

## Studies in the genus *Riccia* (Marchantiales) from southern Africa. 23. *R. bullosa*: typification and a full description

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**Keywords:** *Exormotheca bullosa*, *E. welwitschii*, Marchantiales, Portugal, *Riccia bullosa*, southern Africa, subgenus *Ricciella*, taxonomy

### ABSTRACT

In the protologue of *Riccia bullosa*, Lindenberg (1829) based his vague and incomplete description of the taxon on two heterogeneous elements: a specimen from Portugal and one from the Cape. Stephani (1898) retained the name *Riccia bullosa* for the Cape element and referred the Portuguese plant to *Exormotheca welwitschii* (Stephani 1899). Although generally accepted until 1940, K. Müller (1940) rejected Stephani's segregation and referred the Portuguese element to his new combination, *Exormotheca bullosa* (Link) K. Müller, based on the false assumptions that Stephani had failed to recognize that the Portuguese plant was an *Exormotheca*, and that the Cape plant was insufficiently known and had not been found again. Counter arguments are set out here, urging a return to Stephani's earlier segregation. A lectotype for *Riccia bullosa* is selected, which results in the repudiation of Müller's (and Grolle's) lectotypification of *Exormotheca bullosa* (= *Riccia bullosa*).

### UITTREKSEL

In die protoloog het Lindenberg (1829) sy vae en onvolledige beskrywing van *Riccia bullosa* op twee heterogene elemente gebaseer: 'n eksemplaar uit Portugal en een uit die Kaap. Stephani (1898) het die naam *Riccia bullosa* vir die Kaapse element behou en die Portugese plant na *Exormotheca welwitschii* (Stephani 1899) verwys. Alhoewel algemeen aanvaar tot 1940, het K. Müller (1940) Stephani se segregasie verwerp en die Portugese element verwys na sy nuwe kombinasie, *Exormotheca bullosa* (Link) K. Müller, op grond van die verkeerde aanname dat Stephani nie besef het nie dat die Portugese plant 'n *Exormotheca* is en dat daar te min oor die Kaapse plant bekend was en dit nie weer gevind is nie. Teenargumente ten gunste van die terugkeer na Stephani se vroeëre segregasie, word hier aangevoer. 'n Lektotipe vir *Riccia bullosa* word aangewys, met die gevolg dat Müller (en Grolle) se lektotipifisering van *Exormotheca bullosa* (= *Riccia bullosa*) verwerp word.

### HISTORY AND TYPIFICATION OF *RICCIA BULLOSA*

Recently Dr R. Grolle (in litt.) drew my attention to nomenclatural problems concerning *Riccia bullosa* Link ex Lindemb., that have apparently not yet been satisfactorily resolved. This is due to Lindenberg (1829) having based his original species description on two heterogeneous elements: a specimen from Portugal, now referred to *Exormotheca* and a *Riccia* specimen from the Cape.

Lindenberg stated that he had received the Portuguese specimen under the manuscript name, *Riccia bullosa* Link, and the Cape specimen from Nees under the name *R. crassa*. The protologue (Lindenberg 1829) was incomplete and rather vague, and for the most part, it could apply to either plant.

In his *Monographie der Riccien*, Lindenberg (1836) gave an expanded description and drawings (Figure 1) of the entity which he referred to as *Riccia bullosa* Link. He still considered the Portuguese and the Cape specimens as both belonging to the same entity, even though he observed clear differences between them. He described the Portuguese plant as being less yellow and more lax and the layer of 'horizontal' cell tissue as being much thinner. He also mentioned that the Cape specimen had been collected by Ecklon. The illustrations of *R. bullosa* in Lindenberg (1836) depicts the Cape plant, as will be shown below.

Stephani (1898) took up the name *Riccia bullosa* for the Cape element and excluded the element from Portugal

which in his opinion was clearly not a *Riccia*. At the time he was uncertain to which genus it belonged. He stated, however, that it matched a specimen collected in 1847 by Welwitsch (*Welwitsch 33*, see Mitten 1853) at Vendas on the banks of the Tejo River. In the following year Stephani (1899) referred the Portuguese plant to the genus *Exormotheca* and described it as *E. welwitschii* Steph., placing *Riccia bullosa* Link in Lindemb. ex parte in synonymy under it.

Stephani's interpretation of *R. bullosa* was generally accepted by South African authors, namely Sim (1926), Duthie & Garside (1937), as well as by the Swedish hepatologist, Arnell (1963), who even cited Stephani as the author of this species, and also by myself (Perold 1989). Furthermore, Goebel (1905) in a footnote, had accepted *Exormotheca welwitschii* Steph. (*Riccia bullosa* Link) and so had K. Müller (1906–1911), although the latter admitted that he had not seen the original material at that time. Subsequently, however, K. Müller (1940) rejected Stephani's segregation on the basis that he, Stephani, had given the Portuguese plant a new name, because he had not recognized that *Riccia bullosa* was an *Exormotheca*, a statement which elicited from Schiffner (1942) the comment that Müller had done Stephani an injustice (ein Unrecht). Further evidence that Stephani had indeed known what he was about, is a postcard (xerox copy kindly sent to me by Dr C. Sérgio, LISU) which Stephani had written to Henriques on 13-2-1905, asking him, at Levier's suggestion, to please look for more material of the plant, *Exormotheca welwitschii*, which Welwitsch had collected more than 50 years before at Tejo. Stephani (1898) had clearly stated that Levier had assured him that this plant (i.e. Welwitsch's) was the authentic Portuguese *Riccia*

