically, but soon becomes shallow, dorsal surface flat and at margins slightly raised, glistening greenish-white and felt-like; ventral surface hyaline, flanks green to pinkish red; when fresh or moistened, dorsal surface broadly grooved, pale-green with bright green colour developing in older plants, velvety, convex. *Scales* imbricate at apex and distal margins but absent proximally, shape rounded, upper edge hardly reaching thallus margin, size up to 450 \times 550 μ m, colour pink-red with outer 2-3 rows of cells hyaline, or entirely hyaline, margin nearly smooth with small quadrate cells, central cells oblong 5-6-sided, size 100 \times 25 μ m, walls thin and

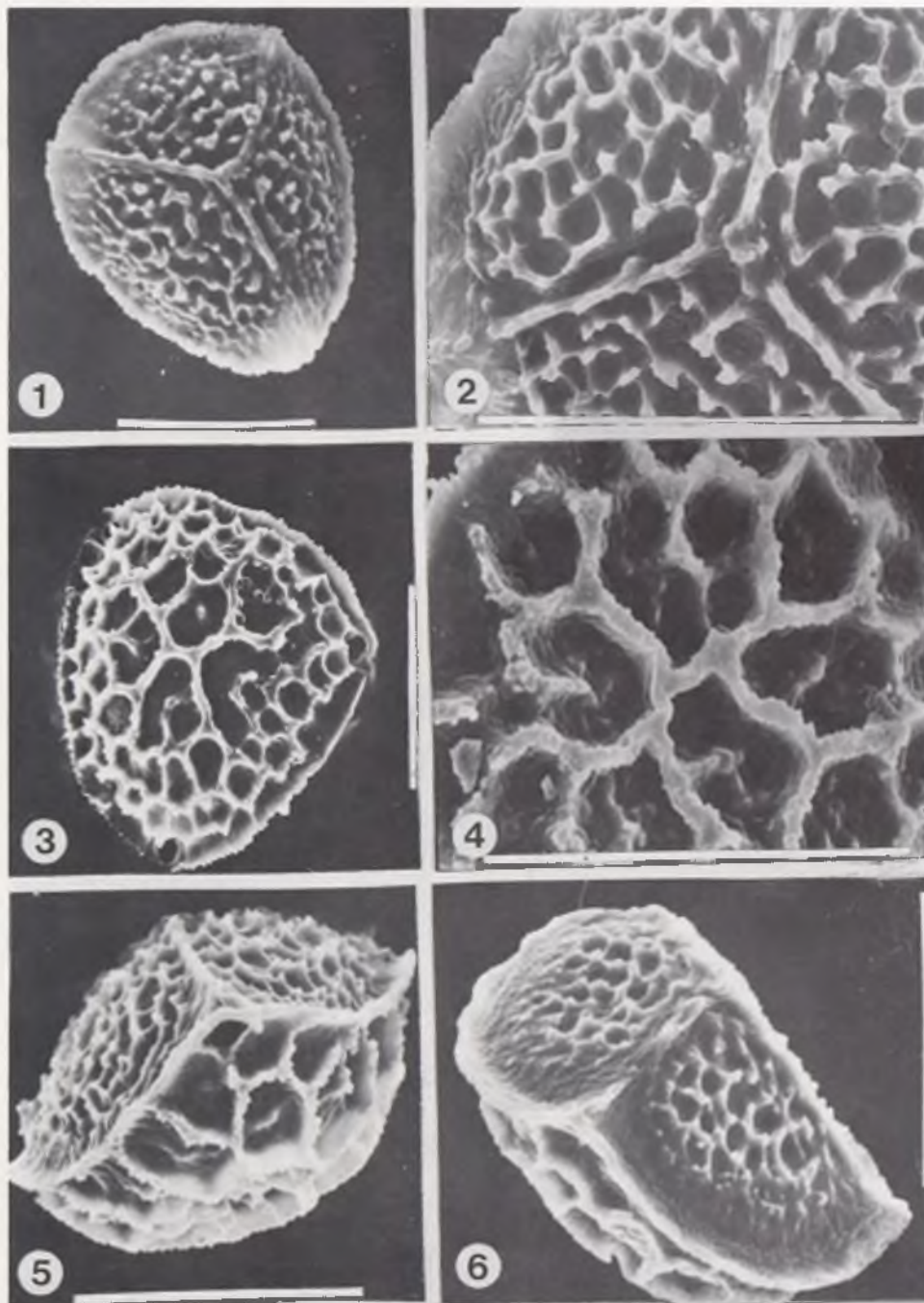


FIG. 3. — *Riccia duhiae* (O. H. Volk 81/273, M; PRE, 1, 3, 4; L. Smook 4036, M; PRE, 2, 5, 6). Spores. 1, proximal face; 2, apex; 3, 4, distal face; 5, 6, side (SEM micrographs by S. M. Perold.) Scale bar = 50 μ m.

straight (Fig. 4.11, 4.12). Cross section of thallus 1,5–2 times broader than high, margins subacute to rounded, flanks steep to outward sloping (Fig. 4.3, 4.4, 4.7), ventral surface almost flat; epithelium