

Studies in the Marchantiales (Hepaticae) from southern Africa. 2. The genus *Athalamia* and *A. spathysii*; the genus *Oxymitra* and *O. cristata*

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Keywords: *Athalamia*, *A. spathysii*, Cleveaceae, Hepaticae, Marchantiales, *Oxymitra*, *O. cristata*, Oxymitraceae, southern Africa, taxonomy

ABSTRACT

The genera *Athalamia* (Cleveaceae) and *Oxymitra* (Oxymitraceae), each respectively represented in southern Africa by a single species, *A. spathysii* (Lindenb.) Hattori and *O. cristata* Garside ex Perold, are discussed.

UITTREKSEL

Die genusse *Athalamia* (Cleveaceae) en *Oxymitra* (Oxymitraceae), wat in Suider-Afrika elk respektiewelik verteenwoordig word deur 'n enkele spesie, *A. spathysii* (Lindenb.) Hattori en *O. cristata* Garside ex Perold, word bespreek.

ATHALAMIA

Athalamia Falconer in *Annals and Magazine of Natural History*, Ser. 2,1: 375 (1848); *ibid.*: 397 (1851); Shimizu & Hattori: 52 (1954); S. Arnell: 57 (1963). Type species: *Athalamia pinguis* Falconer.

Clevea Lindb. 9: 289 (1868); Steph.: 769 (1898); Schiffn.: 29 (1893); Howe: 36 (1899); K. Müll.: 368 (1951–1958); Hässel de Menéndez: 133 (1963). Type species: *Clevea hyalina* (Sommerf.) Lindb.

Spathysia Nees ex Trevis.: 439 (1877). Type species: *Spathysia lindenberghii* Trevis. nom. illeg.

Gollaniella Steph.: 74 (1905). Type species: *Gollaniella pusilla* Steph.

Thallus medium-sized, medianly concave, bright green, in crowded patches; on soil in rocky clefts or under overhangs. *Branches* simple or once pseudodichotomously furcate; thickened over midrib, thinning toward undulate, attenuate margins; apex hardly notched, dorsally not grooved. *Dorsal epidermis* hyaline, cell walls sometimes thickened at corners. *Air pores* simple, small, slightly elevated, stellate or hardly so, surrounded by a ring of cells, the radial walls generally thickened, leading below into individual empty air chambers, these in one or several layers, bounding walls chlorophyllose, rarely with smaller cells containing a single, large oil body; storage tissue with rounded cells fairly closely packed together. *Rhizoids* both smooth and pegged. *Scales* hyaline or purple red, in 2 or more forwardly directed ventral rows, extending beyond thallus margins or not, obtusely triangular, appendage long-acuminate.

Monoicous. *Antheridia* embedded in slightly raised central cushion, or all along midline, opening into projecting, conical papillae. *Archegoniophores* dorsal, single

to several along midline, on short unfurrowed stalk, filiform scales at its top, involucre 1–3, basally connate, each with single, obliquely erect capsule, wall dehiscing by irregular valves, cells with thickening bands. *Spores* rounded distally, somewhat flattened proximally, lacking triradiate mark, densely covered with conical spines. *Elaters* long, tapering, bispiral.

Athalamia spathysii (Lindenb.) Hattori in Shimizu & Hattori in *Journal of the Hattori Botanical Laboratory* 12: 54 (1954); S. Arnell: 57 (1963); Vanden Berghen: 168 (1965); Volk: 230 (1979). Type: Greece, Corfu, leg. *Spathys* (W, holo.!; STR, iso.).

Marchantia spathysii Lindenb.: 104 (1829); Bisch.: 1018 (1835). *Dumortiera spathysii* (Lindenb.) Nees: 171 (1838); Gott. *et al.*: 546 (1846). *Clevea spathysii* (Lindenb.) K. Müll.: 75 (1940); K. Müll.: 374 (1951–1958).

Plagiochasma rousselianum Mont.: 334 (1838). *Clevea rousseliana* (Mont.) Leitgeb in Steph.: 771 (1898). Type: Algeria, 'Boudjareah', Roussel.

Thallus medium-sized, slightly concave along middle, oblong to broadly ovate or obovate (Figure 1A), bright green, sometimes purple along margins, polygonal outlines of subdorsal air chambers clearly visible from above, i.e. reticulate dorsally, central areolae at apex small, enlarging toward margins and then in parallel, radiating rows; air pores tiny, slightly raised, singly placed over each polygonal area, wet; thallus margins clasped together, revealing deep purple, transversely wrinkled underside of wings, dry; in rather crowded patches, simple or once pseudodichotomously furcate. *Branches* (3.5–) 5.0–12.0 × 2.5–7.5 mm, 825–1075 µm thick over midrib, laterally thinning out into attenuate wings; apex slightly notched and dorsally not grooved, with tips of 2 or 3 purple-red ventral scales recurving over edge; margins acute, thin, scalloped, undulate, often somewhat erect, older parts dead, ventrally purple; flanks sloping obliquely; ventral face medianly keeled, green, midrib with row of purple-red scales on either side (Figure 1C).

