Volume 25: 93–128
Publication date: 07 July 2022
dx.doi.org/10.7751/telopea15546

TELOPEA
Journal of Plant Systematics

The Royal Botanic Gardens & Domain Trust

plantnet.rbgsyd.nsw.gov.au/Telopea • escholarship.usyd.edu.au/journals/index.php/TEL • ISSN 0312-9764 (Print) • ISSN 2200-4025 (Online)

The family Calymperaceae (Bryophyta) in Australia. Part 4: The genus *Calymperes*

Rod D. Seppelt[1], David Meagher[2], Andi Cairns[3], Andrew Franks[4]

[1]*Bundall, Queensland 4217, Australia; Biological Sciences, Macquarie University, New South Wales 2109, Australia.*
[2]*School of BioSciences, The University of Melbourne, Victoria 3010, Australia.*
[3]*College of Science and Engineering, James Cook University, Townsville, Queensland 4811, Australian Tropical Herbarium, McGregor Road, Southfield, Queensland 4878, Australia.*
[4]*Queensland Herbarium, Department of Environment and Science, Brisbane Botanic Gardens, Mount Coot-tha Road, Toowong, Queensland, 4060, Australia.*
Corresponding author: rseppelt@onthenet.com.au

Abstract

Fifteen species of the moss genus *Calymperes* Sw. ex F.Weber are known from Australia. Each species is described and illustrated in detail, and a key to species and distribution maps are provided.

Introduction

Calymperes Sw. ex F.Weber is the type genus of family Calymperaceae, and comprises about 50 species (Tropicos 2021). Reese and Stone (2012) reported 14 species from Australia, and an additional species, *Calymperes boulayi,* has since been added to the country's flora. In the following treatment the descriptions are based on studies of a representative sample of collections held in Australian herbaria, supplemented by our own collections.

The notation !d indicates that a high-resolution digital image of a specimen has been seen via JSTOR Global Plants (www.plants.jstor.org).

Intramarginal cells (also known as teniolae or intramarginal ribs) characterise the genus *Calymperes* and are significant in differentiating between species (see the glossary in Seppelt *et al.* 2021).

CALYMPERES Sw. ex F.Weber, *Tab. Calyptr. Operc.* [3] (1814).

Type species: *Calymperes lonchophyllum* Schwägr., designated by Williams (1920).

Plants small to medium sized, to about 10–15(–30) mm tall, forming ± erect tufts, simple or forked; rhizoids usually brown (reddish to dark purple in a few species). Leaves oblong to lanceolate or linear, often dimorphic, commonly with abundant fusiform, seriate-multicellular gemmae on modified tips of gemmiferous leaves; gemmiferous leaves often strongly differentiated from non-gemmiferous leaves and almost always present; leaves bordered entirely or in part by elongate, hyaline cells (border may be weak, incomplete, or ± lacking in

some leaves in some species); with or without intramarginal rows of differentiated, elongate, mostly hyaline cells; such intramarginal cells sometimes indistinct or lacking in some leaves in some specimens; leaf base composed mainly of a pair of lattices of much larger thin-walled, rectangular hyaline cells (hyaline lamina) usually sharply differentiated from chlorophyllose lamina cells; cells of upper lamina ± isodiametric or ± transversely elongate, at least in part. Gemmae clavate-fusiform, usually abundant, borne on short proboscis-like extensions of leaf tips or, in some species, distinct gemma receptacles. Sporophytes frequent in some species, rare in others; seta relatively short, rarely less than 2 mm, smooth; capsule erect, exserted (or emergent in a few species), cylindrical; calyptra large and persistent, spirally furrowed when dry, twisted round the seta below the capsule, enclosing and clasping the capsule by its rostrate operculum, opening by vertical slit-like fissures at maturity; peristome lacking.

Etymology: Greek *kalymma* (hood, veil) + *peres* (going beyond), referring to the large calyptra, completely covering the capsule.

Distribution: All Australian records of *Calymperes* are from the tropics or subtropics. Species are generally epiphytic, but occasionally grow on soil or rocks.

Notes: The key in Seppelt *et al.* (2021) can be used to separate *Calymperes* from other genera of Calymperaceae.

The following key to species of *Calymperes* known from Australia differs from that provided by Reese and Stone (2012). The first couplet of their key is based on the leaves being narrowly linear and lamina cells of the leaf limb being ± transversely elongate (*C. lonchophyllum, C. serratum*) or leaf shape various but not narrowly linear and chlorophyllose lamina cells ± isodiametric (remaining taxa). While the leaves of *C. lonchophyllum* and *C. serratum* are indeed linear-elongate, the chlorophyllose lamina cells in the specimens examined are not markedly transversely elongate but ± isodiametric. Reese and Stone (2012) also differentiated these two species on the length of the medial cells of the abundant axillary hairs, a difference also noted by Ellis (2020).

Within *Calymperes* many species show considerable variation in specific characters, and identification can often be difficult. Key features may be present or sometimes absent in a species, and some may show marked differences in habit whether wet or dry. Habitat and substrate type should be noted for collection and identification. Leaves hold important identification features: monomorphic or dimorphic (particularly the shape of gemmiferous leaves versus non-gemmiferous stem leaves); leaf margins (with rows of intramarginal cells, with or without a stereome, bordered or not, with or without a unistratose extension into the sheathing base); cell surface (smooth or ornamented); structure of the costa in section; proportional length of the hyaline lamina and shape of its distal delineation, as well as cell size; gemmae and where they arise; and the presence or absence of gemma receptacles at the leaf apex, and their shape. Because of the extent of variation shown in some species, several shoots may need to be examined to arrive at a good species identification.

Reese (1993) noted that sterile specimens of *Calymperes* that lack differentiated intramarginal cells (termed 'teniolae' in earlier publications) may be difficult to distinguish from *Syrrhopodon* species.

Gemmae are common within the Calymperaceae and in *Calymperes* species are mostly produced on modified gemmiferous leaves. Gemmae are generally clavate-fusiform, uniseriate (rarely branching), and commonly smooth (Ellis and Pressel 2020). Gemmae production is generally finite; after gemmae are shed, gemmiferous leaves no longer participate in asexual reproduction. However, within Australia, two *Calymperes* species – *C. lonchophyllum* and *C. serratum* – produce gemmae continuously on multicellular stalk-like structures, termed gemmipars by Reese (2001), after earlier descriptions by Hughes (1971). Reese (2001) described gemmae so produced as typically ridged, papillose, and red-brown in colour.

Key to the species of *Calymperes* in Australia

1 Leaves length 10–20' width 2

1: Leaf length 4–8' width (except gemmiferous leaves up to 10' as long) 3

2 Cells of hyaline lamina usually sharply distinct from adjacent cells of limb; costa usually with a single row of medial guide cells; cells of axillary hairs often > 5 times as long as wide ..... **C. lonchophyllum**

2: Cells of hyaline lamina not sharply distinct from adjacent cells of limb; costa usually with 2 rows of medial guide cells, occasionally with additional subsidiary guide cells; cells of axillary hairs mostly < 3 times as long as wide ..... **C. serratum** var. **serratum**

3 Leaves lacking rows of differentiated intramarginal cells, cells of the lamina above and outside the hyaline cells all chlorophyllose 4

3: Leaves with rows of differentiated intramarginal cells, the rows sometimes weak, obscure, ± hidden by papillae, or may be ± lacking in some leaves 7

4 Gemmiferous leaves distinctly differentiated from non-gemmiferous leaves, abruptly flared at apex to form a receptacle enclosing the gemmiferous tip of costa ..... **C. boulayi**

4: Gemmiferous leaves differentiated or not, with a proboscid or rounded apex, lacking a flared receptacle 5

5 Leaves almost uniform, oblong to lanceolate, lingulate; gemmae arising all around leaf tip ..... **C. tenerum**

5: Leaves uniform, or dimorphic with gemmiferous leaves longer than non-gemmiferous leaves, variously shaped; gemmae only on adaxial surface of leaf tip 6

6 Leaves not or slightly dimorphic; margins unistratose, entire; cells of limb smooth to bluntly papillose, weakly to moderately convex on adaxially ..... **C. motleyi**

6: Leaves usually strongly dimorphic; margins uni- to multi-stratose, usually irregularly notched to denticulate, occasionally entire; cells of limb smooth to unipapillose abaxially, bulging mammillose adaxially ..... **C. graeffeanum**

7 Leaf margins grossly tuberculate; intramarginal cells obscured by tuberculose margins, ± distinct in sheath and base of limb; distal margins of hyaline lamina scalariform ..... **C. strictifolium**

7: Leaf margins entire or variously toothed or roughened, not tuberculate; intramarginal rows of cells distinct or sometimes weakly developed, or lacking in some leaves; distal margins of hyaline lamina scalariform or rounded 8

8 Leaves strongly dimorphic; gemmiferous leaves stiffly erect, consisting mostly of a narrowly winged costa, lacking saucer-shaped gemma receptacle at apex 9

8: Leaves mostly monomorphic or only slightly dimorphic; gemmiferous leaves mostly differentiated only at tips, or narrowed throughout but clearly laminate and similar to non-gemmiferous leaves (if strongly differentiated throughout, then gemmiferous leaves flexuose, not stiffly erect, bearing gemmae only on adaxial surface at apex; saucer-shaped gemma receptacle present or absent 12

9 Margins of non-gemmiferous leaves coarsely toothed above and distal margins of hyaline lamina ending in a ± horizontal line ..... **C. porrectum**

9: Margins of non-gemmiferous leaves entire or only inconspicuously toothed and distal margins of hyaline lamina ending in an arched or angled line 10

10 Distal margins of hyaline lamina rounded distally; leaves strongly dimorphic ..... **C. couguiense**

10: Distal margins of hyaline lamina scalariform; leaves dimorphic or not 11

11 Leaf margins weakly dentate or entire; intramarginal rows of cells distinct in non-gemmiferous leaves, marginal or almost so, in the shoulders 1(–3) cells intramarginal ..... **C. subintegrum**

11: Leaf margins usually irregularly notched or denticulate, sometimes entire; intramarginal cell rows lacking above the hyaline region but may be present in leaf base ..... **C. graeffeanum**

12 Adaxial distal cells of hyaline lamina distinctly mammillose, the mammillae pointing towards leaf tip; gemmae borne all round excurrent costa ..... **C. erosum**

12: Adaxial distal cells of hyaline lamina smooth; gemmae borne only on adaxial surface of leaf tip 13

13 Gemmae borne in distinct receptacles 14

13: Gemmae not borne in distinct receptacles 15

14 Leaves crispate when dry; tips of gemmiferous leaves typically strongly folded downward onto adaxial leaf surface when dry; 1–2 intramarginal cell rows, 1 cell inside margin, intermittent, hardly reaching beyond shoulder ..... **C. crassinerve**

14: Leaves variously contorted but never crispate when dry; tips of gemmiferous leaves not folded downward onto adaxial leaf surface; 2–4 intramarginal cell rows, 1–3 cell rows inside margin, extending into limb but often inconspicuous there ..... **C. moluccense**

15 Plants robust, 1–2.5 cm high, dark green to blackish green; leaves linear with ± parallel sides in limb from a slightly broader base; distal margin of hyaline lamina irregular, often with files of hyalocysts extending upwards into the chlorophyllose cells of limb ..... **C. taitense**

15: Plants small, to 1 cm high, yellowish green to brownish green; leaves oblong-lanceolate from a broad erect-sheathing base; distal margin of hyaline lamina ± smooth, at a broad to narrow angle to costa, hyalocysts not extending upwards into the chlorophyllose cells of limb..... **C. afzelii**

1. *Calymperes afzelii* Sw., *Jahrb. Gewächsk* 1: 3 (1818)

Original material: 'Hab. ad Sierram Leonam Africes inque America calidiori. Arboreus.'

Type: Sierra Leone, *s.loc.*, 1792–1796, *A.Afzelius s.n.* holotype: ?S not seen; isotypes: E00011440!d, BM000855290, NY01113882!d.

Illustrations: Eddy (1990: 115), Reese and Lin (1991: 335), Ellis and Tan (1999: 6), Reese (2007: 659).

Plants to 10 mm tall, yellowish green to brownish green, gregarious or in thin to dense tufts or turfs. Stems erect, simple or forked; rhizoids reddish to yellowish brown. Leaves ± dimorphic, patent when moist, slightly curved or contorted when dry; lingulate from an erect-sheathing base, 3–6 mm long. Non-gemmiferous leaves with acute apex, costa ending in or just below apex; gemmiferous leaves with margins constricted at tips, forming a distinct proboscis-like apex with narrowly revolute margins, costa extending into proboscis; limb usually plane, margins thickened but lacking internal stereome, entire or serrate, especially above. Cells of limb small, 4–5 μm, almost smooth to finely papillose abaxially, bulging-papillose adaxially; intramarginal cells mostly distinct and conspicuous in lower limb and sheathing base. Costa smooth in sheath, in upper limb with epidermal layer of conical-mammillose cells, ± rounded in section, with 4–5(–6) medial guide cells, adaxial and abaxial stereid bands. Hyalina lamina sharply defined, reaching to just above shoulder level, ending above in a broad to narrow angle at the costa, with scalariform margins. Gemmae common, adaxial on tips of gemmiferous leaves. Sporophytes not seen in Australian material. (Fig. 1)

Diagnostic characters: *Calymperes afzelii* is perhaps more distinctive under the microscope than in the field, being of similar size to several other species. The ligulate leaves with intramarginal rows of cells, leaf margins that are almost entire or very finely denticulate by projecting cell ends, and the proboscid leaf apex are useful features for identification. *Calymperes erosum* is superficially similar but differs in having the distal cells of the hyaline lamina adaxially mammillose and gemmae borne all around the tip of the excurrent costa which does not have the marginal lamina incorporated into the proboscis. *Calymperes taitense* is a larger, darker plant with the distal margins of the hyaline lamina interlocking with the chlorophyllose lamina cells above, and there are rather coarse marginal teeth.

Distribution: In Australia, known from tropical Western Australia to the Northern Territory (Melville Island) and north-eastern Queensland, from inland of Mackay to Cape York (Fig. 16.1). Otherwise a pantropical species, widespread from southern USA to northern South America, tropical and subtropical central Africa, Madagascar, Réunion, Seychelles, India, Malesia, the Philippines, Papua New Guinea and Vanuatu.

