

Studies in the genus *Riccia* (Marchantiales) from southern Africa. 7. *R. congoana* and its synonyms

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ABSTRACT

R. congoana Steph. is described and illustrated. *R. rhodesiae* S. Arnell, *R. nigrosquamata* E. W. Jones and *R. aegyptiaca* S. Arnell are treated as synonyms under *R. congoana*. *R. congoana* has a wide distribution in Africa, ranging from Egypt in the north to SWA/Namibia and Transvaal in the south, and from Sierra Leone in the west to Tanzania in the east.

UITTREKSEL

R. congoana Steph. word beskryf en geïllustreer. *R. rhodesiae* S. Arnell, *R. nigrosquamata* E. W. Jones en *R. aegyptiaca* S. Arnell word as sinonieme van *R. congoana* beskou. Die verspreiding van *R. congoana* in Afrika strek vanaf Egipte in die noorde, tot SWA/Namibië en Transvaal in die suide, en van Sierra Leone in die weste tot Tanzanië in die ooste.

Riccia congoana Steph. in Bulletin de l'Herbier Boissier 6: 20 (1898); E. W. Jones: 226 (1957). Type: French Equatorial Africa, Forêt de Ceseles, *M. de F. Voz s.n. sub G13336* (G-herb. Steph., ex hb. Bescherelle, holo.!).

R. rhodesiae S. Arnell: 313 (1952); S. Arnell: 29 (1963a). Type: S. Rhodesia [Zimbabwe], Victoria Falls, on soil near Trolley Junction, *Arnell 1291* (S. holo.!, BOL!, PRE!).

R. nigrosquamata E. W. Jones: 222 (1957). Type: Tanganyika [Tanzania], Lighthouse Island, Dar-es-Salaam Harbour, *Jones 699* (BM, holo.; Herb. Jones!).

R. berriei E. W. Jones: 224 (1957). Type: Nigeria, St. Anne's Churchyard, Kudeti, Ibadan, *Berrie 1956* [not seen but placed in synonymy under *R. nigrosquamata* by Berrie (1975)].

R. aegyptiaca S. Arnell: 9 (1963b). Type: Egypt (Egyptian-Sudanese border), Gebl. Elba Distr., Wadi Aideib, *M. Kassas s.n.* (S. holo.!).

R. limbatoides, nom. prov., O.H. Volk: 58 (1984). South West Africa/Namibia, Grootfontein, Farm Gaikos, *Volk 00747* (M, PRE!).

Thallus monoicous, ** perennial, scattered or in irregular, partial rosettes 25.0–30.0 mm across, dorsally bright green to bluish or greyish green, reticulate, occasionally with irregular, white patches, black scales forming a narrow scalloped border; once or twice furcate, branches narrowly to widely divergent (Figures 1A & B; 2A), almost equally long or one branch occasionally longer, usually large to very large, with older parts dead, lobes 6.0–12.0 (–15.0) × (2.0–) 3.0–4.0 (–5.0) mm, (0.65–) 0.75–0.90 (–1.0) mm thick, i.e. about three to five times broader than thick; oblong or obovate, narrower proximally; apex rounded, obtuse, slightly emarginate; sulcus narrow and deep apically, with convex sides, proximally shallow to flat (Figure 1E₁, E₂ &

E₃); pitted around bases of antheridia; margins acute, flanks sloping obliquely up and outward, attenuate; ventral surface green, slightly rounded to convex; when dry (Figure 1D), margins inflexed with large, shiny black or deep reddish purple scales usually meeting along the middle and covering all, or most of the dorsal surface. *Anatomy of thallus*: dorsal epithelium unistratose, cells globose or dome-shaped (Figures 1F & G; 2D), about 30.0–35.00 μm wide, thin-walled, upper wall soon collapsing, air-pores in between cells mostly four-sided (Figure 1G); assimilation tissue (chlorenchyma) (Figure 1E₁, E₂ & E₃) nearly half the thickness of thallus, consisting of vertical columns 6–8 cells high, columns shorter towards margins, cells 45.0–55.0 μm high × 35.0–45.0 μm wide, enclosing narrow, usually 4-sided air-canals (Figure 1F); storage tissue about half the thickness of thallus, cells angular to round, thin-walled, variable in size, many also containing chloroplasts; ventral epidermis giving rise to smooth and tuberculate rhizoids. *Scales* large and conspicuous, borne mostly on ventral side of wings of thallus (Figure 1C), imbricate, stiff, black or deep purple-red, shiny and sometimes duller, crescent-shaped to rounded, 750–900 × ± 800 μm, projecting about 200–250 μm beyond thallus margins and partly adherent to margin (Figure 2B & C), base often hyaline; cells in body of scale long-rectangular, or 5–6-sided, 75.0–85.0 × 25.0–50.0 μm, walls straight (Figures 1H₁ & 1H₂); margin of scales sometimes crenate (Figure 1H₃), with smaller cells; peripheral cell wall often dipping in middle, higher at anticlinal walls, forming so-called 'saddle cells' (O.H. Volk, pers. comm.). *Antheridia* in one to two rows along sulcus, prominent, projecting up to 250 μm, hyaline, bases sometimes tinged reddish pink. *Archegonia* scattered along groove, necks purple. *Sporangia*† single,

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** Volk 00747 (*R. limbatoides* nom. prov.) is stated to be dioicous by Volk (pers. comm.); Stephani reported *R. congoana* as dioicous, but it definitely is monoicous; Jones describes *R. nigrosquamata* as monoicous, and so is S. M. Perold 394.

† Few of the southern African specimens had sporangia, but Berrie (1975) reported the plants from Sierra Leone to be abundantly fertile. E. W. Jones (pers. comm.) states that in Ibadan, *R. nigrosquamata* specimens were also fertile.