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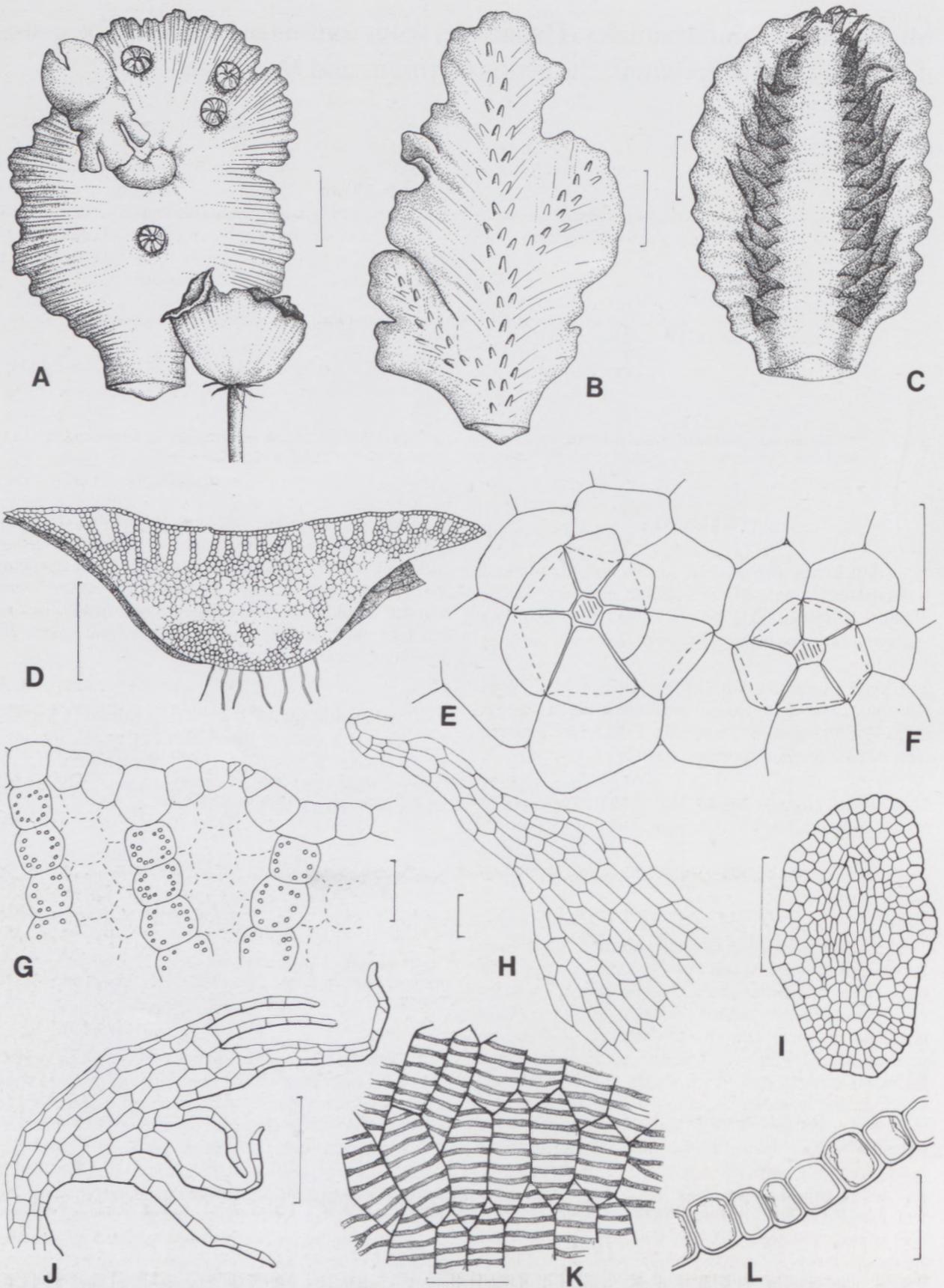


FIGURE 1.—*Athalamia spathysii*. Thalli. A, dorsal view of thallus with stalked archegoniophore and several young sessile ones; inset with archegoniophore and 2 dehiscent sporangia; B, dorsal view of thallus with rows of antheridia; C, ventral view of thallus; D, transverse section of thallus; E, F, dorsal air pores, with thickened radial walls; G, transverse section of air pore; H, ventral scale; I, transverse section of stalk; J, scale from top of stalk; K, capsule wall with cells containing annular thickenings; L, transverse section of capsule wall. A, I–L, *Volk 00589*; B, *Volk 6124*; C–H, *Volk 00904*. Scale bars: A–C, 2 mm; D, 1 mm; E–G, K, L = 50 μ m; H, J = 200 μ m; I = 100 μ m. Illustration by A. Pienaar.