Habitat: Grows on bark, logs and occasionally on rock, in low-altitude forests to about 800 m altitude.

Selected specimen seen: Queensland: Hinchinbrook: Broadwater Camping Area, Abergowrie State Forest, near Ingham, 5 Sep 2013, *D.A.Meagher & A.Cairns WT-220* (BRI AQ1016952).

Etymology: After Swedish botanist Adam Afzelius (1750–1837), who collected the type in Sierra Leone.

Typification: The holotype should be in the Swartz herbarium at the Swedish Museum of Natural History (S), but it is not listed in the museum's collections database and we have been unable to determine whether it is extant. The isotype in E is from herb. Menzies and is annotated 'Calymperes afzelii' on the original sheet. The original packet is annotated 'Sierra Leone leg. Afzelius'. The specimen was determined as *Calymperes perottii* Besch. by Hugh Dixon in 1936, but redetermined as *C. afzelii* by Sean Edwards in 1974. The isotype in BM was determined as such by Len Ellis in 1993 and is from herb. Hampe. It is annotated 'ex herb. Weberi *Calymperes afzelii* Sw. Sierra Leone leg. Afzelius'. The isotype in NY is annotated '*Calymperes afzelii* Sw. Ad Sierra Leone, Africa Afzelius' and was annotated as type material by Peter Florschütz in 1959. Although a note attached in 1986 by Bill Reese says that it does not agree with *C. afzelii* sensu Edwards (1980), we have no reason to think it is not type material.

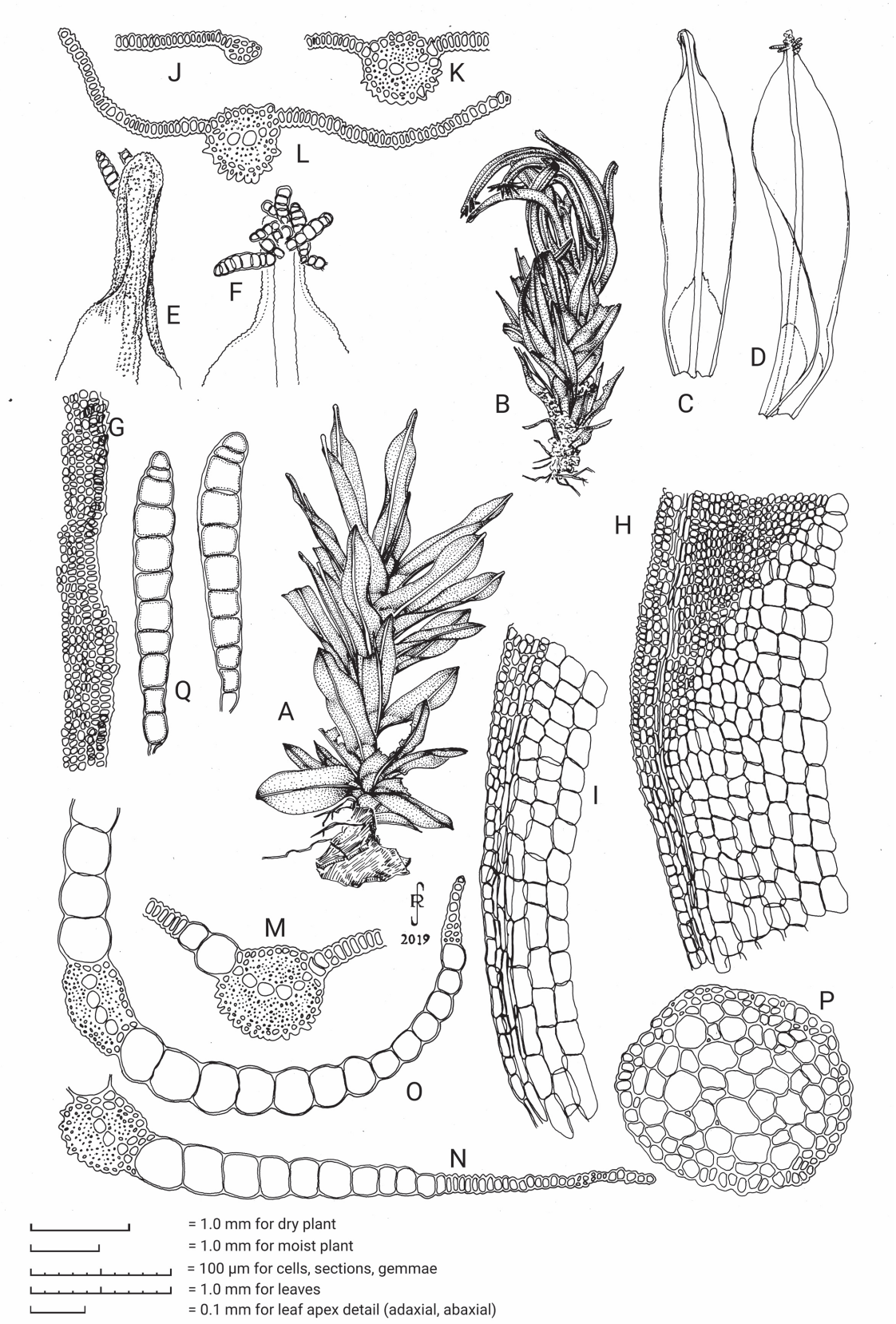

Fig. 1. *Calymperes afzelii* Sw. **A:** Habit of plant, showing both gemmiferous and non-gemmiferous leaves, drawn moist. **B:** Habit of plant, drawn dry. **C, D:** Gemmiferous leaves. **E, F:** Gemmiferous leaf apex (E – abaxial, F – adaxial view). **G:** Mid to upper lamina marginal cells. **H:** Cells of shoulder region of leaf with intramarginal cells, chlorophyllose lamina, and hyaline lamina. **I:** Cells of basal margin of leaf showing intramarginal cells and cells of the hyaline lamina. **J:** Cells of mid-leaf margin. **K, L:** Costa and leaf sections of mid-limb of leaf. **M:** Section of costa and adjacent cells at distal margin of hyaline lamina. **N, O:** Sections of leaf base through hyaline lamina, chlorophyllose lamina, and intramarginal row 2–3 cells thick. **P:** Stem section. **Q:** Gemmae. Drawn from: *D.A.Meagher & A.Cairns WT-220.*

2. *Calymperes boulayi* Besch., *Ann. Sci. Nat., Bot., sér. 8*, 1: 268, 278 (1896)

Original material: 'Bornéo leg. Korthals, Hb. Boulay; Hb. Mus. Par. sub C. Palisoti Dzy et Molk.); Java, associé à C. platycinclis Nob. in Hb. Mus. Lugd. Batav. sub C. moluccensi).'

Type: Indonesia, Kalimantan (Borneo), 1831–1836, *P.Korthals s.n.* lectotype: BM000851724!d, designated by Ellis (1988); isolectotypes: ?L (not seen), NY2045381!d, PC0148228!d.

Illustrations: Eddy (1990: 245), Ellis and Tan (1999: 8).

Plants mostly small, 3–5(–10) mm tall, forming low, compact tufts, green to yellowish green. Leaves soft-textured, dimorphic in gemmiferous plants; non-gemmiferous stem leaves recurved-patent from a slightly broadened sheathing base, lingulate to spathulate, chlorophyllose lamina flat or with incurved margins, 2–3 mm long, 0.5–0.6 mm wide, margins weakly crenulate-denticulate at shoulders; apex broadly rounded; intramarginal rows of cells lacking, upper leaf margins not bordered; cells of chlorophyllose lamina thin-walled, quadrate, 5–7 μm wide, 8–10 μm wide near hyaline lamina. Gemmiferous leaves longer than non-gemmiferous leaves, rigid, erect-spreading when moist, incurved when dry, 3–5 mm long, the blade narrowing from the shoulders or at least in upper limb, acuminate, abruptly flared at apex to form a receptacle enclosing the gemmiferous tip of costa. Costa in non-gemmiferous stem leaves ending just below leaf tip; in section with a median row of guide cells but lacking adaxial or abaxial stereids, cells adjacent to guide cells about 1/2 diameter of guide cells, thin-walled, epidermal layer of cells conical-mammillose, subepidermal cells on abaxial side narrower than interior cells, sometimes in the form of substereids. Distal margins of hyaline lamina broadly rounded above, sharply delimited, ending at or slightly above shoulders, upper hyalocysts ± strongly inflated; intramarginal cell rows weakly developed, indistinct. Sporophytes common. Seta short, about 2–3 mm long; capsule exserted; calyptra densely scabrid with ± erect spinous cell ends. (Fig. 2)

Diagnostic characters: The flared, saucer-shaped gemma receptacles of *Calymperes boulayi*, which are readily apparent under a hand lens even when the leaves are dry, are similar to those of *C. moluccense*, but the latter species clearly has leaves with intramarginal rows of cells extending into the limb. *C. graeffeanum* also has flared gemma receptacles but these are narrower and do not form a saucer-shaped gemma receptacle as in *C. boulayi*. Ellis (1999) nominates the somewhat inflated appearance of the costa and absence of stereids therein in both gemmiferous and non-gemmiferous leaves, the absence of intramarginal rows of cells in the upper leaf, and the distinctive 'collared' gemma receptacle as distinguishing characteristics of *C. boulayi.* However, we are unable to comment further as only one specimen was available for examination.

Distribution: In Australia known from a single collection near Cairns, Queensland (Fig. 16.2). Elsewhere, widespread throughout tropical Asia from Sri Lanka to Thailand, Malesia, Papua New Guinea, Solomon Islands, Micronesia, and Polynesia. Only one Australian collection is known: *I.G.Stone 15349*, collected 27 July 1979 at Crystal Cascades and identified by Len Ellis. Because that collection was not available for study, a specimen from Papua New Guinea is illustrated here.

Habitat: Epiphytic on tree trunks and branches. The habitat of the only known Australian specimen is unknown; the specimen from Papua New Guinea cited below was growing on the trunk of a mature coconut palm in a garden.

Selected specimen seen: Papua New Guinea: Morobe Province; S.I.L. Guesthouse, Lae, 11 Jan 1981, *H.Streimann 10750* (CANB 8102712).

Etymology: After French botanist Jean-Nicolas Boulay (1837–1905), from whose herbarium one of the syntypes was obtained.

Typification: The isolectotype in PC is ex herb. Mus. Ludg. Batav. and is annotated '= *C. boulayi Calymperes Palisoti* Schw. non *C. fasciculatum* Dozy *C. moluccense*' in handwriting and 'Borneo Korthals legit.' in print. It was not cited by Menzel and Schultze-Motel (1990) nor Ellis and Tan (1999).

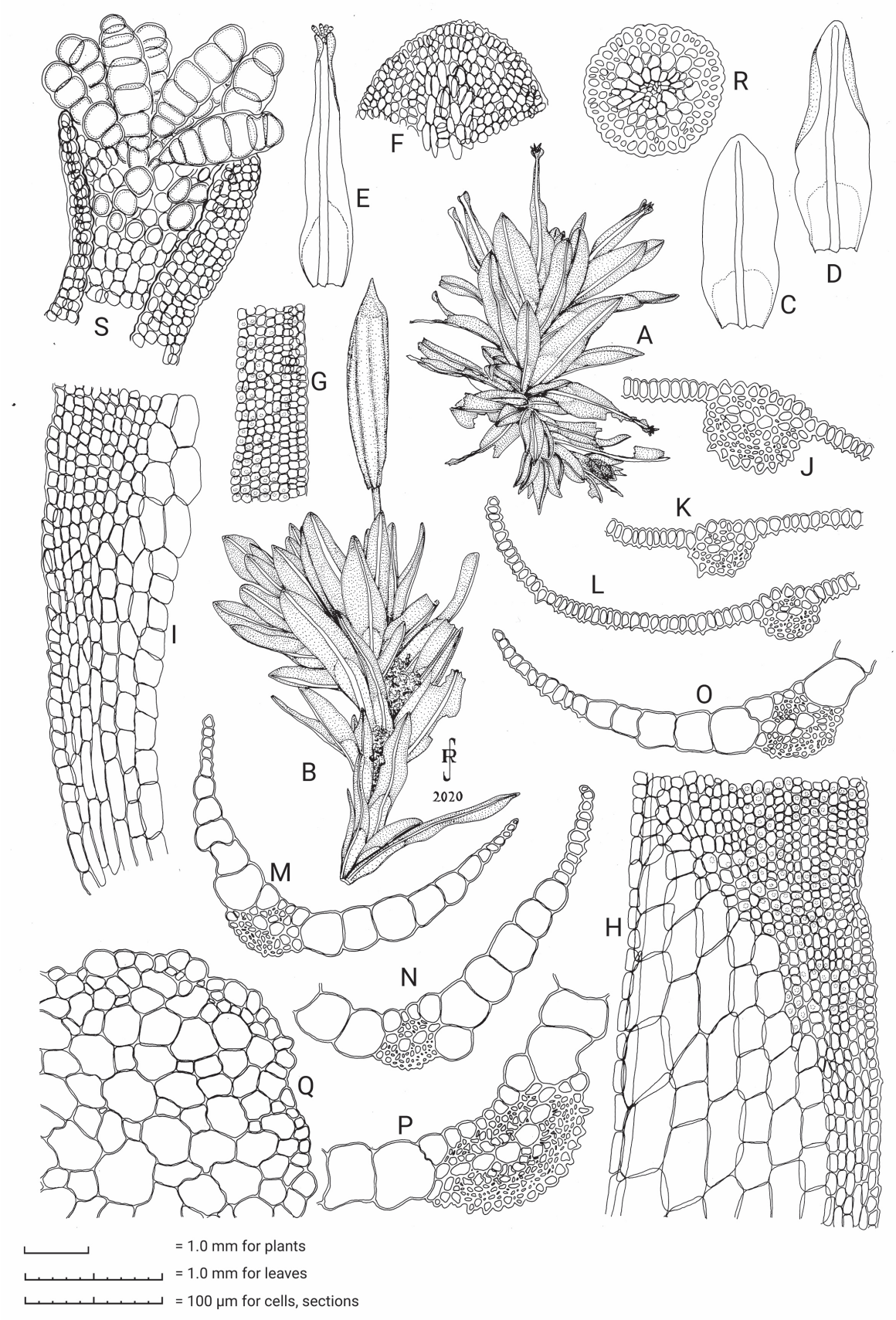

Fig. 2. *Calymperes boulayi* Besch. **A:** Plant with gemmae and perigonia, drawn moist. **B:** Plant with capsule, drawn moist. **C, D:** Stem leaves. **E:** Leaf with gemmae. **F:** Cells of apex of non-gemmiferous stem leaf. **G:** Marginal cells of leaf limb, abaxial view. **H:** Hyaline lamina, abaxial view. **I:** Cell of basal margin of leaf. **J–L:** Sections of leaf limb. **M–P:** Sections of leaf sheath. **Q:** Part stem section. **R:** Section of seta. **S:** Detail of gemma receptacle with gemmae. Drawn from: *H.Streimann 10750*.