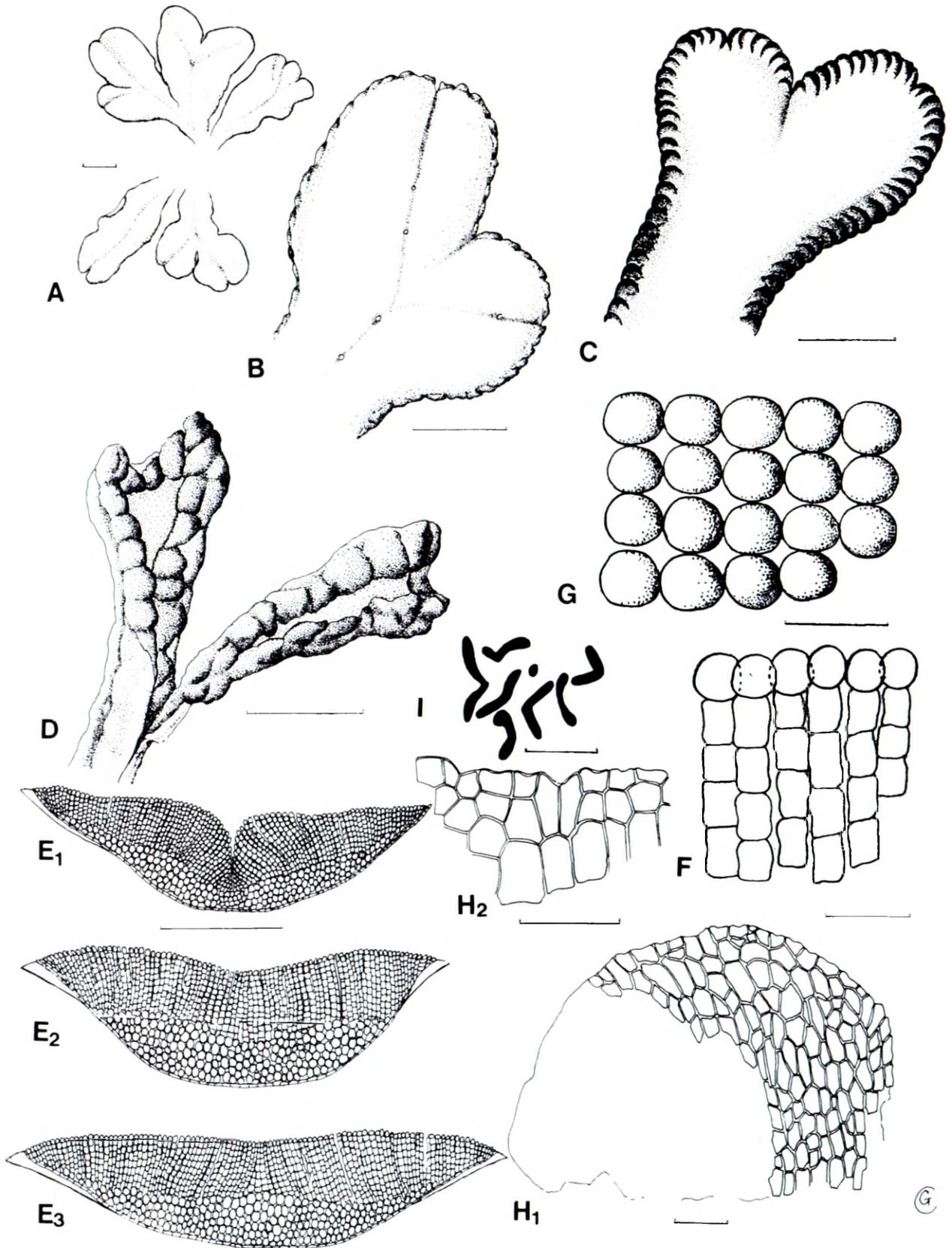


FIGURE 1.— *Riccia congoana* (Smook 5139, PRE). Structure of thallus and scales. A, habit; B, dorsal view of wet thallus; C, ventral view of wet thallus; D, dorsal view of dry thallus; E, transverse sections through lobe at different distances from the apex: 1, near apex; 2, in middle; 3, towards base; F, globose epithelial cells; G, dorsal epithelium and air-pores from above; H₁, scale; H₂, margin of scale; I, chromosomes. [Illustrations A-H, by G. Condy, I, by T. Bornefeld on Volk 00747 (under *R. limbatoides* nom. prov.)]. Scale bars on A = 2 mm; B-E = 1 mm; F, G = 50 μ m; H = 100 μ m; I = 1 μ m.

or several along groove, bulging dorsally, overlying tissue disintegrating and spores lying free in long, broad hollows or 'pits', (Berrie 1975); \pm 250–300 spores contained in each sporangium. Spores subglobular, rarely subtriangular-globular, usually apolar, without wing and triradiate mark, diameter (80–) 100–130 (–135) μm , yellowish brown to reddish brown, semi-transparent, surface granular (under light microscope), regularly reticulated* with 6–8 (–10) angular areolae across diameter of spore (Figure 3A, B, C & D), areolae 10.0–15.0 (–17.5) μm wide, borders usually thin and delicate, with faint striations, tall, 4.0–6.0 μm high, often raised at the nodes into slender, blunt projections. Chromosome number $n = 8$ (Figure 11) (Bornefeld 1984, for *R. limbatoides*, nom. prov.). (Also reported as 8 by Berrie (1975), for *R. nigrosquamata*).

The plants grow on sandy red soil, on black turf, on dolomitic or on disturbed, calcareous soil, the latter also noted by Jones (1957) and by Volk (1984, for *R. limbatoides*, nom. prov.). They have also been collected near waterfalls and seepages (*S. M. Perold* 394), and often show a preference for lightly shaded places beneath *Acacia*, *Kirkia* or *Adansonia* trees.