about 1–2/10, assimilation tissue (chlorenchyma) about 5/10, storage tissue 3–4/10 the thickness of the thallus; dorsal surface covered with short, hyaline, free hair-like pillars 100–160 μ m long (Table 3, Fig. 4.5, 4.6), 2 or 3 and occasionally 1-celled, cells 35–75 μ m long, apical cell conical, mammillate or blunt (Fig. 5.3, 5.4), basal cell up to 80 μ m wide (Table 4); assimilation tissue consisting of columns or plates 1 cell thick and about 8 cells high, enclosing 4–6–8-sided aircanals up to 80 μ m across (Fig. 4.10), these large canals suggest a resemblance to the old subge-

nus 'Ricciella'; storage tissue with rounded, irregularly arranged thin-walled cells 55 μ m across, epidermis of ventral surface with flattened hyaline cells

TABLE 3. — *R. alatospora*, measurements on cross section (cultivated plants of Oliver 8058)

Breadth of thallus	: 0,85–1,0–1,3 mm
Height (thickness)	: 0,6–0,9–1,2 mm
Thickness of epithelium	: 125–145–160 μ m ca 2/10 thickness of thallus
Thickness of chlorenchyma	: 275–495–650 μ m ca 4–5/10 thickness of thallus
Thickness of storage tissue	: 190–200–400 μ m ca 3–4/10 thickness of thallus

