Bothalia 19,2: 161–165 (1989)

Studies in the genus *Riccia* (Marchantiales) from southern Africa. 14. *R. concava* section *Pilifer*

S.M. PEROLD*

Keywords: Marchantiales, *Riccia concava*, section *Pilifer*, southern Africa, taxonomy

ABSTRACT

A historical account is given of the confusion caused by the application of the name *R. concava* to various taxa. A new description of the species as understood by the author is given and a comparison made with related species. Its distribution and ecology are noted.

UITTREKSEL

'n Historiese oorsig van die verwarring veroorsaak deur die toepassing van die naam *R. concava* op verskeie taksons word gegee. 'n Nuwe beskrywing van die spesie, volgens die begrip van die skrywer, word weergegee en 'n vergelyking word met verwante spesies getref. Die ekologie en verspreiding word ook vermeld.

R. concava was initially named by Bischoff (in MS) and described by Gottsche, Lindenberg & Nees ab Esenbeck (1844) from a specimen collected by Krauss in 1838, on decomposing granite, at the Cape of Good Hope. They placed it in their group C, 'Subtus Squamatae', noting that the fronds were glaucous on both sides, becoming whitish when dry, fan-shaped, narrowly canaliculate, 2–4-lobed, occasionally nearly in rosettes, the lobes ovate, obtuse or emarginate, concave in the dry plant, mussel-shaped, with raised margins and underneath, toward the apex, with scales. To them, it was among the biggest species in the genus, with distinctive lobes in the dry plant. Then there follows a rather puzzling observation in that, according to Bischoff (in litt.), the small scales of the dry plant, when casually observed, could be taken for cilia. This is difficult to correlate with the type material as there is no similarity between these scales and cilia, unless Bischoff possibly mistook the dorsal cell pillars towards the margins for cilia, although in the dry state, they would have collapsed and been less visible. Gottsche *et al.* compared it with *R. albomarginata* and with *R. lamellosa*, but observed that in *R. concava* the lobes were ovate and very concave and the scales were only visible at the apex.

The type specimens held at G and S are fragmentary, of poor quality and have probably been pressed. The width of the widest branch is 3,25 mm, segments are 4 mm long and the branches up to 7 mm long, the margins are partly inflexed and the flanks here and there have faint purple colouring; the dorsal cells have collapsed and cannot be measured; a scale from the apex is 850 × 250 μm, cells in the body of the scale are oblong-hexagonal, up to 125 × 62 μm, with smaller cells at the margin. There are no spores. Enclosed with the isotype specimen (G) and mounted between two cover-slips, is a dried transverse section of a thallus branch (by Lindenberg); it is 1,75 mm wide and 0,65 mm thick, with the dorsal cells collapsed, the upper surface is ± concave, the flanks ± rounded and the margins slightly raised and subacute.

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

MS. received: 1989.01.25.

Stephani (1898) originally placed *R. concava* in his Inermes (i.e. without cilia) group IV, but after examining the 'original' plant, transferred it to his group VII (Frons Crassa). He, however, expressed doubts that the plant had been sufficiently studied by Gottsche *et al.*, because they had compared it with *R. albomarginata* which has thin lobes and with *R. lamellosa*, which is fleshy. In his *Icones hepaticarum* (Stephani 1876–1907) (G, M), two widely different cross sections of the thalli of *R. concava* are illustrated, one very thin and slightly concave, with acute, winged margins and the other thicker and concave, with obtuse margins. He also described the scales as large and extending above the thallus margins.

In important aspects, Sim's (1926) description is not correct: these plants do not truly grow in rosettes, nor did he make any mention of the loose dorsal cell pillars, only noting that there are 'upright pillars of lax, chlorophyllose cells with a larger globose epidermal cell on each'. Furthermore, he stated that the spores, 80 (not 8) μm in diameter, are 'laxly reticulated with about 5 areolae on the diameter each way'. Both these characters, viz. a single globose dorsal cell and only about 5 areolae across the diameter of the spore, suggest a different species altogether.

Duthie and Garside did not publish anything on *R. concava*; a note of Duthie's was found with a *Potts* specimen, *CH1010*, to the effect that she was not at all sure of the differences between *R. albomarginata* and *R. concava*. There are, however, several very good Duthie collections of *R. concava* (and presumably named by her) at BOL and S, notably *Duthie 5005*.