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*bullosa*. Incidentally, Levier's notes and drawings (no. 52907) of *Riccia bullosa* are housed at LISU and Sérgio (in litt.) has confirmed that they refer to *Exormotheca bullosa*. The three drawings (two of them are natural size) appear to be an almost exact copy of part of Lindenberg's (1836) illustration of *Riccia bullosa*, which actually is of the Cape *Riccia*, as will be shown below.

In 1940 Müller also published the new combination *Exormotheca bullosa* (Link) K. Müll., wrongly citing Link as author of the basionym. He placed *Riccia bullosa* Link and *Exormotheca welwitschii* Steph. (as well as *?E. holstii* Steph. and *Corbierella algeriensis* Douin & Trabut) in synonymy under it, thereby leaving the South African element without a correct name and thus failed to preserve current usage up to that time (see Recommendation 7B.5 of the I.C.B.N.). According to Müller's (1941) reasoning, Lindenberg (1829) had clearly indicated that the Portuguese element represented the only authentic and original material, because Lindenberg had cited Link (who had brought this specimen from Portugal) as the author and had also adopted Link's epithet, namely *Riccia bullosa*. In addition, Müller argued that Link had not even known about the Cape plant. In Müller's view, he was acting in accordance with the author's (i.e. Lindenberg's) intent. Furthermore, in his opinion Lindenberg's description of the Link species was wrongly expanded by his inclusion of the Cape species and, of even greater importance to Müller, he thought that the drawing of the thallus in cross section, on Table 23, Figure 1.6 (Lindenberg 1836) reproduced here as Figure 1, left no doubt at all that *Riccia bullosa* was identical with *Exormotheca welwitschii*. By his use of the words 'authentic' and 'original' for Link's Portuguese element, Müller (1940) effectively lectotypified *Riccia bullosa* (see Recommendation 7B.4 of the I.C.B.N.). This was accepted and followed by Grolle (1976), who specifically cited the Lindenberg Herbarium No. 9037 as the lectotype.

In considering the various arguments put forward by Müller (1940, 1941, 1947, 1951–1958) in support of his conclusions, Lindenberg's (1829) protologue must be examined first. The fact that Lindenberg cited Link as the author and adopted Link's name for the species are not significant nomenclatural issues, since Link had not validly published the name or a description of the plant; it was merely a manuscript name, as was Nees's name of *R. crassa* for the Cape plant that Lindenberg also referred to in the same description. The two references in this protologue (at the beginning and again at the end) to a groove, in my opinion clearly point to the Cape *Riccia* which, especially in dried material, is distinctly grooved medianly. Stephani (1898) described it as 'profunde sulcata', whereas *Exormotheca* is less obviously so, and except for *E. tubrifera* Kash. (Schiffner 1942), members of this genus are not reported elsewhere in the literature as being grooved.

For the following reasons I also do not agree with Müller that Lindenberg's (1836) drawings are those of an *Exormotheca*: a narrow, deep dorsal groove is clearly shown from above as well as in the transverse section of the thallus; there are no assimilation filaments arising from the base of the air chambers; no stomata are drawn in Lindenberg's figures (Figure 1.5, 1.7 & 1.8) and in fact, in his more detailed description, Lindenberg (1836) stated that open-

ings or pores are absent. Schiffner (1942) also remarked that stomata are absent, which is not strictly correct, but such an observation could never apply to *Exormotheca*, a genus in which stomata are very obvious. Ventral scales, another striking character of *Exormotheca*, are also not illustrated by Lindenberg (1836) and finally, about twice as many air chambers are shown across the width of the thallus in the cross section, as the six (or so) that Müller described for *Exormotheca*. Müller (1947), however, was so confident that Lindenberg's cross section illustrated an *Exormotheca* that he accused Schiffner of remaining silent about it, when Schiffner (1942) had clearly stated that the description and illustration referred to the Cape *Riccia* only. Schiffner's (1942) own drawings of Link's specimen from Portugal (Herb. Lindenberg No. 9037) (Figure 5a, b, c) are obviously those of an *Exormotheca* with triangular scales and with tall air chambers which contain assimilation filaments at the base. Müller (1947) admitted to not having seen the Cape plant, because he could not locate the specimens in Lindenberg's herbarium in Vienna, or at the herbarium of the Botanical Museum in Berlin. He concluded that they must have been with Schiffner in Vienna. In Müller's (1947) opinion, the 'ziemlich ungeklärte *Riccia* vom Kap' was not found again, and because he regarded it as a dubious species, it should get another name! None of these arguments, forwarded by Müller to justify his actions, are correct.

