

## Studies in the genus *Riccia* (Marchantiales) from southern Africa. 21. *R. stricta*, *R. purpurascens* and *R. fluitans*, subgenus *Ricciella*

S.M. PEROLD\*

**Keywords:** Marchantiales, *Riccia fluitans*, *R. purpurascens*, *R. stricta*, southern Africa, subgenus *Ricciella*, taxonomy

### ABSTRACT

Lindenberg (1836) regarded and published *Riccia stricta* as a variety of *R. fluitans* L. Subsequently, Nees (1838) and Gottsche *et al.* (1846) also treated it as a variety. Trevisan (1877) raised its rank and published the epithet, *Ricciella stricta* Trevis. *Ricciella* is, however, regarded as a subgenus; *Ricciella stricta* is, therefore, transferred to *Riccia stricta* (Lindenb.) Perold. It is described in detail and illustrated. *R. purpurascens* Lehm. & Lindenb., a related endemic species, is also more fully described than before and illustrated. *R. fluitans* L. apparently does not occur naturally in southern Africa. As far as is known, a single local specimen of it was introduced.

### UITTREKSEL

Lindenberg (1836) het *Riccia stricta* as 'n variëteit van *R. fluitans* L. beskou en gepubliseer. Vervolgens het Nees (1838) en Gottsche *et al.* (1846) dit ook as 'n variëteit beskou. Trevisan (1877) het dit tot die rang van spesie verhef en het die naam *Ricciella stricta* Trevis. gepubliseer. *Ricciella* word egter as 'n subgenus beskou; derhalwe word *Ricciella stricta* na *Riccia stricta* (Lindenb.) Perold oorgeplaas. Dit word hier volledig beskryf en geïllustreer. *R. purpurascens* Lehm. & Lindenb., 'n verwante endemiese spesie, word ook meer volledig as voorheen beskryf en word geïllustreer. *R. fluitans* L., kom skynbaar nie natuurlik in suidelike Afrika voor nie. Sover bekend, is die enkele lokale voorbeeld daarvan ingevoer.

#### 1. *Riccia stricta* (Lindenb.) Perold, comb. nov.

*R. fluitans* L. var.  $\delta$  *stricta* Lindenb., Monographie der Riccien 84 (1836).—var.  $\delta$  Nees, Naturgeschichte der europäischen Lebermoose 4: 440 (1838).—var.  $\epsilon$  *stricta* Gottsche *et al.*, Synopsis Hepaticarum 610 (1846). *Ricciella stricta* (Lindenb.) Trevis. in Memorie de Reale Istituto Lombardo Ser. 3,4: 62 (1877). Type: Cape, Philipstown, *Ecklon s.n.* (BM-Herb. Lindenb. in Herb. Hampe, holo!). Philipstown, the locality given on the label, is in the central Cape Province, and not in the south-western part of it as indicated by Nees (1838): 'Vorgebirge der guten Hoffnung bei Phillipstown (sic) und Krakakamma', as well as by Gottsche *et al.* (1846): 'Promontorio Bonae Spei'. The substrate 'häufig auch an Bäumen wachsend' or 'ad arborum truncos', as reported by Lindenberg (1836), Nees (1838) and Gottsche *et al.* (1846), is highly suspect: it is not mentioned on the specimen label, neither has this been observed for any *Riccia* species; moreover, soil particles were found with the specimen in the packet.

#### Invalidly published or unpublished synonyms:

*Ricciella tenerrima* Steph. ined. (Icones Ineditae), Natal, dist. Alexandra Sta., Dumisa, *Rudatis* 1291 (M!).

*Ricciella dinteri* Steph. ined., Dinter: 136 (1926), South West Africa [Namibia], Okozongomuinja, *Dinter* 1951.

*Riccia stricta* A.V. Duthie ined., in Arnell: 37 (1963).

*Thallus* monoicous, ?perennial, in long, narrow, to somewhat wider ribbons (Figures 1A; 2A), forming dense, tangled masses, small to medium-sized; branches

repeatedly symmetrically or asymmetrically furcate, moderately to widely divergent, 15–20 mm long, segments generally up to 5 mm long, occasionally longer, (0,2–) 0,5–0,8(–1,2) mm wide, 0,25–0,35(–0,5) mm thick, in section (1–)2–3(–4) or more times wider than thick (Figure 1E, F), linear, apex often bulbous, especially when forking imminent, to slightly narrower and somewhat tapering, notched (Figure 2C) and only grooved toward apex in living plants; bright green, often flecked or streaked with purple along margins and flanks; margins rounded, obtuse to subacute, flanks vertical to sloping obliquely to almost parallel with ventral face, ventral face gently rounded to flat, green, sometimes giving rise to stolons (Figure 1B); when dry, groove more pronounced and seemingly longer, dorsally light green and flattened, to not much altered.

*Anatomy:* dorsal epidermis forming flat cover over elongated air chambers, cells long-hexagonal, 42–65  $\times$  25  $\mu$ m (Figure 1C), smaller at margins and isodiametric,  $\pm$  25  $\mu$ m wide; air pores small,  $\pm$  17  $\mu$ m wide, more numerous toward apex, surrounded by a ring of 5 or 6 smaller,  $\pm$  12,5–17,5  $\mu$ m wide, thin-walled, oval companion cells, partly overlying thicker-walled epidermal cells (Figure 1C); assimilation tissue 100–500  $\mu$ m thick, occupying less than  $\frac{1}{2}$ , to most of thickness of thallus, air chambers lengthwise elongated, in 1 or 2 layers, up to 65  $\mu$ m wide, separated by chlorophyllose cellular plates, cells in one layer, isodiametric, 25–40  $\mu$ m; storage tissue 150–500  $\mu$ m thick, occupying ventral part of thallus, cells rounded,  $\pm$  25  $\mu$ m wide; ventral epidermal cells elongated, 17–20  $\mu$ m wide, bearing rhizoids, 12–15  $\mu$ m wide, mostly smooth, but some tuberculate, abundant at sporangia and terminal bulbous part of occasional stolons (Figure 1B), otherwise rather scanty. *Scales* small, up to 250–500  $\times$  150–400  $\mu$ m, present under apex and rarely protruding slightly (Figure 2C), then at short intervals along ventral

\* National Botanical Institute, Private Bag X101, Pretoria 0001.  
MS. received: 1989.II.27.

