Studies in the genus *Riccia* (Marchantiales) from southern Africa. 12. *Riccia albolimbata* and the status of *R. albosquamata*, white-scaled species originally described by Arnell

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Keywords: Arnell, Marchantiales, *Riccia albolimbata*, *R. albosquamata*, white scales

**ABSTRACT**

Arnell's (1957, 1963) inadequate descriptions, poor drawings, mistakes in the text and key, as well as mixed collections, have all contributed to the confusion regarding the identity of his species *R. albolimbata* and *R. albosquamata*. Volk's collections (Arnell 1957) of the latter consist mostly of two white-scaled species in the same packet: one is *R. albolimbata* and the other is *R. argenteolimata*. Volk & Perold (Volk et al. 1988). Evidently Arnell used characters of both plants to describe *R. albosquamata*, although the type specimen, Volk 452, consists of only *R. albolimbata* (plus fragments of *R. atropurpurea* Sim and *R. trichocarpa* Howe). *R. albosquamata* is accordingly to be regarded as a taxonomic synonym of *R. albolimbata*.

**UITTREKSEL**


**TYPE.**—SWA/Namibia, 2117 (Windhoek): Farm Voigtland, bei Windhoek, gegen Ondekaremba. Kalk­boden (AB). 1956.02.12. Volk 11419 (PRE-CH 4232) (M!, holo., PRE!). 2217 (Windhoek): Binsen­heimkamp (CD), Volk 11080 (M!, PRE!, para.).

**Thallus** monospermic, perennial, in rosettes 15—20 mm across, or in crowded gregarious patches; medium-sized; furcate or bi-furcate, branches ± symmetrical or one branch smaller, diversely divergent, ovate to oblong, up to 8.0 mm long, (1,5—) 1,8—2,2 (-3,0) mm broad, 2—2.5 times wider than thick; apex rounded, emarginate (Figures 1A; 2A); sulcus narrow and deep distally, dis­appearing in proximal parts, which are ± flat or slightly (Figures 1C, 1D1—5), green; when dry, margins inflexed with wavy hyaline-white scales covering most of dorsal surface (Figure 1B).

