



Riccia epecenia: a new species of *Riccia* section *Piliferae* Volk from Australia

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Abstract

A new species of *Riccia* is here described for the first time for Australia for section *Piliferae*, an infrageneric taxon which has its centre of diversity in southern Africa.

Keywords: Australia, Lesotho, liverworts, multi-layered epidermal cells, New South Wales, *Riccia trachyglossum*, South Africa

Introduction

Amongst the complex thalloid liverworts, *Riccia* Linnaeus (1753: 1138) is the most species rich (over 250 species worldwide) and morphologically diverse. This is particularly true of species in southern Africa (over 50 taxa) which show a wide range of morphologies (Perold 1999). Of the infrageneric taxa, one in particular is notable for its narrow geographical range - *Riccia* subg. *Riccia* sect. *Piliferae* Volk (1983: 455, as ‘*Pilifer*’).

Eighteen of the 19 described species in section *Piliferae* occur in South Africa and Lesotho, with a 19th species (*Riccia boumanii* Dirkse, Losada-Lima & Stech 2016: 96) recently described from the Canary Islands (Dirkse *et al.* 2016) which was also very recently found in China (Xiang *et al.* 2022). It is uniquely characterised by plants with uniseriate, dorsal epidermal cells in bi- or multicellular pillars, frequently giving the dorsal surface a velvety or scurfy appearance as well as generally large ventral scales along the flanks, typically hyaline or bicoloured. Other characters defining the section are an entire scale margin, but very rarely also denticulate or with filamentous apices (Perold 1999); almost all species have scales which project well past the thallus margin and eight of the 18 species show a distinct radiating pattern (sometimes also including a reticulate pattern within the same population) on the distal face of their tetrahedral spores.

In 2020, Rosemary Purdie and Murray Fagg collected material of an unusual *Riccia* species near the town of Cooma in the Southern Tablelands region of New South Wales in southeastern Australia. These plants matched collections subsequently made by the author and colleagues near the town of Orange, some 400 km north of Cooma on the Central Tablelands of New South Wales. Plants from both the Cooma and Orange population are unusual due to their velvety dorsal surface and large hyaline scales along the ventral flanks. Closer observation showed the dorsal epidermal cells to be multicellular. These characters place these plants in *Riccia* sect. *Piliferae*, a section previously unrecorded from Australia. The plants do not match any previously described taxa in the genus *Riccia*, and are therefore described here as a new species, only the second species of *Riccia* sect. *Piliferae* known to occur outside of southern Africa.

Materials and methods

Live plants were examined and measured for all morphological characters using Leitz compound and dissecting microscopes. All quantitative characters were based on measurements taken on multiple plants to record the range of variation. Where capsules were present, spores were mounted in water on microscope slides for light microscopy (LM) or on double sided sticky tape on aluminium stubs, gold-coated with an EmiTech K550X Sputter Coater and

viewed using a Zeiss EVO LS 15 Environmental SEM. The Royal Horticultural Society Colour Chart (RHSCC) (Royal Horticultural Society 1995) was employed to describe colours of whole plants, scales and spores. Some *in situ* images of the plants were taken by Murray Fagg with a Canon EOS Mirrorless camera with a Canon EF-M 28 mm f/3.5 macros IS STM lens, other photos taken with an Olympus Tough camera. Light micrographs through the compound microscope were obtained with a Nikon Coolpix 5000 digital camera. All line drawings were made using drawing tube attachments to both microscopes.

Taxonomic treatment

Riccia epecenia Cargill, *sp. nov.* (Fig. 1–6)

Holotype:—Australia. New South Wales. Gum Ridge Fire Trail West, Mt Canobolas State Conservation Area (SCA), 1244 m, 33° 21'S 148° 57'E, 20 May 2022, *D.C. Cargill 1702* (CANB, isotype NSW).

Diagnosis:—Similar to *Riccia trachyglossum*, sharing multistratose dorsal epidermal cells, in 2–4 hyaline layers, apex or top cells globose or occasionally conical, scales more or less hemispherical with an entire margin, and similar spore ornamentation, with a distal surface of radiating lamellae and a reticulate pattern and a proximal surface pattern of irregular short lamellae sometimes forming incomplete areolae. *Riccia epecenia* differs from *R. trachyglossum* in the pale sage green thallus colour and non-tumid margins compared to the blue-green thallus colour and tumid margins of *R. trachyglossum*.