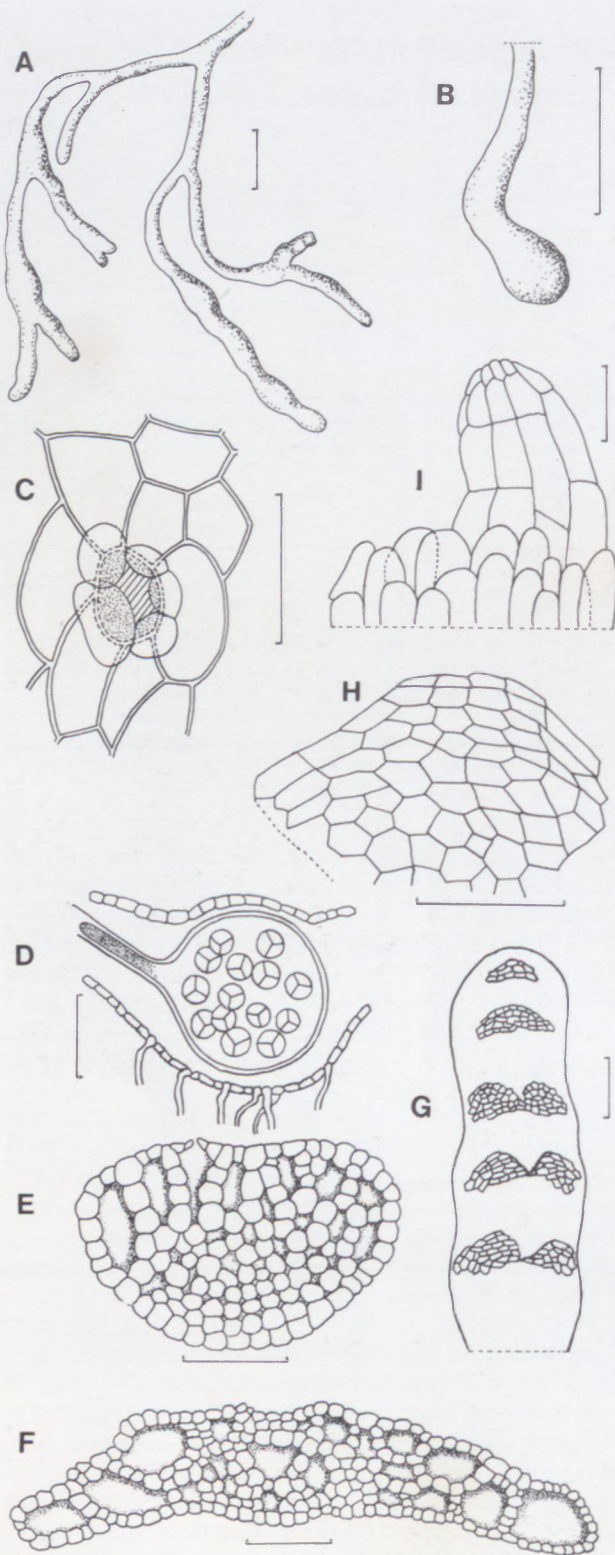


FIGURE 1.—*Riccia stricta*. Morphology and anatomy. A, habit; B, ventral stolon; C, air pore with thin-walled companion cells and thicker-walled epidermal cells; D, longitudinal section through sporangium, showing long archegonial neck and spores still in tetrads; E, transverse section through narrow thallus growing in drier area; F, transverse section through thin, wide thallus from wetter area; G, ventral face with scales; H, single scale; I, antheridial neck with basal collar of conical cells. A, Van Rooy 3539; B, Van Zinderen Bakker 7472; C, S.M. Perold 861; D, S.M. Perold 365; E, G, S.M. Perold 354; F, Magill 6592; H, T.R. Sim PRE-CH 1119; I, S.M. Perold 842. Drawings by J. Kimpton. Scale bars on A, B = 1 mm; C, I = 50  $\mu$ m; D, F, G = 200  $\mu$ m; E, H = 100  $\mu$ m.

face, up to five (Figure 1G), sometimes also at furcations, obtusely triangular, concave, single (Figure 1H), or split into two half-scales, but remaining connected at base, fragile, hyaline or purple, cells 4–6-sided, isodiametric, 50–65  $\mu$ m, 1 or 2 rows toward apex wider than long. *Antheridia* near apex, and more proximally, single, at intervals medianly along branches, necks hyaline, conspicuous, 150–200  $\mu$ m long, basally surrounded by a collar of low, hyaline, conical cells, 37–50  $\times$  30  $\mu$ m (Figure 1I). *Archegonia* median, up to 3 per segment, serially arranged. *Sporangia* frequently at wider and always at thicker sites along thallus, protruding conspicuously on ventral face, subspherical and obliquely orientated (Figure 1D),  $\pm$  600  $\mu$ m wide, containing  $\pm$  270 spores each; neck purple, long, sloping at an angle toward, and opening into an apically directed, shallow furrow, its 'blind' end fringed with a few, erect, hyaline, conical cells (Figure 2H). *Spores* (50–)62–70(–75)  $\mu$ m in diameter, triangular-globular, polar, light brown, semi-translucent; wing thick,  $\pm$  7,5  $\mu$ m wide, usually wider at perforated or notched marginal angles, with a row of fine granules along edge, margin crenulate; ornamentation reticulate on both spore faces, but different: distal face (Figure 3D–F) highly convex, with (4–)5–6 large, deep areolae across diameter of spore, 17–20  $\mu$ m wide, with central pillar or boss, from which several low ridges radiate outward, sometimes forming a network, areolar walls rounded, thick,  $\pm$  3–4  $\mu$ m wide and up to 7,5  $\mu$ m high, extending onto wing, sometimes sparsely granulate; proximal face (Figure 3A–C) with triradiate mark very prominent, up to 5  $\mu$ m high and wide, frequently even wider toward marginal angles at join with wing, each facet with 6–10 areolae, some incomplete, often subdivided by thin, faint, radiating ridges, walls thin,  $\pm$  5  $\mu$ m high, markedly raised at nodes and sometimes joined (Figure 3A). *Chromosome number*  $n = 8$  (Bornefeld 1989).

*R. stricta* grows on damp soil or mud, sometimes in association with other *Riccia* species, e.g. *R. natalensis* Sim, *R. crystallina* L. emend. Raddi, *R. cavemosa* Hoffm. emend. Raddi, and with *Anthoceros* spp. Occasionally it is aquatic and floats in masses on still water or is submerged. The land form of *R. stricta* sometimes forms bulbils at the apices of the thalli (Volk 1984) to survive drought conditions, and also to store food reserves; occasionally propagation is by ventral stolons (Figure 1B).

*R. stricta* is widely distributed in the summer rainfall area and is one of the commonest *Riccia* species in southern Africa (Figure 4). Its range extends further northwards into central Africa: Arnell (1956) reported it from Masai Province in Kenya, and Stephani from Usambara as *R. fluitans* (Stephani in Brunthaler 1913) (see also 'Specimens examined').

Like the other members of the *R. fluitans* complex, *R. stricta* is highly sensitive to the water supply and humidity. It is therefore very variable in its morphology, the thalli generally ranging from thicker and narrower (Figure 1E) in drier localities, to thinner and wider (Figure 1F) in wetter places.

It is well known that species in the *R. fluitans* complex are very variable and notoriously difficult to distinguish from one another, ideally requiring cultivation under similar conditions (Berrie 1964). In Table 1, *R. stricta* is