**Anatomy of thallus:** cells of dorsal epithelium emerging apically from groove in regular rows, hyaline, thin­walled, unistratose, dome-shaped or globose (Figures 1E; 2C), ± 45 x ± 50 μm, each cell usually with a single corresponding column of assimilation cells beneath, bulging upper walls sprinkled with calcium carbonate granules, cells soon collapsing, especially toward margins and more proximally (Figures 1E; 2D); air pores 4—5(-6)-angled, leading to air canals below (Figure 1F); assimilation tissue (chlorenchyma) about ½ the thickness of thallus, cells short-rectangular, ± 50 x 40—45 μm, in columns of 6—8 (-10), enclosing 4—5-sided air canals (Figures 1F, 2E) which widen toward sides of branches (Figure 2B); storage tissue occupying lower ½ of thallus, cells angular, size ± 55 μm. Rhizoids mostly smooth, some tuberculate, 15—20 μm wide. Scales hyaline to white, base often flecked with brown or dark red, closely imbricate, undulating, large, 800—900 (—1200) × ± 600 μm (Figure 1G), extending ± 150 μm above margin of thallus, rounded, edge mostly smooth, cells hexagonal to oblong-hexagonal in body of scale (Figures 1H; 2F), 55—100 × 35—55 μm, marginally smaller, ± 25—40 × 30—40 μm, surface of cells often encrusted with calcium carbonate deposits, cell walls generally free of crystals. Antheridia with thick hyaline necks becoming white and thread-like, in one or two rows along middle of lobe. Archegonia with purple necks. Sporangia with about 300—450 spores each, overlying tissue turning white and spongy, disinte­grating soon and leaving several capsules exposed along the longitudinal hollow. Spores 82—95 (-105) μm in diameter, yellow-brown to dark brown, semi-transparent to opaque, triangular-globular, polar, with wing narrow, 3,0—5,0 μm wide, often with pores at marginal angles, margin crenulate or finely eroded (Figure 3A); distal face with ornamentation quite variable, generally (7—) 10—12 angular to round areolae across (Figure 3B, C, D), 5,0—7,5(-10,0) μm wide, areolar walls varying from thin to thick, with raised papillae at nodes (Figure 3B)....
FIGURE 1.—*Riccia albolimbata* Arnell. Morphology and anatomy. A, fresh thallus; B, dry thallus; C, ventral view of thallus; D1–5, transverse sections of branch at different distances from the apex to older proximal part, S. M. Perold 1380; E, enlargement of transverse section through intact dorsal epithelial cells, capped with calcium crystals and showing narrow air canals in assimilation tissue; on right collapsed dorsal epithelial cells toward margin and larger air canals between columns of cells; F, epithelial cells with calcium crystals, air pores (hatched) overlying 4–5-sided air canals (dotted), as seen from above, S. M. Perold 398; G, scale; H, enlarged scale cells with calcium crystals, S. M. Perold 803. Drawings by J. Kimpton. Scale bar: A–D = 1 mm; E, F, H = 50 μm; G = 100 μm.
FIGURE 2.—Riccia albolimbata Arnell. Morphology and anatomy. A, dorsal view of apex and groove; B, large air pores near margin; C, globose dorsal cells intact at groove; D, collapsed dorsal cells around air pores; E, dorsal cells and air pores, S. M. Perold 398; F, scale cells, Volk 11419; G, scale cells, Volk 452. A–D, SEM micrographs; E–G, LM (light microscope) micrographs. Scale bar on A–G = 100 μm. All SEM and LM micrographs by S. M. Perold.

3F), frequently only a few of the areolae over central area complete, and short, irregular ridges radiating outwards from central areolae and extending onto wing; proximal face with triradiate mark distinct and generally incompletely areolate, walls often thinning out or anastomosing to form irregularly branching ridges (Figure 3A, E). Chromosome number n = 12 (Volk 81/204 p.p.), 16 (Volk 81/160); (Volk 81/231b as R. albosquamata); 24 (Volk 81/164) (Bornefeld 1984).

Different chromosome patterns within the same Riccia species, due to differential multiplication of individual chromosomes, were reported by Bornefeld (1984) and termed ‘nothopolyploidy’. Multiple chromosome numbers in some species (such as R. albolimbata) render chromosome numbers unsuitable as a diagnostic character (Volk et al. 1988).

R. albolimbata is widely distributed in the summer rainfall area of southern Africa and has been collected in South West Africa/Namibia and in Transvaal, Orange Free State and north-eastern Cape Province. It is apparently quite rare in Natal and central Cape and has not been found in the winter rainfall area of the north-western, western and south-western Cape (Figure 5).
It often grows on rocky outcrops, on shallow, calcrete soil at an alkaline pH, and on loamy soil between tufts of grass, sometimes in association with other Riccia species, e.g. R. atropurpurea Sim, R. okahandjana S. Arnell, R. trichocarpa Howe, R. argenteolimbata Volk & Perold and rarely with Marchantia spp.