Arnell's (1963) description may have been based on the correct species, but he did not cite any specific collections, so this can only be checked on specimens named by him; however, here the dorsal cells can no longer be examined reliably and the spore ornamentation, as stated below, is somewhat variable. The width at 1,5 mm, which he reported for the thallus is rather narrow, but the colour, 'glaucous-yellow green', is correct, although also applicable to other species. The inflated dorsal cells are not correctly illustrated, as they are longer than wide and

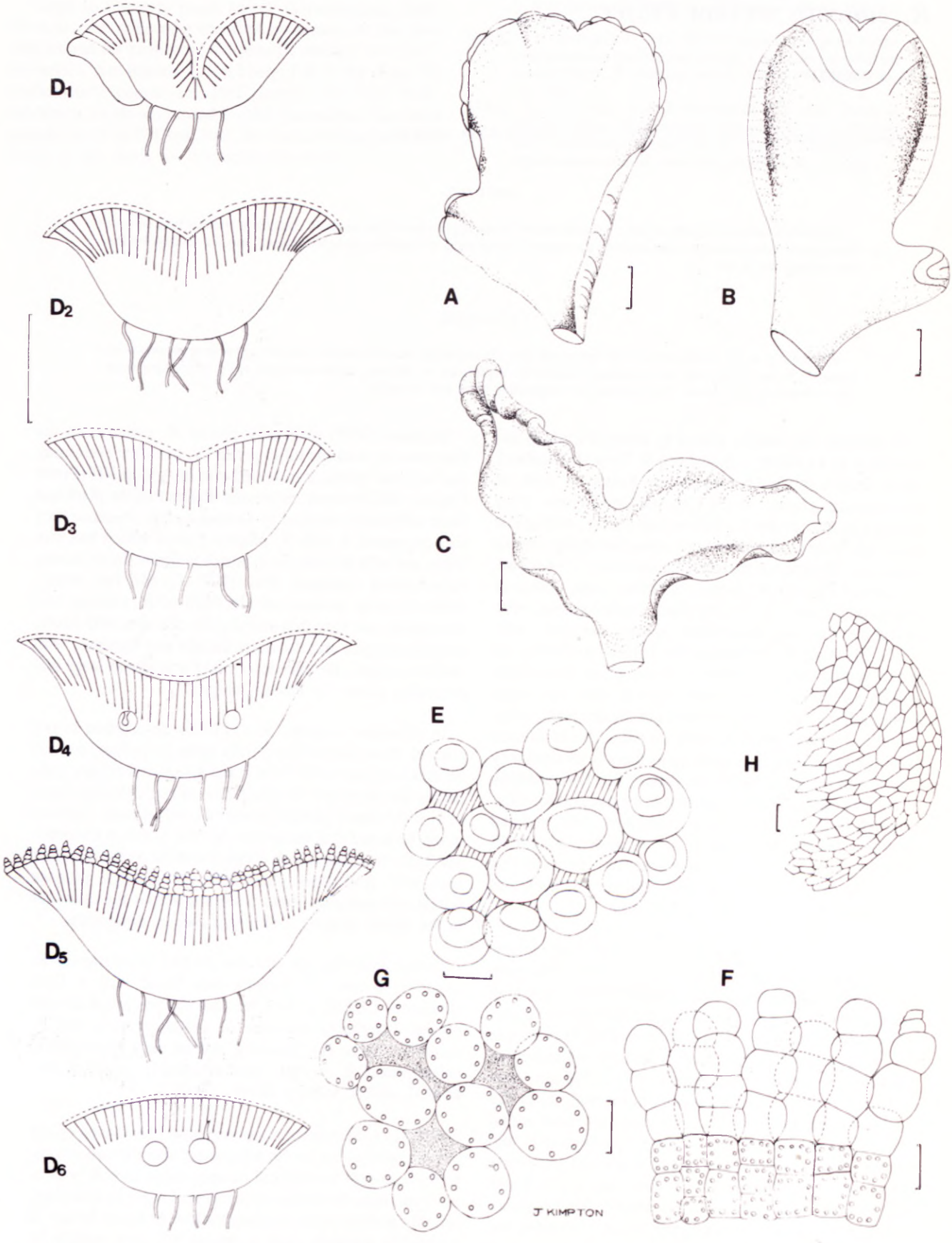

FIGURE 1.—*Riccia concava*. Morphology and anatomy. A, fresh thallus, dorsal view; B, fresh thallus, ventral view; C, dried thallus; D1–6, transverse sections of thallus branch at different distances from apex to older parts; E, epithelial cells and air pores (hatched) from above; F, transverse section through dorsal epithelial cell pillars; G, paradermal section through assimilation tissue; H, scale. A, B, D, *S.M. Perold 1431*; C, *S.M. Perold 1899*; E, H, *Morley 214*; F, *S.M. Perold 1447*; G, *Moll 6015*. Drawings by J. Kimpton. Scale bar on A–D = 1 mm; E–G = 50 μm; H = 100 μm.

partly collapsed, whereas the 'hairlike cell pillars' at the margin, are the scale cells in cross section; spores with thick ridges radiating from the centre as drawn by him, is not a character unique to *R. concava*. As also concluded by Volk (1981), it appears highly probable that Sim and Arnell did not describe the same species.

The specimens Arnell referred to *R. concava* at PRE and S have been examined; some have certainly been correctly determined, but others doubtfully so (see Specimens examined). It seems likely that he lumped together as *R. concava* all those species with loose dorsal pillars (described by him as velvet-like), which he could not refer to either *R. albomarginata* sensu Sim or to *R. villosa*. That this is so, is also suggested by the wide distribution he claimed for it (see below).