Plants prostrate, gregarious in loose mats or forming complete rosettes or infrequent in small, scattered patches, rosettes from 7.8 up to 42 mm in diameter. Plants when moist, pale sage green (RHS 141D, 143D green group, 144A, 144C yellow-green group); when dry, plants shrunk, dorsal surface remaining exposed and surface honeycombed with holes, pale green to pale yellow (RHS 142C green group and 11C yellow group). *Plants* 3.0–8.25 mm long, 2.25–7.8 mm wide. Plants simple, 1–2 times furcate, moderately to widely divergent, diverging from 70°–130°. *Segments* 0.9–8.25 mm long and 1.0–3.0 mm wide, broadly lingulate, quadrate, rectangular to ellipsoid in shape. *Ventral flanks* more or less vertical, green and covered with scales. *Apex* obtuse very broadly rounded to truncate to lanceolate. *Dorsal groove* present, anteriorly narrow and shallow at apex only, disappearing or broadening out posteriorly. *Margin* of thallus flat, non-tumid, crenate due to extended scales. *Scales* present along ventral flanks, hyaline, large, imbricate, mostly free from the flank, 500–2000 × 350–1600 µm. *Cilia* absent. *Dorsal epidermal cells* multistratose, 2–4 cells high, uniseriate, apex cell globose to occasionally more or less conical, cells below apex quadrate to rectangular, hyaline, disintegrating upon drying, apex cells 30–110 µm high and 35–95 µm wide. *Photosynthetic tissue* in loosely packed vertical columns, 3–9 cells long. *Rhizoids* dimorphic, mainly smooth, very few pegged, hyaline. *Tubers* absent. *Monoicous*. *Gametangia* in 2–4 rows; archegonia and antheridia along midline along length of segments. *Antheridia* pyriform to spherical to ovoid, 97.5–325 × 105–360 µm. *Capsules* 5–13 per plant, pale brown to darker brown or reddish, embedded in thallus, prominent on the ventral surface. *Spores* 75–110 µm diameter, irregularly globose to triangular-globose in polar view, 50–70 µm in height, yellowish-brown to reddish-brown (no match on RHS chart); complete wing present, 2.5–22.5 µm wide; margin entire finely papillate, irregularly undulate to ragged. *Distal surface ornamentation* irregularly reticulate, with a radiating pattern of lamellae from the centre, alveoli with thin and low, variable in shape, from 6 to 14 alveoli across distal face, 5–22.5 µm in diameter; *proximal surface* with an irregular pattern of short undulate lamellae, sometimes forming incomplete areolae. *Triradiate mark* distinct, pores present. *Chromosome number* unknown.

Etymology:—From the Greek *epekenia* (Gr.) – beyond, on the far side, referring to the locality of this species in relation to its closest relatives which are all in southern Africa and also in reference to my favourite science cartoonist, Gary Larson and his cartoon series, *The Far Side*.

Distribution and habitat:—Known from three localities in the state of New South Wales in southeastern Australia: Rock Flat, near the town of Cooma and North Ridge Reserve in Cooma, and the Mt Canobolas State Conservation Area near the town of Orange (Fig. 7). All populations were recorded growing on bare patches of soil in between rock slabs and rocky outcrops with other, common *Riccia* species.

Conservation Status:—This species has not been formally evaluated. A conservation coding of “Not Evaluated” (IUCN 2019) is therefore appropriate.