Arnell (1957, 1963) reported R. albolimbata to be dioecious, but it is definitely monoicous (Table 1). There are other inaccuracies in his description as well: with branches 7 x 2 mm, it is not truly ‘minor’, but medium-sized; the dorsal colour of the thallus is green when fresh, not ‘pale green’; the scale cells are not ‘almost quadratic’, except occasionally at the margins: in the body of the scale they are oblong-hexagonal (he also described the cell shape as ‘generally hexagonal’ (Arnell 1957, at the bottom of p. 266), mistakenly referring to it as R. albomarginata, as explained below), and their cell sizes at 55–100 x 35–55 μm are usually somewhat larger than the 30 x 30–40 x 60 μm he reported; the scale cell walls are hardly thinner than in R. albosquamata [in both, the vertical walls are frequently visible (Figures 1 G, H and 2F, G which illustrate only R. albolimbata)]. The surfaces of the scale cells are often encrusted with calcium carbonate, but he did not mention it, only referring to it under R. albosquamata. In R. albolimbata spores, he described the wing as incomplete, but it could have been partly folded inwards or partly obscured, as his illustrations (Arnell 1957, Figure 2; 1963, Figure 14) suggest. Although there are generally papillae arising from the areolar nodes, he stated that they were without papillae; his illustrations show ± 12 areolae across the distal face, but it has been found that the ornamentation shows a good deal of variability, with the areolae often incompletely separated, and hence fewer in number (Table 2). The inner face, however, clearly has ‘irregular, thin lamellae’ as described by him.

In his key to the Riccia species (pp. 13–16), R. albolimbata has been left out and R. albomarginata is listed twice, at Nos 7 and 11. On p. 14, at No. 11, R. albomarginata must be replaced by R. albolimbata, and also on p. 25, as he is comparing R. albosquamata with R. albolimbata (and not with R. albomarginata!). In the couplet (i) and (ii) on p. 14, part of the first sentence must be transposed, to correspond with his information in the text, viz. ‘with a deep and sharp furrow’ belongs with the information about R. albolimbata and ‘slightly concave’ refers to his description of the dorsal surface of
<table>
<thead>
<tr>
<th>Substrate</th>
<th>Arnell</th>
<th>R. albolimbata</th>
<th>Perold</th>
<th>Arnell</th>
<th>R. albosquamata</th>
<th>Perold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Dioicous</td>
<td>Monoicous</td>
<td>Brown soil</td>
<td>Monoicous</td>
<td>Monoicous</td>
<td>Finely textured, gray soil with calcium content ±5 times higher than that of <em>Volk 11419</em> (LINK X-ray Microanalysis)</td>
</tr>
<tr>
<td>Colour</td>
<td>Pale green, shiny when fresh; colourless and 'spongious' over archegonia</td>
<td>Dry specimens white</td>
<td>White, shiny when fresh</td>
<td>White</td>
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<tr>
<td>Size</td>
<td>7 × 2 mm</td>
<td>Up to ±7 mm long, 1.6–1.8 mm wide, 0.9 mm thick</td>
<td>5 mm long</td>
<td>Up to 5 mm long, segments 3 mm long, 1.3(–1.6) mm wide, 0.9 mm thick</td>
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<tr>
<td>Width : thickness</td>
<td>2–3 times broader than thick</td>
<td>1.6–2 times broader than thick</td>
<td>3 times broader than thick</td>
<td>1.4–1.6 times broader than thick</td>
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<tr>
<td>Branching</td>
<td>Bifurcate</td>
<td>Bifurcate</td>
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<td>Bifurcate</td>
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<tr>
<td>Segment shape</td>
<td>Ovate</td>