Riccia concava *Bisch.* in Gottsche, Lindenberg & Nees ab Esenbeck, Synopsis hepaticarum: 604 (1844); Stephani: 325, 378 (1898); Sim: 12 (1926); Arnell: 22 (1963).

TYPE.—Cape, in Capite Bonae Spei locis humidis, in saxis graniticis decompositis. *Krauss s.n.*, 1838 (*G8978* in G, iso.!) ex Herb. Musci. Palat. Vindob.; (S, iso.! fide Grolle 1976: 226) ex Herb. Lehmannianum.

Thallus monoicous, perennial, in crowded gregarious patches, not truly in rosettes (Figure 2A); blue-green (to ± yellowish green when actively growing), becoming whitish along margins, with scales not, or hardly protruding, except at apex where visible from above, also when wet and fully expanded (Figure 1A); medium-sized to large, branches once or twice furcate, rarely simple; medium to widely divergent, 6–8(–10) mm long, 3–4 mm wide, 0,9–1,2 mm thick, i.e. 3–4 times wider than thick in section, broadly ovate to obovate, apex rounded, emarginate, dorsally deeply grooved toward apex (Figure 2B–D), sides convex, soon becoming flat to slightly concave proximally, margins acute to subacute, shortly winged, somewhat recurved, flanks sloping obliquely upward and outward (Figure 1D1–6), ± arched, pale mauve to dark purple, covered by scales; ventral surface rounded, green to purple laterally (Figure 1B); when dry, glaucous to blue-green or mauvish green, scurfy or flaky, dorsally markedly concave, margins raised and incurved, partly inflexed (Figure 1C), occasionally almost meeting, exposing flanks clothed with wrinkled, mostly dull whitish to pale cream-coloured scales, basally often with mauve streaks across or with purple sheen from dark purple flanks underneath.