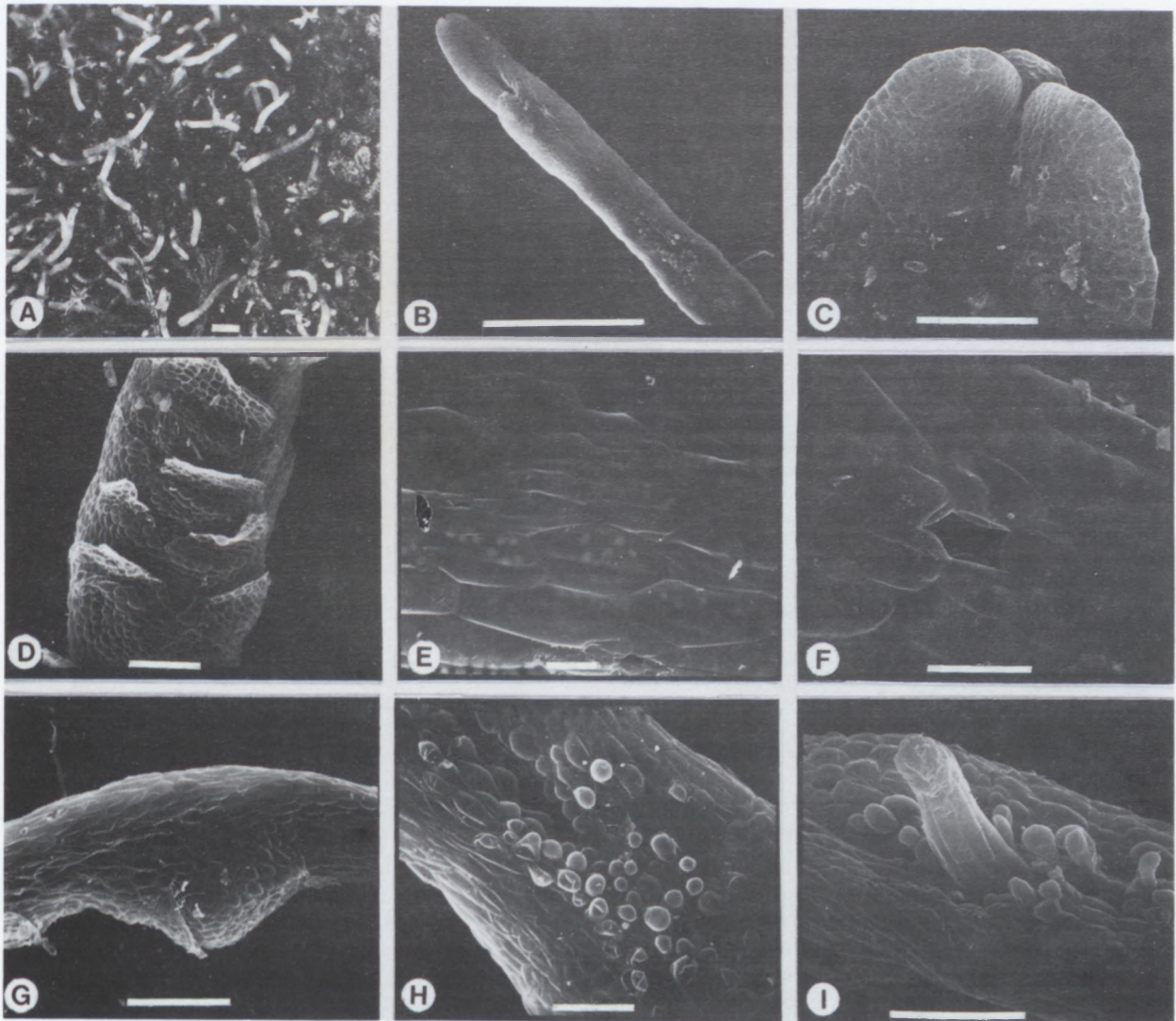


FIGURE 2.—*Riccia stricta*. Morphology and anatomy. A, terrestrial thalli in cultivation; B, apical part of branch with archegonial grooves, fringed by conical cells; C, apex of thallus, with apical notch, scale protruding slightly behind notch; D, ventral scales, single above, split into two below; E, air pores and dorsal cells; F, air pore with companion cells; G, sporangium protruding ventrally; H, apically directed archegonial groove with conical cells; I, antheridial neck with collar of conical cells at the base. A, S.M. Perold 2524; B, Glen 1832; C–I, S.M. Perold 2499. A, by A. Romanowski; B–I, SEM micrographs. Scale bars on A, B = 1 mm; C–D, G–I = 100  $\mu\text{m}$ ; E, F = 10  $\mu\text{m}$ .

compared to *R. fluitans sensu stricto*, *R. canaliculata* and *R. purpurascens*.

Markham (pers. comm.) found a wide range of flavonoid compounds in a specimen of *R. stricta* (S.M. Perold 2611), most of which he had reported (Markham *et al.* 1978) for *R. fluitans*; in fact, no components were found in the specimen by which it could be distinguished chemically from *R. fluitans*. This serves to confirm the close relationship of the two species.

*R. fluitans* L. *sensu stricto* does not appear to occur naturally in southern Africa. A single specimen of it, leg. Stephens BOL 25511, collected in a fishpond in Rondebosch, Cape, was apparently introduced along with other aquatic plants from Europe (note on packet in Schelpe's handwriting). None of the other southern African specimens that were examined, had the same appearance as this, which has somewhat thinner thalli, shorter branches and smaller air chambers with more distinctly visible walls, when viewed from above; dried plants have a slightly 'crinkled', not smooth, appearance

(for differences between the species, see Table 1). Earlier reports of *R. fluitans* from southern Africa by Krauss (1846), Stephani (1913), Sim (1926) (as *R. fluitans-limicola*), and Arnell (1963), have not been verified. The checklist by Magill & Schelpe (1979) records it, and is referred to by Mahu (1985) as proof of its presence in southern Africa. This list, however, was a preliminary account largely based on previous records.

Much of the tropical African material identified as *R. fluitans* or *R. fluitans sens. lat.* may also belong to *R. stricta*. Jones (1957) found that the spores of two of his African collections (655 and 826) named *R. fluitans sens. lat.*, differed from those of European material and Bizot *et al.* (1978) concluded the same for material from Kilimanjaro. The spores illustrated by Jones (1985) (*Foster 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*

TABLE 1.—Comparison of some characters of *R. stricta*, *R. fluitans* *sensu stricto*, *R. canaliculata* and *R. purpurascens*

	<i>R. stricta</i>	<i>R. fluitans</i> *	<i>R. canaliculata</i> *	<i>R. purpurascens</i>
Habitat	aquatic and terrestrial	aquatic and terrestrial	terrestrial	strictly terrestrial
Branch length	15–20 mm	10–15 mm	10–20 mm	9–17 mm
Branch width	0.2–0.5–0.8–1.2 mm	0.8–1.0–1.5 mm	0.6–0.8 mm	1.5–2.0 mm
Branch thickness	0.25–0.35–0.5 mm	± 0.2 mm	± 0.35 mm	0.4–0.6 mm over median, ventrally keeled part thinning towards margins
Apex	slightly narrower than rest of thallus, or bulbous; notched	generally wider than rest of thallus	narrower than rest of thallus, attenuate; notched	slightly narrowed; not emarginate
Groove	only visible in living plants	not very distinct apically, otherwise absent	distinct when dry, otherwise shallow or absent	hardly distinct apically, soon wide and shallow to absent
Walls of air chambers from above	not clearly marked out in distinct air chambers	distinctly areolate with walls of rather smaller air chambers clearly visible	indistinct	indistinct
Ventral scales	slightly protruding ventrally at apex (Figure 2C), other scales paired or single	apical scale not protruding, 2 or 3 others mostly single	single scale protruding ventrally at apex; other scales are mostly paired, sometimes with central lanceolate appendage	small, evanescent, difficult to detect, up to 3 pairs toward apex
Stolons	sometimes present	not mentioned	not mentioned	frequently present
Sexuality	monoicous	dioicous	monoicous	dioicous
Fertility	quite often	extremely rare	quite often	often
Sporangium orientation	oblique	± horizontal	oblique	vertical
Spore diameter	(50–)62–70(–75) µm	(50–)56–75(–80) µm	(70–)75–95(–110) µm	(65–)70–80(–88) µm
Wing	thick, 7.5 µm wide; single pore at marginal angles	sinuate, 4–8 µm wide; single pore at marginal angles	undulating, ± 7 µm wide; single pore at marginal angles	thick, up to 7.5 µm wide; double pores at marginal angles
Triradiate mark	thick and very prominent, 5 µm high	fairly distinct, thin, and 4–5 µm high	not pronounced	prominent, edged with row of papillae
Proximal face	on each facet 6–10 areolae, some incomplete or subdivided by faint radiating ridges	up to ± 10, mostly incomplete areolae on each facet	areolae quite incomplete, probably ± 13 on each facet	areolae rarely complete, walls short and broken, edged with spines, papillae or granules
Distal face	(4–)5–6, large, deep areolae across diameter, 17–20 µm wide, with central boss, walls thick	5–7 incomplete areolae across diameter, 8–16(–20) µm wide, mostly empty, walls fairly thick	3–5(–6) complete areolae across diameter, 15–25(–30) µm wide; walls thin	4–6, incomplete areolae across diameter, ± 20 µm wide; walls densely fringed with granules
Distribution	common and widespread in southern Africa, extending northwards	reputedly world-wide	reputedly world-wide	winter rainfall area of western Cape only

\* partly based on Jovet-Ast (1986); Paton (1973).