<td>Broadly ovate</td>
<td></td>
<td>Slightly concave dorsally</td>
<td></td>
<td></td>
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<tr>
<td>Apex</td>
<td>Subacute</td>
<td>Rounded</td>
<td></td>
<td>Apically grooved, proximally concave, frequently with ± bulging sporangia</td>
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<tr>
<td>Groove</td>
<td>Deep and sharp, except proximally plano-convex, lateral parts of dorsal surface convex</td>
<td>Deep and sharp apically, concave proximally</td>
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<tr>
<td>Margin</td>
<td>Subacute</td>
<td>Acute to subacute</td>
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<tr>
<td>Flanks</td>
<td>Obliquely ascending at 45–60°</td>
<td>Steep in old, long dried herbarium specimens, mostly oblique when fresh but degree possibly somewhat affected by shade and moisture conditions</td>
<td></td>
<td></td>
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<tr>
<td>Epithelium</td>
<td>Cells thin-walled, upper wall subepithelial</td>
<td>Collapsed, except in groove at apex</td>
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<tr>
<td>Scales</td>
<td>Large, exceeding margin of thallus, entire, rounded, imbricate, cells thin-walled, almost quadritary, 30 × 30 to 40 × 60 μm</td>
<td>1200 × 700 μm, cells in body of scale hexagonal, up to 100 × ±35 μm, wavy, hyaline; in other specimens white with calcium deposits</td>
<td>Thin-walled, ± cubic, 20 μm, soon destroyed</td>
<td>Large, imbricate, white with pale purple base, widely exceeding margin of thallus, margin entire, rounded, like scales of <em>R. limbata</em>, cells large, 50 × 70 μm, thick-walled, lumen ± filled of (sic) fine granules</td>
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<tr>
<td>Spores</td>
<td>80–100 μm</td>
<td>(See Table 2)</td>
<td>Yellow-brown to dark brown</td>
<td>70–80 μm</td>
<td>Dark brown</td>
<td>Presumably referring to <em>R. argenteolimbata</em></td>
</tr>
<tr>
<td>Diameter</td>
<td>Brown</td>
<td>Yellow-brown to dark brown</td>
<td>Partly folded or obscured</td>
<td>2–4 μm</td>
<td>Irregularly areolate, 7–8 areolae in diameter, (8)–10–12 μm wide, 'processes of reticulum as spines in the wing'</td>
<td>Presumably referring to <em>R. argenteolimbata</em>; scales in *Volk 452, 450–1 000 × 550 μm, cells oblong-hexagonal, 60–75 × 37 μm, not thicker-walled, white, heavily encrusted with overlying calcium deposits, perhaps due to much higher calcium content in substrate</td>
</tr>
<tr>
<td>Colour</td>
<td>Incomplete</td>
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<tr>
<td>Wing</td>
<td>Fooveolae 8–10 μm wide, rounded, without papillae, thin reticulum</td>
<td>±12 areolae across distal face, as illustrated in drawing by Arnell (variable)</td>
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<td></td>
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<tr>
<td>Outer face</td>
<td>Irregular, thin lamellae</td>
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<td></td>
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<tr>
<td>Inner face</td>
<td>(See Table 2)</td>
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*Table 1.* Comparison of Arnell's data on *Riccia albolimbata* and *R. albosquamata*. Observations and/or comments on type and other specimens by author.
R. albosquamata. It has now, however, become clear that the dorsal surface of R. albolimbata is only apically deeply grooved, and flat to somewhat concave proximally, whereas that of the other white-scaled species in these Volk collections, R. argenteolimbata (Volk et al. 1988), is deeply grooved along the entire length of the thallus.