Schiffner had by 1942 decided that *Exormotheca bullosa* (Link) K. Müll. nov. comb. should be withdrawn as a species, 'als Art einzuziehen', and he referred to the Portuguese plant as *Exormotheca welwitschii*. Müller, however, (1947, 1951–1958) continued to defend his point of view. In passing, it could perhaps be mentioned that both Schiffner (1862–1944) and Müller (1881–1955) were engaged in studying and describing *Exormotheca* species at about the same time and there may have been a measure of competition between them.

To summarise: judging from Lindenberg's (1829) reference to a 'grooved' plant, as well as his drawings and expanded description (Lindenberg 1836), he was referring to the Cape plant, even though he had credited Link as the author and had adopted Link's unpublished name for the species. These are, however, without nomenclatural significance, as remarked upon before.

Article 8.1 of the I.C.B.N. states that: the author who first designates a lectotype must be followed (in this case Müller), but his choice is superseded if various conditions are not met:

(b) if it can be shown that it is in serious conflict with the protologue and another element is available which is not in conflict with the protologue (the Cape element is 'grooved', whereas Link's is not, but otherwise the description is vague, and one may hesitate to invoke the term 'in serious conflict with...');

(c) if it was based on a largely mechanical method of selection (Müller could not locate the Cape element and only the Link element was available to him, which can be interpreted as a 'largely mechanical method of selection'); (d) if it is contrary to Article 9.2, which states 'if it is proved that such a type herbarium sheet or preparation contains parts belonging to more than one taxon, the name must remain attached to the part (lectotype) which corresponds most nearly with the original description' (in this case 'grooved').