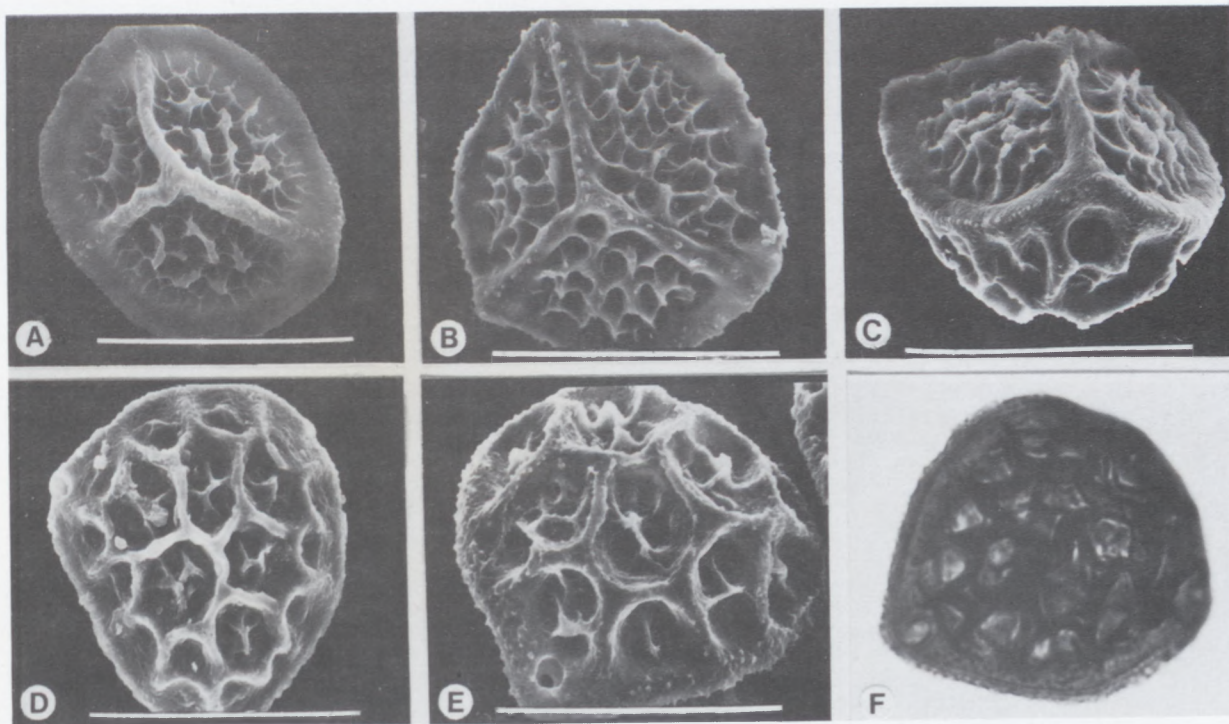


FIGURE 3.—*Riccia stricta*. Spores. A, B, proximal face; C, proximal face in side view; D, F, distal face; E, distal face from the side. A, Van Rooy 2201; B, T.R. Sim PRE-CH 1090; C, Van der Bijl 10; D, Van Zinderen Bakker 7472; E, F, T.R. Sim 7590. Scale bars on A–E = 50  $\mu$ m; diameter of spore on F =  $\pm$  70  $\mu$ m.

A.V. Duthie in S. Arnell (1963) Hep. South Afr., p. 37, est peut-être identique au taxon reconnu au Shaba.

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.

In spite of the uncertainty concerning the classification of the *R. fluitans* complex, a number of new species have been described in the group in recent years. Examples are: *R. rhenana* Lorb. (1934) (possibly a diploid form of *R. fluitans*); *R. duplex* Lorb. (? a diploid form of *R. canaliculata* (Berrie 1964) (see also Stottler & Crandall-Stottler 1977); *R. gamsiana* Lorb. (= *R. canaliculata*);

*R. media* Klingmüller (1957); *R. abuensis* Bapna (1962) from India; *R. limicola* Jovet-Ast (1978) from Galapagos; and from Australia, *R. luticola* Na-Thalang, as well as two varieties of *R. duplex* and several of *R. multifida*, all by Na-Thalang (1980). In a new species described from Brazil, *R. jovet-astiae* (Vianna 1988), the SEM micrographs of the spores are very similar to those of *R. stricta* and the differences cited by Vianna between this new species and *R. stricta* are not all significant, for example, specimens of *R. stricta* are not dioicous, but definitely monoicous, although in recently cultured material, antheridia and archegonia were consistently found in separate plants; the spore size exhibits a wide range in the many fertile southern African specimens examined (although Arnell's (1963) figure at 40–50  $\mu$ m, seems a trifle on the small side); the thalli are certainly not always markedly wider at the sporangia either. The thallus branches in *R. jovet-astiae*, however, appear to be rather shorter than in *R. stricta*.

*R. stenophylla* Spruce, one of the 'older' species in this group, also seems to be closely related to *R. stricta*. This is confirmed by examination of the spores of Volk 82/895 from Rio, identified as *R. stenophylla*. These spores are indistinguishable from three specimens in PRE identified as *R. fluitans*: Schiffner 1873/74 (Java), Verdoorn IX 1930 (Java) and Wright CH 810 (? Cuba).

To conclude, perhaps one should bear in mind Meijer's (1958) words of caution, to postpone future splitting of this cosmopolitan species complex, *R. fluitans*, until more detailed studies, based on living material from many parts of its whole range, have been made. *R. stricta*, of course, is not a new species but merely a new combination.

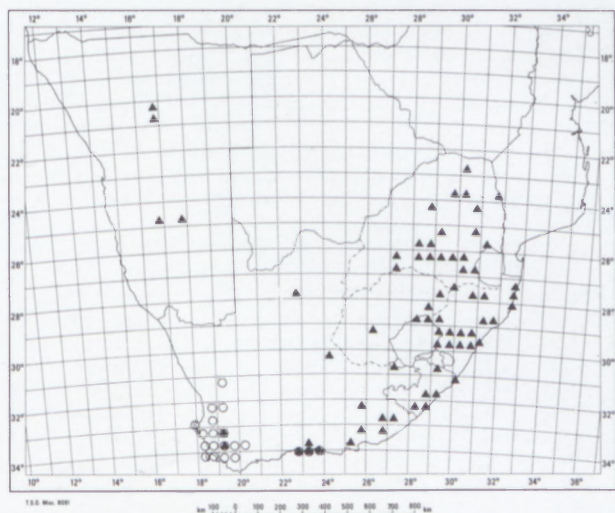


FIGURE 4.—Distribution map of *R. stricta*,  $\blacktriangle$ ; and *R. purpurascens*,  $\circ$ , in southern Africa.

## SPECIMENS EXAMINED

ZIMBABWE.—1725 (Livingstone): Victoria Falls, *Kuun 5307, 5308* (BOL); *T.R. Sim 9056, 9066* (PRE), *PRE-CH 1114* (PRE). 1831 (Marandellas): Marandellas, *Eyles 3885* (BOL). 2028 (Bulawayo): Bulawayo hillside, submerged in stream and on streambank, *Eccles BOL 25757* (BOL); Khama stream, *T.R. Sim 9067 (PRE-CH 1095)* (PRE).

MOZAMBIQUE.—2532 (Lourenço Marques): Maputo, *Junod 324* (PRE); Antioka, Magude, *H.A. Junod* (PRE). Exact localities not given, *Wäger 10, 60* (PRE).

All of the above specimens from Mozambique had been identified as *R. fluitans* or as *R. purpurascens*.

NAMIBIA.—2016 (Otjiwarongo): Waterberg Sta., Groot Waterberg, occasional on moist earth around reservoir (–BC), *Schelpé 4807* (BOL); Farm Otjihaenamaparero (OTJ 92), unter Wasser, kleine Polster bildend, im Quellbach bei Dinosaurierspuren (–CD), *Giess 15236* (PRE). 2416 (Maltahöhe): Karab MAL23 (–DA), *Volk 01261* (M, PRE); 2417 (Mariental): Haribes (–DA), *Volk 12460* (M, PRE); Pavienskolk, Haribes (–DA), *Volk 5313* (M, PRE).