R. congoana has been recorded from Nigeria: Jones 1154 (Herb. Jones!), Jones 1168 (Herb. Jones!); Tanzania: Jones 699 (Herb. Jones!), Jones 2252 (Herb. Jones!) (as *R. nigrosquamata*) and from Uganda: Gittins 12/22 (Herb. Jones!).

Besides his type specimen from Victoria Falls, Zimbabwe, Arnell (1963)** reported *R. rhodesiae* from the Gold Coast, Nigeria, Uganda, Tanganyika (= Tanzania), as well as from Egypt (as *R. aegyptiaca*), but he gave no details of the localities, except for the specimen from Egypt.

Berrie's collections (1975) of *R. nigrosquamata* are from Sierra Leone (near Freetown); Pettet (1967) reports plants very similar to *R. nigrosquamata* from Sudan: Khartoum Province; Jones (1957) mentions the closely similar *R. kassaica*, a manuscript name used by Stephani, from the Belgian Congo [Zaire].

In southern Africa *R. congoana* is known from South West Africa/Namibia and from the northern, eastern and southern parts of Transvaal. Figure 4.

DISCUSSION

The types of the synonyms cited were examined and compared.

1. *R. congoana* Steph. and *R. nigrosquamata* E. W. Jones

Jones (1957) distinguished the above two species on the following differences observed by him:

(a) *behaviour of the thallus margins when drying*: in *R. congoana*, they become inflexed and 'inrolled', and even remain inflexed near the apex on re-wetting; in *R. nigrosquamata*, the opposite margins meet 'face to face' along the middle of the thallus;

(b) *the thickness of the thalli*: Jones states that *R. congoana* is quite distinct from *R. nigrosquamata* in its 'thinner thallus'.

On the other hand, Jones found some resemblance in the scales of the two species; in both he described them as large, imbricate and violet-black. His descriptions and illustrations of the spores of the two species are also similar (see also SEM micrographs, Figures 5A–D, 6A–D).

The behaviour of the thallus margins when drying, is not regarded as conclusive, since in *R. nigrosquamata* (for example Jones 2252) even on the same branch, one lobe had the margins and scales tightly inflexed and meeting along the middle, whereas in another lobe, the sides and apex were only raised and partly folded inwards. Berrie (1975) reported that thalli of the hygromorphic form of *R. nigrosquamata*, were closely applied to the moist soil. On drying, the upper surface became strongly concave, but the margins did not completely leave the ground. In the xeromorphic form, the margins folded inwards on drying and the plants 'buried' themselves.

With regard to the thickness of the thalli, transverse sections found with the holotype of *R. congoana* (*M. de F. Voz s.n. in G13336*) are 0.55–0.65 mm thick. Stephani's drawings and these sections are scarcely 'thinner' than usual. They also show a distinct groove, which he describes as well (1898), but my examination of the thalli, reveal them to be thin, flat and expanded, with the groove only present at the apex. Gittins 12/22 (Herb. Jones!), collected at Murchison Falls, presumably a fairly damp habitat (although without the hyaline scale margins Berrie (1975) reported for the hygromorphic form of *R. nigrosquamata*), are 0.4 (–0.5) mm thick, somewhat thinner (but not broader) than *R. nigrosquamata* thalli, which Jones stated to be 0.6–0.8 (–0.9) mm thick. Abeywickrama (1945) observed: 'Increase in moisture, accompanied by shading, resulted in the thallus becoming broader and thinner . . .', which may account for the relative thinness of the Gittins specimens.

In the light of the above, it is concluded that *R. congoana* and *R. nigrosquamata* are not two different species, but that *R. nigrosquamata* should be treated as a synonym of *R. congoana*.

2. *R. nigrosquamata* E. W. Jones and *R. berriei* E. W. Jones

Jones (1957) distinguished these two species because of the following differences:

(a) *R. nigrosquamata* with the scales large, imbricate and completely violet-black;

(b) *R. berriei* with the scales small, distant, entirely hyaline or violet with hyaline margins.

* O. H. Volk (pers. comm.) drew my attention to a fine, delicate reticulation faintly visible beneath the exine.

** E. W. Jones (pers. comm.) informs me that Arnell was citing his (Jones's) records of *R. 'rhodesiae'* sensu Jones, so that the distribution given by Arnell is in part that of *R. atropurpurea*.