3. *Calymperes couguiense* Besch., *Ann. Sci. Nat., Bot., sér. 5*, 18: 206 (1873)

Original material: 'Ad cortices in monte Cougui (Balansa)'.

Type: New Caledonia, Grande Terre, Mt Koghi (Cougui), 1868–1870, *M.Balansa s.n.* PC0148258!d, PC0148259!d.

Illustrations: Ellis (2002: 154).

Plants dull, dark green to brownish, to 5(–8) mm tall, in loose tufts and turfs. Stems erect, simple; rhizoids brown. Leaves strongly dimorphic; non-gemmiferous stem leaves oblong-lanceolate from a broader base, (2.2–)2.5–4.0 mm long, straight when moist, ± involute or folded along limb; when dry, loosely curled and involute; margins slightly thickened, ± entire; cells of chlorophyllose lamina ± isodiametric, sharply papillose with large papillae on both surfaces; intramarginal cell rows present but often obscured by inrolled margins; gemmiferous leaves roughened, stiffly erect when wet, erect to curved when dry, the chlorophyllose lamina reduced to narrow wings or ridges in upper 1/3 of leaf. Distal margins of hyaline lamina rounded to almost scalariform. Gemmae common, borne terminally at the leaf apex, surrounded by an apical fringe of smaller sterile, finger-like projections. Sporophytes unknown. (Fig. 3)

Diagnostic characters: Reese and Stone (2012) suggested that *C. couguiense*, *C. strictifolium* and *C. subintegrum* form a natural group, based on their general similarity. Colonies of *C. couguiense* and *C. subintegrum* often appear bristly because of the stiffly erect gemmiferous leaves. In *C. subintegrum* the distal margins of the hyaline lamina are acute, and in *C. strictifolium* the leaf margins are grossly tuberculate. In addition, both of those species lack the fringe of sterile projections at the apex of gemmiferous leaves that are present in *C. couguiense*.

Distribution: Occurs in north-eastern Queensland from Paluma Range, north of Townsville, to Torres Strait (Fig. 16.3). Elsewhere known from eastern Papua New Guinea (New Britain), New Caledonia, and Pacific islands as far east as Tahiti.

Habitat: Wet to very wet lowlands and foothills from sea level to about 500 m, growing on tree bark and sometimes soil or rock, in coastal mesophyll and notophyll vine forests.

Selected specimens seen: Australia, Queensland: c. 8 km west of Babinda, 7 July 1987, *W.D. Reese 17038*, *I.G. Stone* & *A.G. Stone* (CANB 2103890A). Solomon Islands: Choiseul, Sasamuga, Vavudu village, 3 Aug 1991, *M. Qusa s.n.* (CBG 9300171.1).

Etymology: Cougui + *–ense* (coming from), referring to Mt Cougui in New Caledonia, where the type was collected.

Typification: PC0148258 and PC0148259 are on the same sheet, which bear an original label from Herb. Mus. Paris that identifies the material as type. The former is annotated '*Syrrhopodon* [amended to *Calymperes* in pencil] Besch. a Mont. Cougui.' in handwriting and 'Nouvelle Calédonie. M. Balansa, 1868–1870.' in print, and the latter is annotated '*C. Couguiense* Besch. Cougui Balansa' in handwriting. Neither is identified as having come from herb. Bescherelle, but it is clear that both are original material, the latter probably being a segregate of the former. BM-000675199 is from Bescherelle's herbarium but is annotated in script 'Nv-Caled. Balade Vieillard No. 1776'. It was identified as type material by Bill Reese in 1982 (perhaps thinking 'Balade', a locality on Grande Terre, was 'Balansa'), but Len Ellis noted that it was not type material in an annotation dated July 2000. A 2001 annotation from Len Ellis identifies this specimen as a neotype, but as there are at least two extant specimens of the original material a neotye is not required. A lectotype should be chosen from the material in PC, but a close inspection of the two specimens is needed before this is done.

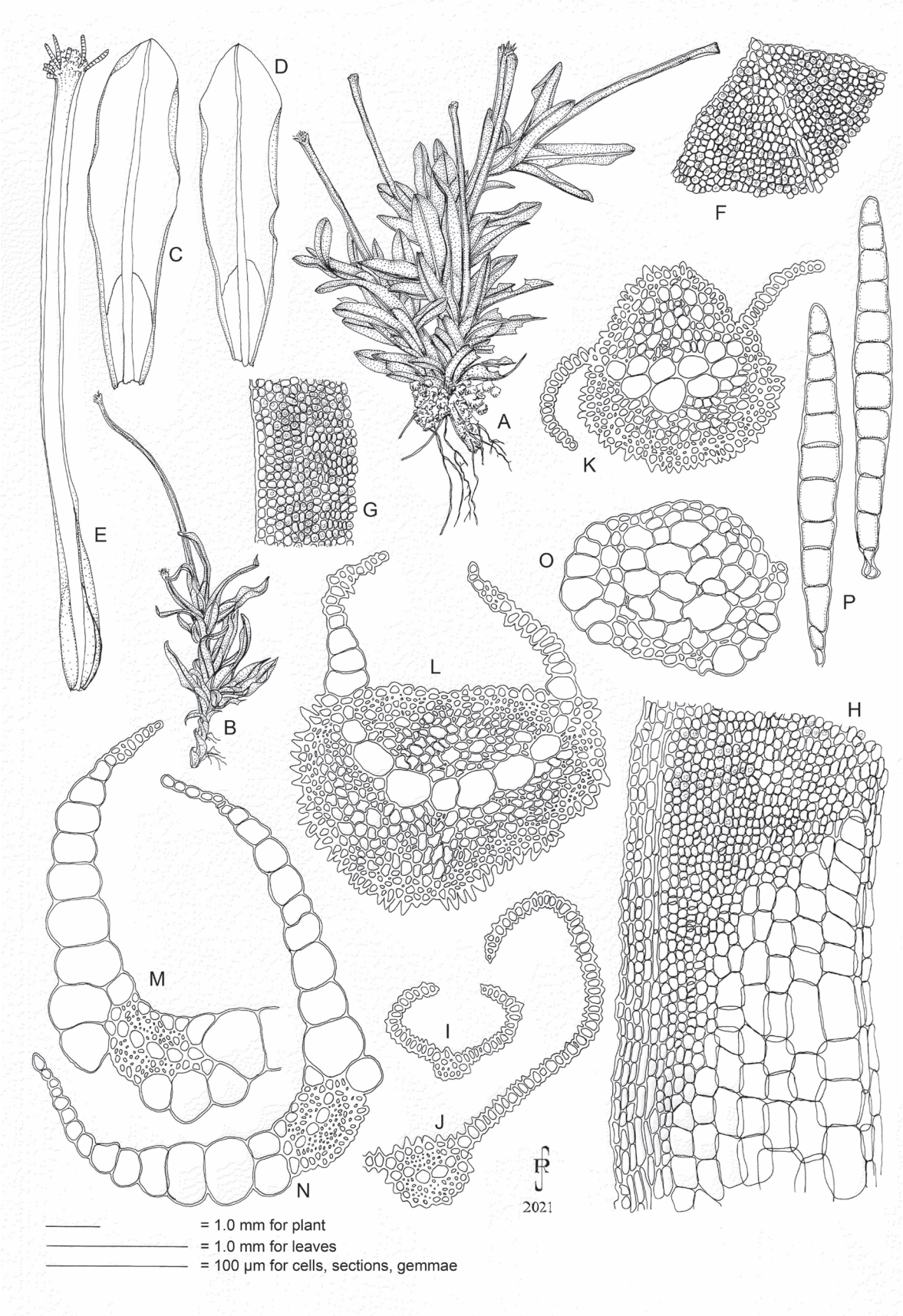

Fig. 3. *Calymperes couguiense* Besch. **A:** Habit of plant, drawn moist. **B:** Habit of plant, drawn dry. **C, D:** Vegetative leaves. **E:** Gemmiferous leaf. **G:** Cells of upper leaf margin. **H:** Cells of leaf shoulder region, with hyaline lamina, intramarginal cells, cells of chlorophyllose lamina. **I:** Section near apex of gemmiferous leaf. **J:** Section of mid to upper region of gemmiferous leaf. **K, L:** Mid-leaf sections of gemmiferous leaf. **M, N:** Sections of chlorophyllose lamina of gemmiferous leaves. **O:** Stem section. **P:** Gemmae. Drawn from *M. Qusa 122.*

4. *Calymperes crassinerve* (Mitt.) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1871–72: 481 (1873). *Thyridium crassineve* Mitt., *J. Linn. Soc., Bot.* 10: 189 (1868)

Original material: 'Tutuila, on bark. No. 129.'

Type: Samoa, Tutuila, *T. Powell 129,* 1845–1867, holotype NY1127898!d; isotypes BM000663116!d, BM000663119!d

Illustration: Eddy (1990: 122).

Plants small, to about 5 mm tall, green to yellowish green, forming low dense tufts. Stems erect to repent, mostly simple. Leaves dimorphic; non-gemmiferous stem leaves 1–2 mm long, blunt, crisped when dry; folded to weakly undulate when moist; lingulate above a broader base, shoulders often flaring; margins unistratose, entire; intramarginal rows distinct, 1–2 cells wide and 1 cell inside margin, intermittent, not extending far up limb above shoulders; hyaline lamina truncate distally, ending in a ± horizontal line at about leaf shoulder level, sharply demarked from chlorophyllose cells of lamina, the lamina cells not decurrent down costa or margins; gemmiferous leaves slightly longer than non-gemmiferous leaves, contracted below apical saucer-shaped gemma receptacle, typically strongly inflexed near apex when dry so that gemmiferous portion becomes appressed to adaxial leaf surface; gemmae pale green, in hairbrush-like tufts adaxially on leaf tips. Costa strong, especially in gemmiferous leaves, failing below leaf tip; in section with well-developed stereid bands above and below guide cells and a differentiated epidermal layer. Cells of chlorophyllose lamina ± rounded-quadrate, thin-walled, ± smooth, typically biconvex. Sporophytes rare in Australian collections. Seta reddish, 1.5–2.0 mm long; capsules emergent, 1.0–1.5 mm long; calyptra about 2.5 mm; operculum about 0.75 mm long; spores 34–36 μm in diameter, finely granular. (Fig. 4)

Diagnostic characters: This small moss is easily recognised by its small lingulate leaves (1–2 mm long) and when dry by its ± crispate leaves and gemmiferous leaf tips which fold downwards and inwards to the adaxial surface of the leaf, giving the appearance of a brush-like tuft of gemmae. *Calymperes crassinerve* is generally smaller and more compact than *C. boulayi* or *C. moluccense*, although the form of the gemmiferous leaves is similar. When dry, the gemmiferous leaf tips of *C. moluccense* and *C. boulayi* remain erect. *Calymperes crassinerve* differs from *C. boulayi* in having distinct rows of intramarginal cells bordering the proximal chlorophyllose lamina. *Calymperes motleyi* is also similar in the tips of the gemmiferous leaves curving inwards when dry but lacks intramarginal cells, as in *C. boulayi*, but the cells of the chlorophyllose lamina of *C. motleyi* are thick-walled and the hyaline lamina broader. The widely flared shoulders and flat distal margins of the hyaline lamina of *C. crassinerve* also resemble *Mitthyridium* but there the leaf border is always broader and located at the margin, not intramarginal.

Distribution: Known in Queensland from Cardwell to Cape York (Fig. 16.4). Elsewhere widespread from tropical Asia to New Guinea and eastward into Oceania.

Habitat: Occurs on trees, including mangroves, stumps, rotted logs, rarely on rock, mostly at or near sea level but up to about 500 m altitude.

Selected specimens seen: Queensland: Cook: Emmagen Creek crossing, Cape Tribulation Road, Daintree National Park, 11 May 2013, *D.A.Meagher & A.Cairns WT-160* (BRI AQ1016908); Cairns: Behana Gorge, Behana Creek, south of Gordonvale, 16 May 2014, *D.A.Meagher & A.Cairns WT-454* (BRI AQ1019055); Cassowary Coast: Clift Road via Elderbeck, 2.5 km north of Cardwell, 26 May 2015, *D.A.Meagher & A.Cairns WT-601A* (BRI AQ1019799).

Etymology: Latin *crassus* (thick) + *nervum* (sinew), referring to the thick costa.