Anatomy of thallus: dorsal epithelium consisting of 3(–4)-celled, free-standing, hyaline pillars (Figure 2E, F), ± 180–260 μm long, top cell smallest, globose or conical, 35–42 × 45–60 μm, frequently collapsed, second cell usually wider and inflated, 50–62 μm long and up to 85 μm wide, basal cell(s) ± rectangular, 50–75 × 68–75 μm (Figure 1F); on dorsal face seen from above, cells in apical parts closely packed, inflated, shiny, like small round glass beads, in rows, cells in basal parts less orderly arranged and collapsing; air pores small, 4–5-sided (Figure 1E); assimilation tissue ± 450 μm thick in section, occupying almost ½ the thickness of thallus and consisting of vertical columns of 6–8 short-rectangular cells, up to 55 × 43 μm, enclosing narrow 4–5-sided air canals (Figure 1G); storage tissue ± 300 μm thick, ± ⅓ (or less) the thickness of thallus, cells crowded together, round to angular, 55–62 μm wide; rhizoids arising from ventral epidermis ± 20 μm wide, some smooth, others tuberculate. *Scales* semicircular, imbricate, hyaline, not or hardly extending beyond thallus margins except at apex, mostly ventrally situated along concave flanks, 900–1 200 × 600 μm, cells in body of scale long rectangular, or 5–6-sided, up to 160 μm long × 50–65 μm wide, walls straight, at scale margin one row of smaller cells, wider than long (Figure 1H). *Antheridia* with hyaline necks ± 250 μm long, in 2 rows along middle of lobes. *Archegonia* with purple necks. *Sporangia* ± 500 μm wide, single or in pairs, each with ± 350 spores, bulging dorsally, overlying tissue disintegrating and liberating spores. *Spores* 75–90(–100) μm in diameter, triangular-globular, polar, dark brown, with narrow wing up to 5 μm wide, angles notched or with a pore, margin finely crenulate; ornamentation somewhat variable, reticulate to vermiculate, or with radiating ridges: distal face with 10–14 deep-set areolae across the diameter, up to 7,5 μm wide, some with a central papilla, radial walls thick (Figure 3C), often dusted with granules (Figure 3D), usually raised at nodes, occasionally forming short, irregular ridges radiating outwards from centre (Figure 3E, F); proximal face with triradiate mark quite prominent, sparsely granular, numerous (30–40) small round areolae on each facet, walls raised at nodes (Figure 3A, B). *Chromosome number* n = 8 (Bornefeld (1984) on *S.M. Perold 470, 485*).

R. concava can be distinguished from the other species in section *Pilifer* Volk (1983), by its broad thallus, up to 4 mm wide when fully expanded, concave when dry, glaucous or scurfy blue-green colour, rounded apex, somewhat overhanging margins mostly obscuring the scales except those at the apex, and fragile, inflated, generally wider than long dorsal cells in loose pillars. On exposure to bright sunlight, it develops a deeper purple colour at the flanks and ventrally.

In this section, most of the other species, currently totalling ± 12 species and some still to be described, have conspicuous hyaline scales, except for *R. alatospora* Volk & Perold (1985) and *R. hantamensis* Perold (1989). In *R. albomarginata* sensu Sim [the name has been misapplied since Sim (1926)—Perold in prep.], the dorsal cell pillars tend to be more persistent, tall and narrow with all the basal cells ± equally long; *R. villosa* is easily recognized by large, triangular scales and papillose spores; *R. parvoareolata* Volk & Perold (1984) has spores with numerous small areolae; the rest of the species have tapering or uniform pillars with cells that are generally longer than wide. To examine the dorsal cells, living material is required, as they cannot be reconstituted in long-dried herbarium material.

Differences in the spore ornamentation between *R. concava*, *R. albomarginata* Bisch. ex G.L. & N., and one or two new, as yet undescribed species in the section, are sometimes quite difficult to discern, even on SEM micrographs, nor are radiating ridges on the distal face altogether distinctive. Moreover, the spores of *R. concava* can be quite variable, even when from the same sporangium.