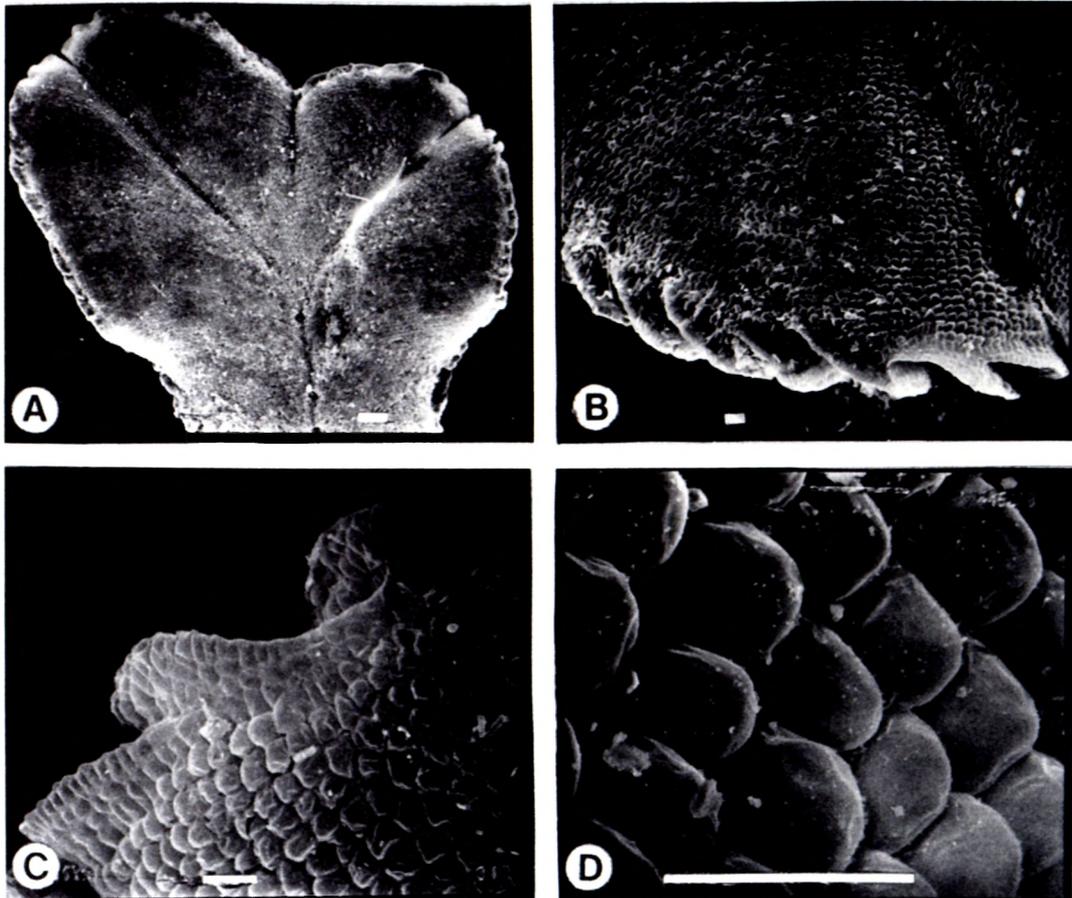


FIGURE 2. — *Riccia congoana* (Smook 5139, PRE). Thallus, scales and epithelium. A, dorsal surface view of thallus with young ostioles along groove; B, apex of thallus with groove and scales; C, position of scales along margin; D, dorsal epithelial cells (SEM micrographs by S. M. Perold). Scale bars on A = 500 μ m; on B–D = 100 μ m.

He remarked, however, that the spores of the two species bear a close resemblance.

Berrie (1975) studied the same colonies of plants during wet and dry seasons and concluded that they represented two forms of the same species, a hygromorphic form with small hyaline scales and a xeromorphic form, with large violet-black scales. Berrie therefore placed *R. berriei* into synonymy under *R. nigrosquamata*.

Jones reported the dimensions of the thalli growing in wet conditions to be 0.6–0.8 mm thick and 2.5–3.5 mm wide. They are slightly thinner and wider than those he gave for the xeromorphic form, 0.7–0.9 mm thick and 2.0–2.5 mm wide (see Abeywickrama's observation above).

3. *R. rhodesiae* S. Arnell and *R. aegyptiaca* S. Arnell

It is probable that Arnell did not see Stephani's *R. congoana*. He described *R. rhodesiae* (1952) and *R. aegyptiaca* (1963b), two geographically widely separated plants. He drew no comparisons between them, although he referred to similarities and differences between *R. aegyptiaca* and other species. His memory may have failed him, or else his own inaccuracies, listed below, misled him (as they did others):

(a) in his key (1963a), he placed *R. rhodesiae* under 'smaller plants . . .' together with *R. capensis*

sensu Arnell, which is truly small, its lobes being less than 1 mm wide and under 5 mm long. *R. rhodesiae* is by no means small; as Arnell states the lobes are 5–8 mm long and they are much wider than 1 mm (See under 'b', below);

(b) in the Latin diagnosis, the width of the lobes is given as 3–4 mm, but it was left out in the English description (1952) and also in *Hepaticae of South Africa* (1963a);

(c) the dark purple scales were described as 'triangular-lanceolate', which is incorrect, as they are crescent-shaped or rounded;

(d) the type specimens of *R. rhodesiae* are a mixed collection and most of the material is *R. atropurpurea* Sim (See below).

Although Arnell's description is inexact, his drawing of the spore (Figure 7B), and a slide of spores prepared by him (on loan from S) (Figure 7A), clearly indicate that he was referring to the *R. rhodesiae* portion of the collection. Spores collected from the type specimen by me are similar, but the tall thin areolar borders are less conspicuous (Figure 7C & D).

The thalli and scales of *R. rhodesiae* and *R. aegyptiaca* show a close resemblance. The spores of the type of *R. aegyptiaca*, *M. Kassas s.n.* (S!), appear to have lower and slightly thicker areolar borders, with