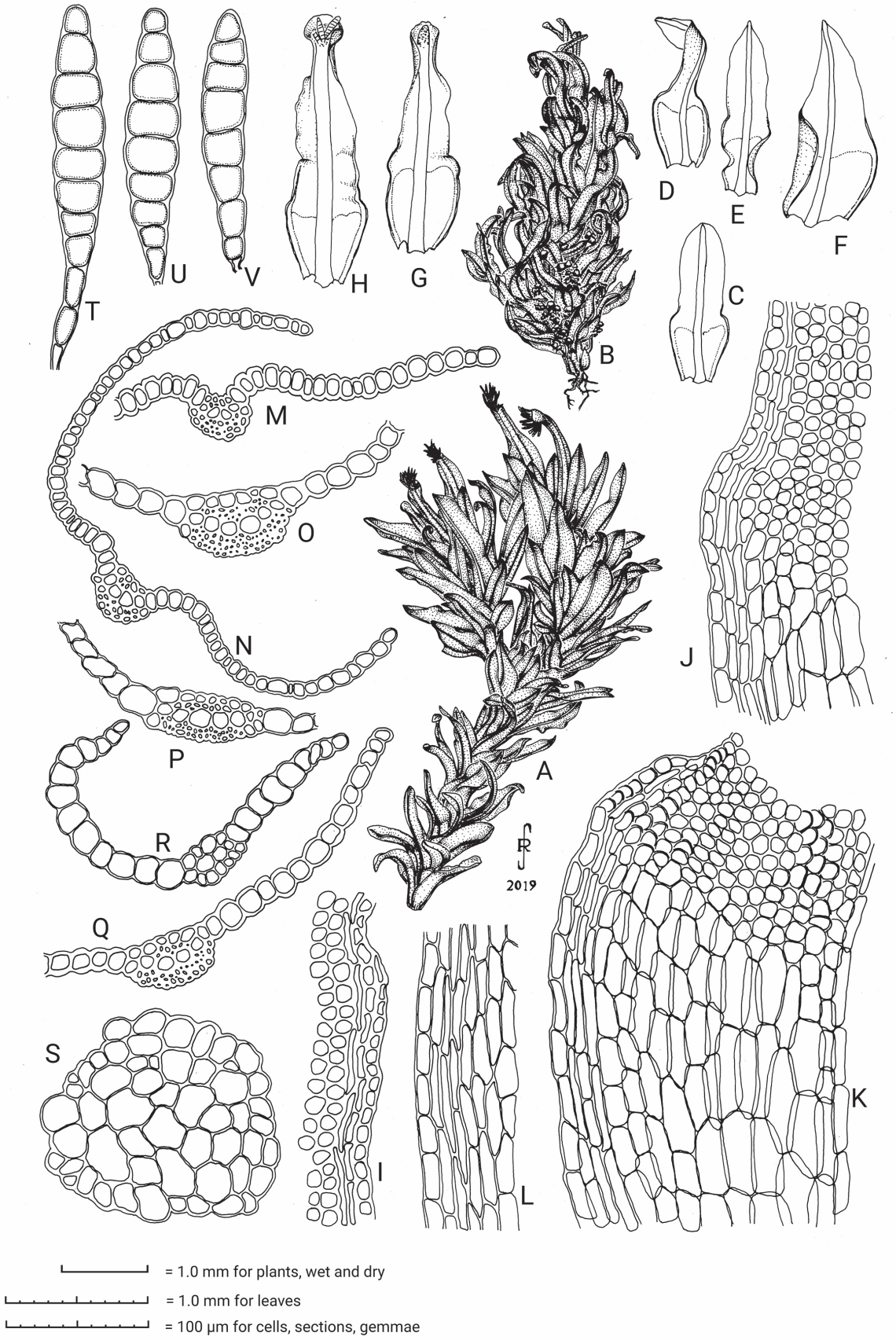

Fig. 4. *Calymperes crassinerve* (Mitt.) A.Jaeger **A:** Habit of plant, drawn moist. **B:** Habit of plant, drawn dry. **C–F:** Non-gemmiferous leaves. **G, H:** Gemmiferous leaves. **I:** Cells of mid to lower margin at mid limb. **J:** Cells of shoulder region with hyaline lamina, chlorophyllose lamina cells and intramarginal cells. **K:** Cells of shoulder region. **L:** Cells of basal angle of leaf. **M, N:** Sections of leaf limb. **O–R:** Sections of sheathing base of leaf. **S:** Stem section. **T–V:** Gemmae. Drawn from: *D.A.Meagher & A.Cairns WT-601A*.

5. *Calymperes erosum* Müll.Hal., *Linnaea* 21: 182 (1848).

Original material: 'An Baumstämmen bei Paramáribo. Unter No. 539, des Hb. Kegelian, zwischen Cladonien steril. Mit Früchten erhalten von Herrn Professor Miquel unter *Hypnum microtheca* n. sp.'

Type: Suriname: near Paramaribo, July 1844, *H.Kegel 539*, lectotype: PC0148269!d, designated by Reese (1961); isolectotypes: GOET011748!d, JE04001397!d, ?BM000575254!d, ?BM000855301.

Illustrations: Eddy (1990: 117), Reese and Lin (1991: 334), Ellis and Tan (1999: 8).

Plants small to medium sized, to 10 mm tall, green to yellowish green or dark green, sometimes with a pinkish tinge, forming low dense tufts or turfs. Stems erect, often curved, simple or forked; rhizoids reddish brown. Leaves somewhat dimorphic, mostly 3–4 mm long, about 1.0 mm wide at shoulders; ascending to spreading when moist, lanceolate to ligulate above a broader base; margins slightly thickened, finely serrate; when dry leaves incurved and with involute margins; leaf apex very variable, obtuse to bluntly mucronate with the costa percurrent in non-gemmiferous stem leaves and excurrent in gemmiferous leaves with gemmae borne all round the tip. Cells of chlorophyllose limb small, ± quadrate, 5–8 μm wide, minutely papillose abaxially, bulging conical-mammillose adaxially; intramarginal cell rows usually well developed, forming a pellucid band 3–6 cells intramarginal at shoulders, with 1–2 rows of ± quadrate marginal cells externally, continuing well up margins of limb, extending into the base and intramarginal by 1–2 rows of pellucid thin-walled cells. Hyaline lamina sharply delimited from chlorophyllose lamina, the distal margins broadly rounded, ending at or just above shoulder; upper cells of hyaline lamina and lower chlorocysts with conspicuously projecting cell ends, at least abaxially, giving a scabrid appearance to leaf surface. Gemmae common, reddish, borne all round tip of costa in spherical clusters. Sporophytes not seen in Australian collections. (Fig. 5)

Diagnostic characters: *Calymperes erosum* is similar to *C. afzelii* but differs in that the unistratose, elongate, hyaline intramarginal cells of the leaf sheath of the latter species are bordered on its outside by 3–6 rows of pellucid rectangular cells, not a single row as in *C. erosum*. Gemmae are borne only adaxially in *C. afzelii,* not all round the apex of the costa and the tip of the costa in *C. erosum* is naked and scabrid, whereas in *C. afzelii* the costa apex is bordered by a narrow band of chlorophyllose laminal cells. Further, the upper cells of the hyaline lamina in *C. afzelii* are not highly inflated or mammillate as in *C. erosum*. When dry the leaf sheath of *C. erosum* usually has a characteristic glossy iridescence.

Distribution: In Australia, known from northern Northern Territory and north-eastern Queensland from Cape York to inland of Mackay (Fig. 16.5). Reese and Stone (2012) reported *Calymperes erosum* from the Kimberley region in Western Australia, but the collection they cited (*I.G.Stone 23497*) is a mixture of five species, none of which is *C. erosum*. A pantropical species.

Habitat: Occurs on trees, including mangroves, roots, rock, soil, humus, in monsoonal rainforest from sea level to about 1000 m altitude.

Selected specimen seen: Queensland: Cassowary Coast: Edmund Kennedy National Park, 23 July 1987, *W.D.Reese, I.G.Stone and A.Stone 17203* (BRI AQ1019727).

Etymology: Latin *erosum* (eroded), referring to the erose-denticulate margins of the leaves.

Typification: The material collected by Miquel was identified by Reese (1961) as belonging to *Calymperes uleanum* Broth., a long-recognised synonym of *C. pallidum* Mitt. Ellis (2018) discussed the confusion surrounding the supposed holotype of *Calymperes erosum* in GOET suggested by Reese (1993), and pointed out that the lectotypification of *C. erosum* by Reese (1961) remains effective under the International Code (Turland *et al.* 2018). The isolectotype in JE and two likely isolectotypes in BM cited here have not been recognised previously.

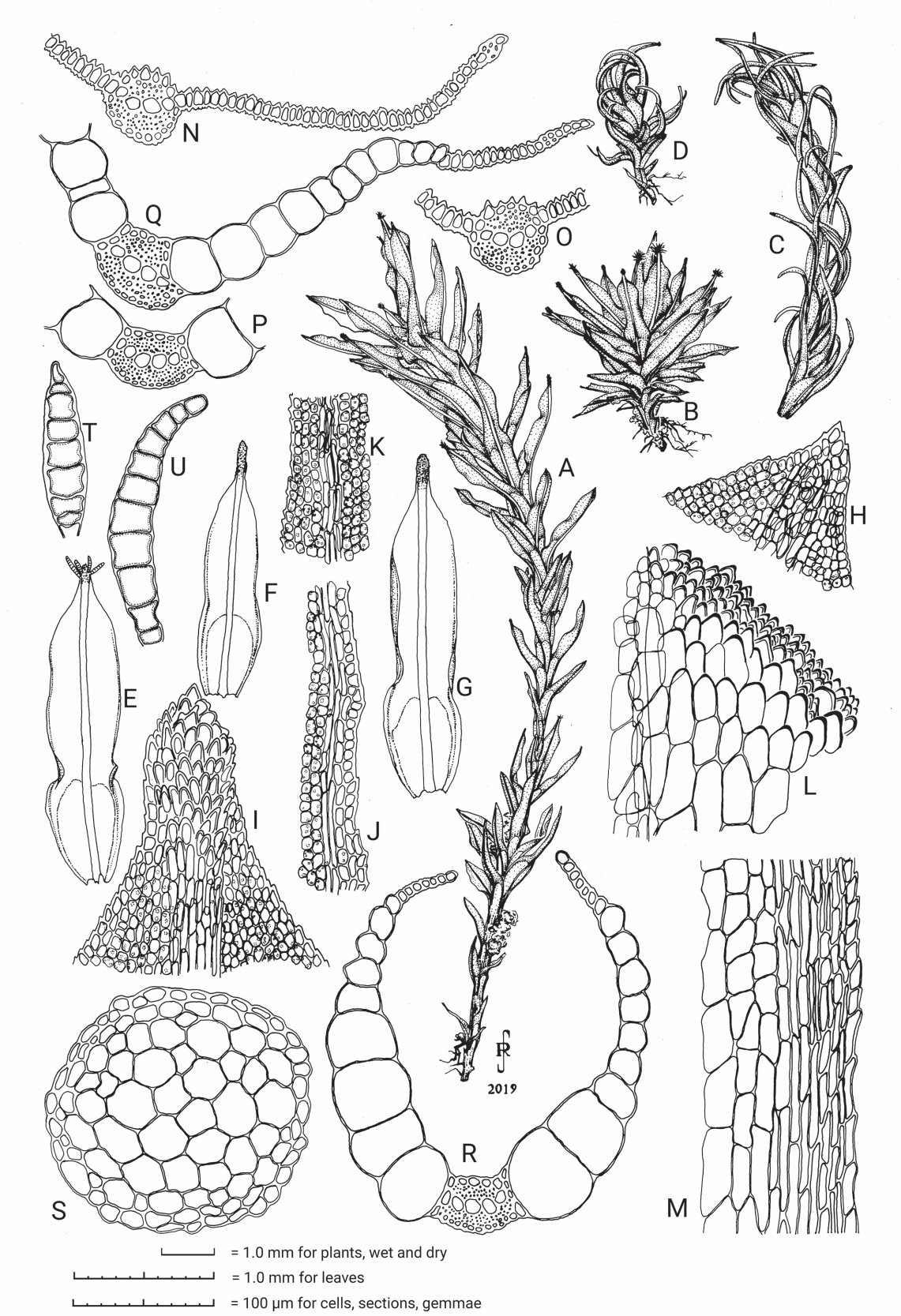

Fig. 5. *Calymperes erosum* Müll.Hal. **A, B:** Habit of plants, drawn moist. **C, D:** Habit of plants, drawn dry. **E–G:** Gemmiferous leaves. **H:** Cells of apex of non-gemmiferous leaf. **I:** Cells of apex of gemmiferous leaf. **J:** Cells of lower limb margin, with intramarginal cells. **K:** Marginal cells of upper limb, showing intramarginal hyaline cells. **L:** Mammillose cells of upper hyaline lamina and lower chlorophyllose laminal cells. **M:** Marginal cells of sheathing leaf base. **N, O:** Sections of costa and chlorophyllose lamina of upper leaf. **P–R:** Sections of costa and sheathing leaf base. **S:** Stem section. **T, U:** Gemmae. Drawn from: *W.D.Reese, I.G.Stone and A.Stone 17203.*

6. *Calymperes graeffeanum* Müll.Hal., *J. Mus. Goddefroy* 3(6): 64 (1874)

Original material: 'Upolu, as truncos Mangrove dictos.'

Type: Samoa: Upolu, *s.d.*, *Graeffe, s.n.* holotype: B (destroyed); isotypes: BM000855010!d, BM000855011!d, BM000518500!d, NY01113939!d.

Illustrations: Eddy (1990: 127), Ellis and Tan (1999: 9).

Plants small, often wiry, to about 5 mm tall; pale green to darker green, forming loose to compact tufts. Stems mostly simple, erect or curved; rhizoids brown to reddish brown. Leaves usually strongly dimorphic: non-gemmiferous leaves mostly 2–3 mm long, mostly involute or folded when moist, oblong to linear from a broadened base; margins uni- to multi-stratose, sometimes with stereids, notched to minutely irregularly denticulate or rarely ± entire, occasionally toothed at shoulders; cells of chlorophyllose lamina smooth to unipapillose abaxially, bulging mammillose adaxially; narrow rows of intramarginal cells present but confined to the leaf base, rarely reaching the leaf shoulders, sometimes indistinct; hyaline lamina broad, distinct, scalariform to rounded distally; cells of chlorophyllose lamina decurrent down margins of hyaline lamina, becoming ± hyaline, smooth and rectangular towards the base; gemmiferous leaves usually narrow and erect, the gemma receptacle often well-developed and spoon-shaped, occasionally reduced or lacking and forming only an indistinct receptacle, not completely enclosing the gemmiferous apex of the costa although chlorophyllose lamina usually continuous as a narrow band forming a rounded or truncate leaf tip. Gemmae common, glossy, red to reddish green. Sporophytes not seen in Australian collections. (Fig. 6)

Diagnostic characters: *Calymperes graeffeanum* is similar to *C. boulayi*, but the gemma receptacles of the former are narrower and the upper leaf margin is usually bordered and at least bistratose. *Calymperes motleyi* and *C. tenerum* are also similar to *C. graeffeanum*, particularly in the absence of gemmiferous leaves, but they lack differentiated intramarginal cells in the leaf base. The distal margins of the hyaline lamina in *C. graeffeanum* are broader and rounder to scalariform distally, rather than truncate as in *C. motleyi* and *C. tenerum*. The leaf shoulders are often ± toothed in *C. graeffeanum*.