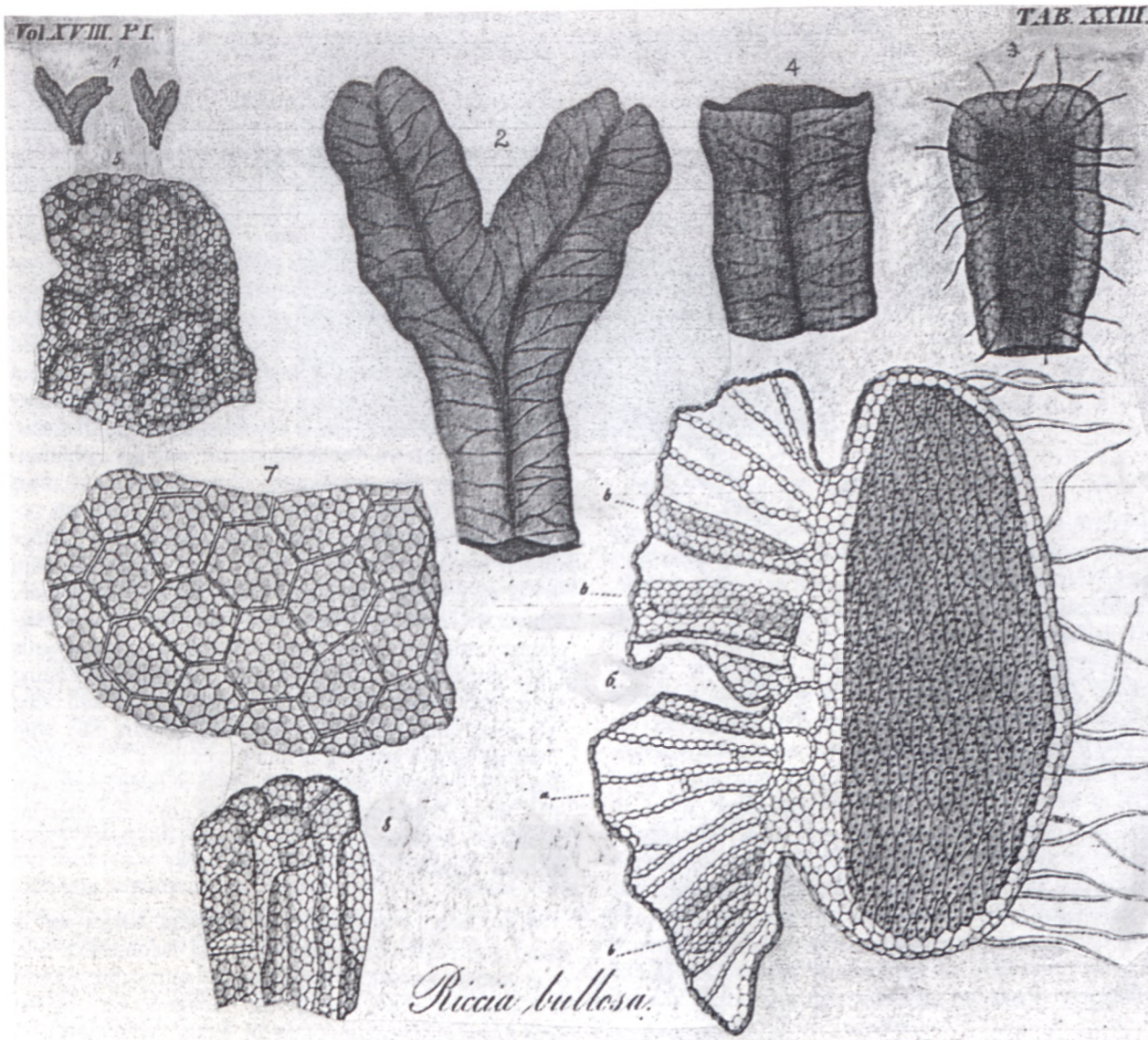


FIGURE 1.—Reproduction of TAB. XXIII. Fig. 1. Vol. XVIII PI *Monographie der Riccien* by J.B.G. Lindenberg, p. 443. Captions translated into English: 1.1, *Riccia bulbosa*, natural size; 1.2, enlarged. The walls of the air chambers appear as veins on the surface; 1.3, a piece of the thallus, enlarged, from below; 1.4, a piece of the thallus, much enlarged, so that the texture together with the transparent air bladders are visible; 1.5, a piece of the thallus, even more enlarged; 1.6, transverse section: a.a. the air canals; b.b. the same with side walls; 1.7, a piece of the epidermis, much enlarged; 1.8, some air canals, of which some are divided by a cross wall.

Müller's manner of selecting the lectotype was largely mechanical, which would be the most decisive reason for not following him.

Müller's (1940) comb. nov. and his and Grolle's (1976) lectotypification are therefore superseded here and it is proposed that the nomenclature should revert to that of Stephani.

***Riccia bulbosa* Link MS ex Lindenb.** in *Nova Acta Academiae Caesareae Leopoldino Germanicae Naturae Curiosorum* 14 (Supplement): 119 (1829); Lehm.: 371 (1829); Lindenb.: 441 (1836); Nees: 391, 433 (1838); Gott. *et al.*: 609 (1844–1847); Steph.: 377 (1898); Sim: 13 (1926); S. Arnell: 42 (1963).

**TYPE.**—Promontorio Cap, terrestris, ad montem tabularem versus montem Leonio *sine coll. et no.* (STR!, selected here as lecto.)

*R. crassa* Nees ex Lindenb. in *Nova Acta Academiae Caesareae Leopoldino Carolinae Germanicae Naturae Curiosorum* 14 (Supplement): 119 (1829) nom. inval.

*R. montaguensis* S. Arnell in *Botaniska Notiser* 105: 308 (1952); S. Arnell: 44 (1963). Types: Cape Province, Montagu, Bath Kloof, near the caves, S. Arnell 714 (BOL!, PRE!), 741 (BOL!).

**Thallus** dioicous (Figure 2A,B), ?perennial, in crowded, gregarious patches or scattered (Figure 3A); apically light green, soon turning straw-coloured, deeply grooved, laterally swollen to bloated, with small, polygonal, domed areas, becoming proximally pitted and spongy; when dry, rather deflated and with folds across, sides not inflexed, margins scalloped; branches once, occasionally twice dichotomously furcate, sometimes simple, shortly to deeply divided, moderately to widely divergent; broadly ovate to oblong, 5.0–15.0 × 3.5–5.5 mm, 1.5–2.5 mm thick, in section 2.0–2.5 times wider than thick; apex obtuse to truncate, emarginate. Groove deep and narrow, sometimes split into two by raised wedge of tissue (Figure 3B), disappearing toward base or at sporangia. Thallus margins obtuse, rounded, often overhanging. Flanks sloping obliquely, ventral face rounded to keeled, green. Scales hyaline, vestigial (Figure 3C), in pairs, ventral, toward apex only.