TRANSVAAL.—2230 (Messina): Venda, Nwanedi Nat. Park, river nr compound manager's house, submerged (–CB) *Glen 1832* (PRE); Sebasa, ± 3 miles [4.8 km] due S of Lake Funduzi, submerged in spring and small stream (–CD), *Meeuse 9411* (PRE). 2329 (Pietersburg): Letaba Valley, 23 km along road R528 from Tzaneen to Haenertsburg, at seepage area (–DD), *S.M. Perold 2455* (PRE). 2330 (Tzaneen): Lemana (–AA), *Junod PRE-CH69* (PRE); Lemonia Wood, Spelonken (–CA), *Junod 3 (PRE-CH1049)* (PRE); Woodbush For. Res. nr waterfall (–CC), *Magill 6592* (PRE). 2331 (Phalaborwa): Kruger Nat. Park, east of Singwedzi road, Letaba River (–AB), *Brandt 5360* (BOL); Lebombo Mts, potholes on Bangu Creek, just S of Olifants River (–DD), *Magill 5039* (PRE). 2428 (Nylstroom): Doorndraai Nat. Res., 35 km NNW of Naboomspruit, in vlei above dam, on mud (–BD), *S.M. Perold 438* (PRE); Platrivier, 5 km W of Warmbaths, submerged in stream (–CC), *S.M. Perold 2611* (PRE). 2430 (Pilgrims Rest): SW of Phalaborwa, Farm Parsons, along Olifants River (–BB), *Venter 12199* (PRE). 2528 (Pretoria): Pretoria, Rietfontein (–CA), *H.A. Wäger 18* (PRE); Malanspruit, on road from Moloto to Cullinan, submerged, in dense masses (–DA), *Mauve & Venter 5077* (PRE); 18 km NE of Cullinan, 'Grotte', above stream (–DA), *S.M. Perold 2600* (PRE). 2529 (Witbank): Loskop Dam Nat. Res., Rhenosterhoek, in damp gully under vegetation on edge of exposed rock sheet (–AD), *Reid 1106* (PRE). 2530 (Lydenburg): Sabie, Bridal Veil Falls, on sandy, muddy shallow bank on path to falls (–BA), *Thompson 295* (PRE). 2531 (Komatipoort): Barberton (–CC), *Hendry PRE-CH 1107* (PRE). 2627 (Potchefstroom): Gerhard Minnebron, by Oog, in stromende water (–AC), *Louw 1621* (PRE); same locality *Ubbink 1154* (PUC); noord van Kleerkskraal, by Eerste Oog (–AC), *Ubbink 1004* (PRE); Pienaarkamp by permanente drinkgat op vertikale walle (–CA), *Ubbink 964* (PRE); Potchefstroom, north of Mooirivier (–CA), *Goosens PRE-CH 3672* (PRE). 2628 (Johannesburg): Johannesburg, Melville (–AA), *T.R. Sim PRE-CH 1088* (PRE); Eloff (–BA), *T.R. Sim PRE-CH 1083* (PRE). 2629 (Bethal): 15 km along road R545, between Balmoral and Ogies, pan at roadside, at turnoff to Roodepoortjie (–AA), *S.M. Perold 360* (PRE); 17 km W of Hendrina, on soil, at edge of pan (–BA), *S.M. Perold 354* (PRE); 5 km N of Hendrina, on soil next to road (–BA), *S.M. Perold 356* (PRE); 24 km from Bethal on road R29 to Ermelo, at furrow in vlei nr dam (–BC), *S.M. Perold 365* (PRE). 2630 (Carolina): Chrissiesmeer, nr lake in damp furrow (–AD), *S.M. Perold 1051* (PRE); ± 21 km from Panbult on road to Amersfoort (–CD), *Germishuizen 2922a* (PRE); 3 km S of Amsterdam on road to Piet Retief, on damp soil (–DA), *S.M. Perold 1071* (PRE).

O.F.S.—2729 (Volksrust): 31 km NE of Verkykerskop on road from Memel, Farm Swiza, at seepage (–CD), *S.M. Perold 1277* (PRE). 2828 (Bethlehem): 23 km W of Harrismith on road to Kestell, at turnoff to Rydal Mount, on damp rock outcrop (–BD), *S.M. Perold 1284* (PRE). 2926 (Bloemfontein): Bloemfontein, in small dry pan nr Lambton's plantation, SW corner of College grounds (–AA), *Van Zinderen Bakker 7472* (BOL).

NATAL.—2729 (Volksrust): Majuba Nek, on wet soil in shade of rocks (–BD), *Herschel PRE-CH 1089* (PRE). 2730 (Vryheid): Vryheid (–DD), *T.R. Sim PRE-CH 1074, PRE-CH 1120* (PRE); hill above Vryheid (–DD), *T.R. Sim PRE-CH 1123* (PRE). 2731 (Louwsburg): Ngoma State For. Res., along sides of damp pathway through Ntendeka Forest (–CD), *Nicholas 1194* (PRE). 2732 (Umbombo): Imbezane, on earth bank of stream

(–BC), *Eyles 1405* (PRE); Manywana River, at crossing of southern dirt road to Sodwana Bay, NW of False Bay (–CD), *Magill 5385* (PRE); Ubombo, Sodwana Bay, floating in river (–DA), *Gerstner 705* (PRE). 2828 (Bethlehem): Mont-aux-Sources, Saxton, Tugela (–DD), no collector's name or number (BOL). 2829 (Harrismith): Oliviershoek Pass, between Harrismith and Bergville, at waterfall on wet cliff (–CA), *Van Rooy 1167* (PRE). 2831 (Nkandla): Nkandla, inheems bos by swembad en munisipale karavaanpark Eshowe op dooie drywende blare in poel met stilstaande water (–CD), *Botha & Van Wyk 1016* (PRE); same locality, *Nixon 109* (BOL); Ngoya (–DC), *T.R. Sim PRE-CH 1105* (PRE). 2832 (Mtubatuba): St Lucia Res., Fanie's Island, Umkhiwane trail, at side of ditch (–AB), *Glen 2029* (PRE). 2929 (Underberg): Giant's Castle (–AB), *Symons PRE-CH 1104* (PRE); bush below Cathkin Peak (–AB), *T.R. Sim PRE-CH 1103* (PRE); Sweetwaters, at stream (–BA), *T.R. Sim PRE-CH 1092* (PRE); Estcourt, along stream (–BB), *West PRE-CH 3668* (PRE); Nottingham Road (–BD), *Van der Bijl PRE-CH 1112* (PRE); Sani Pass Hotel, 1 km beyond, streamlet at roadside, partly submerged (–CB), *S.M. Perold 2499* (PRE); Xumeni For. Res. (–DD), *Doidge PRE-CH 3580* (PRE). 2930 (Pietermaritzburg): Tweedie (–AC), *G.W. Sim 8093* (PRE); Fort Nottingham Commonage, Lion's River Dist. (–AC), *Hilliard & Burt 10344* (PRE); Howick Falls (–AC), *G.W. Sim PRE-CH 1087* (PRE); Muhwati, New Hanover (–BC), *T.R. Sim PRE-CH 1118* (PRE); Pietermaritzburg, stones in Umsundusi (–CA), *T.R. Sim 7593* (PRE); Town bush (–CB), *T.R. Sim PRE-CH 1106, PRE-CH 1122, PRE-CH 1075* (PRE); nr top of Zwaartkop (–CB), *T.R. Sim PRE-CH 1109* (PRE); Scottsville (–CB), *T.R. Sim PRE-CH 1072* (PRE); Alexandra Park (–CB), *T.R. Sim PRE-CH 1115* (PRE); Carter's Nurseries, under bank on dam overflow (–CB), *Wells 57* (PRE); Pinetown Dist., Everton, on damp shady soil in garden (–DD), *Hilliard & Burt 8151* (PRE); New Germany (–DD), *Moonsammy 14* (PRE), *Van der Bijl 14, 19* (PRE); Durban, Palmiet Nat. Res., wet vertical cliff face above fast-flowing river (–DD), *G. Lambert 6* (PRE); Isipingo Flats, on moist, sandy clay along water furrow (–DD), *Ward PRE-CH 5354* (PRE). 2931 (Stanger): Tongaat Sugar Estate Gardens, on rock in pond (–CA), *S.M. Perold 27* (PRE); Verulam, Zwolle (–CA), *Van der Bijl PRE-CH 1097* (PRE). 3029 (Kokstad): Kokstad (–CB), *Mogg PRE-CH 1078* (PRE).

LESOTHO.—2828 (Bethlehem): 38 km W of Oxbow Lodge, seeps in shallow sandstone cave along road (–CB), *Magill 4626* (PRE). 2929 (Underberg): in flats S of Sani border post, alpine meadow (–CB), *Magill 7067* (PRE); Sani Top, at disused airstrip, N of mountaineer's chalet, on vertical earth wall of ditch (–CB), *S.M. Perold 2521* (PRE); Sani Top, S side of dam, nr border post, vertical earth wall of ditch (–CB), *S.M. Perold 2528* p.p., 2529 p.p. (PRE).

TRANSKEI.—3128 (Umtata): 4 km from Elliotdale on road to 'The Haven', disturbed, wooded stream (–DC), *Van Rooy 2141* (PRE). 3129 (Port St Johns): Hluleka Nat. Res., Hluleka Forest, on sandy soil (–CD), *Van Rooy 2201* (PRE). 3130 (Port Edward): Mutentu River (–AA), *Burt Davy PRE-CH 110* (PRE). 3228 (Butterworth): Kentani Dist., growing on waters' edge and vleis, common (–AD), *Pegler 1354* (BOL, PRE); 9 km from Dwesa along road to Idutywa, wooded road cutting (–BD), *Van Rooy 2089* (PRE); Dwesa Nat. Res., Dwesa For., on shale on streambank (–BD), *Van Rooy 2123* (PRE).