Dorsal epidermal cells unistratose, hyaline, polygonal or isodiametric, (32.5–)57.5–62.5 × 30.0–42.5 µm, thin-walled, but frequently thickened at corners, in transverse section 40 µm thick; air pores very slightly raised (Figure 1G), simple, small, 7.5–12.5 µm wide, 65–150 µm distant from each other and usually bounded by innermost hyaline circle (Figure 1F), the remains of a collapsed cell ring, otherwise surrounded by a ring of 4–6(–7) bluntly triangular cells, 15.0 × 22.5–32.0 µm, the radial walls mostly thickened and pores thus stellate (Figure 1E, 1F), partly overlying adjacent dorsal cells. *Assimilation tissue* 350–500 µm thick with air chambers empty, in one layer or sometimes in several layers, 50–95 µm wide, vertical or sloping forward, oblique laterally (Figure 1D), unistratose walls consisting of chlorophyllose cells, roundish or oval, 40.0–62.5 × 45.0 µm; storage tissue ± 600 µm thick, cells fairly densely packed together, rounded, up to 62.5 µm wide; rhizoids mostly smooth, 25–35 µm wide. *Scales* purple-red, arranged in 2 forwardly directed ventral rows, one on either side of midrib, not or somewhat extending beyond margins of thallus, recurved at apex, obtusely triangular (Figure 1H), margins entire or sometimes slightly dentate on oblique side of base, not constricted where joined with acuminate, apically pointed and tapering appendage, total length (including 750 µm appendage) ± 1300 µm, width at base up to 1000 µm, cells (4-)5- or 6-sided, 90–137 × 40–50 µm; oil bodies absent.

Monoicous, but occasionally only antheridia or archegonia found. *Antheridia*, when present with archegonia in a group, proximal to archegoniophore, embedded in central, slightly raised, ill-defined cushion lacking scales, otherwise in rows along entire middle of thallus (Figure 1B), sunken, saccate, 500 × 230 µm, narrowed at neck, opening into raised, conical papillae projecting 200 µm above surface and 300 µm wide at base. *Archegoniophores* single or several, linearly and acropetally arranged on dorsal

face, when young sessile, rounded, and basally surrounded by inconspicuous, filiform scales, air pores and air chambers lacking; stalk cylindrical, pellucid, eventually 1.6–7.0 mm long, round to ovate in cross section (Figure 1I), diameter 250 µm, without rhizoidal furrow; scales eventually carried upwards and then only present at top of stalk, where joined to archegoniophore, hyaline or pink, basally 750 × 500 µm, with 4 or 5 filiform, apical strands (Figure 1J), up to 750 µm long, cells 75 × 48 µm; archegoniophore white to greenish white, central disc absent, with 1–3 involucre, connate at their bases and attached to top of stalk, bilabiate by vertical cleft, each with single capsule, brown, globular, 1250 µm in diameter, borne obliquely erect on 850 × 600 µm seta with bulbous foot, dehiscing by several irregular valves, wall unistratose (Figure 1L), cells spindle-shaped, up to 75 × 30 µm, with annular or spiral thickening bands (Figure 1K). *Spores* (60–)65–75(–78) µm in diameter, globular, with distal face convex (Figure 2A, B), no triradiate mark on somewhat flatter proximal face, golden brown, semitransparent, thickly covered with dense conical spines (Figure 2A–D), 5 µm high and 15 µm wide at base, sprinkled with fine granules (Figure 2E). *Elaters* yellow-brown, slightly tapering toward ends, 275–350 µm long, 7.5–10.5 µm wide in middle, bispiral (Figure 2F), very occasionally branched, sometimes bent. *Chromosome number*: n = 9 (Bornefeld 1987); as *Clevea rousseliana*: n = 9 (Heitz 1927).

DISCUSSION

Athalamia spathysii is rarely collected in southern Africa, the gatherings by Volk (1979) being restricted to Namibia (Figure 3). It grows in periodically dry areas, on soil overlying slate, granite or sandstone, in rocky crevices or under overhangs, where runoff may be concentrated and some protection against radiation is afforded; sometimes it occurs together with *Plagiochasma* spp., *Targionia*