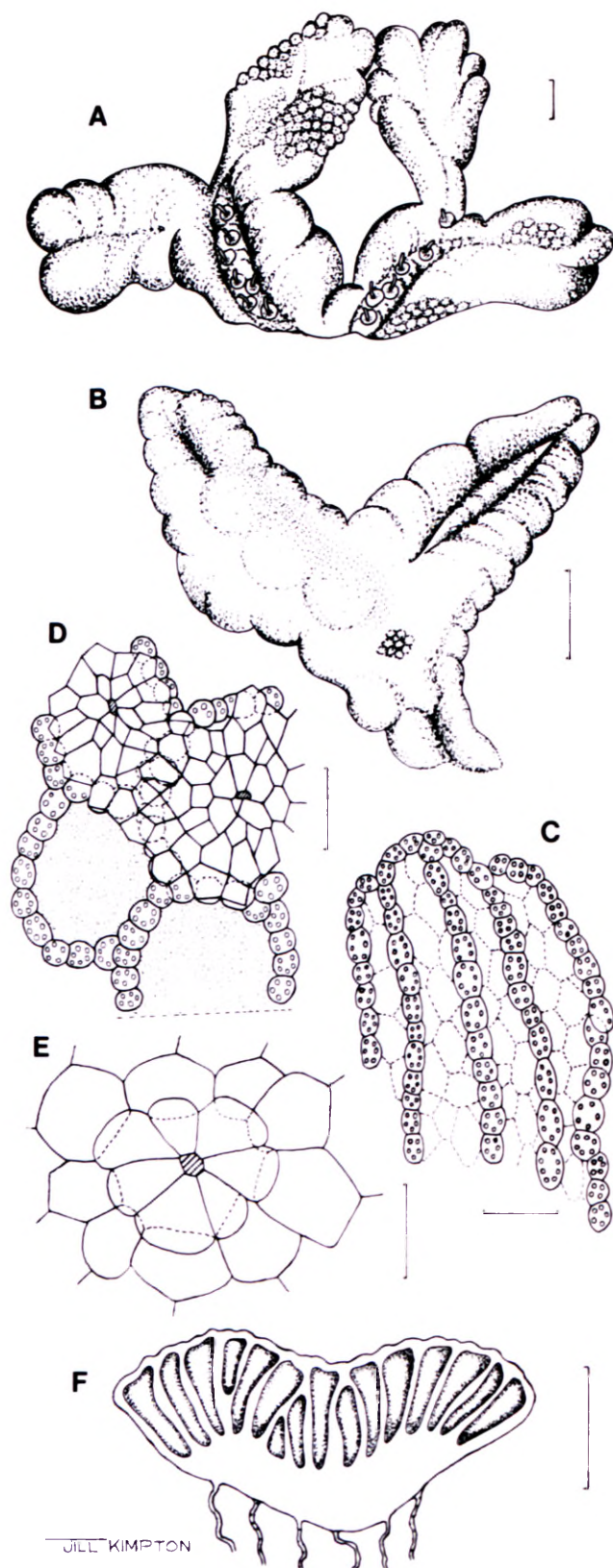


FIGURE 2. —*Riccia bullosa*. A, male thallus; B, female thallus; C, cross section of epidermis and assimilation tissue; D, epidermal cells and air pores (hatched) overlying air chambers, the latter exposed (and stippled) below; E, air pore (hatched) and surrounding cells as seen from above; F, cross section of branch. A, B, S.M. Perold 467; C–F, Van Rooy 3541. Scale bars on A, B, F = 1 mm; C, D = 100  $\mu$ m; E = 50  $\mu$ m.

*Anatomy of thallus:* dorsal epidermis forming a domed roof over each air chamber (Figure 2C), cells 4–6-sided, 62–75  $\times$  35–40  $\mu$ m, air pores ringed by 6 or 7 wedge-shaped cells, smaller (Figures 2D, E; 3B) and often

thinner-walled, 37  $\times$  17  $\mu$ m, breaking down with age and exposing air chambers; assimilation tissue 1000–1500  $\mu$ m thick, occupying  $\frac{3}{5}$  of thickness of thallus, air chambers tall, mostly in one layer, vertical medianly and sloping obliquely toward margins (Figure 2F), 175–250  $\mu$ m wide, narrower toward centre and apex, separated by chlorophyllose plates, one cell thick; storage tissue  $\frac{2}{5}$  the thickness of thallus, cells angular, closely packed, 65–75  $\mu$ m wide, containing starch granules. *Antheridia* in one or two crowded rows along slightly raised central ridge in groove, hyaline necks protruding from small pits, up to 500  $\mu$ m long. *Archegonia* in a row along groove, purple necks  $\pm$  300  $\mu$ m long. Sporangia  $\pm$  1100  $\mu$ m wide (Figure 2B), crowded together, bulging dorsally, overlying tissue thinning and disintegrating, containing  $\pm$  700 spores each. Spores (100–)130–150(–160)  $\mu$ m in diameter, triangular-globular, polar, yellow-brown, becoming darker with age, semitransparent; wing thin, undulating, up to 10  $\mu$ m wide, often perforated at marginal angles, margin finely crenulate, occasionally partly erose; ornamentation reticulate, rather similar on two spore faces: distal face (Figure 3E) with 10–12 rounded areolae across diameter, 10–15  $\mu$ m wide, sometimes larger and incompletely separated by low, fragmentary ridges radiating from central pillar, areolar walls finely granular,  $\pm$  5  $\mu$ m high, thin, generally becoming higher and thicker over centre, raised at nodes and often extending onto wing; proximal face (Figure 3F) with triradiate mark consisting of thin ridges up to 7.5  $\mu$ m high, frequently joined by areolar walls, each of three facets with (13–)18(–25) rounded areolae, 10–15  $\mu$ m wide, often incompletely separated and adjoining ones confluent. *Chromosome number:* n=8 (Bornefeld 1989).

*Riccia bullosa* is endemic to southern Africa and is found at seepages or on damp sandy soil underneath brush, or at granitic, basaltic or sandstone outcrops in the western and southern Cape and in the subalpine belt of the Drakensberg Mountain range of Natal and Lesotho in grasslands or bogs (Figure 4). It is placed in the subgenus *Ricciella* and can be distinguished from related species, *R. garsidei* and *R. volkii*, by its straw-coloured or yellowish green, rather swollen thalli. *R. garsidei* Sim is often larger, almost white when dry, with many exposed air chambers; its spores have fewer and larger areolae. *R. volkii* is less robust and not so bloated, with narrowly winged, smaller spores and its distribution is restricted to the summer rainfall areas.