Distribution: In Australia known from Northern Territory and east Queensland from Cape York as far south as near Proserpine (Fig. 16.6). Elsewhere widespread from Cameroon (Western Central Africa), the Seychelles, India, Sri Lanka, tropical Asia, Malesia, the Philippines, Papua New Guinea, Micronesia and Polynesia. Grows on tree trunks, logs and boulders in complex mesophyll vine forests, and on mangrove trunks; mostly at or near sea level, but up to about 500 m altitude.

Note: The leaf shoulder is often indistinct in Australian material of *C. graeffeanum* we have seen, and the apex of gemmiferous leaves has a broader laminal area. However, without further investigation we prefer to maintain this species in the Australian flora.

Selected specimens seen: Queensland: Whitsunday: Hayward Gully, Conway National Park, 1 Jul 2014, *A.J.Franks AJF1407002* (BRI AQ0910162); Cassowary Coast: Boulder Creek, north of Mt Tyson, west of Alligator's Nest, near Tully, 18 Nov 2014, *D.A.Meagher and A. Cairns WT-462* (BRI AQ1019058).

Etymology: After Swiss naturalist Eduard Heinrich Graeffe (1833–1916), who collected the type.

Typification: According to annotations on BM000518500 and BM000855010, the type was collected from the trunk of a mangrove, as stated in the protologue. The holotype was undoubtedly destroyed in 1943 when the Berlin herbarium was hit by a bomb. As far as we know, a lectotype has not been selected.

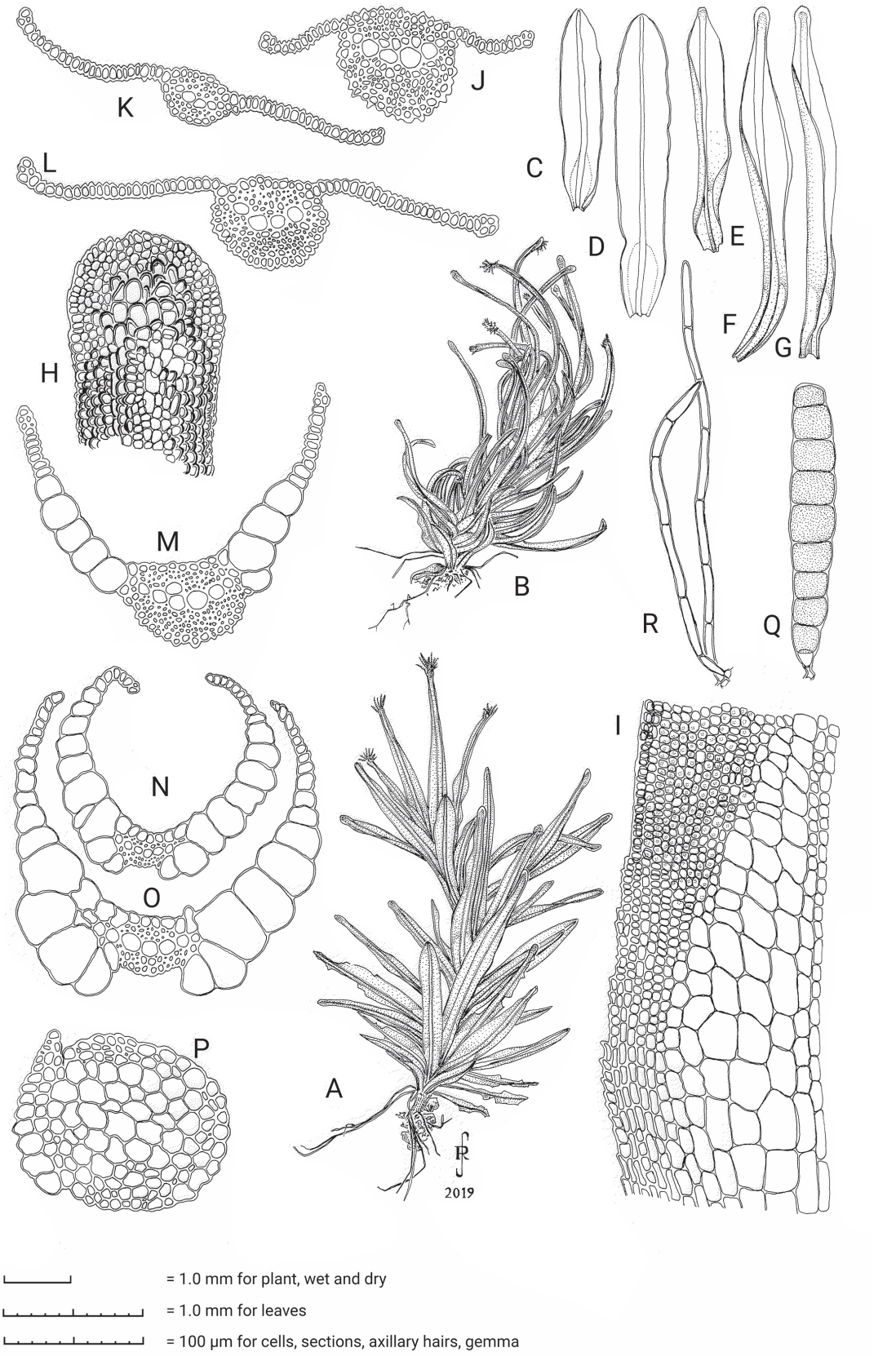

Fig. 6. *Calymperes graeffeanum* Müll.Hal. **A:** Habit of plant, drawn moist. **B:** Habit of plant, drawn dry. **C, D:** Non-gemmiferous leaves. **E–G:** Gemmiferous leaves. **H:** Cells of leaf apex, abaxial view. **I:** Cells of leaf shoulder region. **J:** Section of gemmiferous leaf near apex. **K, L:** Sections of chlorophyllose lamina and costa. **M–O:** Sections of sheathing leaf base and costa. **P:** Stem section. **Q:** Gemma. **R:** Axillary hairs. Drawn from: *A.J.Franks AJF1407002*.

7. *Calymperes lonchophyllum* Schwägr., *Sp. Musc. Frond., Suppl.* 1, 2: 333 (1816)

Original material: 'In arboribus Gujanae legit clar. Richard.'

Type: French Guiana, 1781–1789, *L.C.Richard s.n.* lectotype: G00042891 not seen, designated by Ellis (2011); isolectotypes: E00226214!d, PC0148308!d.

Illustrations: Eddy (1990: 97), Reese and Lin (1991: 327), Akiyama and Reese (1992: 204), Ellis and Tan (1999: 11).

Plants light to dark green, forming low tangled mats; ± stemless; rhizoids light brown. Leaves monomorphic, ribbon-like from an ovate sheathing base, 8–25 mm long, sometimes more, limb 0.3–0.5 mm wide, sheathing base about 1.5 mm wide, straight when moist; margins of limb thickened, mostly variously double-toothed above; margins of sheath entire, or serrate from 1 or more marginal rows of delicate protruding hyaline cells; cells of limb transversely elongate, smooth, often irregularly bistratose; intramarginal cells lacking; hyaline lamina large, occupying most of the sheath, sharply delimited distally from chlorophyllose lamina cells which are decurrent down costa and margins, rounded to ± scalariform distally; costa strong, smooth, percurrent, in limb covered by an epidermal layer of cells similar to lamina cells, in section plane adaxially, keeled or strongly convex abaxially, with 1(–2) series of guide cells; intramarginal cells, at least in lower part of sheath, 2–4 cells wide, bordered on outside by 1–2 rows of thin-walled hyaline ± denticulate cells. Gemmae reddish, sparse, inconspicuous, ± warty, borne adaxially on leaf tips, occasionally forming on abaxial and adaxial gemmipars along costa and margins of older leaves. Sporophytes not seen in Australian material. (Fig. 7)

Diagnostic characters: The linear leaves with transversely elongate lamina cells should readily distinguish *Calymperes lonchophyllum* from all other Australian species except *C. serratum*. In *C. serratum*, the distal cells of the hyaline lamina gradually blend with the adjacent chlorophyllose cells of the limb, in contrast to the sharply demarcated hyaline lamina of *C. lonchophyllum*. The medial and distal cells of the axillary hairs are also much shorter in *C. serratum* than those of *C. lonchophyllium*. Rhizoids of *C. serratum* are dark red-purple while those of *C. lonchophyllum* are brown.

Distribution: In Australia, known from north-eastern Queensland, from Iron Range to Cardwell (Fig. 16.7). A widespread pantropical species known from the Caribbean, Central America, northern South America, Andaman Islands, India, Sri Lanka, Thailand, China, Malesia, the Philippines, Papua New Guinea, east to Polynesia and Fiji.

Habitat: Grows on tree trunks and rock, mainly along streams, to about 600 m altitude.

Selected specimen seen: Queensland: Cassowary Coast: Along 'Sullivan's Track', about 6 km WNW of Cardwell, 22 July 1987, *W.D.Reese, I.G.Stone and A.Stone 17179* (BRI AQ1019726).

Etymology: Greek *lonche* (spearhead) + *phyllon* (leaf), referring to the shape of the leaves.

Typification: E00226214, not cited by Ellis (2011), is undoubtedly an isotype as it is annotated 'Cayennes (a cl. Richard)' and its appearance agrees with that of the other isotype. (Cayenne is the capital of French Guiana.)

Fig. 7. *Calymperes lonchophyllum* Schwägr. **A:** Habit of plant, drawn moist. **B:** Habit of plant, drawn dry. **C:** Leaf. **D, E:** Cells of leaf apex. **F, G:** Cells of leaf shoulder region. **H, I:** Sections of chlorophyllose lamina and costa. **J, K:** Cells of sheathing leaf base. **L:** Stem section. **M:** Leaf base with hyaline lamina. **N:** Leaf apex with gemmae. **O:** Gemma. **P:** Leaf base with paraphysis-like axillary hairs. **Q:** Axillary hairs. Drawn from: *W.D.Reese, I.G.Stone and A.Stone 17179*.

8. *Calymperes molucccense* Schwägr., *Spec. Musc. Frond., Suppl. 2*, 1(2): 99. pl. 127 (1824)

Original material: 'In insula Rauwack Moluccensi lignis adnatum legit clar. Gaudichaud iu itinere cum navarcho Freycinet instituto.'

Type: Indonesia, Muluku Islands, Rauwack Island, 1823, *C.Gaudichaud-Beaupré s.n.* lectotype: G00042890, not seen, designated by Ellis (2011); ?isolectotypes: BM000518167!d, BM000851801!d, BM000851798!d, BM000851786!d, M000851791!d.

Illustrations: Eddy (1990: 123), Reese and Lin (1991: 339), Ellis and Tan (1999: 12).

Plants 5–15 mm tall, in dark green to reddish brown tufts; shoots densely foliate. Stems erect or curved, simple or forked; rhizoids brown to reddish brown. Leaves wide-spreading from the sheathing base when moist; non-gemmiferous stem leaves oblong-lingulate from a broader base, shoulders often flaring, to 3.5 mm long; gemmiferous leaves to 4.0 mm long, with a narrowing limb ± obsolete in the acumen then abruptly flaring to form a receptacle around the gemmiferous tip of costa. Leaf margins slightly thickened above, entire to weakly denticulate; cells of limb thick-walled with rounded lumens, smooth to distinctly papillose abaxially, bulging to sharply mammillose-papillose adaxially; intramarginal cell rows distinct and pellucid at leaf shoulders, 2–4 cells wide and 1–3 cells intralaminal, continuing into limb but becoming ill-defined, reduced to a 1–2 stratose marginal or 1 cell intralaminal band of yellowish, slightly elongated cells which may run into the leaf acumen or end well below the apex. Distal margins of the hyaline lamina rounded or truncate distally, ending level with or just below the leaf shoulder level in an abrupt and almost transverse line. Gemmae glossy, reddish to dark red or blackish, often in hairbrush-like tufts adaxially at tips of gemmiferous leaves. Sporophytes rarely found in Australia. Calyptra about 3.5 mm long. Seta yellow to red, 2–3 mm long. Capsule about 2 mm long; operculum about 0.75 mm long. Spores 24–40 μm in diameter, surface finely granular. (Fig. 8)

Diagnostic characters: The stiff texture and dark colour of *Calymperes moluccense* are distinctive, as are the gemmiferous leaves with the gemmae occurring in hairbrush-like tufts and usually borne in a distinct receptacle. A common and often abundant species at low altitudes, particularly along the coast. Plants of *C. graeffeanum* and *C. motleyi* can look very similar, but in those species the intramarginal cells are confined to the leaf base. *Calymperes crassinerve* is also similar, but there the leaves are crispate and the gemmiferous leaves have the brush-like tufts of gemmae folded down to the adaxial leaf surface when dry. In *C. moluccense* the gemmiferous leaf tips remain erect when dry, not downfolded at the tips.

Calymperes moluccense also appears to be closely related to *C. palisotii* Schwägr., (not been reported from Australia), and Schwägrichen (1824) himself suggested that it might be a variety of that species. Reese and Mohammed (1985) and Reese *et al.* (1986) treated *C. moluccense* as a synonym of *C. palisotii*, but Ellis (1987) showed that the two species are consistently different and represent separate taxa, the latter species having proboscid, not broadly hooded, gemmiferous leaf apices, and the lamina cells are thinner-walled with rounded mammillae, not sharply conical-mammillate as in *C. moluccense*. *Calymperes palisotii* also lacks the band of thick-walled cells bordering the inner cells of the hyaline lamina, and the intramarginal cells are often discontinuous in the shoulder and lower limb (Ellis 1987, Eddy 1990).

Distribution: Occurs in Australia from Goode Island and Cape York south to Proserpine with a single record from the Northern Territory (Fig. 16.8). Elsewhere known from Andaman Islands, Sri Lanka, south east Asia, China (Hainan Island), Malesia and Oceania.

Habitat: Grows on trees and rocks, in mangrove swamps, from sea level to about 600 m altitude.