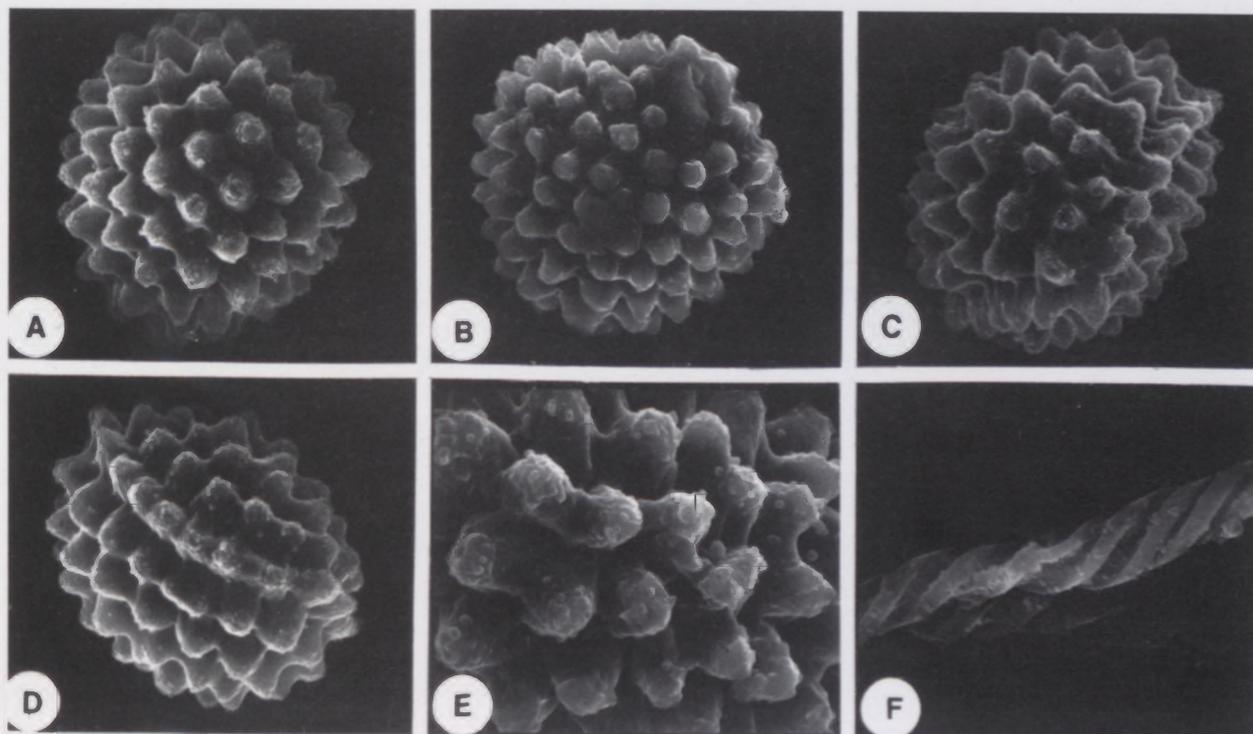


FIGURE 2.—*Athalamia spathysii*. SEM micrographs of spores. A, B, distal face; C, side view of distal face; D, side view of both faces; E, spinous processes much enlarged; F, elater. A–F, Volk 00589. A–D, × 580; F, × 1000.

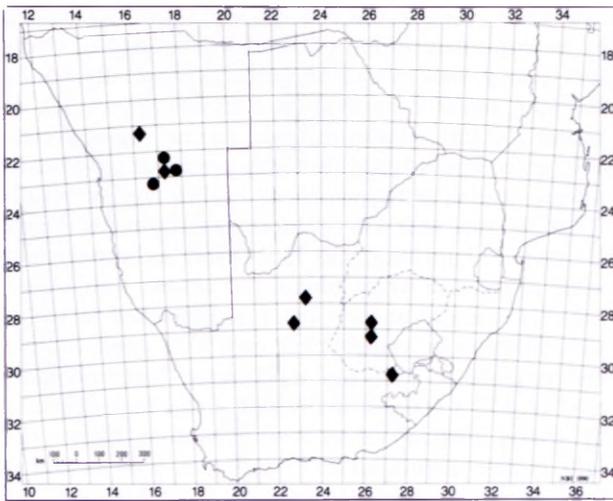


FIGURE 3.—Distribution of *Athalamia spathysii*, ●, and *Oxymitra cristata*, ◆ in southern Africa.

hypophylla etc., but is distinguished from them by the reticulate dorsal surface, small and slightly raised, mostly stellate air pores, empty air chambers, scales with acuminate appendages, cells of the capsule wall with spiral thickenings and by bluntly spinous spores.

It has also been reported from further north in Africa, i.e. from Tanzania (= Tanganyika) by Vanden Berghen (1965). *Athalamia spathysii* is furthermore known from Israel, North Africa, the Canary Islands and the Mediterranean countries (Müller 1951–1958), the type specimen having been collected at Corfu. Frey & Kürschner (1988) report it from Yemen and Oman in the Arabian Peninsula, and state that its distribution includes Turkey and Jordan.

Athalamia is classified in the family Cleveaceae Cavers, together with the genera *Peltolepis* Lindb. and *Sauteria* Nees, but neither of the latter two occur in southern Africa.

There are at least 10 species world-wide in the genus *Athalamia*, with *A. spathysii* the only representative in southern Africa, *A. pulcherrima* (Steph.) Hatt. being from Ethiopia and distinguished by larger, hyaline ventral scales and cells with much thickened radial walls surrounding the dorsal air pores. Another species recorded from Africa, in Algeria, is *Clevea (Athalamia) trabutiana* Steph., but it is regarded by Grolle (1976) as conspecific with *A. hyalina* (Sommerf.) Hatt. In *A. spathysii* the radial walls of the pore cells are only somewhat thickened, a possible response to growing in sunlight, as was found in cultivation studies by Müller (1951–1958). Shimizu & Hattori (1954), however, reported for this genus, that they had observed pores with both thickened radial walls (stellate) or with thin walls (not stellate) on the same plant!

According to Müller (1939), Arnell (1963), Vanden Berghen (1968) and Volk (1979) oil bodies are absent in the genus *Athalamia*. I also found them to be absent in *A. spathysii*, but fresh material was not available for study. Shimizu & Hattori (1954), however, reported oil cells in *Athalamia glauco-virens* as well as in *A. nana* (Shimizu & Hattori 1955). Schuster (1992) states that sparse, scattered oil cells may be present or absent.