Arnell (1963) regarded *R. bullosa* as intermediate between (*Eu-*) *Riccia* and *Ricciella* with its narrow air spaces in the median part of the thallus and wide air chambers in the lateral parts. This is rather similar to Stephani's (1898) interpretation of *R. vesiculosa* Carr. & P. from Australia, which prevented him from dividing the genus *Riccia* into two subgenera, but as Na-Thalang (1980) and Volk (1983) have shown, it is not correct to separate these two subgenera on the size of the air chambers; the anatomy of the air chambers, the pores and the arrangement of the epidermal cells should be considered to be of greater importance.

Arnell (1952) described a new species, *R. montaguensis*, admitting that it was very similar to *R. bullosa* in habit and colour, although somewhat smaller. The supposedly smaller spores, which he reported to be 80  $\mu$ m in diameter, were found to be rather larger at 100–130  $\mu$ m (refer also

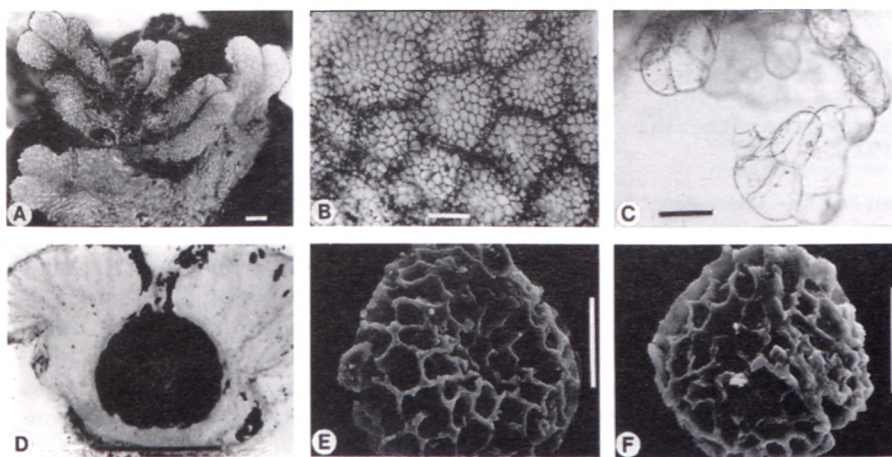


FIGURE 3.—*Riccia bullosa*. A, living thalli; B, dorsal epidermal cells from above, air pores hardly visible; C, vestigial ventral scales; D, cross section through thallus and sporangium; E, distal face of spore; F, proximal face of spore. A, Jean Thompson 278; B, D, Oliver 8038; C, Van Rooy 354; E, F, *Riccia crassa* Nees (STR). Scale bars on A, D = 1 mm; B ± 200 μm; C, E, F = 50 μm.

Garside's note on the herbarium sheet of specimen *S. Arnell 714* (BOL)). The ornamentation on the distal face is incomplete, with some large areolae containing a central papilla and low, radiating ridges (Perold 1989).

Specimens of *R. montaguensis* were closely examined and found to be indistinguishable from *R. bullosa*, which can vary considerably in size from rather small to large. Spores from all the sporulating material of this species at BOL and the many recent collections at PRE have been measured and photographed and they exhibit a continual gradation in size and also in the completeness or incompleteness of the ornamentation, so that a broader circumscription of *R. bullosa*, which includes these variations, is necessary. *R. montaguensis* S. Arnell is therefore included in the synonymy of *R. bullosa*.

Sim's (1926) description of *R. bullosa* is quite clear and it will be noticed that he refers to the central channel as very pronounced but narrow, that ventral scales are absent, that there are about 12 'air cavities' on each side of the central channel and that the air pores are minute, but with age the air cavities are left open at the top. The spore diameter should, however, be 170 μm and not 17 μm, clearly a conversion error.

Sim's observation that *R. capensis* (Brunnthaler 1913) appears to be a young sterile condition of this, is inexplicable, as they are completely different species: *R. capensis* has been placed in synonymy under *R. limbata* (Perold & Volk 1988). The Giffen collection (ex Herb. Sim) from 'Ookiep', Namaqualand, which Sim cites, has been referred to *R. schelpei* Volk & Perold (1986), but the Pole Evans collection from Premier Mine, Transvaal, has not been traced. It is most probably a specimen of *R. volkii*, judging by the distribution of this species.