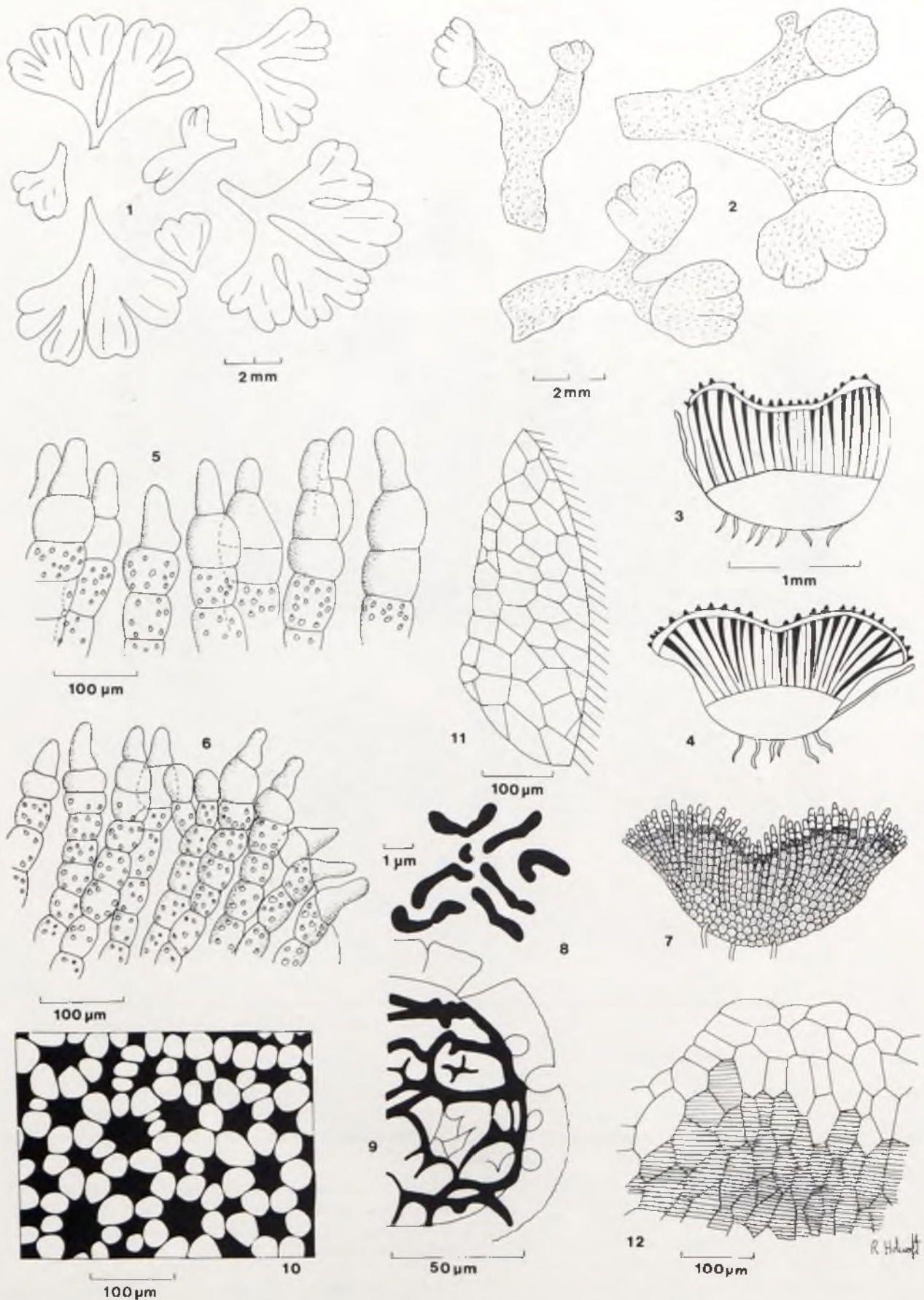


FIG. 4. — *Riccia alatospora* [A. V. Duthie 5004 (BOL) = CH 1007 (PRE)]; 1–4, 10–12, Naudé s.n., BOL; 9, E. G. H. Oliver 8058, PRE, 5–8]. Structure of the thallus. 1, fresh thalli; 2, shrinking thalli; 3, 4, cross sections of thallus; 5, 6, epithelium; 7, detailed cross section of thallus; 8, chromosomes; 9, spore with notch and perforations in wing; 10, air canals in horizontal section; 11, 12, ventral scales. (1–6, 9–12 by O. H. Volk; 7 by R. Holcroft; 8 by T. Bornefeld.) Scale bar 1, 2 = 2 mm; 3, 4, 7 = 1 mm; 5, 6, 10–12 = 100 µm; 8 = 1 µm; 9 = 50 µm.