Selected specimens seen: Queensland: Cairns: Cape Tribulation National Park, Dubuji Boardwalk, Myall Creek, 12 May 2013, *D.A.Meagher & A.Cairns WT-182* (BRI AQ1016930); Cassowary Coast: Attie Creek Falls, Cardwell Forest Drive, north west of Cardwell, 1 Sept 2013, *D.A.Meagher & A.Cairns WT-224* (BRI AQ1016954).

Etymology: After the Muluku (Molucca) islands, where the type was collected.

Typification: Ellis (2011) noted the confusion about possible isolectotypes and syntypes, and therefore listed only potential isolectotypes cited above and some possible syntypes in G and BM. He did not cite G00050657!d, from Hb. Delessert, which was collected by Gauidichaud on Rawauck and is labelled as type of *Calymperes moluccense*. It was annotated as lectotype of *C. moluccense* by Zen Iwatsuki in 1967 (although he did not publish it as such) but subsequently identified as *C. palisotii* by Bill Reese in 1984. Several other possible isolectotypes or syntypes were not cited by Ellis (2011) (G00050658!d, BM000675192!d, BM000851785!d, BM000851786!d, PC0148327!d, PC0148323!d, PC0148324!d, PC0148325!d, NY01113971!d, MO5912319!d, MO407685!d) but it is beyond the scope of this paper to assess their status.

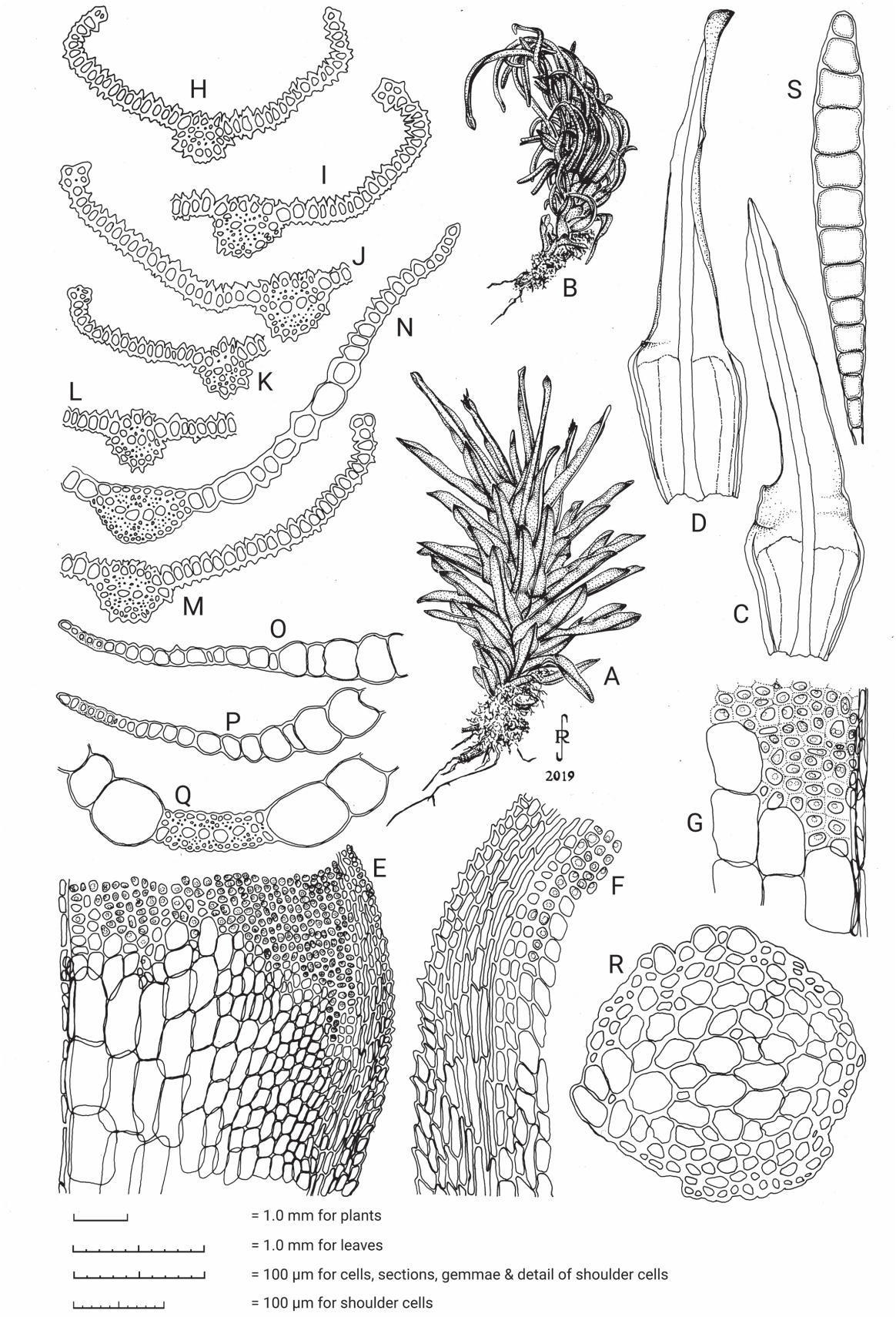

Fig. 8. *Calymperes moluccense* Schwägr. **A:** Habit of plant, drawn moist. **B:** Habit of plant, drawn dry. **C:** Non-gemmiferous stem leaf. **D:** Gemmiferous leaf. **E:** Cells of leaf shoulder. **F:** Marginal cells of sheathing base of leaf. **G:** Upper cells of the lamina and lower chlorophyllous lamina at costa. **H–M:** Sections of chlorophyllose lamina and costa. **N:** Leaf section of distal margin of hyaline lamina. **O, P:** Sections of leaf margin of sheathing base of leaf. **Q:** Costal section near insertion. **R:** Stem section. **S:** Gemma. Drawn from: *D.A.Meagher & A.Cairns WT-182.*

9. *Calymperes motleyi* Mitt. ex Dozy & Molk., *Bryol. Jav.* 1: 48 (1856)

Original material: 'Habitat insulam Borneo, Laboean, prope Tanjong Koebong legit Motley, communicavit Mitten.'

Type: Indonesia: Borneo, *s.d.,* [1852], leg. *J. Motley s.n.* holotype: L-0060052, not seen, designated by Touw (2013); isotypes: NY01113972!d, ?MICH525294!d.

Illustrations: Eddy (1990: 129), Ellis and Tan (1999: 12).

Plants small, compact, dark green, to 8 mm tall, mostly shorter; in thin to dense tufts. Stems erect, to 8 mm tall, mostly shorter; rhizoids reddish brown. Leaves closely set, erect-spreading, folded and curved when moist, oblong or bluntly pointed above the base, not or only slightly dimorphic, lingulate to spathulate, without flared shoulders, upper limb typically wider than sheathing base, 1.0–2.0 mm long, 0.5–0.7 mm wide in mid limb, apex abruptly narrowed to a broadly rounded-mucronate tip; intramarginal cells lacking; margins entire, unistratose; cells of chlorophyllose lamina smooth to bluntly papillose, the surfaces convex, cells comparatively large, pellucid, (5–)8–10(–12) μm, walls moderately thickened, strongly convex adaxially, moderately so abaxially but with a median papilla or mammilla over lumen; chlorophyllose lamina cells in shoulder region and bordering the hyaline lamina with pronounced corner thickenings; hyaline lamina distinct, narrow, truncate to rounded distally, sometimes obliquely rounded; gemmiferous leaves constricted at the tips; costa strong, ending shortly below the apex, mostly bearing clusters of gemmae on adaxial tips; in section, costa covered by a layer of chlorophyllose cells, with about 4 large guide cells, adaxial and abaxial bands of substereid cells. Gemmae small, green to reddish, in brush-like tufts adaxially on costa tip; when dry, leaf tip usually not strongly infolded to adaxial surface as in *C. crassinerve*. Sporophytes rare. Calyptra about 2 mm long, spirally ribbed or folded. Seta reddish-yellow, 1–2 mm long. Capsules 0.5–1.0 mm long, shortly exserted; operculum about 0.5 mm long. Spores 26–31 μm in diameter, finely granular. (Fig. 9)

Diagnostic characters: *Calymperes motleyi* is easily recognised when bearing gemmiferous leaves by the characteristic shouldered appearance of the gemmiferous leaf tips with the apex of the costa included within the margins of the leaf tip. The species is similar to *C. crassinerve*, but there the leaves have rows of intramarginal cells, and also similar to *C. tenerum*, but that species has gemmae borne all around the leaf tip.

Distribution: In Australia, known from Northern Territory, Melville Island, north-eastern Queensland from Cape York as far south as Mackay (Fig. 16.9). Elsewhere, scattered through Seychelles, India, Thailand, Malesia, Polynesia, Oceania.

Habitat: Grows on trees, palms, rarely on dead wood and rock, mainly in low coastal and near-coastal forests, including mangroves, but up to about 400 m altitude.

Selected specimens seen: Queensland: Mackay: Kommo Toera Trail, Keeley's Road, Slade Point, about 6.5 km north of Mackay, 20 June 2016, *A.J.Franks AJF1606019* (BRI AQ0799544); Cairns: Lake Placid Tourist Park, Caravonica, 5 Mar 2016, *D.A.Meagher & A.Cairns WT-675* (BRI AQ1019827).

Etymology: After English engineer and naturalist James Motley (1822–1859), who collected the type in Borneo.

Typification: Touw (2013) noted that Menzel and Schultze-Motel (1990) cited a collection in NY (NY01113972!d, herb. Mitten) as the holotype, but he considered this to be an error. Len Ellis (in litt.) noted that Dozy and Molkenboer seem to have used Mitten's manuscript at the head of their account, which probably led Menzel and Schultze-Motel to state 'Mitt. in Dozy & Molk.,' as the authorship and therefore to consider the original material to be in Mitten's herbarium in NY rather than L.

MICH525294 seems to be a segregate of the NY material, but closer inspection is needed. The date of collection cited above is taken from NY01113972.

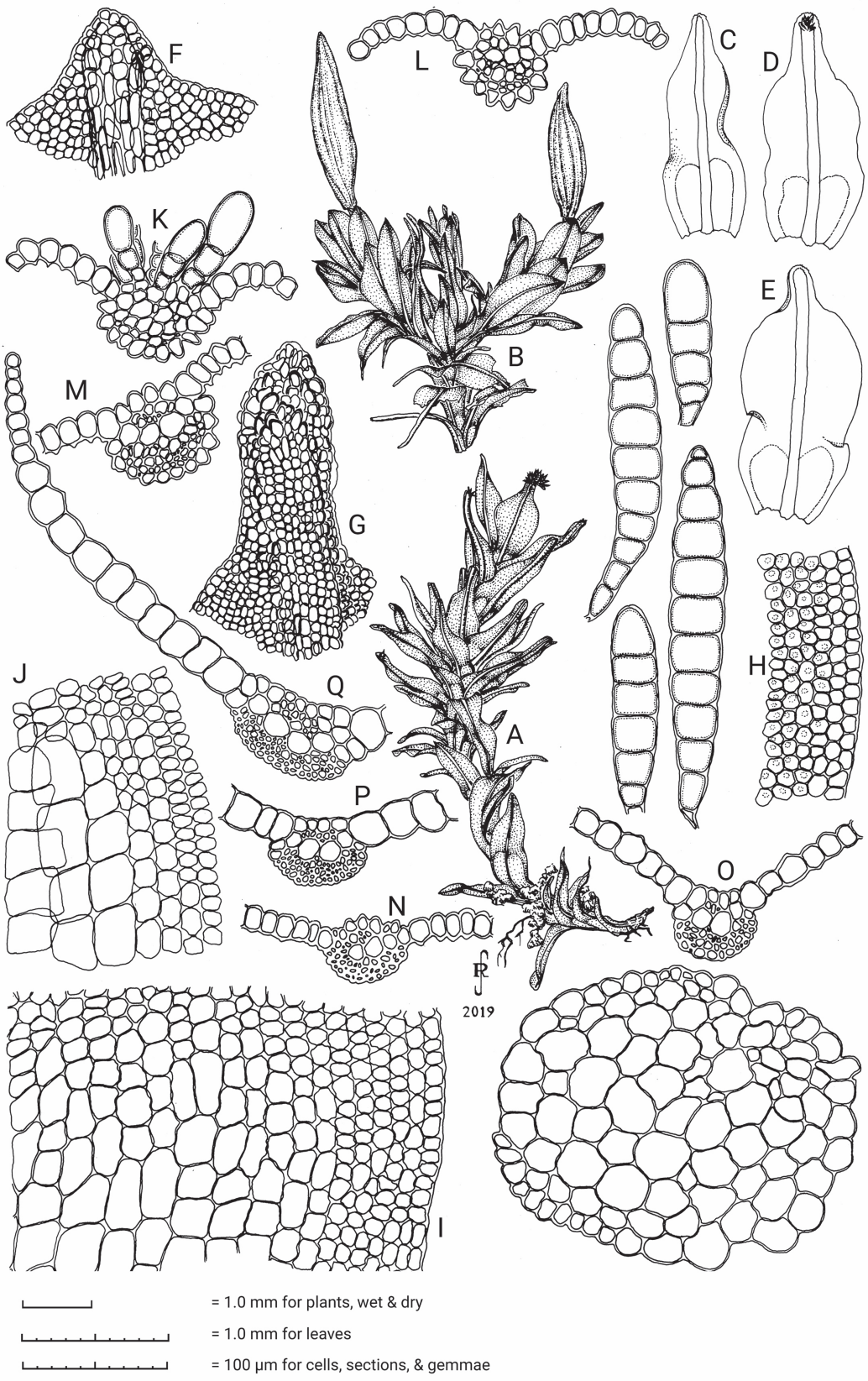

Fig. 9. *Calymperes motleyi* Dozy & Molk. **A:** Gemmiferous plant, drawn moist. **B:** Plant with sporophytes, drawn moist. **C:** Non-gemmiferous leaf. **D, E:** Gemmiferous leaves. **F:** Cells of non-gemmiferous leaf apex. **G:** Cells of apex of gemmiferous leaf, adaxial view. **H:** Mid limb marginal cells. **I, J:** Cells of distal end of hyaline lamina and lower chlorophyllose lamina. **K:** Section of apex of costa and leaf, with gemmae. **L, M:** Sections of chlorophyllose lamina and costa. **N–Q:** Sections of costa and hyaline lamina in sheathing base of leaf. **R:** Stem section. **Q:** Gemmae. Drawn from: *D.A.Meagher & A.Cairns WT-675* (A–E, H, I, K–Q); *A.J.Franks AJF1606019* (F, G, J).