Close examination of Nees's material, now held at STR, shows that the contents of the two packets labelled *Riccia crassa* are indeed *R. bullosa*. One of these two specimens is a single thallus containing a sporangium with ripe spores (Figure 3E, F). The other specimen is here selected as lectotype because it agrees well with the protologue, its locality is clearly stated and it is reasonably good material; the specimen is identified on the label and in the protologue as *R. crassa*, but no collector's name is given. It must have been Ecklon, however, (Lehmann 1829), as also cited by Stephani (1898). The latter's three herbarium

specimens at G were seen, and these are most probably duplicates. They had been identified as *R. bullosa* and no mention is made of *R. crassa*. For this reason none of these specimens were selected as lectotype. The contents of a third packet, labelled *R. bullosa*, cannot be identified. The packet labelled *R. ecklonii* c. tr. *R. bullosa*, appears to contain a male plant of *R. purpurascens* Lehm. This is also inferred from Nees's (1838) description, where it is added in a footnote that the male plant he described was from 'Vorgebirge der guten Hoffnung', meaning the Cape of Good Hope, but the word, Cape, was left out [as Lindenberg (1836) also did]. Nees (1838) also described the antheridia causing bulging of the frond above and below. The bulges below were, according to him, richly supplied with rhizoids and therefore resembled sporangia of *R. natans* (= *Ricciocarpos natans* (see Perold 1990, Figure 6F)). Such dorsiventral swellings are quite conceivable in the thin thallus of *R. purpurascens* but hardly in a thallus as thick as that of *R. bullosa*.

#### Typification of *Exormotheca welwitschii* Steph.

TYPE.—Portugal, Vendas am Tejo, *Welwitsch s.n.* (but no. 33 fide Mitten 1853) (BM, LISU, G!) fide Stephani 1899, Species hepaticarum, Bulletin de l'Herbier Boissier 7: 220. *Riccia bullosa* auct. non Link ex Lindenberg 1829; Müller 1940, Rabenhorst's Kryptogamen Flora von Deutschland und der Schweiz 6 (Ergänzungsband): 278–280.

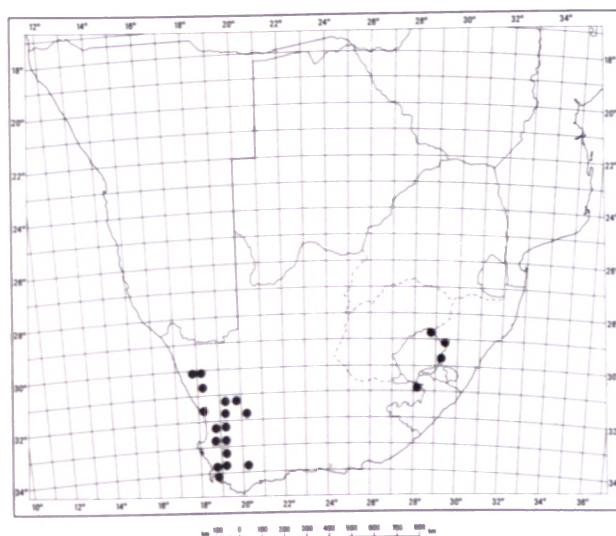


FIGURE 4.—Distribution of *Riccia bullosa* in southern Africa.

## SPECIMENS EXAMINED

O.F.S.—2828 (Bethlehem): Witzieshoek, Drakensberg, at base of Sentinel, (—DA), *Schelppe 7690* (BOL, PRE); Drakensberg, Sentinel Pass, (—DB), *Oliver 7324* (PRE); Wintershoek, Sentinel, footpath, (—DD), *Jean Thompson 277, 278* (PRE); Sentinel, along path from parking area to chain ladder, (—DD), *Van Rooy 1086* (PRE).

NATAL.—2828 (Bethlehem): Mont-aux-Sources, Drakensberg, (—DD), *Schelppe 23856* (BOL); Mont-aux-Sources, (—DD), *Ellis CH13474* (PRE). 2929 (Underberg): Bergville, Drakensberg, Injasuti area, (—AB), *Esterhuysen 26141* (BOL).

LESOTHO.—2828 (Bethlehem): Oxbow, 2 km W of Lodge, (—DC), *Magill 4588* (PRE); Mahlasela Hill (West), 10 km from New Oxbow Lodge to Mokhotlong, (—DC), *Van Rooy 2995* (PRE); 4 km from New Oxbow Lodge to Butha Buthe, (—DC), *Van Rooy 3133, 3135, 3136, 3142* (PRE). 2929 (Underberg): Sani River, circa 7 km from Sani Top to Mokhotlong, (—CA), *Van Rooy 3462* (PRE); Sani Pass, marsh flats with scattered rock outcrops N of mountain lodge, (—CB), *Magill 4401A* (PRE); south of Sani Pass on Border Post, (—CB), *Magill CH4509* (PRE); Sani Top, at disused air strip, N of mountain chalet, (—CB), *S.M. Perold 2523* (PRE); Sani Top, south side of dam, near border post, in ditch, (—CB), *S.M. Perold 2527, 2528A* (PRE); Sani Top, along upper Sani Valley, N of border post, (—CB), *Van Rooy 3535* (PRE); Sani Top, mountain slopes W of border post, (—CB), *Van Rooy 3541, 3578, 3579* (PRE); Sehlabathebe Nat. Park, (—CC), *Magill 4317* (PRE).