Besides the types, there are fortunately several other fairly good specimens of R. albolimbata with spores [Volk 11080 (M!, PRE!), 11401 (M!), 11705 (PRE!) and 11946 (M!, PRE!),] identified by Arnell, to enable one to form a clear concept of the characters of this species. Volk 11967 (PRE!), is possibly a large plant of R. atropurpurea, judging by the spore ornamentation, but the thalli are broken up and it is difficult to make a definite decision about its identity. In notes found with some of Duthie’s collections from Fauresmith and Middelburg (Cape) and now identified as R. albolimbata, she referred to them as the ‘Doomberg’ species, thus clearly indicating that she recognized them as belonging to a distinct species. Regrettably, she made no attempt to describe it.

R. albolimbata is closely similar to R. albornata Volk & Perold (Volk et al. 1988), but the former often grows in rosettes, the dorsal tissue covering the sporangia turns chalk-white and spongy, its scales are somewhat smaller and the spore ornamentation is coarser. Furthermore, the distribution ranges of the two species do not appear to overlap, except for two localities at Middelburg and Britstown, in the central Cape, and a doubtful one in northern South West Africa: Namibia.

R. albida Sull., described by Frye & Clark (1937) as having a white, spongioid dorsal surface (which they called ‘calcified’), differs in other respects from R. albolimbata by being a small plant, 2–4 mm long and 1,1 mm wide; the ventral scales are minute and the spores nearly smooth. Na-Thalang (1980) regarded R. austini Steph., R. albolimbata S. Arnell, R. albosquamata S. Arnell and R. albomarginata Bisch. as species closely related to R. lamellosa Raddi. However, R. albomarginata belongs to section Pilifer Volk, which is endemic to South Africa and is characterized by a dorsal epithelium of loose cell pillars (Volk 1983). R. lamellosa [= R. austini (Müller 1954)], is a larger plant with thallus lobes up to 20 mm long and with a somewhat different spore wing and spore ornamentation (Jovet-Ast 1986), neither has it been recorded from southern Africa.


Arnell (1957, 1963) recognized two species, R. albolimbata and R. albosquamata on the basis of the following (see also Table 1):

(i) the monoicism or dioicism of the plants;
(ii) the so-called differences in the colour, size and branching of the thalli;
(iii) differences in the shape of the dorsal groove, margins and flanks;
(iv) the thin-walled subspherical or cubic-shaped dorsal epithelial cells;
(v) the hyaline or white-spotted scales with, respectively, thin or thick cell walls;
(vi) the different 'texture' of the spores, i.e. ± 12–14 areolae across the diameter, forming a reticulum without papillae, in his spore drawing [Table 1, Figure 2 (1957), Figure 14 (1963)], as opposed to 7–8 areolae across the spore diameter [Table II, Figure 1 (1957), Figure 15 (1963)], with processes of the reticulum (projecting) as spines in the wing'.

The holotype collection of R. albosquamata, Volk 452, is a mixed gathering which also contains R. trichocarpa Howe and R. atropurpurea Sim and several branches of a white-scaled species. Detailed investigations of the white-scaled material resulted in the following findings: the plant appears to be monoicous, as R. albolimbata was also found to be, and the branching, shape and size of the lobes fall within the normal range for R. albolimbata. The material is, of course, no longer fresh and green and dorsally it has turned whitish. The groove is only distinct apically, flattening out and becoming slightly concave proximally. The margins are subacute, the flanks are steeper and less sloping than...
usual and the ventral surface is convex. The dorsal epithelial cells have collapsed, but the pores are 4–5-angled, the latter not commented on by Arnell. The scales are white with a reddish purple base, imbricate, large, 850–1000 × ± 550 μm, and extend above the margin of the thallus; the cells are ± 60–75 × 35 μm (Arnell reported 70 × 50 μm), calcium carbonate granules cover the cell surfaces and do not fill the cell lumens as stated by Arnell. The cell walls are ± 60–75 × 35 μm (Arnell reported 70 × 50 μm), calcium carbonate granules cover the cell surfaces and do not fill the cell lumens as stated by Arnell. The cell walls are not truly thicker either (Figure 2G). The spores were found to be 70–100 μm in diameter (Table 2) (Arnell reported 70–80 μm), yellow-brown to dark brown, triangular-globular, polar, with the wing (3–)5(–7) μm wide, sometimes with radial folds, pores at the marginal angles and the margin crenulate (Figure 4A); distal face with 8–10 (–12) areolae across (Figure 4B, D, E, F), (5,0–) 7.5–12.5 μm wide and often incomplete; sometimes the branched ridges over the centre of the face are more prominent (Figure 4B, F), as also seen in Arnell’s figure. The smaller number of slightly wider areolae Arnell described and illustrated for *R. albosquamata* spores, namely 7 or 8 as opposed to ± 12 he illustrated for *R. albolimbata* spores, are due to several areolae being incompletely separated and becoming confluent. Papillae project from the areolar nodes as in *R. albolimbata* spores. Arnell made no mention of the proximal face, but with thin, irregular ridges and a distinct triradiate mark (Figure 4A, C), it is indistinguishable from that of *R. albolimbata*.