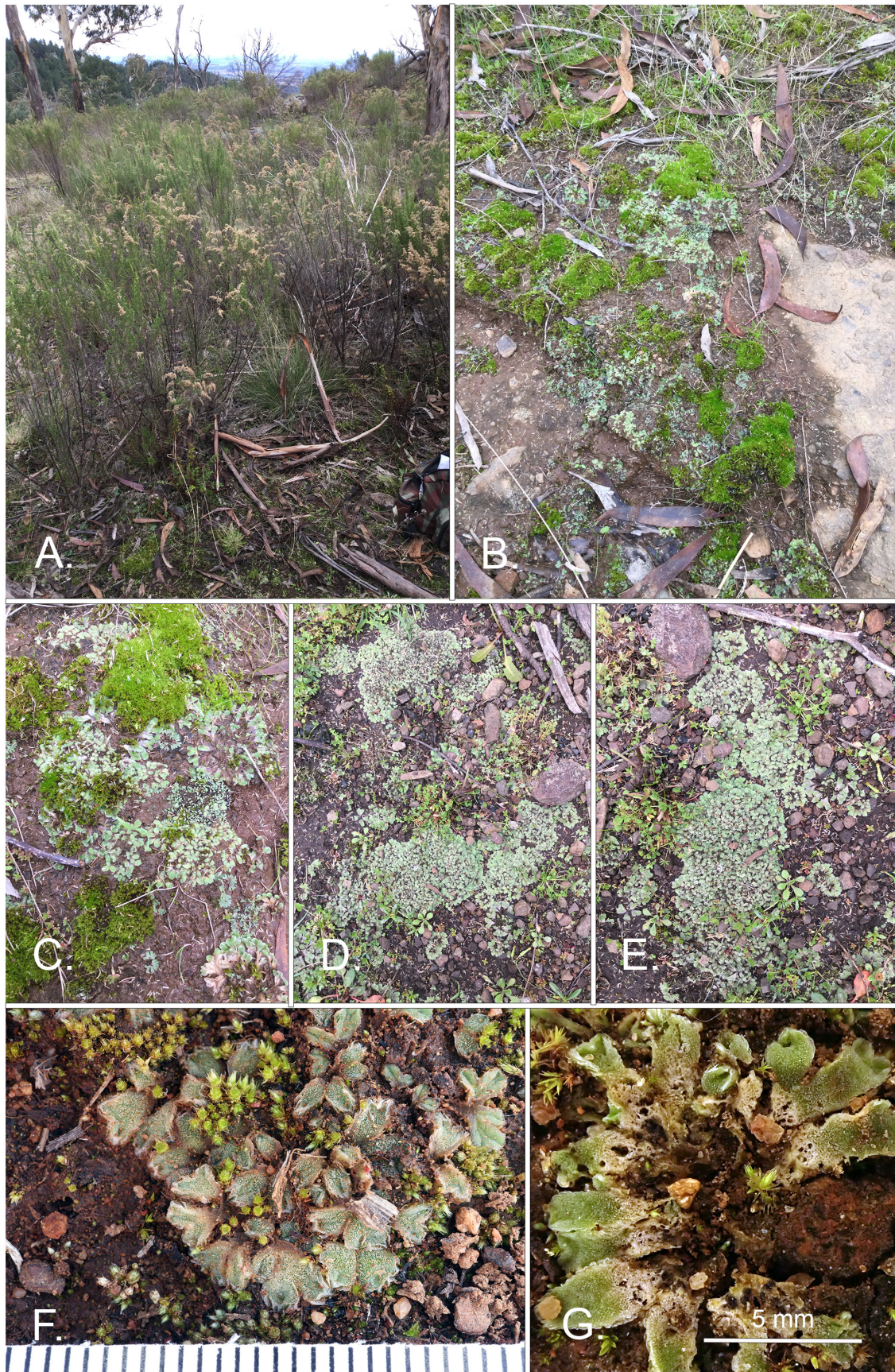


FIGURE 1. *Riccia epecenia*. Populations of the species *in situ*. A Habitat of populations at the Mt. Canobolas State Conservation Area (SCA), New South Wales. B–E Populations of the species *in situ* at the Mt. Canobolas SCA. F A population at Rock Flat (scale = 1 mm). G Rosette from North Ridge Reserve, Cooma, New South Wales. F R.W. Purdie 12106; G D.C. Cargill 1694. Photo credits: A–E, G D.C. Cargill; F Murray Fagg.