R. concava often grows in association with other *Riccia* species of section *Pilifer* and with the moss species

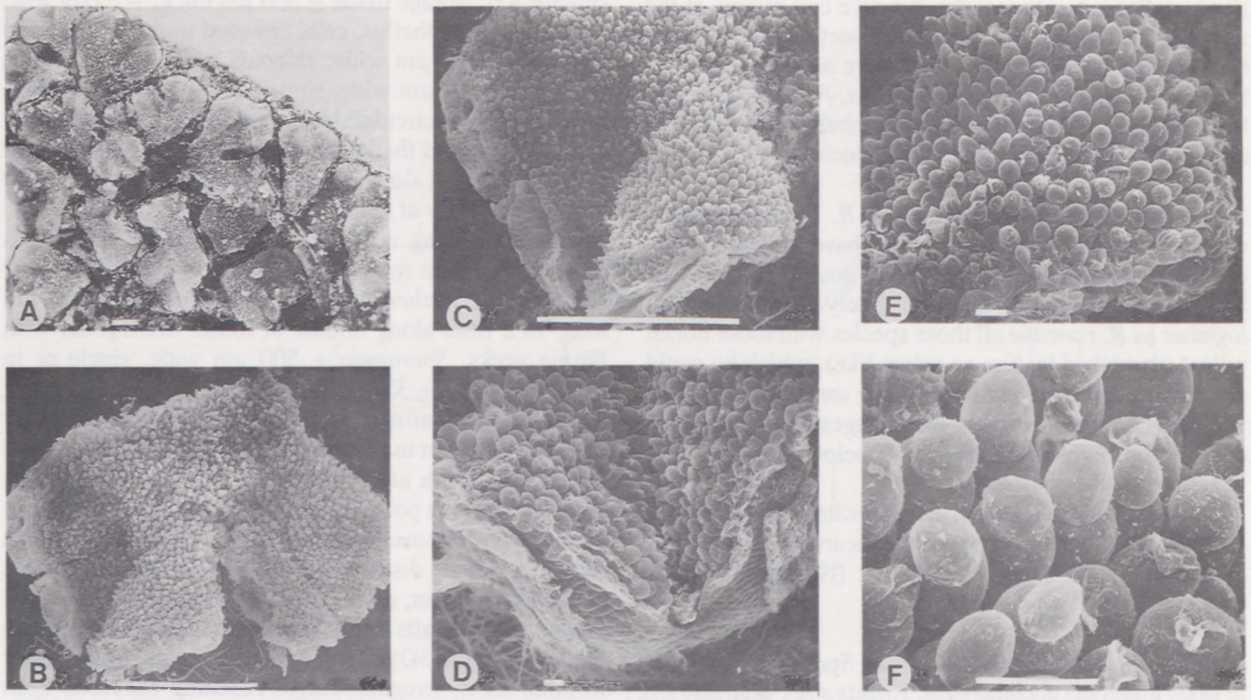

FIGURE 2.—*Riccia concava*. Morphology and anatomy. A, thalli not in rosettes; B, dorsal view of thallus; C, D, apex with dorsal groove; E, F, dorsal cell pillars. A–F, *S.M. Perold 2312*. Scale bar on A–C = 1 mm; D–F = 50 μm.