I therefore conclude that the white-scaled branches included in the type gathering of *R. albosquamata* represent *R. albolimbata*. I hereby sink *R. albosquamata* S. Arnell under *R. albolimbata* S. Arnell, because the type collection of *R. albolimbata* represents only one species and the description refers to only one species, whereas *R. albosquamata* is based on a mixed type collection and its description is based on different species.

The identification of the other specimens which Arnell placed under *R. albosquamata* are as follows: Volk 453 (M, PRE!): the PRE specimen contains only *R. trichocarpa*; Volk 881 (paratype) (M!, PRE!): *R. albolimbata* and *R. argenteolimbata* Volk & Perold; Volk 883 (M!, PRE!): *R. albolimbata*, *R. argenteolimbata* and *R. atropurpurea* Sim; Volk 11906 (M!): *R. argenteolimbata*, *R. okahandjana* S. Arnell, *R. trichocarpa* and *R. atropurpurea*; Volk 12744 (M!, PRE!): *R. albolimbata* and an unidentified *Riccia* species. None of these white-scaled
specimens, except for the unidentified fragment of Volk 12744 and Volk 452, have spores.

It will be noticed that three of the above specimens also contain R. argenteolimbata Volk & Perold in the mixed collections. It is evident that Arnell based his characters from both. The references to 'thin and scale-like margins, perpendicular sides, white scales with pale purple bases 'resembling the scales of R. limbata in shape and size' and presumably the 'cubic' dorsal cells, indicate that he referred to the R. argenteolimbata part of the collections, whereas the 'concave dorsal face' of the thallus and the spores with a wing (i.e. polar), are R. albolimbata characters; R. argenteolimbata has a long, sharp dorsal groove and the spores are wingless and apolar, its thallus is compact and the dorsal air pores are mostly triangular, but he did not note this. To give Arnell the credit due to him, he obviously recognized that there were two white-scaled species present, but he failed to distinguish clearly between them. As concluded above, R. albosquamata is a taxonomic synonym of R. albolimbata; R. argenteolimbata has been described as a new species (Volk et al. 1988).

SPECIMENS EXAMINED

SWA-NAMIBIA — 1917 (Tsuenb); Farm Kurkaus (a), E. Retief 1459 (PRE). 1918 (Grootfontein); Ossa, on dolomite (=AC), Volk 81-146 (M, PRE); Gaikos (a) Volk 84-703 (M, PRE); Nettus (=BC), Volk 452 (M). 2017 (Waterberg); Oros 98 (a) (=AA); Hoffmann PRE-CH 4516 (PRE); OTJ 147 (a) (=CA); Volk 881 (p, p.), 883 (p, M, PRE); Wilhelmstal (=CD), Volk 84-717, 84-721 (M, PRE). 2116 (Okahandja): Erschefle, on Kalk (=DA), Volk 11946 (M, PRE). 2118 (Steinhausen): Gebahis, Farm Sturmfeld (=DB), Toetken 5558 (PRE). 2216 (Ombingwbe): OM 37 Otjua (a) (=AA), Volk 81-115 (M, PRE). 2211 (Windhoek): Rietfontein, on calcareous soil (=DB), Volk 11080 (M, PRE); Wilhelmstal (=CD), Volk 84-717 (M, PRE). 2316 (Nauchas); Farm Naos, on calcareous crust (=BA), Volk 81-200 (M, PRE). 2317 (Rehoboth): Gravenein (=BC), Volk 11705 (M, PRE). 2416 (Maltahohe): MAL 98 (a) (=DD), Volk 02544 (M). 2516 (Helmringhausen). Duwisib (=BR). M (M, PRE).