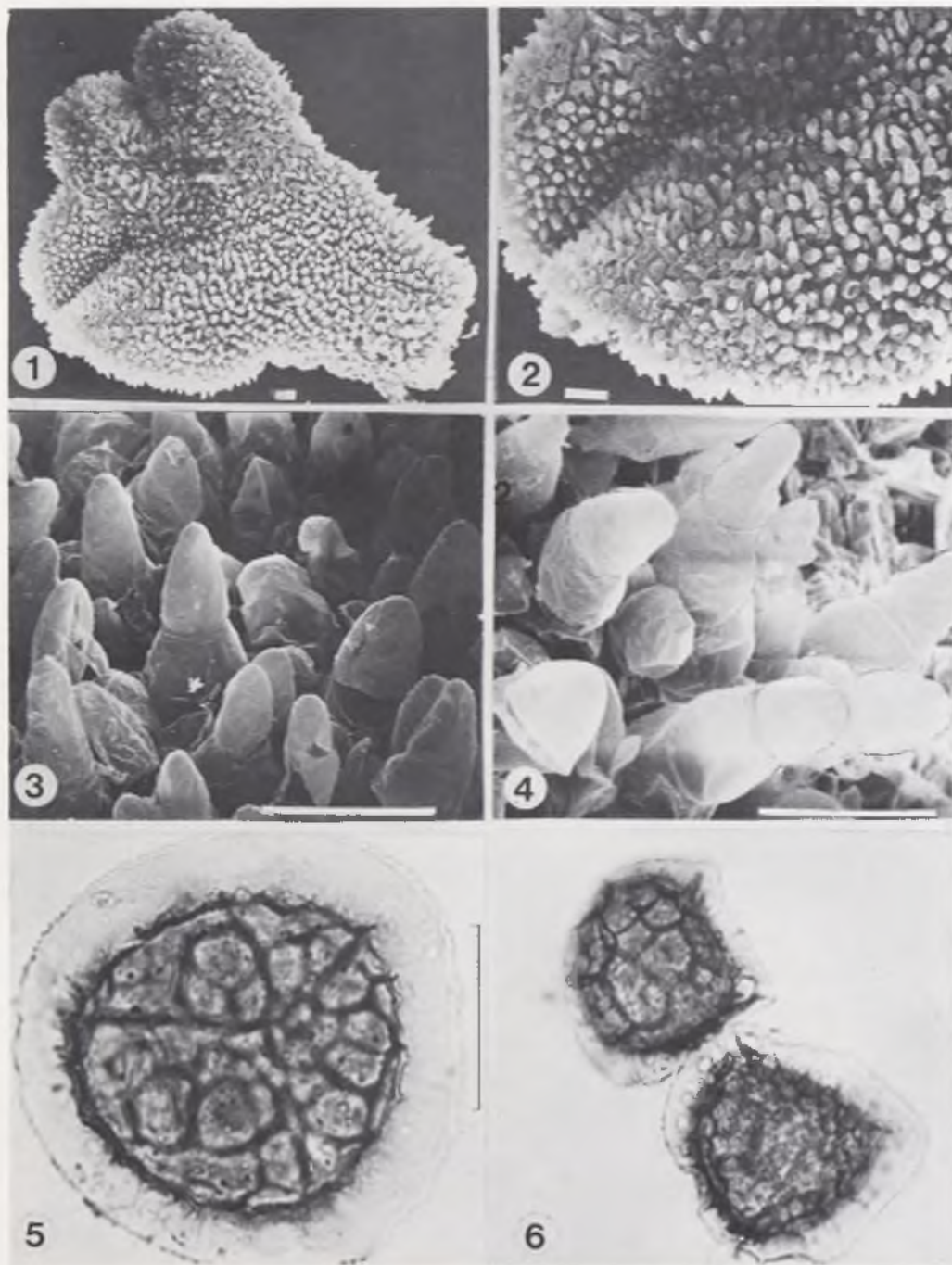


FIG. 5. — *Riccia alatospora* [E. G. H. Oliver 8058, PRE 1-4; A. V. Duthie 5004 (BOL) = CH 1007 (PRE), 5, 6]. Thallus, epithelium and spores. 1, 2, thallus; 3, 4, terminal cells of the epithelium; 5, proximal face of spore; 6, distal and proximal faces of spore. (1-4 SEM micrographs; 5-6 L.M. photographs by S. M. Perold.) Scale bar = 50 μ m.