10. *Calymperes porrectum* Mitt., *J. Linn. Soc. Bot.* 10: 172 (1868)

Original material: 'Hab. Tutuila, on bark. No. 10.'

Type: Samoa: Tutuila, Oct 1831, leg. *T. Powell 10.* Holotype: NY01114069!d; isotypes: BM000663161!d, MICH525295!d.

Illustrations: Eddy (1990: 106, 107), Ellis and Tan (1999: 14).

Plants robust, pale green, darker in older parts, 1.5–3.0 cm or taller, forming compact cushions or tufts. Stems mostly simple, erect; rhizoids reddish brown. Leaves strongly dimorphic; non-gemmiferous leaves translucent, oblong-lanceolate, recurved-squarrose from a broad sheathing base, 3–5 mm long, about 1.0 mm wide at shoulders; spreading-ascending when moist, patent when dry, from an ovate base narrowed above to a triangular-lanceolate acute apex; margins coarsely toothed with large single teeth; cells of chlorophyllose lamina smooth, thick-walled with rounded lumens, about 10 μm diameter but variable in size; intramarginal cells prominent, in leaf shoulders 6–10 cells intralaminal, continuing into the limb as a distinct intramarginal border extending to mid limb or beyond, composed of 2–3 rows of elongated, pellucid, thick-walled cells 2(–4) cells thick, the walls sinuose or pitted, reducing to an irregular series of elongated cells above. Costa of non-gemmiferous leaves smooth, in section with 4–8 guide cells sharply delimited from adaxial and abaxial stereid bands, with a differentiated epidermal layer. Gemmiferous leaves larger than non-gemmiferous leaves, stiffly erect from a broadly ovate to lanceolate sheathing base, 4–8 mm long, abruptly narrowing above the sheathing base to a subulate limb where the lamina narrows to meet the margin, the limb ending in a broader, rounded to spathulate, gemmiferous tip. Costa of gemmiferous leaves stouter than that of non-gemmiferous leaves, smooth adaxially, hispid abaxially with conically projecting cells and in section with a zone of substereids adjacent to the guide cells. Hyaline lamina large, ending at about shoulder level in an abrupt ± transverse demarcation line, or apices rounded and ± scalariform; gemmae reddish, tightly clustered on tips of gemmiferous leaves; gemma receptacle not developed. Sporophytes not seen. (Fig. 10)

Diagnostic characters: The strongly dimorphic leaves, non-gemmiferous leaves that are patent when dry and gemmiferous leaves stiffly erect wet or dry, make for ready identification. Microscopically, the coarsely toothed non-gemmiferous leaves with the teeth single and mostly multicellular, smooth chlorophyllose lamina cells and prominent intramarginal cells are diagnostic. The species is also similar to *C. couguiense*, which is a smaller plant with spathulate leaves and leaf margins irregularly denticulate, not coarsely serrate.

Distribution: In Australia, known from north-eastern Northern Territory and Cape Tribulation in Queensland (Fig. 16.10). Elsewhere, known from India, Sri Lanka, Malesia, the Philippines, Papua New Guinea, Oceania to the Society Islands. First reported for Australia by Reese and Stone (1987).

Habitat: Grows on tree trunks, moist rock ledges, in vine forests, at low altitudes, with an average annual rainfall of 3000–4000 mm.

Selected specimen seen: Queensland: Cook: Cape Tribulation, Noah Creek, 24 June 1982, *I.G.Stone 19318* (MEL 2245591).

Etymology: Latin *porrectum* (spread out, extended), probably referring to the elongate stems, or possibly the patent leaves when dry.

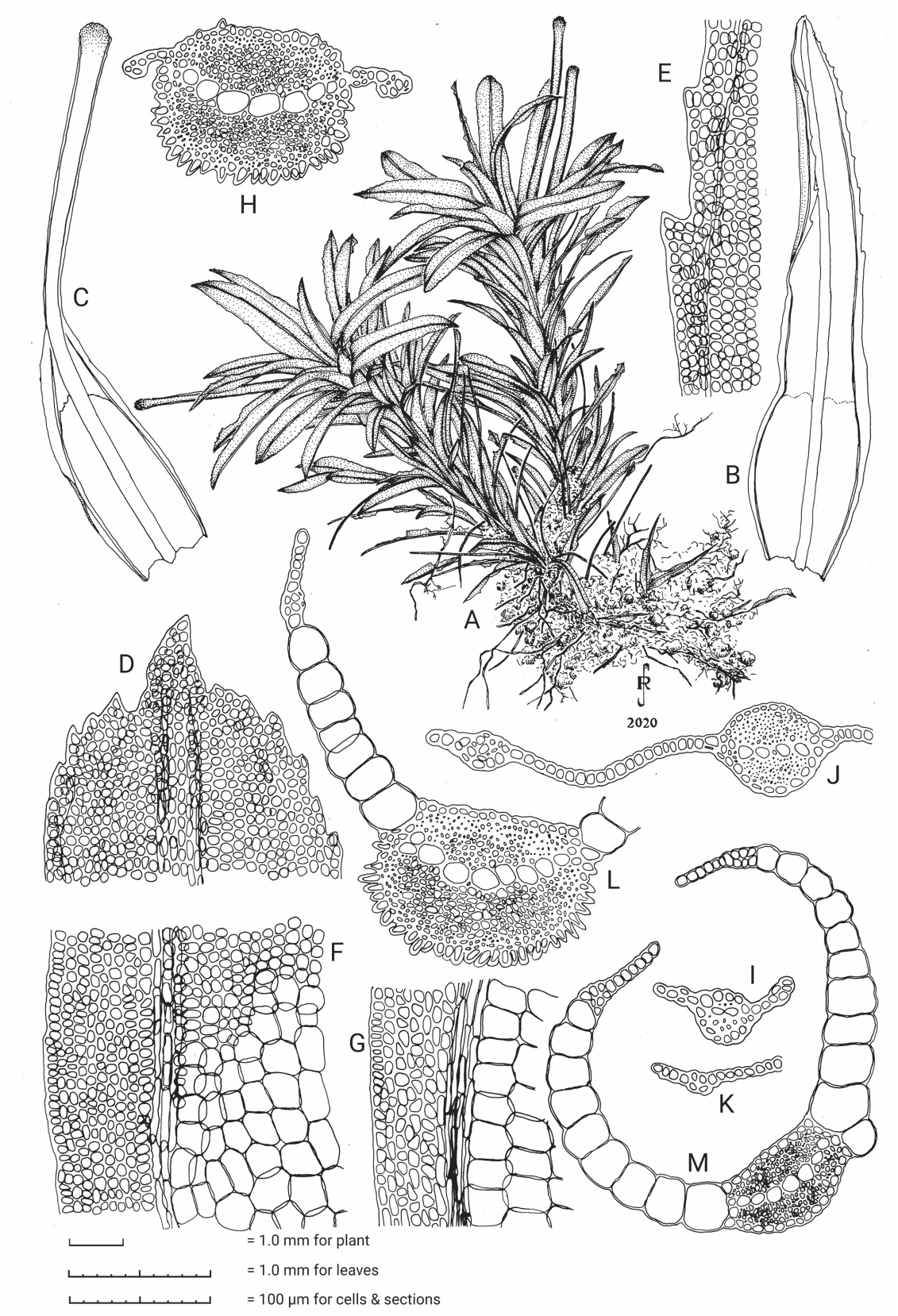

Fig. 10. *Calymperes porrectum* Mitt. **A:** Habit of plants, drawn moist. **B:** Non-gemmiferous leaf. **C:** Gemmiferous leaf. **D:** Cells of apex of non-gemmiferous leaf, abaxial view. **E:** Cells of serrate upper limb margin, with intramarginal cells. **F:** Cells of upper sheathing leaf base with intramarginal cells and hyalocysts of the hyaline lamina. **G:** Cells of lower margin of sheathing base. **H:** Section of limb of gemmiferous leaf. **I:** Section of apex of non-gemmiferous leaf. **J:** Section of limb of non-gemmiferous leaf, with intramarginal cells. **K:** Section of leaf margin with intramarginal cells. **L:** Section of sheathing base of gemmiferous leaf. **M:** Section of sheathing base of non-gemmiferous leaf. Drawn from: *I.G.Stone 19318*.

11. *Calymperes serratum* A.Braun ex Müll.Hal., *Syn. Musc. Frond.* 1: 527 (1849)

Original material: 'Patria. Java: Junghuhn.'

Type: Indonesia: Java, 1835–1849, *Junghuhn s.n.* holotype: ?B (presumed destroyed); isotypes: BM000851693!d, BM000851691!d *p.p.* (right-hand specimen only).

var. ***serratum***

Illustrations: Brotherus (1909: 379), Eddy (1990: 100, 101), Reese and Lin (1991: 330), Ellis and Tan (1999: 16).

Plants dark green to olive-green; forming low, tangled, grass-like tufts or mats. Stems erect, stemless to very short, several plants often seeming to arise from a single point source; rhizoids dark red to blackish purple; with dense tufts of elongate axillary hairs to 350–600 μm in length, the lower cells elongate rectangular, 5–10' longer than wide, median to upper cells 2–3' longer than wide. Leaves monomorphic; linear, (5–)10–15 mm long, 0.2–0.4 mm wide, ribbon-like from a short sheathing base slightly wider than the limb, slightly narrowed above the shoulders but not distinctly petiolate, straight when moist, curled when dry, margins irregularly serrate above; unistratose from the insertion to shortly above the shoulder then thickened and distinctly bordered almost to apex; borders ± trigonous in section, marginal stereome present or lacking, or a few stereids only, surrounded by chlorocysts; leaf shoulders unistratose, ± serrate by projecting cell ends; intramarginal cells in leaf sheath variable, ± distinct and up to 4 cells wide; costa percurrent or ending just below apex, ± smooth, plane adaxially, rounded-keeled abaxially, with (1–)2(–3) series of guide cells, thick stereid bands adaxially and abaxially, and an epidermal layer of lamina-like cells; lamina cells small, 5–7 μm wide, thick-walled, of variable shape, corners rounded, ± smooth; hyaline lamina variable, not clearly demarcated from chlorophyllose lamina cells, merging into chlorophyllose lamina. Gemmipars present, sparse, branching, ridged, papillose, reddish, on abaxial surface of distal lamina. Sporophytes rare. Calyptra about 4 mm long. Seta red to dark red, 4–6 mm long. Capsules emergent, about 2 mm long; operculum about 1 mm long. Spores 26–36 μm in diameter, smooth to inconspicuously granular. (Fig. 11)

Diagnostic characters: The species is similar in appearance to *Calymperes lonchophyllum* but differs in its indistinctly demarcated hyaline lamina and the short cells of the axillary hairs, although the cell length appears to be rather variable and might not be a reliable distinguishing feature. In the Australian material examined, the distinction in cell size of the axillary hairs is certainly not as clear cut as depicted by Akiyama and Reese (1992). In both *C. serratum* and *C. lonchophyllum* gemmae may occur on gemmipars along the upper margins and chlorophyllose lamina, an unusual feature in *Calymperes*, where the gemmae are usually borne at the leaf tips (Reese 2001). *Calymperes serratum* var. *subulatum* (E.B.Bartram) L.T.Ellis has relatively smaller cells in the chlorophyllose lamina, usually narrowly linear leaves, and usually longer cells in the axillary hairs (Ellis 2020). It is known from New Guinea, New Caledonia and other Pacific islands, and should be kept in mind when examining Australian material.

Distribution: In Australia, occurs in north-eastern Queensland from Windsor Tableland to Tully (Fig. 16.11). Elsewhere known scattered from tropical Africa, Sri Lanka, Thailand, China, Malesia, the Philippines, Papua New Guinea, to Polynesia, Fiji, New Caledonia.

Habitat: Grows on trees in rainforest to about 1000 m altitude.

Selected specimen seen: Queensland: Cairns: Mossman Gorge, Daintree National Park, 6 km west of Mossman. 26 Aug 1999, *H.Streimann & T.Pócs 64457* (BRI AQ0717259).

Etymology: Latin *serratum* (saw-toothed), referring to the serrated upper margins of the leaves.

Typification: BM000851693 is annoted 'Calymperes serratum n. sp. Java' in ink and 'A Braun' and 'serratum isotype' in pencil, so it is undoubtedly an isotype. BM000851692 is from Schimper's herbarium and is much more compact than the preceding specimen, so we doubt that it is an isotype. BM000851691 is from Hooker's herbarium, ex Junghuhn's herbarium ('in horto Academiae Lugduno Batavae') and is annotated 'Ins. Java legit. Dr. Fr. Junghuhn, so it too is undoubtedly an isotype, but according to a pencilled note, we think in Bill Reese's hand, only the right-hand of the two specimens on the sheet is *C. serratum*, the other being *C. lonchophyllum*. BM000518004 is in Herb. Hooker ex herb. Dozy & Molk., annotated 'Calymperes serratus A.Br.'; there is no evidence that it is type material.