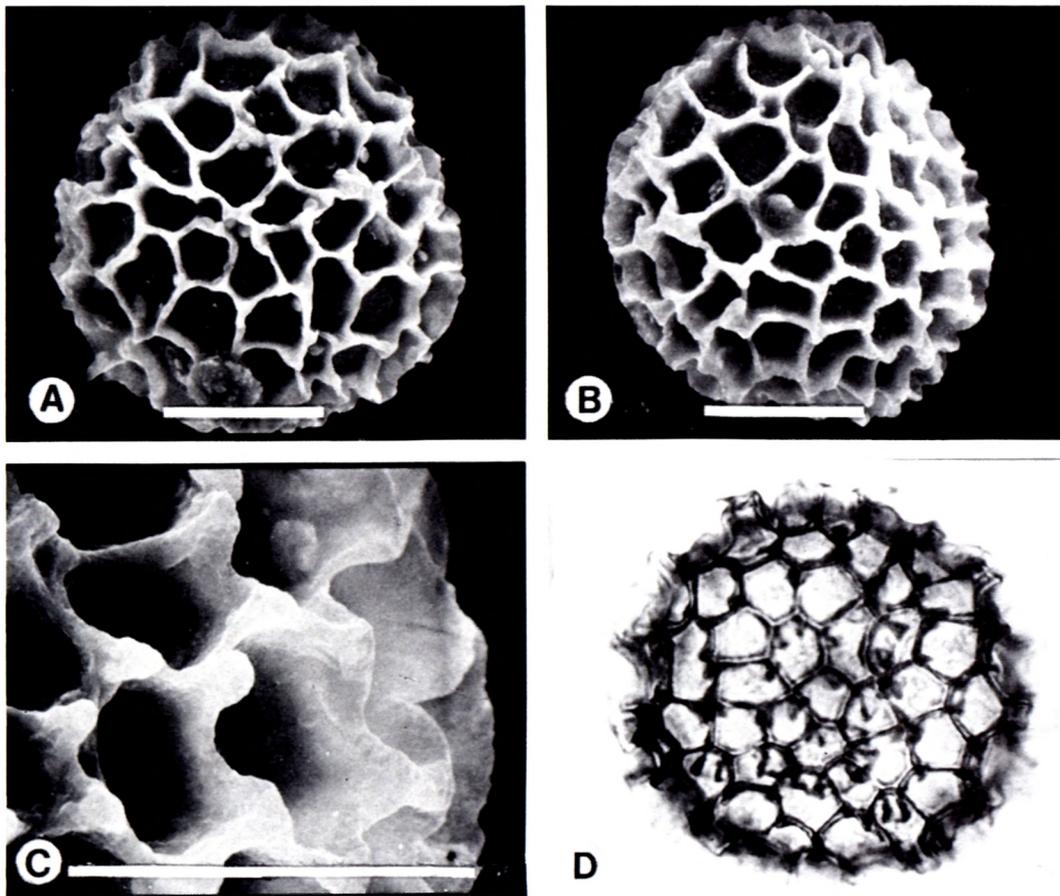


FIGURE 3. — *Riccia congoana* (S. M. Perold 394, PRE). Spores. A & B, spore faces with areolae; C, margin with tall areolar borders and nodes with projections; D, thin, fragile borders. (A–C, SEM micrographs; D, LM (light microscope) by S. M. Perold). Scale bars on A–C = 50 μm; diameter of spore on D ± 130 μm.

fewer papillae at the nodes (Figure 7E & F). Their light yellow colour and the many malformed ones, suggest somewhat ‘younger’ spores, but not those of a different species.

R. rhodesiae and *R. aegyptiaca* are therefore considered to be conspecific and both are regarded as synonyms of *R. congoana* on account of their grooved wide thalli, sloping flanks, distinctive dark coloured scales and spores with angular, generally thin-walled areolae.

4. *R. rhodesiae* sensu E. W. Jones non S. Arnell and *R. atropurpurea* Sim

Because of Arnell’s inaccuracies and the mixed collections, Jones (1957) mistakenly identified the *R. atropurpurea* portion of the specimens as *R. rhodesiae*.

In his description of *R. rhodesiae*, Jones comments that ‘Arnell did not note the hyaline margins to the thallus and scales . . .’ The thalli of *R. atropurpurea* have hyaline margins and so do the scales.

In *R. rhodesiae* S. Arnell the thalli never have hyaline margins, although the scales may have them in the hygromorphic form, as Berrie reported (1975) (not seen by me, however).

Jones’s illustrations and description of the spores clearly refer to the spores of *R. atropurpurea*, which are blackish brown and have low, thick-walled areolae (Figure 8B); Arnell’s drawing of the spores of *R.*

rhodesiae shows the areolae to be thin-walled, with larger, angular areolae (Figure 7B). Comparison of the *R. atropurpurea* portion of Arnell 1291 and its spores (Figure 8A & C), with the types of *R. atropurpurea*, Sim 8112 (CH1023) (PRE!) and Sim s.n. (CH1024) (PRE!) (Figure 8D), confirms beyond doubt that they belong to the same species.

The following specimens from Herb. Jones are therefore now identified as *R. atropurpurea* Sim:

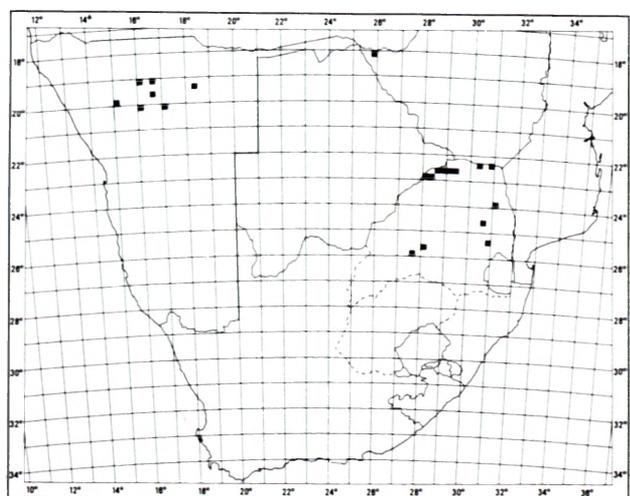


FIGURE 4. — Distribution map of *R. congoana* in southern Africa.