CAPE.—3017 (Hondeklipbaai): Kamiesberg Pass, circa 5 km from Kamieskroon, (—BB), *S.M. Perold 1600* (PRE). 3018 (Kamiesberg): 5.2 km along Rooifontein turn-off from Kamieskroon-Liefontein road, (—AA), *S.M. Perold 1471, 2170* (PRE); Farm Welkom, N of Liefontein, Rooiberg Peak, (—AC), *Ellis CH 13467* (PRE); Kamiesberg, plateau N of Liefontein towards Draaiklip, (—AC), *Oliver 8038* (PRE); Studer's Pass, 8 km from foot of pass, on road to Garies, (—AC), *S.M. Perold 1615* (PRE); on road between Kamieskroon and Liefontein, 5 km before Liefontein, (—AC), *S.M. Perold 2097* (PRE); southern Kamiesberg, Klippoort SE of Hoedberg, (—CB), *Oliver 9555* (PRE). 3028 (Matatiele): Barkly East, Naude's Nek, (—CC), *Jean Thompson 266, 267* (PRE). 3118 (Van Rhynsdorp): Olifants River Valley, between Klawer and Citrusdal, (—CA), *Wilman 663* (BOL). 3119 (Calvinia): Nieuwoudtville-Calvinia road, 7 km along Rondekop turnoff, (—AC), *S.M. Perold 2320* (PRE); Calvinia, Hantamsberg, main plateau, south end, (—BD), *Oliver 8876* (PRE); Hantamsberg, Farm Van Rhynshoek, NE of Calvinia, near FM tower, (—BD), *S.M. Perold 1821, 2335* (PRE); Botterkloof Pass, Farm Daantjie se Kraal, 37 km along road between Soetwater and Clanwilliam, (—CB), *S.M. Perold 1872, 1874* (PRE). 3120 (Williston): N Roggeveld, Knechtsbank, (—CC), *Oliver 8926* (PRE). 3218 (Clanwilliam): 16 km E of Clanwilliam, along Pakhuis Pass, (—BB), *S.M. Perold 1919, 1924* (PRE); 20–23 km N of Citrusdal, near Olifants River, (—BD), *S.M. Perold 536, 2388, 2396* (PRE); Farm Middelpoos, on road from Goedverwag, NW of Piketberg, (—DC), *S.M. Perold 510* (PRE). 3219 (Wuppertal): on road between Soetwater & Clanwilliam, 3 km before turnoff to Biedouw/Wuppertal, (—AA), *S.M. Perold 1881* (PRE); Biedouw Youth Camp, 19 km along road to Wuppertal, (—AA), *S.M. Perold 1897* (PRE); 30 km E of Clanwilliam beyond Pakhuis Pass, (—AA), *S.M. Perold 1945* (PRE); Biedouw Valley, Farm Mertenhof, Bushman Cave on slope facing west, (—AB), *Oliver 1466* (BOL); Cedarberg Pass, at end of pass, before entering Perdekloof, (—AC), *S.M. Perold 555* (PRE); between Sneeuberg and Cedarberg, (—AC), *S.M. Perold 562* (PRE); 46 km from Berg-en-dal to Clanwilliam, via Cedarberg, (—AC), *Stirton 9175* (PRE); Farm Kleinplaas, 17 km from Citrusdal on road to Ceres, (—CA), *S.M. Perold 2400* (PRE); 55 km from Ceres, along road to Op-die-Berg, (—CD), *Koekemoer 319* (PRE). 3318 (Cape Town): Stellenbosch, (—DD), *Duthie CH 1055* (PRE); Stellenbosch, between Union Park and Marais Park, (—DD), *Duthie s.n.*, 2-12-1936 (BOL); Stellenbosch, (—DD), *Duthie s.n.*, 20-9-1937 (BOL); *Duthie s.n.*, 10-1937 (BOL); Stellenbosch, Plakklip, (—DD), *Duthie 5486a* (with *R. compacta*) (BOL); Stellenbosch flats, (—DD), *Garside 2, 3* (PRE); Stellenbosch, Plakklip, near Municipal dumping ground, (—DD), *Morley 215* (PRE), *S.M. Perold 467* (PRE). 3319 (Worcester): Tulbagh, just NE of Saronsberg, (—AA), *Oliver 1475* (BOL, PRE); Op-die-Berg, near Dutch Reformed Church, (—AD), *Morley 272* (PRE), *S.M. Perold 566, 2401* (PRE); Ceres end of Baineskloof, (—CA), *Oliver 1476* (BOL, PRE); on road between Franschoek and Paarl, (—CC), *Morley 306* (PRE). 3320 (Montagu): Montagu, (—CC), *S. Arnell 741* (BOL); (type specimen of *R. montaguensis* S. Arnell). 3324 (Steytlerville): on road between Patensie and Willowmore, (—CA), *Koekemoer 284* (PRE). 3418 (Simonstown): Harmony Strand, NW of Gordon's Bay, (—BB), *Oliver 8777* (PRE).

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