Asexual reproduction is said to be absent. Stephani (1895) suspected that adventitious growth in the form of ventral shoots from the costa was partly the reason for the 'dichten verfilzten niedrigen Rasen' in *Clevea pulcherrima* Steph. As in *Plagiochasma* spp., the apical part of the thallus continues to grow and increase in length, beyond the archegoniophore after the latter has differentiated.

Kashyap (1915) described a mycorrhizal region in the midrib of *A. pinguis*, the hyphae having penetrated the thallus via the rhizoids. Sterile specimens of *A. spathysii* have been confused with *Asterella muscicola* (Arnell 1957), because of the stellate dorsal pores, but the latter does not grow in Namibia (Volk 1979), its ventral scales have scattered oil bodies, the stalk has a rhizoidal furrow and the capsule wall lacks thickenings.

Specimens examined

NAMIBIA.—2217 (Windhoek): WIN 63 (Neudamm), schattige Glimmerschieferfelsen am Rivier, (–AD), *Volk 00952* (BOL; PRE); unterhalb Brücke, Glimmerschiefer, (–AD), *Volk 86-877* (Herb. Volk); 1 mile west of Windhoek, (–CA), *Schelpe 4763* (BOL); WIN 62, Hatsamas/Dordabis, Kalkfels, (–DC), *Volk 00589* p.p. (Herb. Volk). 2218 (Gobabis): WIN 70, schattiges Tälchen an den Gobabisstrasse, Glimmerschiefer, (–??), *Volk 00904* (BOL; PRE). 2316 (Nauchas): WIN 39 (Mahonda), schattige Überhänge, Glimmerschiefer, (–BA), *Volk 6124* (PRE).

OXYMITRA

Oxymitra Bisch. ex Lindenb., Synopsis hepaticarum europaeorum: 124 (1829); Gott., Lindenb. & Nees: 597 (1846); Frye & Clark: 40 (1937); K. Müll.: 410 (1951–1958); Hässel de Menéndez: 200 (1963); Arnell: 11 (1963). Lectotype species: *O. incrassata* (Brotero) Sérgio & Sim-Sim.

Pycnoscenus Lindb.: 606 (1863), nom. illeg.

Tessellina Dumort.: 164 (1874), non Dumort.: 78 (1822) orth. var.: *Tessellina* Dumort. mut., Schiffn.: 15 (1893). Type species: *Tessellina coriandrina* (Spreng.) Dumort.

Thallus medium-sized, deeply and sharply grooved dorsally, pale green to deep green, in gregarious or rosette-like stands; rare, on soil, sometimes derived from ironstone. *Branches* broadly ovate or oblong, pseudo-dichotomously furcate; thickened over midrib, thinning toward margins; apex emarginate. *Dorsal epidermis* hyaline, persistent. *Air pores* tiny, simple, radial walls thickened, stellate, leading below into tall, narrow, subvertical, empty air chambers, bounded by unistratose, chlorophyllose cell walls. *Storage tissue* with rounded or angular cells, closely packed together; rhizoids numerous, some smooth, others pegged. *Scales* large and conspicuous, arising ventrally and projecting far above thallus margins, triangular, dark red to almost black or hyaline.

Monoicous or dioicous. *Antheridia* medianly grouped behind archegonia or mixed with them when monoicous, embedded, with hyaline necks projecting, at their bases surrounded by capillary hairs, vestigial or prominent. *Archegonia* several in a row along midline, flask-shaped, protected in a continuous, crest-like, fleshy involucre, or

individually enclosed in conical or pyramidal, chambered involucre with scales around the base. *Sporangia* without stalk or foot, globose, capsule wall hyaline, unistratose, delicate. *Spores* triangular-globular, anisopolar, black, opaque; distal face with several large areolae, containing a central nodule or not; proximal face with triradiate mark distinct or not, irregularly reticulate or smooth. *Elaters* absent, but some sterile cells reputed to be present.

***Oxymitra cristata* Garside ex Perold, sp. nov.**

Type: Cape, near Bredby Mine (25 miles S of Kuruman), *Schelpa* 5900 (BOL, holo.).

Fronde caespitosae confertae, virides; squamae ventrales atro-violaceae, oblique triangulares, marginem frondis bene superantes. Antheridia in pulvillos medianos lineares immersa. Archegonia ante antheridia posita, in serie unica lineari disposita atque in involucra connata immersa, cristam medianam prominentiam crenatam formantia, bracteae desunt. Sporae 100–115 μm diametro: exterior (distalis) facies irregulariter reticulata, interior (proximalis) facies laeves.

O. incrassata, species altera generis, archegoniis in involucre conicis vel pyramidalibus singulatim inclusis, bracteis multis concomitatis ab *O. cristata* differt.

Thallus smallish to medium-sized, apically emarginate, dorsally deeply grooved along entire midline (Figure 4A, C), except where interrupted by gametangia, broadly ovate or oblong, bright green to deep green, dark red along margins, sometimes bronze-brown proximally, forming a broad, deeply coloured 'V' over base, reticulate from above, with outlines of subdorsal air chambers clearly visible, air pores tiny, hardly raised (Figure 4G), numerous but singly placed above each polygonal air chamber, wet; thallus margins incurved or raised and tightly clasped together, flanks covered by large, triangular, shiny dark red scales, dry; in crowded, overlying patches, once to several times pseudodichotomously furcate. Branches (3–)5–10(–12) \times 2.5–4.8 mm, 1100–2000 μm thick over midrib; margins rather obtuse to acute, scalloped or undulating, much exceeded by projecting, triangular scales; flanks deep purple, steeply rising (Figure 4C), to sloping obliquely upward and outward (Figure 4D); ventral face rounded to flattish, green (Figure 4B).