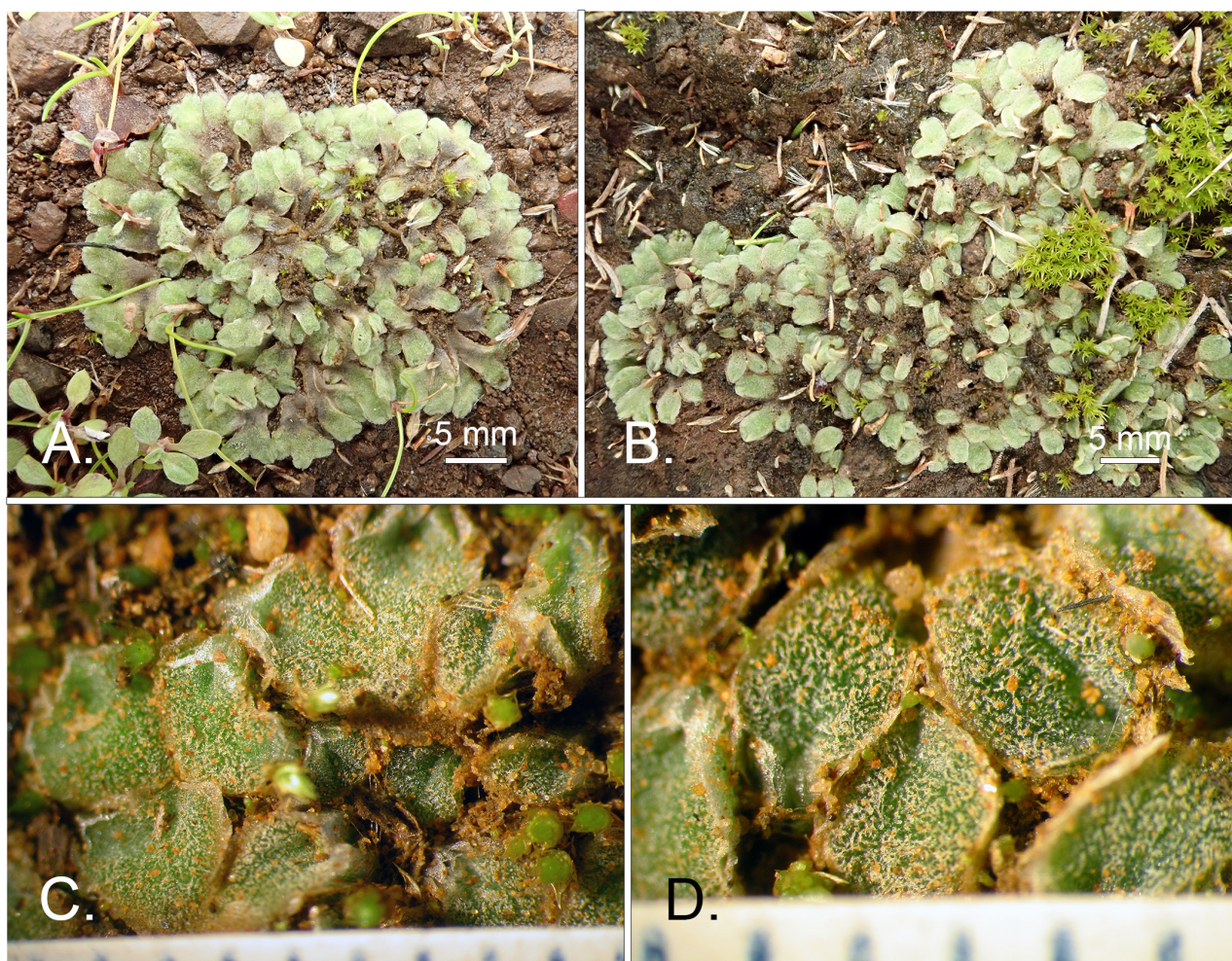


FIGURE 2. *Riccia epecenia*. A–B Rosettes of plants *in situ*. C–D Close up of the dorsal surface of the thallus. A D.C. Cargill 1698; B D.C. Cargill 1700; C & D R.W. Purdie 12106. Photo credits: D.C. Cargill.

Specimens examined:—AUSTRALIA. New South Wales: Tom Groggin Rd, 2km east of Monaro Hwy junction at Rock Flat, 985m, 36° 20'S 149° 13'E, 29 August 2020, *R.W. Purdie 12106* (CANB, NSW); North Ridge Reserve, Cooma, 890m, 36° 12'S 149° 7'E, April 2022, *M. Smith 002* (CANB); North Ridge Reserve, Cooma, 890m, 36° 12'S 149° 7'E, 8 May 2022, *D.C. Cargill 1693, 1694* (CANB); Gum Ridge Fire Trail West, Mt Canobolas State Conservation Area (SCA), 1244m, 33° 21'S 148° 57'E, 20 May 2022, *D.C. Cargill 1698, 1700* (CANB, NSW)

Discussion

The two most important characters uniting the species within *Riccia* section *Piliferae*, as noted above, are the multicellular, uniseriate pillars of dorsal epidermal cells and the mainly large, mainly hyaline scales with entire margins which extend well beyond the margin of the segments. The centre of diversity for the section is southern Africa, with most species endemic to South Africa and the landlocked enclave of Lesotho, within the borders of South Africa. One species occurs on the Canary Islands.

A recent NGS target enrichment sequencing project by Rabeau & Reeb (unpublished data) had the objective of sequencing all species of *Riccia*. Sixteen of the 19 species of sect. *Piliferae* were sequenced, including *R. epecenia*. Twelve of these species form a single clade (the “*Piliferae*” clade), all from southern Africa, with *R. epecenia* nested deep within this group (Rabeau 2019). One other species in the section is in a clade sister to the *Piliferae* clade and the remaining three species are in two separate clades.