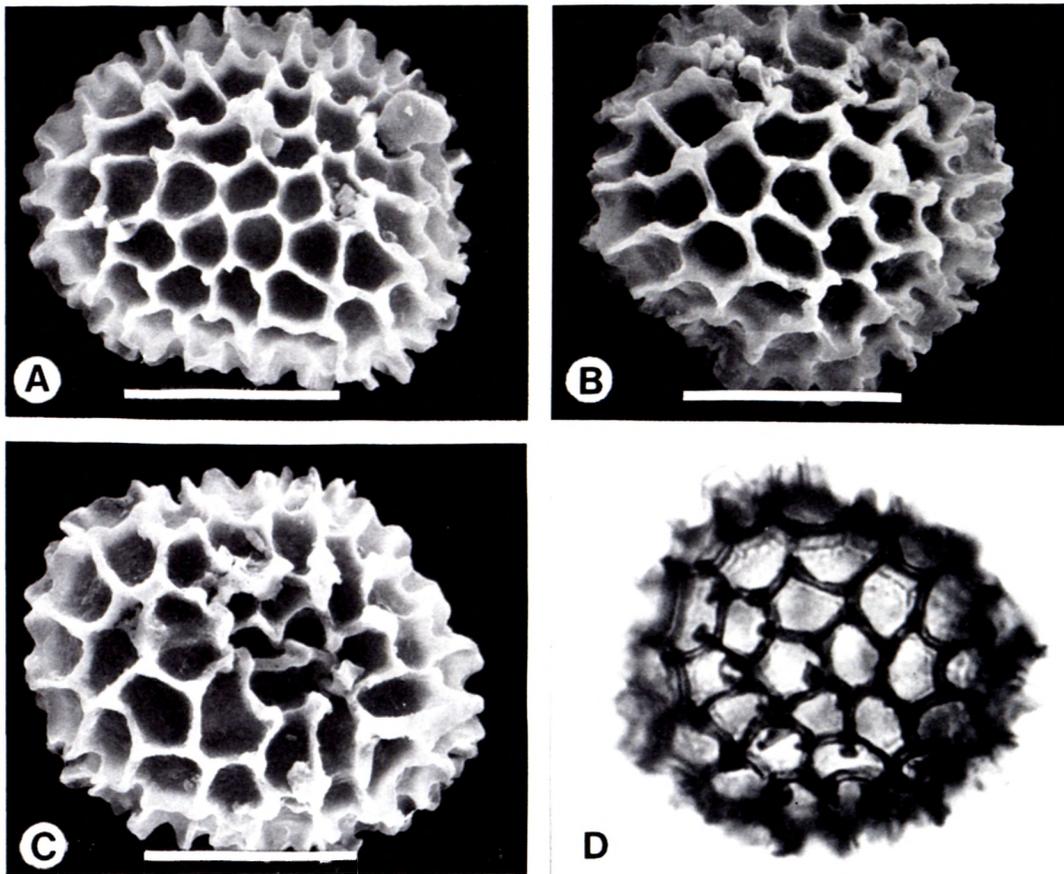


FIGURE 5. — *Riccia congoana* [Type *M. de F. Voz s.n sub G13336* (G-Herb. Steph)]. Spores. A, B, C, D, spore faces with areolae. (A–C, SEM micrographs; D, LM (light microscope) by S. M. Perold). Scale bars on A–C = 50 μm ; diameter of spore on D \pm 100 μm .

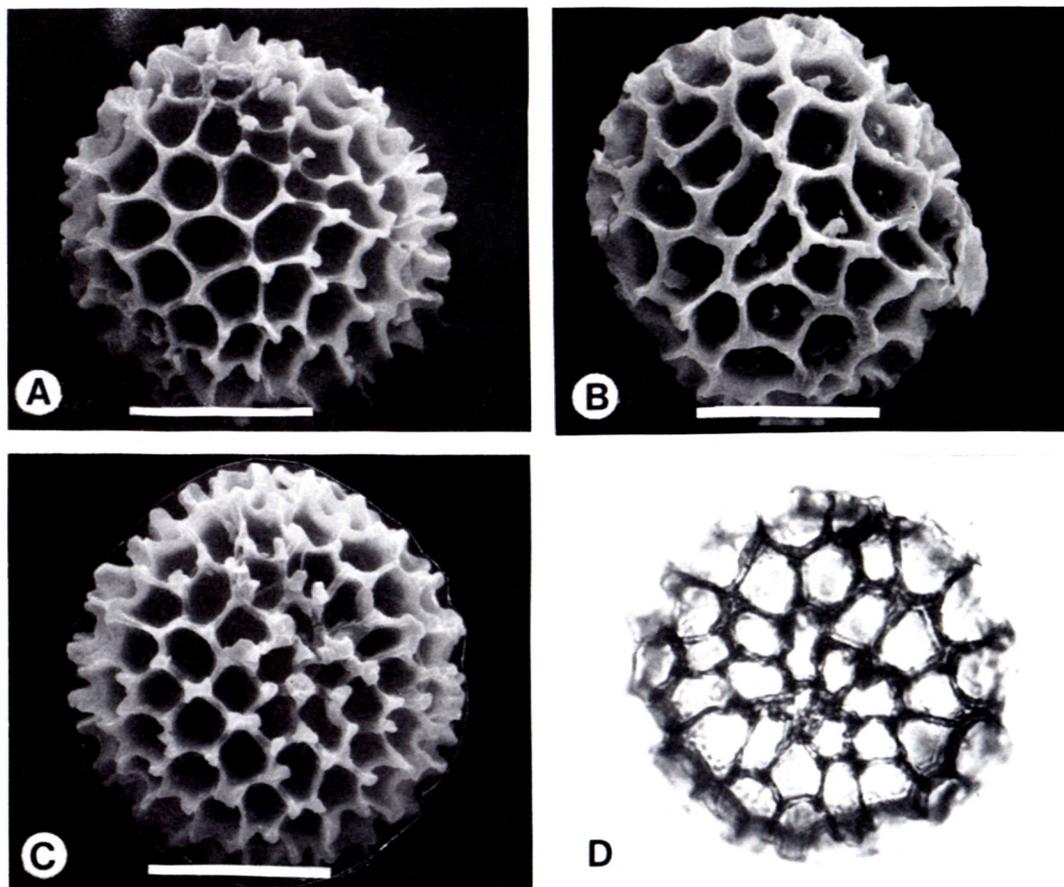


FIGURE 6. — *Riccia nigrosquamata* (Jones 699, isotype, Herb. Jones). Spores. A, B, C, D, spore faces with areolae. (A–C, SEM micrographs; D, LM (light microscope) by S. M. Perold). Scale bars on A–C = 50 μm ; diameter of spore on D \pm 110 μm .