Dorsal epidermal cells unistratose, hyaline, from above polygonal, (22.5–)37.5–45.0(–52.0) \times 27.5–37.5(–47.5) μm , in transverse section brick-shaped, 25–35 μm thick. *Air pores* stellate (Figure 4H), small, simple, slightly raised (Figure 4G), 5–10 μm wide, 4- or 5-(6)-sided (Figure 4H), 75–112 μm distant from each other, bounded by 4 or 5, rarely 6, small, bluntly wedge-shaped cells, 12.5–15.0 \times \pm 25 μm across base, radial walls slightly thickened, partly overlying, or occasionally adjoining larger, polygonal cells. *Assimilation tissue* 400–600 μm thick with air chambers empty (Figure 4F), in one layer, 32–65 (–100) μm wide, bounding walls unistratose, cells 37–47 \times 25–35 μm ; storage tissue composed of rounded or angular cells, \pm 50 μm wide. *Rhizoids* numerous, 17–25 μm wide, some pegged, others smooth. *Scales* arising ventrally and projecting up to 375 μm above thallus margins, dark red to almost black, shiny, basal part of apical scales hyaline, densely imbricate, obliquely triangular (Figure

4I), 1250–1375 μm long, 1075–1200 μm wide across base, margins entire, sometimes crenate or shortly toothed toward base of forwardly directed side, cells in body of scale (4-)5- or 6-sided, \pm 100 \times 25 μm , smaller at rounded margin.

Monoicous. *Antheridia* in a row along midline, proximal to archegonia (Figure 4A, E), immersed, necks hyaline, cylindrical, 75 μm wide, protruding 210 μm above dorsal surface. *Archegonia* in a median row, in flask-shaped cavities, partly sunken into thallus and as a group enclosed above by a 600 μm high, irregular, crest-like, fleshy ridge (Figure 4D), tinged reddish on top around openings of archegonial necks, these long and turning purple with age. *Sporangia* ventrally partly sunken into thallus, dorsally bulging on either side of central crest, capsule \pm 750 μm wide, wall hyaline, thin and delicate. *Spores* (108–)110–115(–125) μm in diameter, triangular-globular, polar, black, opaque, wing \pm 5 μm wide, entire, anisopolar, with ornamentation different on two faces: distal face (Figure 5A–C) with 6 or 7 large central areolae, up to 30 μm wide, smaller toward margin, generally with a nodule and thin radiating ridges in the middle of each, areolar walls thick; proximal face with triradiate mark distinct (Figure 5D, E), 3 facets with incomplete areolae, walls irregular (Figure 5E, F), sometimes rather indistinct (Figure 5D). *Chromosome number* $n = 18$ (Baudoin 1976).

DISCUSSION

Grolle (pers. comm.) has pointed out to me that *O. cristata* Garside was invalidly published as it did not comply with Art. 37.1 of ICBN because it was published after 1 January 1958 without indication of the holotype. Garside's paper was published in April 1958 and two type specimens were cited: *Schelpa* 5900 and *Duthie* 5531, but no holotype was designated. *Oxymitra cristata* Garside ex Perold is therefore accordingly newly described here, together with a Latin diagnosis; *Schelpa* 5900 is designated as the holotype.

Oxymitra cristata is endemic to southern Africa, and very rarely collected. Garside (1958) remarked that 'the detailed geographical distribution is not yet completely known' and this is still true today, only a few more collections having been made during the intervening 35 years. It is known from Namibia, Orange Free State and northern and eastern Cape (Figure 3). It has been found mainly on substrates derived from ironstone, and it occasionally grows in association with *Plagiochasma* spp. and *Riccia* spp. *Oxymitra cristata* is distinguished by its large, obliquely triangular, shiny, dark red scales and by the row of archegonia enclosed in an irregular, but continuous, crest-like, fleshy ridge of tissue. Garside (1958) regarded the ridges as composed of fused involucre. In the only other species in the genus, *O. incrassata* (Brotero) Sérgio & Sim-Sim, better known as *O. paleacea* Bisch. ex Lindenb. (Sérgio & Sim-Sim 1989), each archegonium is individually enclosed in a conical or pyramidal involucre, containing air chambers and air pores. These involucre are arranged in two rows along the midline and are accompanied by numerous bracts. *Oxymitra incrassata* also differs from *O. cristata* by its hyaline ventral scales, by its spore ornamentation, with the areolae on the distal face lacking a central nodule and by the smooth facets on the