TRANSVAAL — 2228 (Maasvlakk): Alldays, 55 km W of, on calcareous soil (=DA), S. M. Perold 770 (PPE); Gregory Hall (=DA), S. M. Perold 737 (PRE), 38 km W of Alldays (=DB), S. M. Perold 759 (PRE). Bulkop, on calcareous soil (=DC), S. M. Perold 793-795 (PRE). 2229 (Waterpoort): Chasa (=TA), Limpopo River, precise locality unknown, Stephanus 5392 (BOL), 4 km W of Alldays, Farm Bavaria (=CA), S. M. Perold 773 (PRE); Wylie's Poort (=DD), S. M. Perold 801 (PRE). 2327 (Ellibrass); Villa Nova, 29 km NW of Farm Franchoek (=BD), Smook 4231 (PRE). 2329 (Pietersburg): Vlo, 15 km No (=AB), S. M. Perold 725 (PRE); Denhoff, 25 km S of (=AD), S. M. Perold 719 (PRE). 2330 (Tzaneen); Lebowa Ga-Modjadji (=AD), Gen 1400, 1404 (PRE). 2428 (Skeiding): between Groenvaal and Roedtan, Farm Ziekt; Koppen (=BD), S. M. Perold 339 (PRE). 2430 (Pilgrims Rest); Phalaborwa. Farm Parsons 155, next to Ofilants River (=BB), Venter 12197 (PRE). 2527 (Rustenburg): 14 km N of Rustenburg, on calcareous soil (=CA), S. M. Perold 222, 228 (PRE); Maanhaarrand, on soil at streamside (=CD), S. M. Perold 454 (PRE); 2530 (Lydenburg): Sudwala, on earth bank (=BC), S. M. Perold 598 (PRE). 2531 (Komatipoort): Koppie, Namaqualand. Kaapse plateau (=CV), Vogel TI.36 (Mainz). 2627 (Potchelstroom); Wonderfonteinspruit, 6 km N of Carltonville (=CC), S. M. Perold 1026 (PRE); Gerhardsmoor (=CA), Ubibok (CA); Venterkroon (=CA), Ubibok 1291 (PUC). 2725 (Bloemfontein); Wolmaransstad, Farm Leeufontein (=BB). A. E. van Wijk 5753 (p, PRE).

NATAL — 2730 (Vryheid); Burgers Pass (=CB), S. M. Perold 699 (PRE).

O.F.S — 2726 (Ondenaardsrus); Ondenaardsrus (=DC), Smook 6583a, 6584 (p, p.) 2727 (Kroonstad); Heilbron, at stream, S. of town (=BD), S. M. Perold 1364 (PRE). 2728 (Frankfort); Wonderfonteinspruit, 40 km from Bethlehem on road to Lindley (=CC), S. M. Perold 1365 p.p. (=CC). 2729 (Boshof); Farm Goedehoop (=BA), Volk 81-204 p.p. 81-210 (M, PRE). 2730 (Sekatari); Alldays, at calcareous soil (=CD), Volk 84-653 (M, PRE). 2731 (Chapmanville); Venter 12442 (PUC). 2732 (Mahalapye); Volk 11705 (M, PRE). 2733 (Waterberg); Oros 980 (=CA). 2734 (Vredefort); Volk 12197 (M, PRE). 2735 (Mapungubwe); Volk 12445 (PUC). 2736 (Witbank); Volk 12449 (PUC).

CAPE — 2624 (Vryburg); 8 km E of Vryburg (=DD), S. M. Perold 1380 (PRE). 2724 (Taung); Reverol Farm Sebetse Tsapitse 894 (AD), Venter 12457 (PRE). 2823 (Greekswadi); precise locality unknown. Wilmun 5517 (BOL). 3025 (Boschberg); Boshoff (=DA), Volk 84-717, 84-718 (M, PRE). 3026 (Gibbsberg); Focke, near Keerweer (=DD), Volk 02544 (PUC).

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REFERENCES