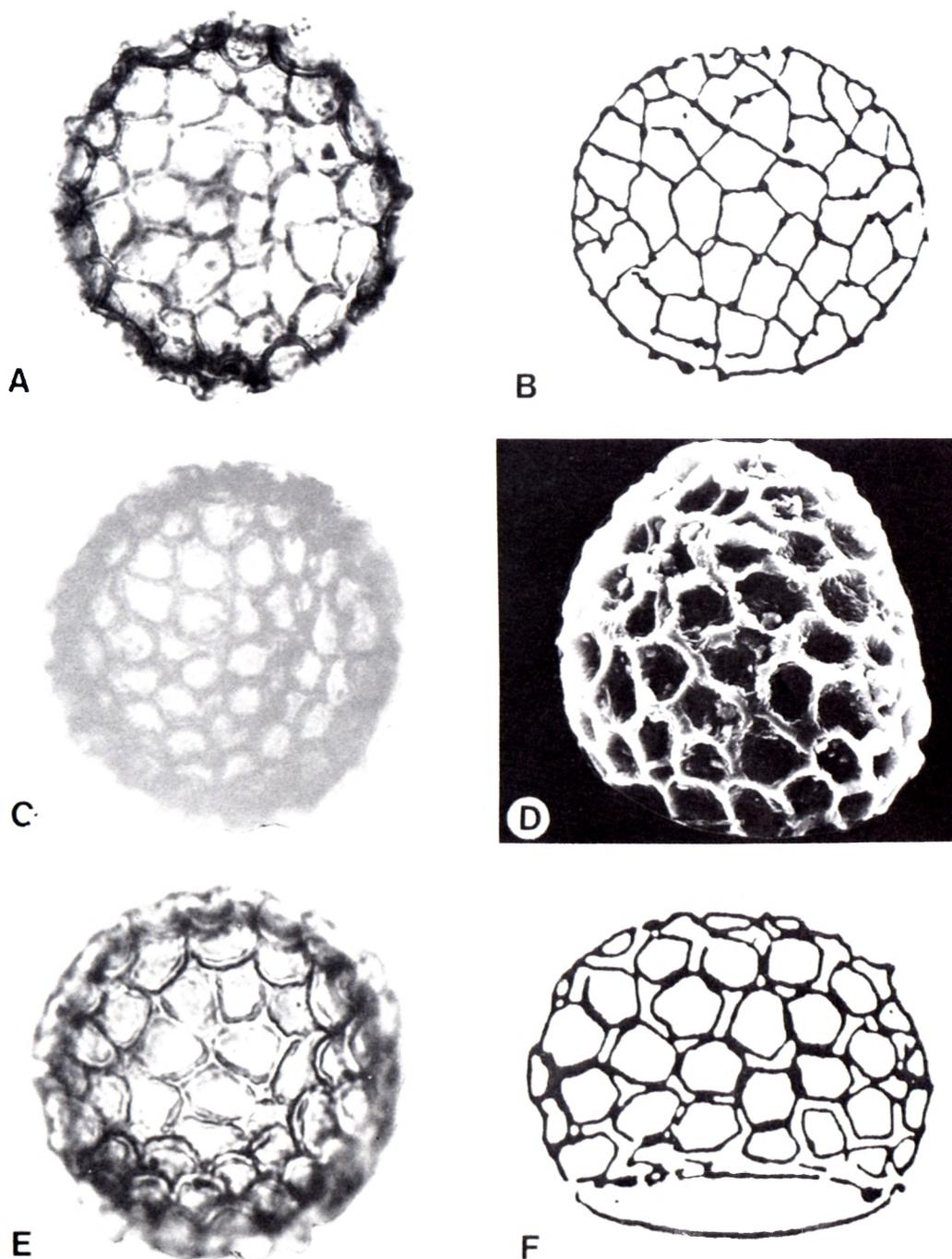


FIGURE 7. — *Riccia rhodesiae* and *R. aegyptiaca*. Spores. A. LM (light microscope) micrograph of spore on Arnell's slide 1291, portion of type specimen of *R. rhodesiae* in S; B. enlarged copy of Arnell's drawing of the spore ornamentation (1952); C, D. LM and SEM micrographs resp., of spores collected from Arnell 1291 (portion of type specimen on loan from S); E. LM micrograph of spore collected from *M. Kassas s.n.* (type specimen of *R. aegyptiaca*, on loan from S); F. enlarged copy of Arnell's drawing of spore ornamentation (Arnell 1963b) areolar borders too thick, due to enlargement of drawing. Diameter of spores on A, C & D $\pm 110 \mu\text{m}$; on E $\pm 90 \mu\text{m}$. All SEM and LM micrographs by S. M. Perold.

Jones 685 (Tanzania); *Wood 1190* (mixed with *R. okahandjana* S. Arnell (Uganda); *Jones 457* (Nigeria) and *Boughey s.n.*, Oct. 1953 (mixed with *R. congoana* Steph.) (Ghana).