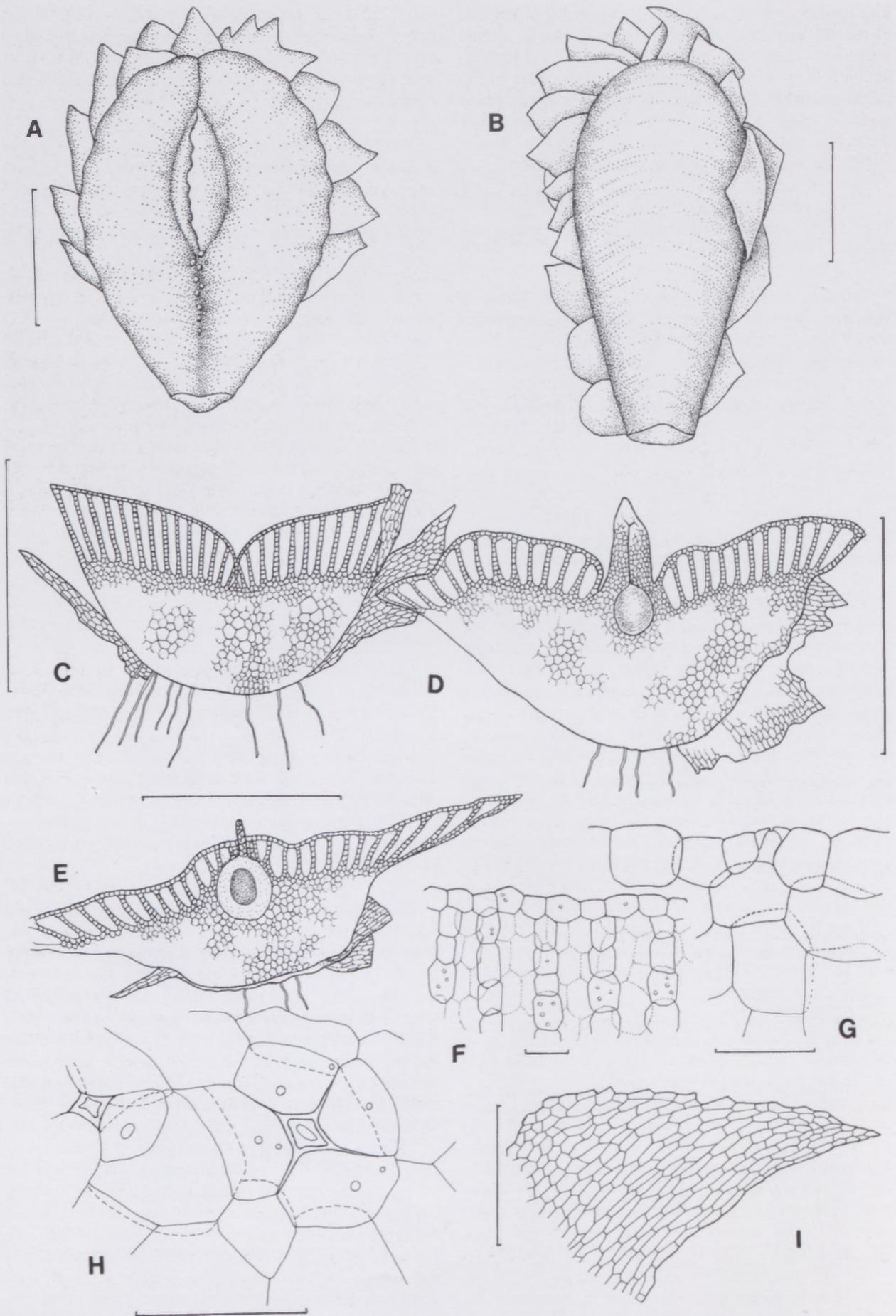


FIGURE 4.—*Oxymitra cristata*. Thalli. A, dorsal view of thallus with crest-like involucre and, proximally, row of antheridia; B, ventral view of thallus; C, transverse section of thallus through dorsal groove; D, transverse section of thallus through involucre with archegonium; E, transverse section through antheridia, dorsal cells and air chambers; G, transverse section through much enlarged air pore; H, air pore and surrounding cells seen from above; I, ventral scale. A, B, D, Volk 00906; C, F-I, Volk 81/050; E, Volk 00957. Scale bars: A-E, 2 mm; F-H, 50 μ m; I, 500 μ m. Illustration by A. Pienaar.