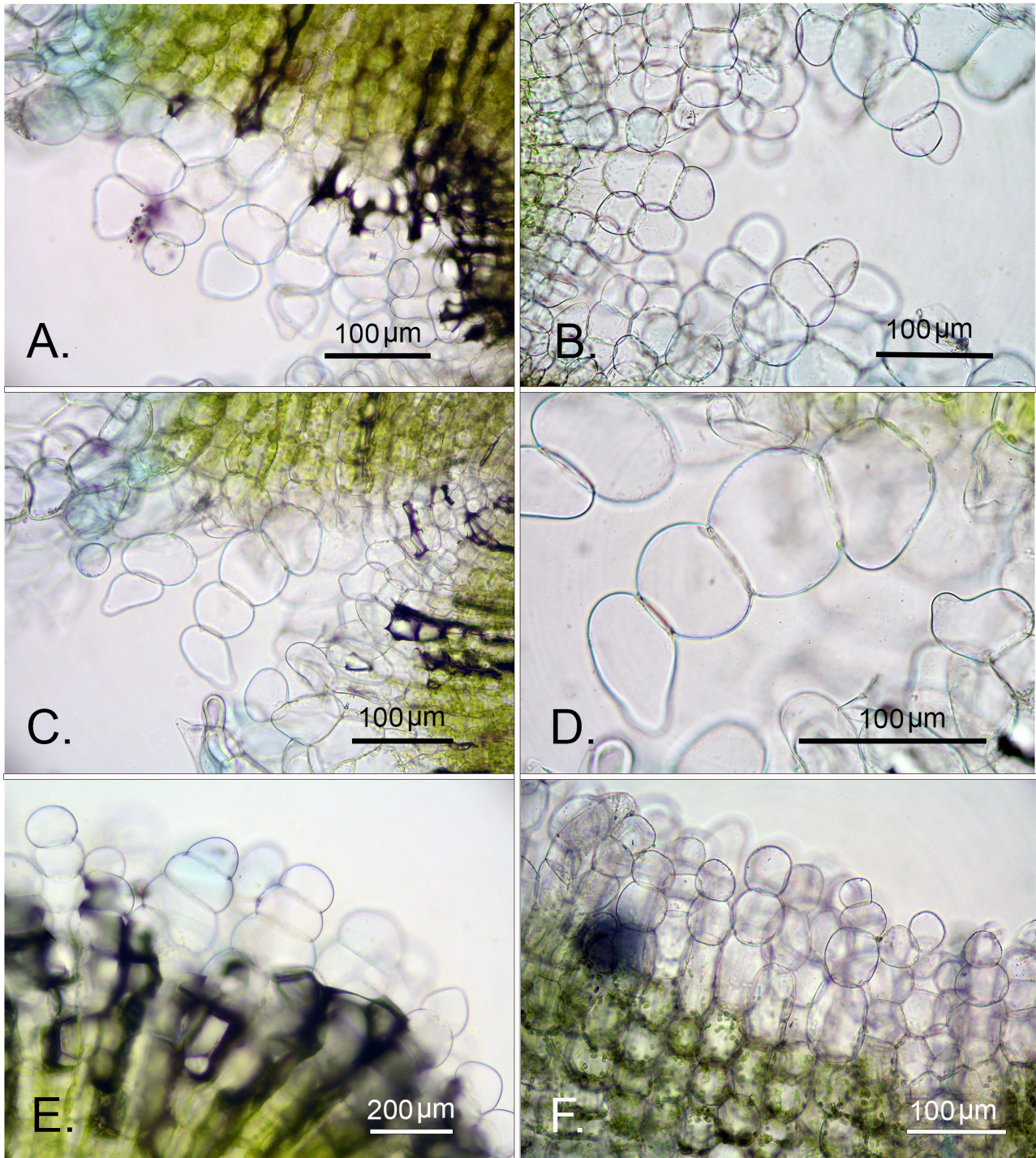


FIGURE 3. *Riccia epecenia*. A–F Multiple layered dorsal epidermal cells showing the variation in the shape of the cells and the length of the uniseriate pillars. Purple or blue colouring in all images due to staining by toluidine blue dye. A–E *R. W. Purdie* 12106; F *M. Smith* 002. Photo credits: D.C. Cargill.