TABLE 4. — *R. alatospora*, size (in μ m) of the cells of the epithelium and its other parts on cross section (cultivated plants of Oliver 8058)

	Average size		Length: Breadth	Variation in size	
	Length	Breadth		Length	Breadth
Terminal cell	48	35	1,4:1	40-55	30-40
2	50	47,5	1,0:1	35-75	40-60
Basal cell	44	60	0,7:1	40-60	45-80
Total length	142			115-190	
Chlorenchyma	40	55	0,7:1		
	55	60	0,9:1		

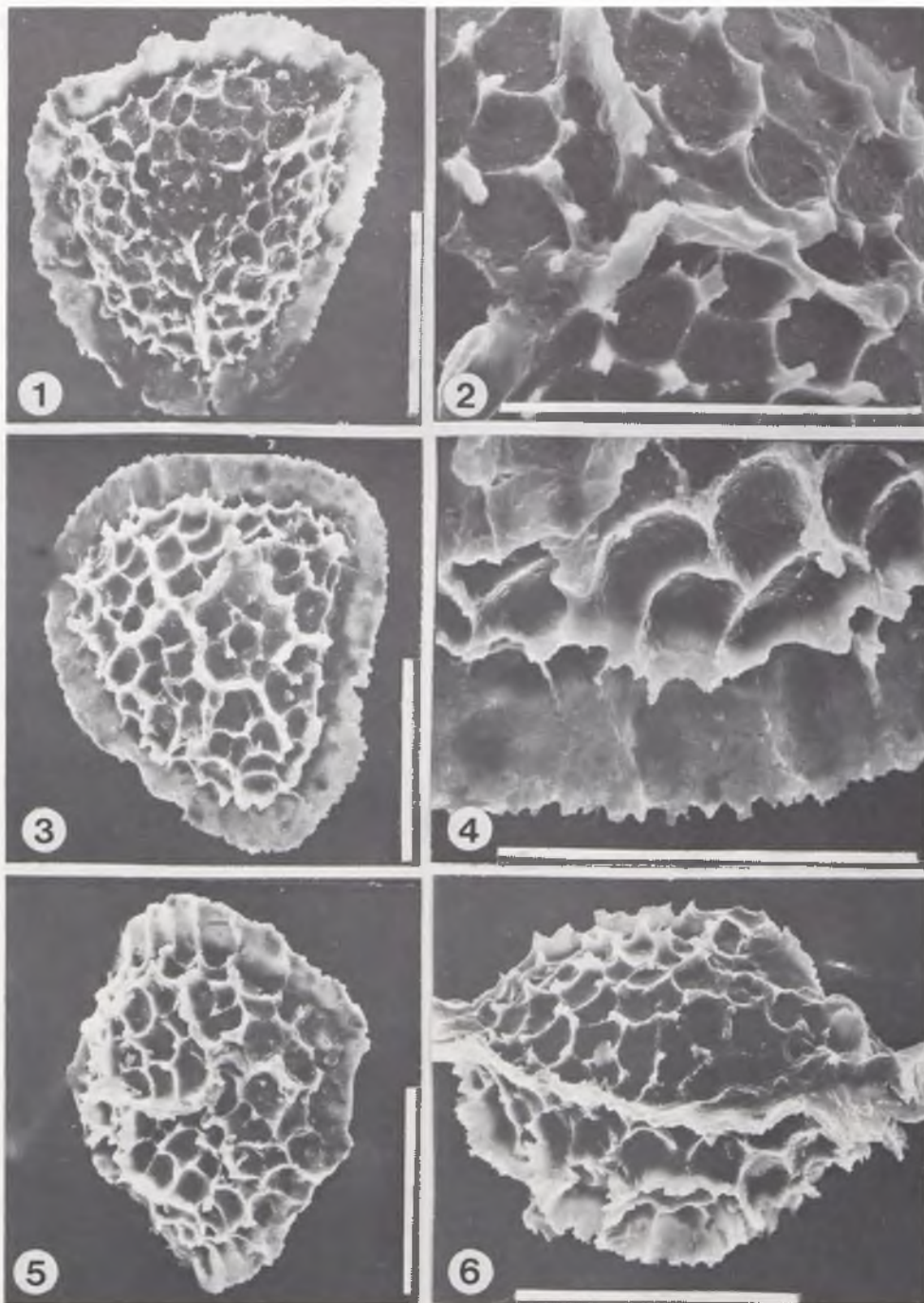


FIG. 6. — *Riccia alatospora* [A. V. Duthie 5004 (BOL) = CH 1007 (PRE)]. Spores. 1, proximal face; 2, apex; 3, 5, distal face; 4, margin; 6, side. (SEM micrographs by S. M. Perold.) Scale bar = 50 μ m.