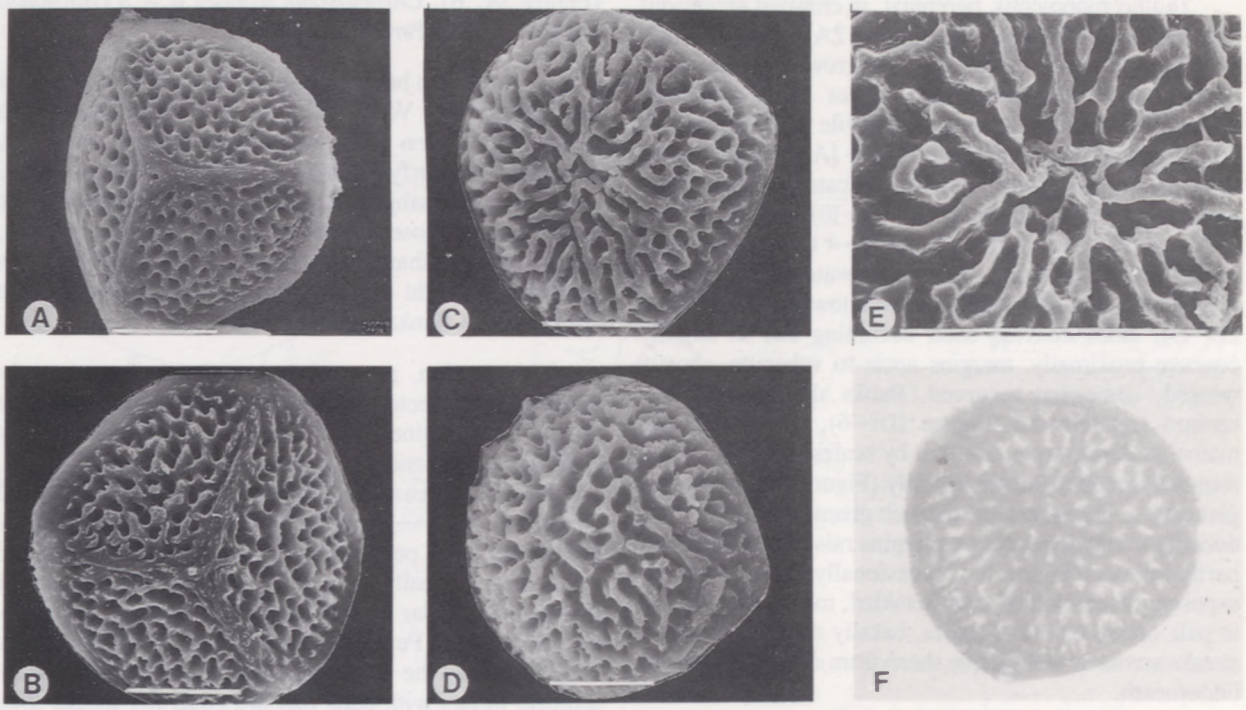

FIGURE 3.—*Riccia concava*. Spores. A, B, proximal face; C, D, F, distal face; E, radiating ridges on distal face. A, *S.M. Perold 2313*; B, *S.M. Perold 1791*; C, *S.M. Perold 1500*; D, *S.M. Perold 1773*; E, F, *Garside 6128*. Photography by S.M. Perold. Scale bar on A–E = 50 μm; diameter of spore on F, ± 90 μm.

Barbula crinita Schultz, *Desmatodon convolutus* (Brid.) Grout and *Chamaebryum pottioides* Thér. & Dix. It prefers damp, not wet places, being found away from seepages, on sandy, well drained soil overlying granite outcrops. It is fairly common in the north-western, western, south-western and southern Cape Province (Figure 4). Besides the western Cape, Sim (1931) and Arnell (1963) also reported it from Natal, Transvaal, S Rhodesia, Portuguese East Africa, Madagascar and the Canary Islands, but this has not been verified (see below). (At PRE, a Sim specimen from Magude, P.E.A. [Mozambique] has been identified as *R. concava*, but it has black scales.)

Arnell's specimens, *Arnell s.n.*, 11.3.59 (*UPS 20635*) (Lagunetas); 13.3.59 (*UPS 20636*) (Cueva Grande) and 28.2.59 (*UPS 20637*) (La Calzada) from the Canary Islands, which he named *R. concava*, do not belong here, as the shape of the thalli in transverse section, the width to thickness proportions and the spore ornamentation with fewer and larger areolae on the dorsal face and granules

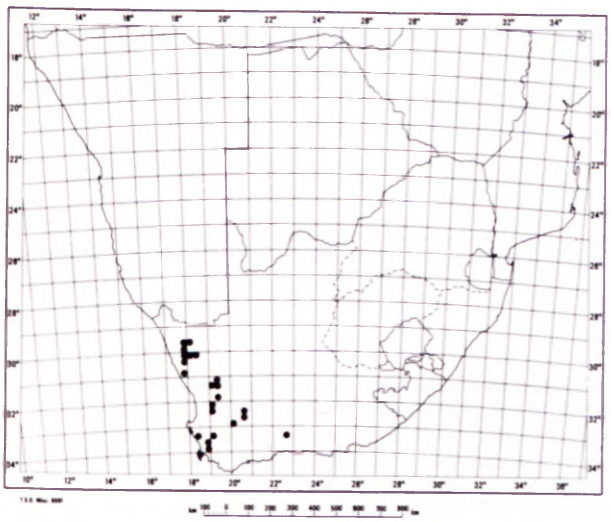

FIGURE 4.—Distribution map of *Riccia concava* in southern Africa.

on the proximal face, do not correspond with those of *R. concava*. It should be deleted from the species list of the Macaronesian Islands (Arnell 1961; Düll 1984; Eggers 1982; Sergio 1984). These plants do, however, belong to section *Pilifer* Volk, which is unique to southern Africa, except for the above, and for specimens from Île de l'Est (Crozet Archipelago), assigned to *R. albomarginata* by Jovet-Ast (1986). Unfortunately the identity of Arnell's specimens from Gran Canaria is still uncertain and will probably remain so, unless fresh material can be collected. Regardless of which species of section *Pilifer* they belong to, their original dispersal from southern Africa to Macaronesia, whether by man or by migrating birds, is highly probable.