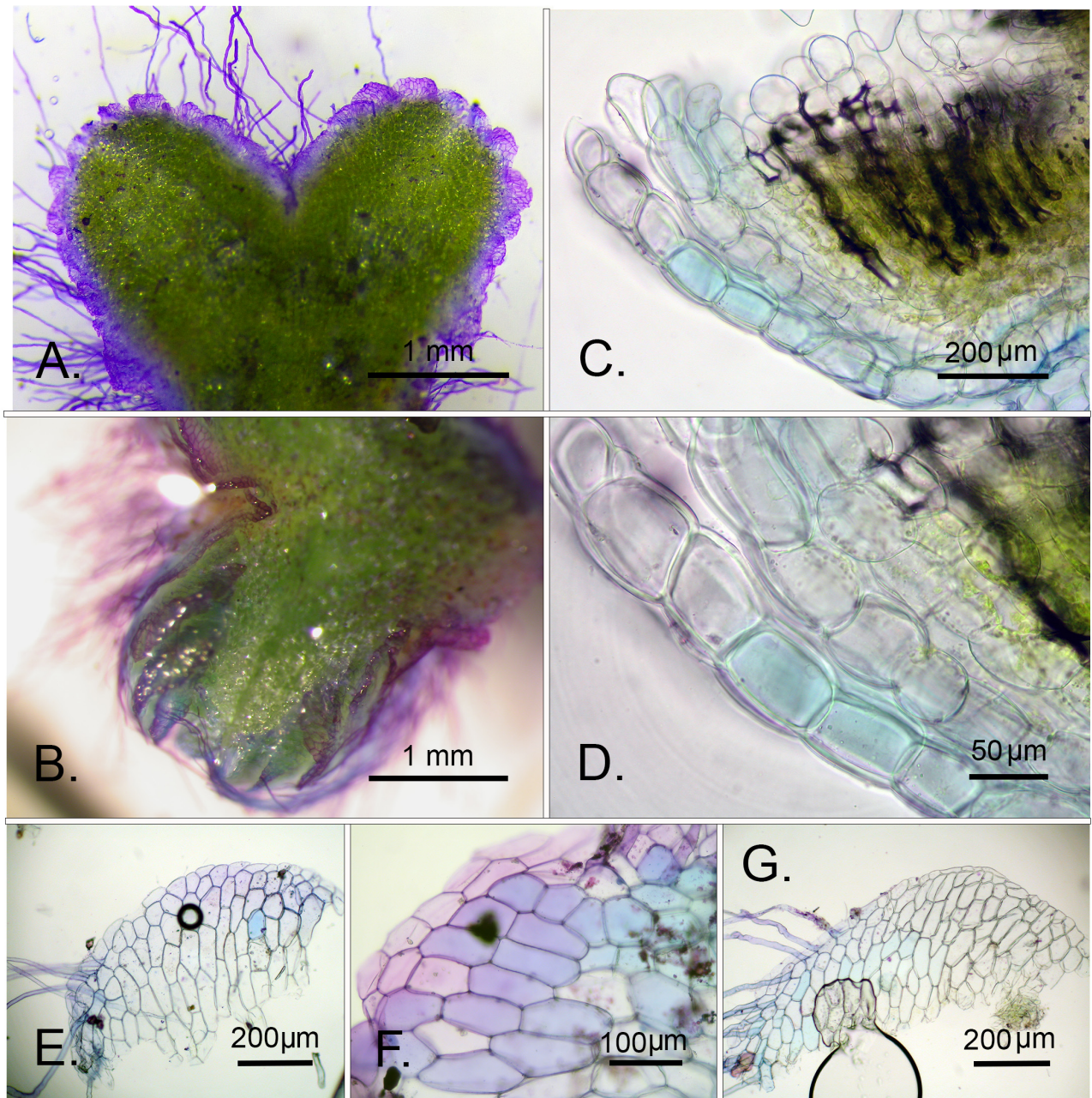


FIGURE 4. *Riccia epecenia*. A–B Scales along the ventral flanks of the segments extending beyond the margins. C–D Cross section through the thallus showing the single layered scales with thickened cell walls. E–G Individual scales. Purple or blue colouring in all images due to staining by toluidine blue dye. A D.C. Cargill 1698; B–D, F R.W. Purdie 12106; E D.C. Cargill 1698; G M. Smith 002. Photo credits: D.C. Cargill.

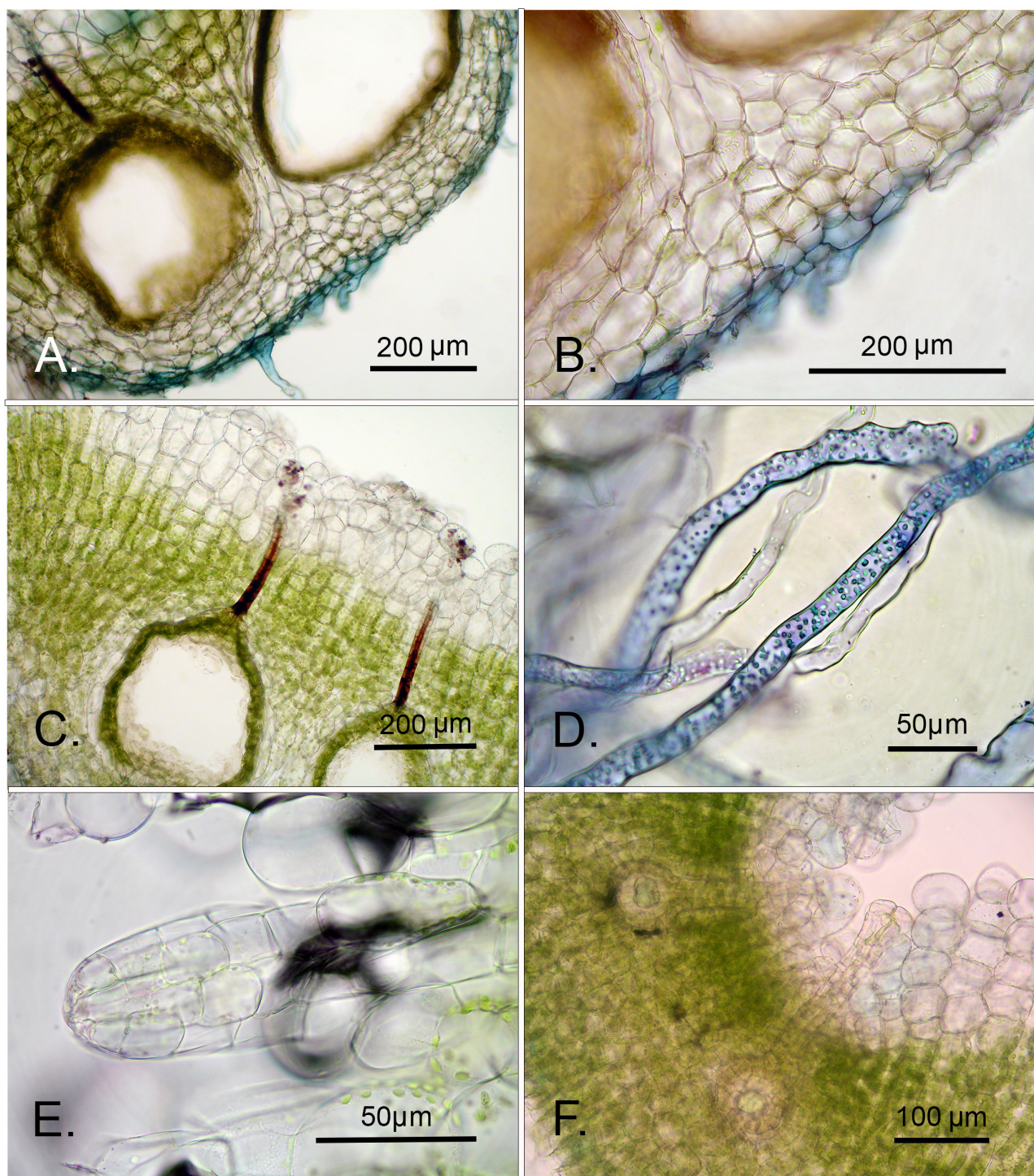


FIGURE 5. *Riccia epecenia*. A Cross section through the thallus showing two developing capsules. B Cross section through thallus showing the ventral storage tissues. C Cross section of thallus showing the photosynthetic tissue and the multi-layered dorsal epidermal cells. D Smooth and pegged rhizoids (stained with toluidine blue). E Neck of an antheridium. F Two archegonia embedded within the thallus. A–B *M. Smith 002*; C *D.C. Cargill 1700*; D–E *R.W. Purdie 12106*; F *D.C. Cargill 1698*. Photo credits: D.C. Cargill.