5. *R. discolor* L. & L., *R. intermedia* E. W. Jones and *R. billardieri* Mont. & Nees

Vanden Berghen (1972) in his description of *R. intermedia* E. W. Jones (placed in synonymy under *R. discolor* L. & L. by Pandé & Udar (1957)) adds in

a note '*R. rhodesiae* S. Arnell (1952) *Bot. Not.*, p. 313. est peut-être identique à l'espèce décrite par E. W. Jones', which expresses some uncertainty on his part. Judging by the specimens of *R. intermedia* (= *R. discolor*) in Herb. Jones that were examined, I tend to disagree with him, because the lobes are much elongated, have parallel sides, develop a strong purple colour dorsally and the assimilation tissue appears less compact. It is reported to be strictly dioecious, and the spores have ridges equally high and not raised at the nodes, with 8–10 areolae

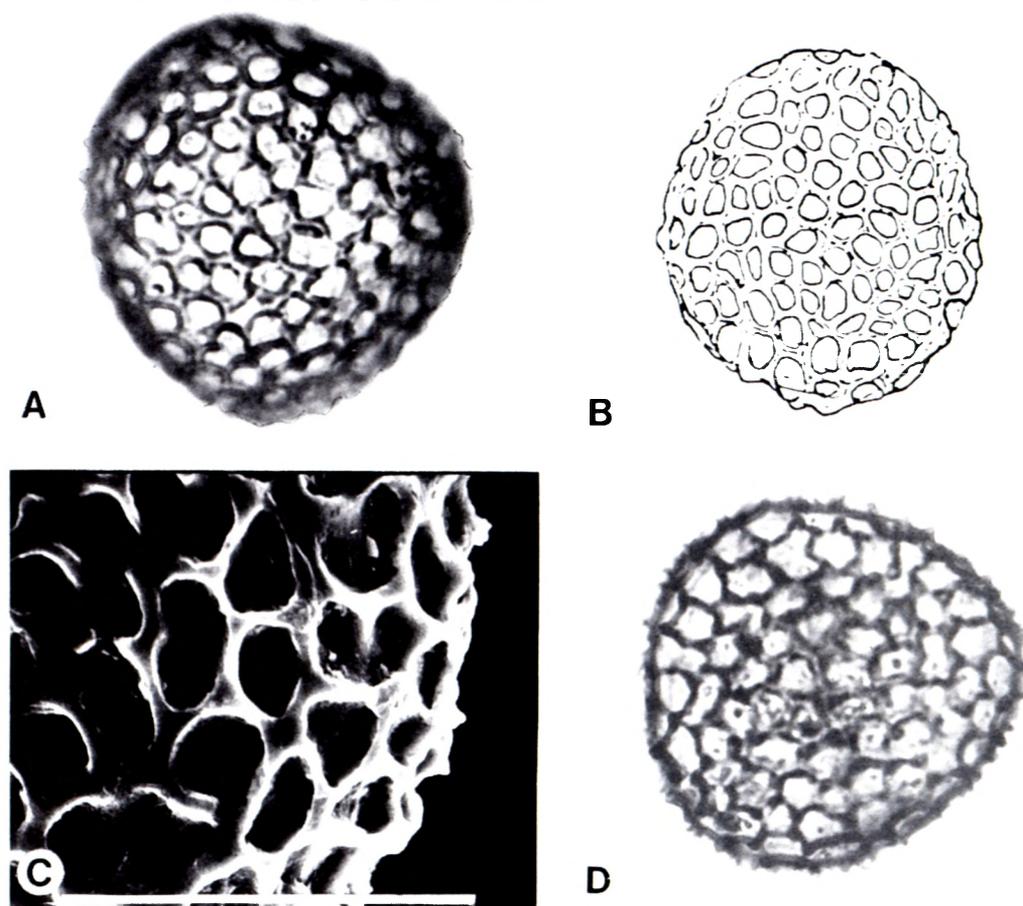


FIGURE 8. — *Riccia atropurpurea* Sim. Spores. A. LM (light microscope) micrograph of spore of *R. atropurpurea* portion of Arnell 1291 (portion of type specimen of *R. rhodesiae*); B. enlarged copy of Jones's drawing of the spore ornamentation of *R. rhodesiae* sensu Jones; C. SEM micrograph of areolae and borders of *R. atropurpurea* portion of Arnell 1291; D. LM (light microscope) micrograph of spore of syntype of *R. atropurpurea*, Sim CH 1024. Diameter of spores on A & D = 100 μm ; scale bars on C = 50 μm . All SEM and LM micrographs by S. M. Perold.

across the diameter of the spore, 7.5–10.0 μm wide. Vanden Berghen makes no mention of *R. rhodesiae* as described by Jones.

R. billardieri Mont. & Nees as described and illustrated by Pandé & Udari (1957), seems to be closer to *R. congoana*, and indeed, the single specimen of *R. billardieri* (leg. et det. V. Schiffner, IV 1894, fide E. Levier) from Java (Indonesia) that was examined, reveals a marked similarity to *R. congoana*, both in vegetative as well as in spore characters. However, in view of the problems experienced by some of the earlier Indian authors in distinguishing *R. discolor* and *R. billardieri* (as well as their several synonyms) from one another (Udari 1957; Pandé & Udari 1957), intensive study of more material of these two species is imperative, before any decision about their relationship to *R. congoana* can be reached.

CONCLUSION

There has obviously been much confusion about the *R. congoana* species-complex and it is hoped that this study will stimulate renewed interest in it.

The distribution of *R. congoana* covers a large area, where widely differing climatic conditions un-

doubtedly significantly affect the morphology of the plants.

I have been able to examine a large number of specimens from different habitats and have also cultivated plants for a considerable period of time; I find no significant characters that differ so consistently that the continued separation of the species seems justified. It is therefore proposed that *R. rhodesiae*, *R. nigrosquamata* and *R. aegyptiaca* be regarded as synonyms of *R. congoana*.

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SPECIMENS OF *RICCIA CONGOANA* EXAMINED

- Glen 1378, 1401, 1402, 1423, 1428 PRE.
- Hardy 6446 PRE. Hoffman CH 4513 PRE.
- S. M. Perold 130, 173, 175, 394, 732, 738, 744, 746, 747, 757, 762, 771, 763, 778, 779, 797 PRE.
- I. M. Retief 248, 249 PRE.
- Smook 5118b, 5139 PRE.
- Vogel T82A M. PRE. Volk 00722, 00747, 00978, 84/693a M. PRE.