SPECIMENS EXAMINED

CAPE.—2917 (Springbok): Springbok, opposite Country Club, rock outcrops (−DB), *S.M. Perold 1414, 1415* (PRE); 14 km N of Springbok at edge of large granite dome (−DB), *S.M. Perold 2054, 2057* (PRE); S of Springbok, 6 km from Kokerboom Motel on road to Kamieskroon (−DD), *S.M. Perold 1438* (PRE). 2918 (Gamoep): Carolusberg, near gate (−CA), *S.M. Perold 1431, 1432* (PRE). 3017 (Hondeklipbaai): 2 km N of Kamieskroon, granitic rock outcrops (−BB), *S.M. Perold 1447, 1454, 1455, 2091, 2094* (PRE); Kamiesberg Pass, drier area above seepage (−BB), *S.M. Perold 1604* (PRE); Rietkloof, 14 km S of Kamieskroon, edge of rock outcrop (−BD), *S.M. Perold 2103−2105* (PRE); Brakdam, 31 km S of Kamieskroon, rock outcrops (−BD), *S.M. Perold 2113, 2115* (PRE). 3018 (Kamiesberg): 18 km NE of Kamieskroon, on road to Rooifontein (−AA), *S.M. Perold 1460, 1465, 1466* (PRE); 4−5 km along road to Rooifontein, from Kamieskroon-Leliefontein road (−AA), *S.M. Perold 2148, 2172, 2173* (PRE); Pedroskloof, on road to Rooifontein (−AA), *S.M. Perold 1493* (PRE); Kamassies, large rock outcrop (−AB), *S.M. Perold 1500, 1501* (PRE). 3119 (Calvinia): E of Slagberg, between Nieuwoudtville and Loeriesfontein, Farm Koringhuis (−AB), *S.M. Perold 1795, 1798* (PRE). Nieuwoudtville, sandstone outcrops 2 km SW of town (−AC), *S.M. Perold 2195* (PRE); Nieuwoudtville Falls (−AC), *S.M. Perold 1788, 1791, 1792, 2312, 2313, 2316* (PRE); Nieuwoudtville, Farm Oorlogskloof (−AC), *C.M. van Wyk 1493* (PRE); Van Rhyns Pass, in ditch on plateau (−AC), *S.M. Perold 2185* (PRE); Groothoek, 18 km on dirt road to Rondekop, Soetlandsfontein River (−AD), *S.M. Perold 1773* (PRE). 3219 (Wuppertal): Biedouw Youth Camp, sandstone rock outcrops (−AA), *S.M. Perold 1888* (PRE); Algeria Forest Station, 4 km S of streambank (−AC), *S.M. Perold 2362* (PRE). 3220 (Sutherland): near Sutherland (−BC), *Duthie 5407* (BOL); Montagu, Bath Kloof (−CC), *Arnell 753* (BOL, S); Klein Roggeveld, De Kom, clay soil over shale (−DA), *Oliver 8949* (PRE); Haashoogte, damp E slope (−DA), *Oliver 8957a* (PRE); 50 km S of Sutherland, 21 km along road to Wolfhoek, Farm Bergsig, streambank (−DA), *S.M. Perold 2426, 2427* (PRE). 3318 (Cape Town): Darling, 5 km S of, (−AD), *S.M. Perold 485* (PRE); Lion's Head above Fresnaye (−CD), *Arnell 12a, 67a* (BOL); Signal Hill (−CD), *Garside 6128* (BOL); Wellington (−DB), *Duthie 5470* (BOL); Stellenbosch, clayey ground below municipal farm near railway line (−DD), *Duthie 5005* (BOL, S); railway embankment (−DD), *Duthie 5417* p.p. (BOL); E end of Stellenbosch Flats near farm, on earth bank of sloot (−DD), *Garside 6108* (BOL); Stellenbosch, Platklip (−DD), *Morley 214* (PRE), *S.M. Perold 470* (PRE); Stellenbosch, Papegaaiberg (−DD), *S.M. Perold 478* (PRE). 3319 (Worcester): Tulbagh (−AC), *Duthie 5468* (BOL). 3322 (Oudtshoorn): Meiringspoort, on disturbed soil at roadside (−BC), *S.M. Perold 899* (PRE).