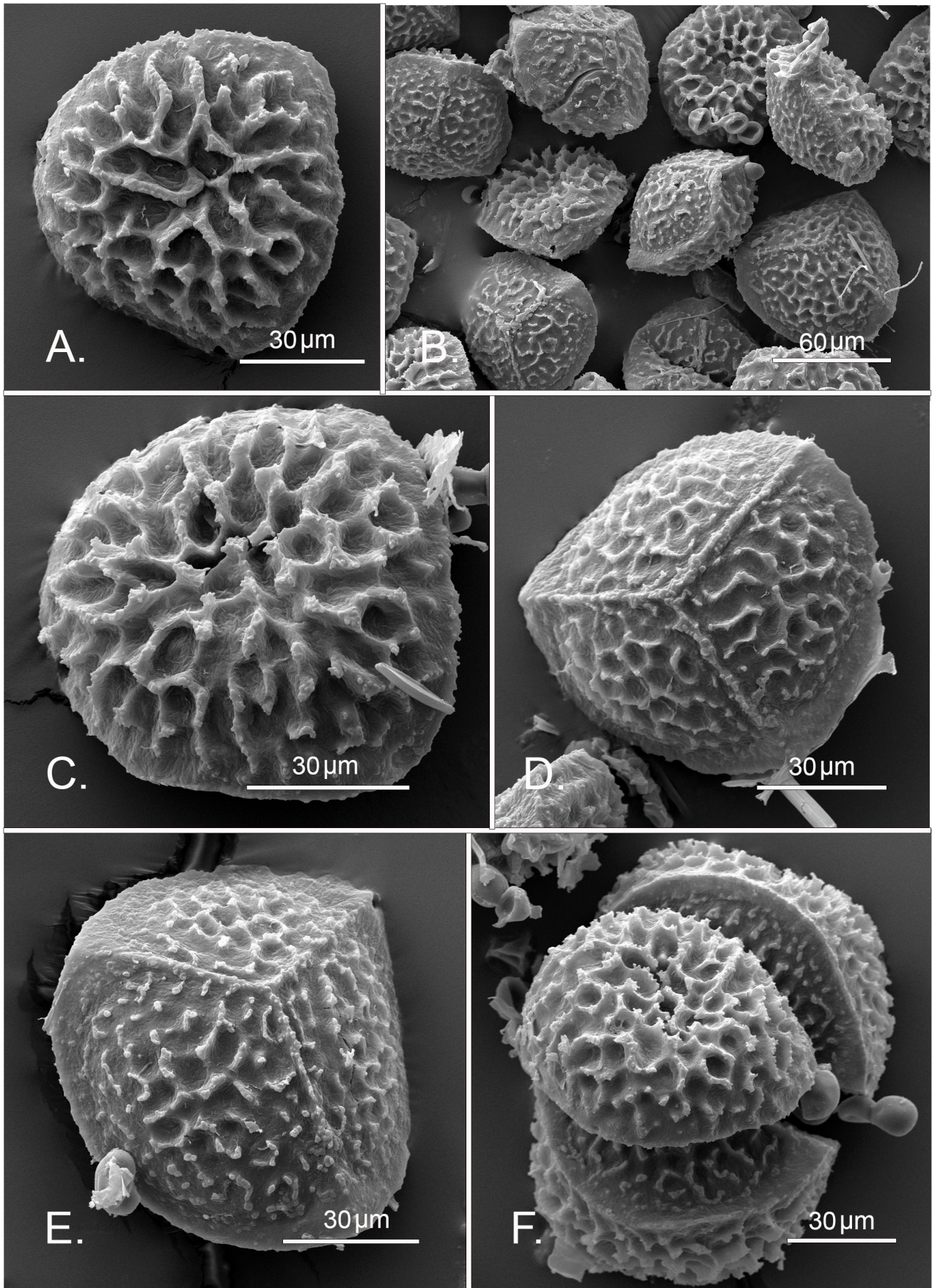


FIGURE 6. *Riccia epecenia*. SEM images of spores. A, C Distal view of spores. B Group of spores. D–E Proximal view of spores. F. Tetrad of spores. A–F *R.W. Purdie 12106*. Photo credits: D.C. Cargill.