CAPE.—2722 (Olifantshoek): Langeberg (–DD), *Duthie 5384* (BOL). 3024 (De Aar): Phillipstown (sic) (–AD), *Ecklon s.n.* (BM, holo.). 3027 (Lady Grey): Barkly East Dist., 12 km from Lunding's Nek turnoff (–CA), *Thompson 260* (PRE). 3225 (Somerset East): Cradock, Fish River (–BA), *Duthie 5143* (BOL). 3226 (Fort Beaufort): Alice, in dam nr river in village, aquatic, floating on surface (–DD), *Potts 1758* (BOL); Alice, plants on edge of dam, nr river in village (–DD), *Potts 1760* (BOL). 3227 (Stutterheim): Hogsback, indigenous forest (–CA), *McDonald PRE-CH 13422* (PRE); Kingwilliams Town, in water (–CD), *T.R. Sim 313* (PRE). 3319 (Worcester): Tulbagh, Farm Kleinberg, irrigation furrow (–AC), *Duthie 5022, 5391, 5477* (BOL), *Theron 5379* (BOL); Worcester, Hexrivier (–CB), *Naude 5429* (BOL). 3323 (Willowmore): Diepwalle For. Sta., nr Grootboom, on damp soil (–CC), *S.M. Perold 913* (PRE). 3325 (Port Elizabeth): Zuurburg Nat. Park, upper pool (–BC), *B.E. & M. van Wyk 933, 2091, 2093* (PRE); springs at Uitenhage (–CD), *T.R. Sim 9041* (PRE). 3326 (Grahamstown): nearby Grahamstown (–BC), *Britten 2785* (PRE); Round Hill, Oribi Res., on surface of water (–BD), *Wirminghaus 247* (PRE). 3422 (Mossel Bay): nearby Knysna (–BB), *Davey 17009* (PRE). 3423 (Knysna): Knysna, Forest Hall (–AA), *Duthie 5043, 5044, 5220, 5386* (BOL); Belvidere (–AA), *Duthie 5388, 5390* (BOL); Brenton (–AA), *Duthie 5387* (BOL); Woodbourne (–AA), *Duthie 5389* (BOL); Plettenberg Bay (–AB), *Duthie 6004* (BOL); Storms River Mouth, Tsitsikama Nat. Park (–BB), *Wagner 1, 2* (PRE).

2. *R. purpurascens* Lehm. & Lindenb. in Linnaea 4: 371 (1829); Lehmann: 23 (1832); Lindenb.: 451 (1836); Gottsche *et al.*: 611 (1846); Stephani: 363 (1898); Sim: 15 (1926); S. Arnell: 36 (1963). *Ricciella purpurascens* Trevis.: 62 (1877). Type: Cape, Crescit humi in sylvula quercina ad latus boreale et ad radicem montis Tafelberg in Promont. Bonae Spei, *Ecklon s.n.* (Gl., lecto., selected here) (ex Herb. L., ex Herb. Rom.).

*Thallus* dioicous, annual, in thin, somewhat lax strands or ribbons (Figure 5A), frequently overlapping and becoming quite densely massed (Figure 6A), medium-sized to rather large; branches repeatedly and irregularly furcate, 9–17 mm long, segments 1–5 mm long, narrowly to moderately divergent, 1,5–2,0 mm wide, 0,4–0,6 mm thick medianly, over keeled ventral part, lateral wings up to 0,3 mm thick, in section (Figure 5F) 3–5(–7) times wider than thick, linear, apex slightly narrowed (Figure 6B), not emarginate (Figure 6C); groove hardly distinct toward apex, soon becoming wide and shallow or disappearing altogether; light green, sometimes almost translucent, occasionally purple along margins and over gametangia; margins subacute, rather irregularly undulating, winged or attenuate, flanks sloping obliquely to almost flat, green; ventral face flat to narrowly keeled medianly, frequently giving rise to stolons; when dry, yellowish green, thin and flat.

*Anatomy*: dorsal epidermis forming a flat cover over large air chambers (Figure 5C), cells 5-sided or oblong-hexagonal, up to  $110 \times 35$ – $60 \mu\text{m}$ , at apical margin rectangular, smaller,  $45 \times 30 \mu\text{m}$ ; air pores small (Figure 6D), surrounded by (4–)5 radially arranged, thin-walled cells (Figure 5D),  $17$ – $35 \times 12$ – $15 \mu\text{m}$ , partly overlying thicker-walled epidermal cells; assimilation tissue  $\pm 300$ – $400 \mu\text{m}$  thick, occupying most of thickness of thallus, air chambers polyhedral, in 2 layers medianly, uniseriate laterally, separated by chlorophyllose plates, one cell thick; storage tissue mostly only 1–4 layers of cells, angular,  $50$ – $62 \mu\text{m}$  wide; rhizoids arising from ventral epidermis medianly, numerous at sporangia and tips of stolons (Figure 5B),  $\pm 15 \mu\text{m}$  wide, some smooth, others tuberculate. *Scales* small, hyaline, ventral, toward apex only, up to three pairs, remaining attached in the middle, difficult to detect, evanescent. *Antheridia* serially arranged along middle in groups of 2 or 3 with sterile areas in between, bulging above and below (Figure 6F), antheridial necks up to  $200 \mu\text{m}$  long, at base surrounded by collar of hyaline, conical cells,  $\pm 50 \mu\text{m}$  long (Figure 6F). *Archegonia* median, single or in pairs, sometimes adjacent, necks vertically orientated, brownish purple with hyaline tip, opening into a depression (Figure 6E), at base surrounded by conical cells  $30$ – $40 \mu\text{m}$  long (Figure 5E). *Sporangia*  $\pm 550 \mu\text{m}$  wide, causing widening of thallus at maturity, bulging ventrally with surrounding tissue thickening into  $\pm 6$  layers of cells, containing up to 580 spores each. *Spores* (65–)70–80(–88)  $\mu\text{m}$  in diameter, triangular-globular, polar, yellow to bright brown, semi-translucent; wing thick and up to  $7,5 \mu\text{m}$  wide, at marginal angles 2 small pores, one on either side of each arm of triradiate mark, margin finely crenulate; ornamentation incompletely reticulate and different on 2 spore faces: distal face (Figure 7E, F) with 4–6 large, angular, mostly incomplete areolae across diameter,  $\pm 20 \mu\text{m}$  wide, usually subdivided by secondary ridges or a central pillar into smaller areolae, toward margin often reduced to short

ridges only, walls  $\pm 5 \mu\text{m}$  high, densely fringed with granules, slightly raised at nodes; proximal face (Figure