which bear mostly smooth, occasionally tuberculate rhizoids. *Antheridia* scattered, ostioles colourless, 150 μ m long. *Archegonia* along centre of thallus, neck purple, 90 μ m long. *Sporangia* bulging, up to 0.5 mm in size, containing about 150–200 spores each. *Spores* (Fig. 6) with diameter (90–) 110 (–125) μ m, colour brownish-yellow to straw-coloured, semi-transparent, shape triangular-globular, polar, wing broad 12.5–15 μ m wide, slightly and irregularly wavy (Fig. 6.4) margin finely crenulate to denticulate, sometimes partly eroded, occasionally with round perforations (Fig. 4.9), distal (outer) face with 4 or 5 large areolae in the centre (Fig. 6.3, 6.5), up to 40 μ m across, formed by thick crenulate ridges 12 μ m high, partially or completely subdivided into

smaller areolae by low ridges, often radiating star-like from the centre; marginally a ring of smaller areolae surround large central ones; ridges occasionally extend across wing (Fig. 6.5), proximal (inner) face with apex acute and high suture ridges, triadate mark distinct (Fig. 6.1, 6.2), each facet with about 30 smallish complete or incomplete areolae, 12.5 μ m across, with spinous thickenings at angles of areolae. Chromosome number $n = 8$ (Bornefeld) (Fig. 4.8).

R. alatospora grows in dense colonies in flat depressions on rock outcrops, periodically submerged or wet with winter rain and then dried out for long periods of time. They survive by producing many

bulbils (60–70 per cm²): most of the thallus shrinks and accumulates foodstuff in its tip (Fig. 4.2). Soil very shallow, consisting of decomposed granite mixed with fine sand and dust, dark grey in colour, pH 5.3 (Oliver 8058). In her letter to Sim (10 June 1929) Duthie wrote: 'I have found it growing in some abundance in hollows on a dome-shaped boss of granite . . . These hollows, some of which are several feet across, are very damp during our rainy season and often fill up with water. The little species . . . grows on damp sand.'

R. alatospora is closely related to *R. duthieae*. It is distinguished from it by its smaller thalli but larger spores with very broad and often perforated and eroded wings. It is endemic to the Cape and since its initial collection in 1929, is known only from Stellenbosch.

CAPE. — 3318 (Cape Town): Stellenbosch Platklip (–DD), Aug. 1933 *Duthie* 5004 (BOL); *Duthie* 5324 (BOL); Oct. 1935 A. Naude s.n. (BOL); Aug. 1983 E. G. H. Oliver 8058 (PRE); Nov. 1935 O. Pretorius s.n. (BOL).

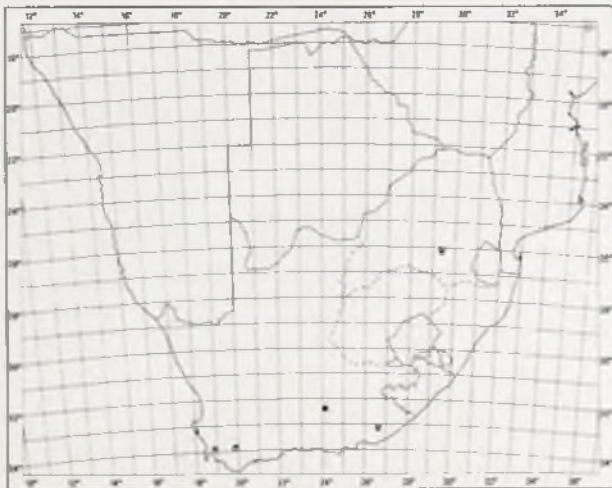


FIG. 7. — Distribution map of • *Riccia duthieae* and + *R. alatospora*.

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UITTREKSEL

Twee nuwe spesies van Riccia, R. duthieae en R. alatospora word beskryf. Albei spesies behoort tot die seksie Piliifer Volk (1983) wat gekenmerk word deur die unieke samestelling van die dorsale epiteel wat bestaan uit los kolomme selle.

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