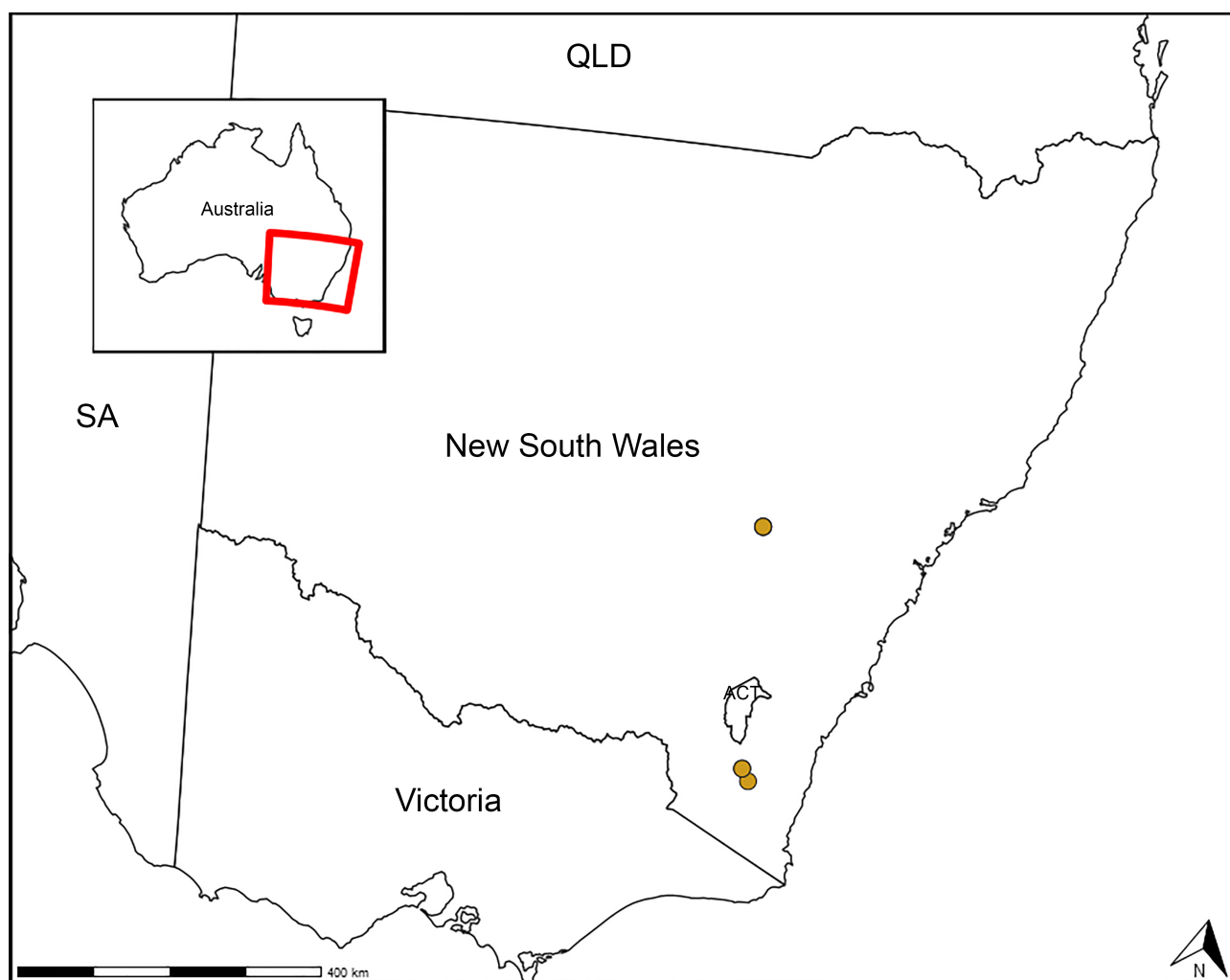


FIGURE 7. Map of New South Wales showing the three localities of *Riccia epecenia* as yellow dots. ACT = Australian Capital Territory; QLD = Queensland; SA = South Australia.

The closest relative genetically (Rabeau & Reeb unpublished) and morphologically to *R. epecenia* is the Lesotho endemic *R. trachyglossum* Perold (1990: 172). It is a species which has been found only in the highlands of Lesotho at 2,500–3,000 m asl growing on soil banks in bogs (Perold 1990). Both species share multilayered dorsal epidermal cells, 3–4 layers high, which give the surface of the plant a velvety or scurfy appearance; hyaline scales seen more prominently at the anterior end of the branches, with an entire margin and spores with somewhat of a radiating reticulate distal pattern and an almost random pattern of short lamellae on the proximal face. Both species also appear to share similar environmental preferences, occurring at relatively high altitudes in their respective ranges.

Differences between the two species include the colour of the plants, which are blue-green in *R. trachyglossum* vs pale green for *R. epecenia*. Perold (1990) also describes the margins of *R. trachyglossum* as ‘raised, tumid’ vs flat margins in *R. epecenia*.

This paper is dedicated to my friend and colleague, Dr Jeff Duckett, with whom I have had the joy of spending time in his company in the field and benefitting from his extensive bryological knowledge.

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