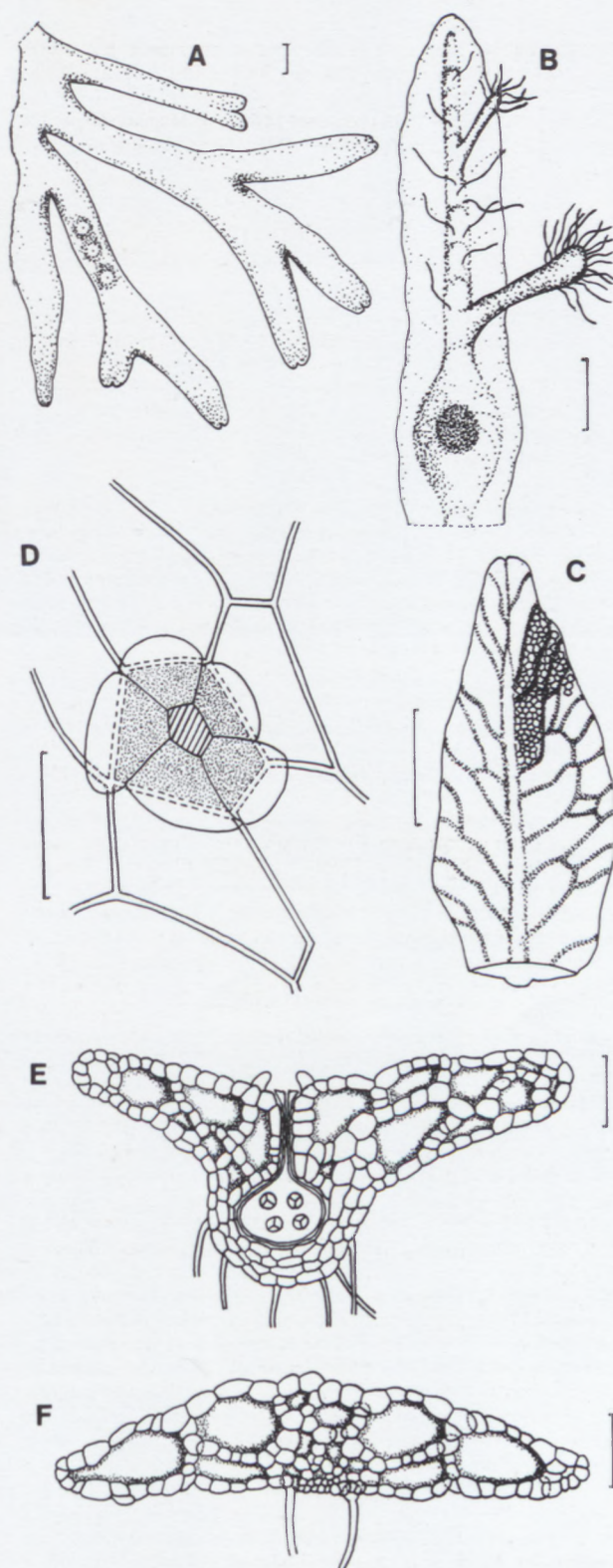


FIGURE 5.—*Ricciella purpurascens*. Morphology and anatomy. A, habit; B, ventral face with stolons and sporangium; C, dorsal face with air chambers and epidermal cells partly drawn in; D, air pore with thin-walled companion cells and thicker-walled epidermal cells; E, transverse section through sporangium, with conical cells at depression; F, transverse section through thallus. A, B, F, Morley 291; C, S.M. Perold 1941; D, E, S.M. Perold 1170. Drawings by J. Kimpton. Scale bars on A, B, C = 1 mm; D =  $50 \mu\text{m}$ ; E, F =  $200 \mu\text{m}$ .

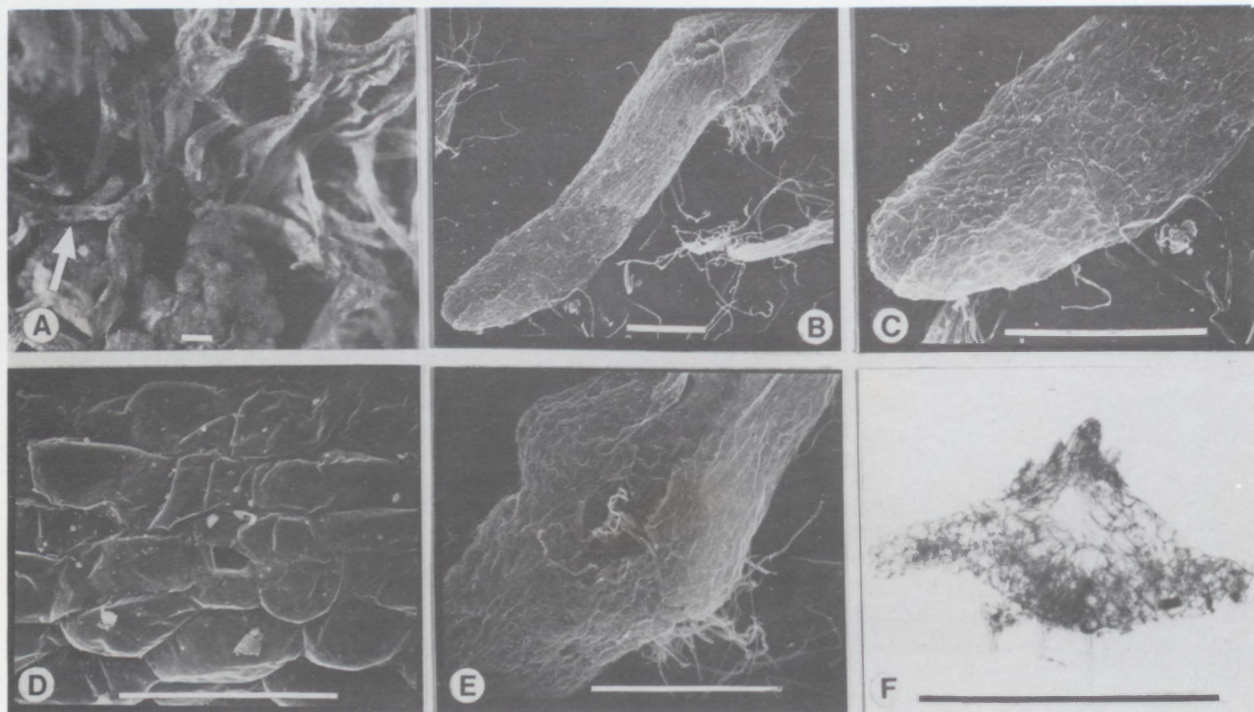


FIGURE 6.—*Riccia purpurascens*. Morphology and anatomy. A, field-grown thalli, arrow indicating row of gametangia; B, branch with sporangium and rhizoids protruding ventrally; C, apex of thallus, not notched, without protruding scale; D, air pore and dorsal cells; E, thallus above sporangium; F, cross section through antheridium, bulging above and below thallus, base of neck with conical cells. A, S.M. Perold 2386; B-E, Koekemoer 284 p.p.; F, S.M. Perold 611. A, by A. Romanowski; B-E, SEM micrographs; F, LM photograph. Scale bars on A-C, E, F = 1 mm; D = 100  $\mu$ m.

7A-D) with triradiate mark prominent,  $\pm 2,5 \mu$ m wide, becoming wider toward marginal angles at juncture with wing, row of superimposed papillae running along the arms, on each of 3 facets rarely any complete areolae, mostly short broken walls, straight or curved, edged with tall uneven spines, warty papillae or low granules. Chromosome number  $n = 8$  (Bornefeld 1989).

*R. purpurascens* grows on damp, sandy soil or on mud, sometimes on streambanks and rarely in light shade, occasionally in association with other *Riccia* species, such as *R. cupulifera* Duthie, *R. bullosa* Link ex Lindenb., *R. crozalsii* Lev. and *R. limbata* Bisch. ex Krauss as well as with *Fossombronia* spp. and *Gongylanthus* spp. It is endemic to the north-western, south-western and southern