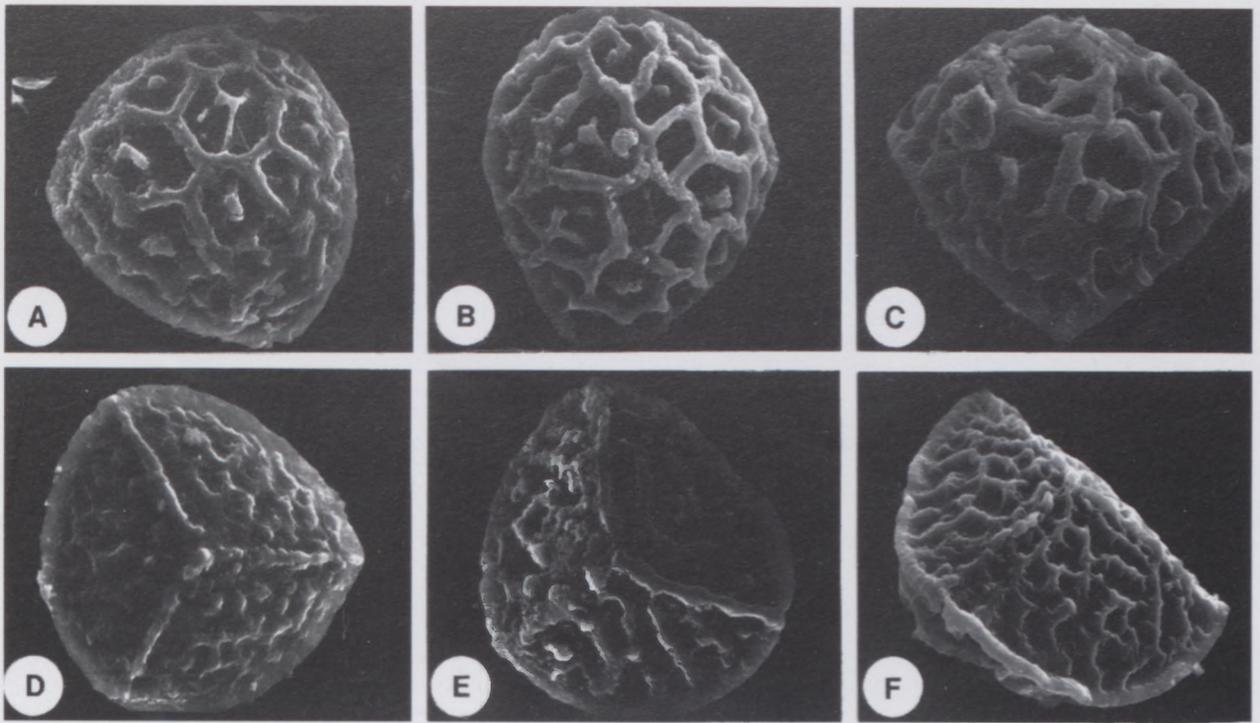


FIGURE 5.—*Oxymitra cristata*. SEM micrographs of spores. A, B, distal face; C, side view of distal face; D, E, proximal face; F, side view of proximal face with areolar walls more pronounced. A, D, Volk 00906; B, C, E, F, Volk 5050. A, B, D, E, $\times 320$; C, F, $\times 345$.

proximal face, by the chromosome number $n = 9$ and by its distribution: it is known from Europe, North Africa, the Canary Islands, North and South America.

Bischler (1988) records the presence of tubers in *Oxymitra*, but these have not been observed in the present investigation of *O. cristata*. The two species of *Oxymitra* are placed in the family Oxymitraceae K. Müll. ex Grolle. The sporangia, partially embedded in the thallus tissue, the loss of a foot and seta of the capsule, the absence of elaters, spore release only after destruction of surrounding tissue and the sporeling type (Baudoin 1976), all indicate the relationship of Oxymitraceae to Ricciaceae, and they have been classified together in the suborder Ricciineae (Schuster 1984), although Schier (1974), on the basis of biochemical studies, had segregated the Oxymitraceae into their own suborder, the Oxymitrineae.

Oil bodies have not been observed in *O. cristata*, but Müller (1939) reports their presence (after Györfy) in the storage tissue of *O. incrassata* during spring and autumn. The generic description has had to be emended somewhat to accommodate the gametangial differences in the two species, the first set of particulars in each case referring to *O. cristata*.

SPECIMENS EXAMINED

NAMIBIA.—2216 (Otjimbingwe): OM 37 Otjua, (–AA), Volk 00957 (herb. Volk). 2217 (Windhoek): Voigtland, feuchte Klüfte, (–CB), Volk 5050 (herb. Volk). 2218 (Gobabis): WIN 70, schattiges Tälchen, Glimmerschiefer (+ *Plagiochasma* sp. & *Athalamia spathysii*), (–?), Volk 00906 (PRE, herb. Volk).

O.F.S.—2826 (Brandfort): Glen Agricultural College, on stony kopje, (–CD), Zietsman 943 (PRE). 2926 (Bloemfontein): Bloemfontein, Botanical Garden, not cultivated part, on hill, (–AA), Volk 81/050 (PRE); Bloemfontein, next to Botanical Garden, shallow soil over rock, (–AA), Volk 81/291 (PRE); Bloemfontein, near Hillandale, (–AA), Gemmell

(=Duthie 5501) (BOL); Bloemfontein, Eagle's Nest, on ironstone kopje, in shelter of grass and boulders, (–AA) Gemmel & Lujeharns (=Duthie 5460) (BOL).

CAPE.—2723 (Kuruman): near Bredby Mine, 25 miles S of Kuruman, (–CA), Schelpe 5900 (BOL) (holotype). 2822 (Glen Lyon): Olifantshoek area, on farm belonging to Mr Rossouw, on stony koppie, with *Riccia* spp. and *Plagiochasma* sp. (–BA), Koekemoer 1024 (PRE); Griqualand West, Groenwater Valley, Hay, east of Postmasberg (sic) [Postmasburg], (–DD), Cooke s.n. (=Duthie 5531) (BOL). 3027 (Lady Grey): Herschel, mudbanks of Sterkspruit, with *Riccia* sp., (–CB), Hepburn CH 1043 (PRE).

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