Only specimens which unequivocally could be referred to *R. concava*, have been included in the above list. New collections have all been cultivated and observed over a period of time. If there was the slightest element of doubt about the identity of old collections from the western and south-western Cape Province, that had been named by Duthie and by Garside, or by Arnell, they have been excluded.

ACKNOWLEDGEMENTS

The author wishes to thank the curators of BOL, S and UPS for the loan of specimens; Prof. (emer.) Dr O.H. Volk of Würzburg University, W Germany, for numerous discussions concerning *R. concava*, its identification and distribution and Dr (habil.) T. Bornefeld, Am Reelein 1, Hochberg, W Germany, for the chromosome counts. Sincere thanks to Mrs A.J. Romanowsky for developing and printing the micrographs; to the artist, Ms J. Kimpton and to Mrs M. van der Merwe for typing the manuscript.

REFERENCES

ARNELL, S. 1961. List of the Hepaticae of the Canary Islands. *Svensk botanisk Tidskrift* 55: 379−393.

ARNELL, S. 1963. *Hepaticae of South Africa*. Swedish Natural Science 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.

DÜLL, R. 1984. Bryogeographische Analyse der Makaronesischen Inseln mit besonderer Berücksichtigung der Kanarischen Inseln Tenerife und La Palma. *Proceedings of the Third Meeting of the Bryologists from Central and East Europe, Praha, 14−18 June, 1982*: 177−190. Univerzita Karlova, Praha.

EGGERS, J. 1982. Artenliste der Moose Makaronesiens. *Cryptogamie, Bryologie et Lichénologie* 3: 283−335.

GOTTSCHE, C.M., LINDENBERG, J.B.G. & NEES AB ESENBECK, C.G. 1844. *Synopsis hepaticarum*. Hamburg. Reprinted 1967.

GROLLE, R. 1976. Verzeichnis der Lebermoose Europas und benachbarter Gebiete. *Feddes Repertorium* 87: 171−279.

JOVET-AST, S. 1986. *Riccia* de l'Archipel des Crozet (Île de L'Est). *Cryptogamie, Bryologie et Lichénologie* 7: 479−485.

PEROLD, S.M. 1989. Studies in the genus *Riccia* (Marchantiales) from southern Africa. 13. A new species, *R. hantamensis* in section *Pilifer*, and a new record for *R. alatospora*. *Bothalia* 19: 157−160.

PEROLD, S.M. in prep. Studies in the genus *Riccia* (Marchantiales) from southern Africa. 16. *R. albomarginata* and *R. simii* sp. nov. *Bothalia*.

SERGIO, C. 1984. The distribution and origin of Macaronesian bryophyte flora. *Journal of the Hattori Botanical Laboratory* 56: 7−13.

SIM, T.R. 1926. The bryophytes of South Africa. *Transactions of the Royal Society of South Africa* 15: 1−475. Cape Town.

SIM, T.R. 1931. South African Bryophyta. Further notes. *Transactions of the Royal Society of South Africa* 20: 15−17.

STEPHANI, F. 1876−1907. *Icones hepaticarum*. Ed. P. Geissler. IDS Microform Publishers, Zug, Switzerland. Publ. 1986.

STEPHANI, F. 1898. Species hepaticarum. *Bulletin de l'Herbier Boissier* 6: 309−411.

VOLK, O.H. 1981. Beiträge zur Kenntnis der Lebermoose (Hepaticae) aus Südwestafrika (Namibia). II. *Mitteilungen aus der Botanischen Staatssammlung, München* 17: 245−252.

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. 1984. Studies in the genus *Riccia* (Marchantiales) from the south-west Cape. *Bothalia* 15: 117−124.

VOLK, O.H. & PEROLD, S.M. 1985. Studies in the genus *Riccia* (Marchantiales) from southern Africa. 1. Two new species of the section *Pilifer*: *R. duthieae* and *R. alatospora*. *Bothalia* 15: 531−539.