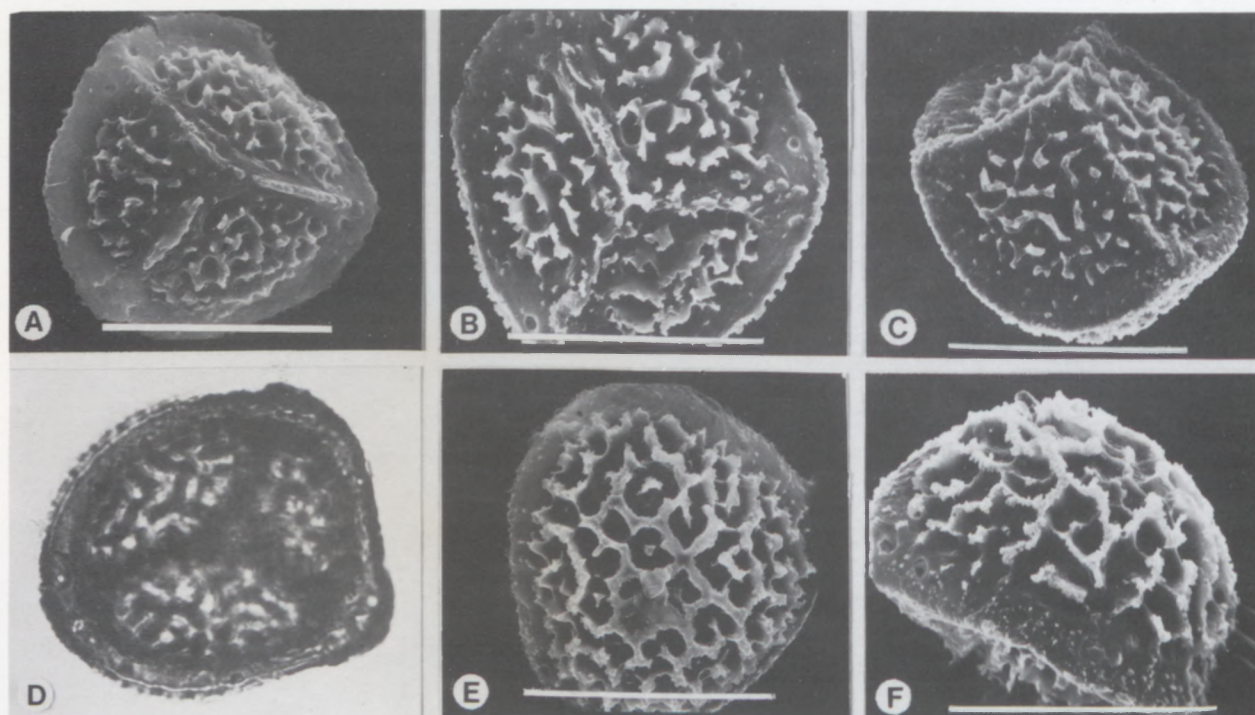


FIGURE 7.—*Riccia purpurascens*. Spores, A, B, D, proximal face; C, proximal face, partly from the side; E, distal face; F, distal face seen from the side. A, S.M. Perold 1170; B, D-F, McLaughlin PRE-CH 4197; C, S. Arnell 3321. Scale bars on A-C, E, F = 50  $\mu$ m; diameter of spore on D,  $\pm 80 \mu$ m. All micrographs by S.M. Perold.



Cape, which are winter rainfall areas (Figure 4). Arnell (1963) reported *R. purpurascens* from Victoria Falls, Zimbabwe, but these specimens were actually *R. stricta* and had been misidentified, as were several others at PRE. The deep purple colouration that thalli of *R. stricta* develop on exposure to the sun, may have led to this error.

*R. purpurascens* and *R. stricta* are two southern African 'linear' species with ventral sporangia, and both produce stolons. Although there is some overlap in their distribution in the southern Cape, they generally occupy distinct climatic areas, with *R. stricta* being far more widespread in the summer rainfall areas; *R. stricta* is also sometimes aquatic, whereas *R. purpurascens* is strictly terrestrial. In addition, they differ in their apices, scales, the strict dioecy of *R. purpurascens*, the vertically positioned sporangia in the latter, its larger-sized thalli as well as differences in the spore ornamentation, with the areolar walls thinner and usually incomplete on the distal face.

Oil cells were not found in the stolons of *R. purpurascens* as reported by Sim (1926); numerous starch granules are, however, present.

#### SPECIMENS EXAMINED

CAPE.—3119 (Calvinia): 2 km from Nieuwoudtville, on mud in ditch at roadside (—AC), *S.M. Perold* 1755 (PRE). 3217 (Vredenburg): Witteklip, south of Vredenburg (—DD), *Leighton* 537 (BOL). 3218 (Clanwilliam): 17 km E of Clanwilliam, along Pakhuis Pass, at Leipoldt's grave, weathered sandstone rocks (—BB), *S.M. Perold* 1935 (PRE); 5 km along road to Cedarberg, after turnoff to Algeria For. Sta., damp overhang nr road (—BD), *S.M. Perold* 2347 (PRE); Citrusdal, 22 km N of sandstone rock outcrops above Olifants River, Hex River Estates (—BD), *S.M. Perold* 2386 (PRE); Weltevrede, 17 km W of Piketberg, banks of Grootberg River (—DC), *S.M. Perold* 500 (PRE). 3219 (Wuppertal): Wuppertal, streambank (—AC), *Malherbe & Davies* 5377 (BOL). 3318 (Cape Town): Darling (—AD), *Duthie* 5425 (BOL); Malmesbury Commons (—AD), *Garside* 26210 (BOL); 1 mile outside Malmesbury on Piquetberg road, on soil (—BC), *Schelppe* 3901 (PRE); Lion's Head, nr Round House (—CD), *S. Arnell* 240, 330 (PRE); Lion's Head above Clifton (—CD), *S. Arnell* 494 (PRE); above Bakoven (—CD), *S. Arnell* 922 (BOL); between Kloofnek and Round House (—CD), *S. Arnell* 248, 251 (PRE); Tafelberg in Promont. Bonae Spei (—CD), *Ecklon s.n.* (G. lecto.); Table Mountain, rock shelf nr dripping water (—CD), *Esterhuysen* 19232 (BOL); Table Mountain, streamside, on lower W slopes above Camps Bay (—CD), *Esterhuysen* 21718 (BOL); Devil's Peak (—CD), *T.R. Sim* PRE—CH 1498 (PRE); Cape Town (—CD), *Wäger* PRE—CH 253 (PRE); Stellenbosch (—DD), *Duthie* PRE—CH 1125, PRE—CH 1128 (PRE), *Garside* PRE—CH 1126 (PRE); Stellenbosch, riverbank (—DD), *Duthie* 5012 (BOL); Stellenbosch, Platklip (—DD), *Duthie* 5325 (BOL); lower slopes above Brandwacht, damp, sandy soil at small stream (—DD), *Oliver* 9027 (PRE); Stellenbosch, Papegaaiberg, partly dried furrows (—DD), *Malan s.n.* (BOL); Papegaaiberg, on soil at foot of hill (—DD), *S.M. Perold* 477 (PRE). 3319 (Worcester): Tulbagh (—AC), *Duthie* 5381a (BOL); Tulbagh, waterfall in cave (—AC), *Greenwald* 5327 (BOL); Franschoek, nr Waterfall Farm, on soil at bridge over stream, (—CC), *S.M. Perold* 634a (PRE); Nuy, Rabiesberg, E of Worcester, on soil (—DA), *Morley* 360 (PRE); Farm Leipzig, Rabiesberg, E of Worcester (—DC), *S.M. Perold* 587 (PRE). 3320 (Montagu): Montagu, Bath Kloof (—CC), *S. Arnell* 724, 725, 755 (BOL); Cogman's Kloof, up in kloof, on dried mud (—CC), *S.M. Perold* 590 (PRE). 3418 (Simonstown): Clovelly Railway Sta. (—AA), *S. Arnell* 569 (PRE), 638 (BOL); Constantia slopes (—AA), *S. Arnell* 330, 332, 401 (BOL); Cape Point, mountain slope (—AD), *Duthie* 5510 (BOL); Harmonystrand, flats NW of Gordon's Bay (—BB), *Oliver* 8778 (PRE). 3419 (Caledon): Bot River area, Adakrivier, slopes E of Suikerboskop (—AC), *Oliver* 9224 (PRE); Greyton, kloof, on soil at rock wall next to footpath (—BA), *S.M. Perold* 611, 1170 (PRE); Greyton, kloof, on mud (—BA), *Morley* 291 (PRE); Riviersonderend beyond dumping ground on mud at streambank (—BB), *S.M. Perold* 594 (PRE). 3423 (Knysna): Knysna, Belvidere (—AA), *Duthie* 5382, 5434 (BOL), 23 (PRE); Knysna, Gouna Forest track, Lily Vlei (—AA), *S. Arnell* 1734 (BOL); Knysna, Rectory

grounds (—AA), *Duthie* 5423 (BOL); Knysna, Woodbourne (—AA), *Duthie* 5437 (BOL); Knysna, Erica Farm (—AA), *McLaughlin* 1211 (PRE).

#### ACKNOWLEDGEMENTS

I wish to thank the curators of BOL, BM and G for the loan of specimens. I am most grateful to Prof. honoraire S. Jovet-Ast for critically reading the manuscript, for information concerning *R. canaliculata* and for the gift of specimens; and thanks also to Dr E.C. Vianna. Sincere thanks to Dr E.O. Campbell, Massey University, for reading the manuscript and for mediating with Dr K. Markham, who very kindly performed flavonoid analyses on two specimens, which were much appreciated. Above all, I wish to thank Prof. (emer.) Dr O.H. Volk, who also very generously sent me specimens, literature and photographs, and with whom I have had numerous discussions. Ms J. Kimpton, artist, Mrs A. Romanowski, photographer, and Mrs J. Mulvenna, typist, are thanked for their valued contributions.

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