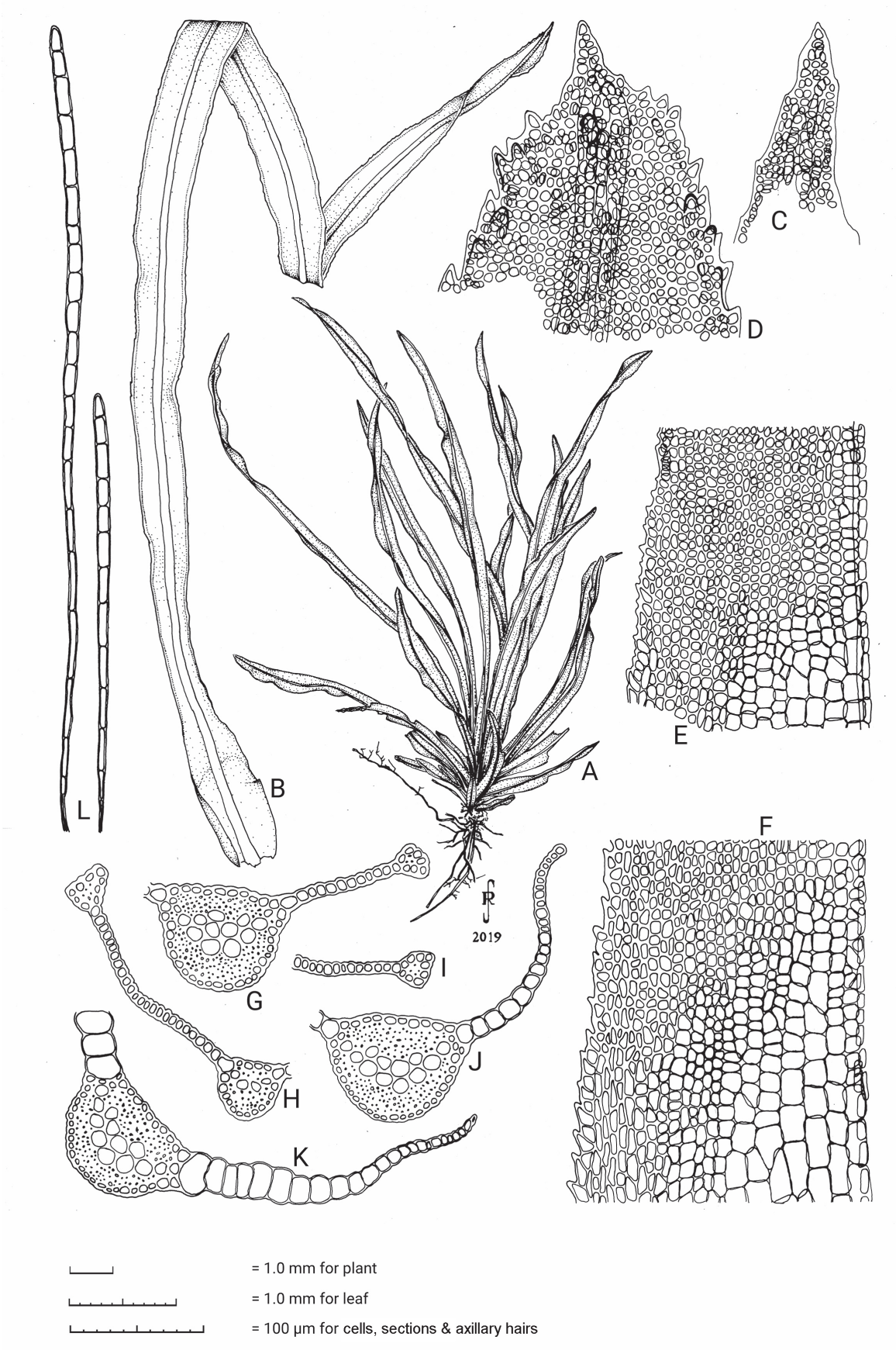

Fig. 11. *Calymperes serratum* A.Braun ex Müll.Hal. **A:** Habit of plant, drawn moist. **B:** Leaf. **C:** Cells of leaf apex, adaxial view. **D:** Cells of leaf apex, abaxial view. **E, F:** cells of upper hyaline lamina. **G, H:** Sections of chlorophyllose lamina. **I:** Section of chlorophyllose lamina margin. **J, K:** Sections of sheathing base of leaf. **L:** Axillary hairs. Drawn from: *H.Streimann and T.Pócs 64457*.

12. *Calymperes strictifolium* (Mitt.) G.Roth, *Hedwigia* 51: 127 (1911). *Syrrhopodon strictifolius* Mitt., *Fl. Vit.* 388 (1873)

Original material: 'Samoan Islands, Tutuila (Powell!).'

Type: Samoa, Tutuila, c. 1831, *T. Powell s.n.* holotype (mounted on 2 sheets): NY (NY01127836!d / NY01127837!d); isotypes: PC0100852!d; BM000663170!d.

Illustrations: Eddy (1990: 112), Reese and Lin (1991: 338), Ellis and Tan (1999: 17).

Description: Plants to about 10 mm tall, occasionally more, glaucous green to brownish green, in dense wiry tufts. Stems erect, simple; rhizoids brown. Leaves essentially monomorphic, erect flexuose when moist, little altered but slightly incurved when dry; most or all leaves gemmiferous, oblong-ligulate to broadly linear above a broadened ovoid base, 3–4(–5) mm long, 0.3–0.55 mm wide in sheathing base and 0.2–0.3 mm wide in limb, ending abruptly in a rounded-truncate tip; margins thickened, strongly warty-rugulose with multicellular nodules of chlorophyllose cells; intramarginal cells ± distinct in sheath and base of limb, 2–4 cells wide and 3–5 cells intralaminar, weakly developed and ± hidden in thickened upper leaf margin; cells of limb small, 5–6 μm wide, ovoid-rectangular, walls moderately thickened, inconspicuously pluripapillose; hyaline lamina large, sharply defined, scalariform. Costa stout, warty-rugulose with multicellular excrescences like those of leaf margins, in section with 4–6 guide cells, thick adaxial and abaxial stereid bands and epidermal layer of chlorophyllose cells. Gemmae borne at apex of leaf on adaxial side of costa. Sporophytes not seen in Australian material. (Fig. 12)

Diagnostic characters: The warty, rugose leaf margins and costa are unique and, together with the scalariform hyaline lamina with ± inflated hyalocysts, particularly distally, make the species readily identifiable, even with only a hand lens.

Distribution: North-eastern Queensland from Innisfail to Cairns (Fig. 16.12). Elsewhere known from China, Taiwan, Malesia, the Philippines, Papua New Guinea, French Polynesia, New Caledonia. Eddy (1990) noted that the species is widely scattered in its range but uncommon generally, although locally frequent in New Guinea and adjacent islands.

Habitat: Grows on tree trunks, rotting wood and rocks in wet to very wet mesophyll vine forest, typically in densely shaded, moist sites below 750 m altitude.

Selected specimen seen: Queensland: Cairns: near Cairns, 1 Aug 1890, *C.J. Wild s.n.* (BRI AQ0719287).

Etymology: Latin *strictus* (drawn together, tight) + *folium* (leaf), referring to the densely tufted leaves.

Typification: NY01127836 and NY01127837 (which are on a single sheet) and BM000663170 are stamped 'loaned to Dr. G. Roth for drawing for the Aussereuropaischen Laubmoose' and 'type'. NY001127836 appears to be a single stem sent to E.B. Bartram and subsequently returned.

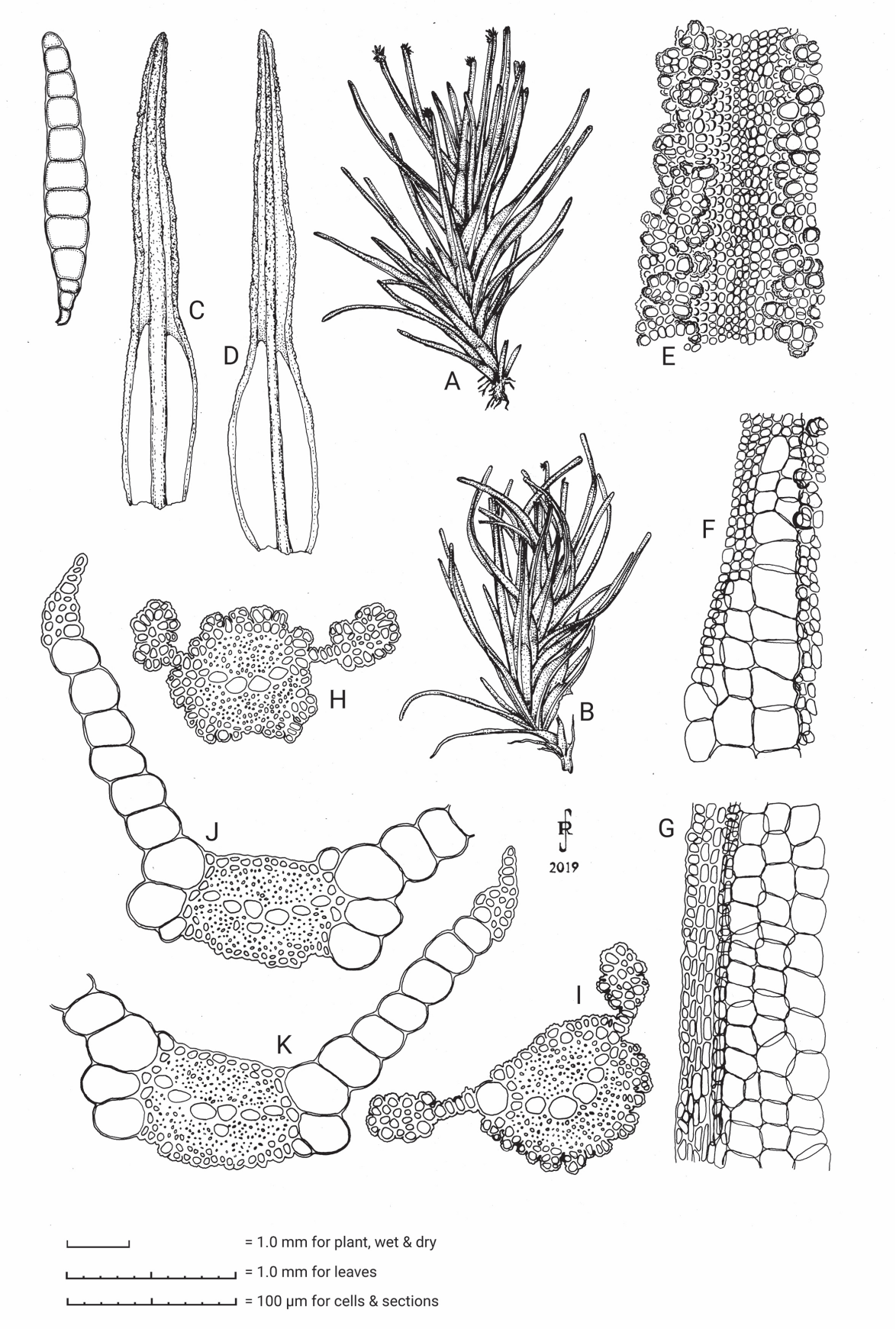

Fig. 12. *Calymperes strictifolium* (Mitt.) Roth. **A:** Habit of plant, drawn moist. **B:** Habit of plant, drawn dry. **C, D:** Leaves, abaxial view. **E:** Cells of leaf margin (left), chlorophyllose lamina and costa (right) of limb. **F:** Distal end of hyaline lamina. **G:** Cells of sheathing base with intramarginal cells. **H, I:** Sections of chlorophyllose lamina. **J, K:** Sections of sheathing base of leaf. **L:** Gemma. Drawn from: *C.J.Wild s.n.*

13. *Calymperes subintegrum* Broth., *Bot. Tidsskr.* 24: 119 (1901)

Original material: 'Lem Dan, on rocks and trees near the Sea.'

Type: Thailand: Koh Chang (island), Lem Dan, 7 Jan 1900, *J. Schmidt 23*. holotype: HBR, not seen; isotypes: BM000518251!d, NY01114094!d, PC0148379!d.

Illustrations: Eddy (1990: 110, as *C. schmidtii*), Ellis and Tan (1999: 17).

Plants small, to about 0.5 mm tall, mostly dark green to brownish, forming loose to compact turfs. Stems erect, simple; rhizoids brown. Leaves strongly dimorphic; non-gemmiferous stem leaves lingulate to spathulate, 2–3 mm long, 0.5–0.6 mm wide, spreading, sheathing base narrower than limb; apex rounded-obtuse; straight and involute when moist, loosely uncinate to curled-contorted when dry; margins weakly dentate or entire, often inflexed; with distinct intramarginal cells innon-gemmiferous leaves, the intramarginal cells marginal or almost so, in the shoulders 1(–3) cells intramarginal, bounded on outer edge by a row of rectangular, pellucid cells which may project as serrations; chlorophyllose lamina cells ± quadrate, thin-walled, 6–8 μm wide, conically prominent on adaxial side, papillose on abaxial side. Gemmiferous leaves to 6 mm long, stiffly erect from an ovate sheathing base, the limb linear; costa thick, with chlorophyllose lamina narrow to the spathulate apex. Costa of non-gemmiferous leaves narrow, roughened by conically projecting epidermal cells, in section with 4–5 guide cells, adaxial and abaxial stereid bands; costa of gemmiferous leaves stronger, hispid on both surfaces with conical to sub-spiniform epidermal cells; guide cells in irregular rows with adaxial and abaxial thin-walled substereids. Gemmae arising from the adaxial surface of the leaf apex. Sporophytes not seen in Australian material. (Fig. 13)

Diagnostic characters: Similar in general appearance to *Calymperes couguiense* but differs in its smaller stature and in having the delicate hyaline marginal cells forming teeth at mid leaf and below, particularly in the shoulder region, although these cells may not be present on all leaves. Reese *et al*. (1986), Menzel and Schutze-Motel (1990) and Eddy (1990) treated *C. subintegrum* as a synonym of *C. schmidtii* Broth. However, Ellis (1991) showed that the two were different species.

Distribution: In Australia, known in north-eastern Queensland from the Paluma Range, north of Townsville, to the Daintree River (Fig. 16.13). Elsewhere known from Sri Lanka, Thailand, China (Hainan Island), Malesia, Philippines, Polynesia, New Caledonia.

Habitat: Grows on soil and rock, sometimes on tree bases and rotting wood in rainforests and wet sclerophyll forest up to about 850 m.

Selected specimens seen: Queensland: Cairns: Graham Range communication towers access road, Bramston Beach, 07 Nov 2014, *A.J.Franks AJF1411003* (BRI AQ0910205); Cassowary Coast: Weir on Boulder Creek, uphill from gate at Alligator's Nest, north of Tully, 7 May 2014, *D.A.Meagher & A.Cairns WT-352* (BRI AQ1017016).

Etymology: Latin *sub* (incompletely) + *integrum* (whole, entire), referring to the subentire leaves.

Typification: The collection number and date are taken from the isotypes. NY01114094 is annotated 'Koh Chang, Klong Majum' and the collecting number 23 is included, indicating that it is also an isotype.

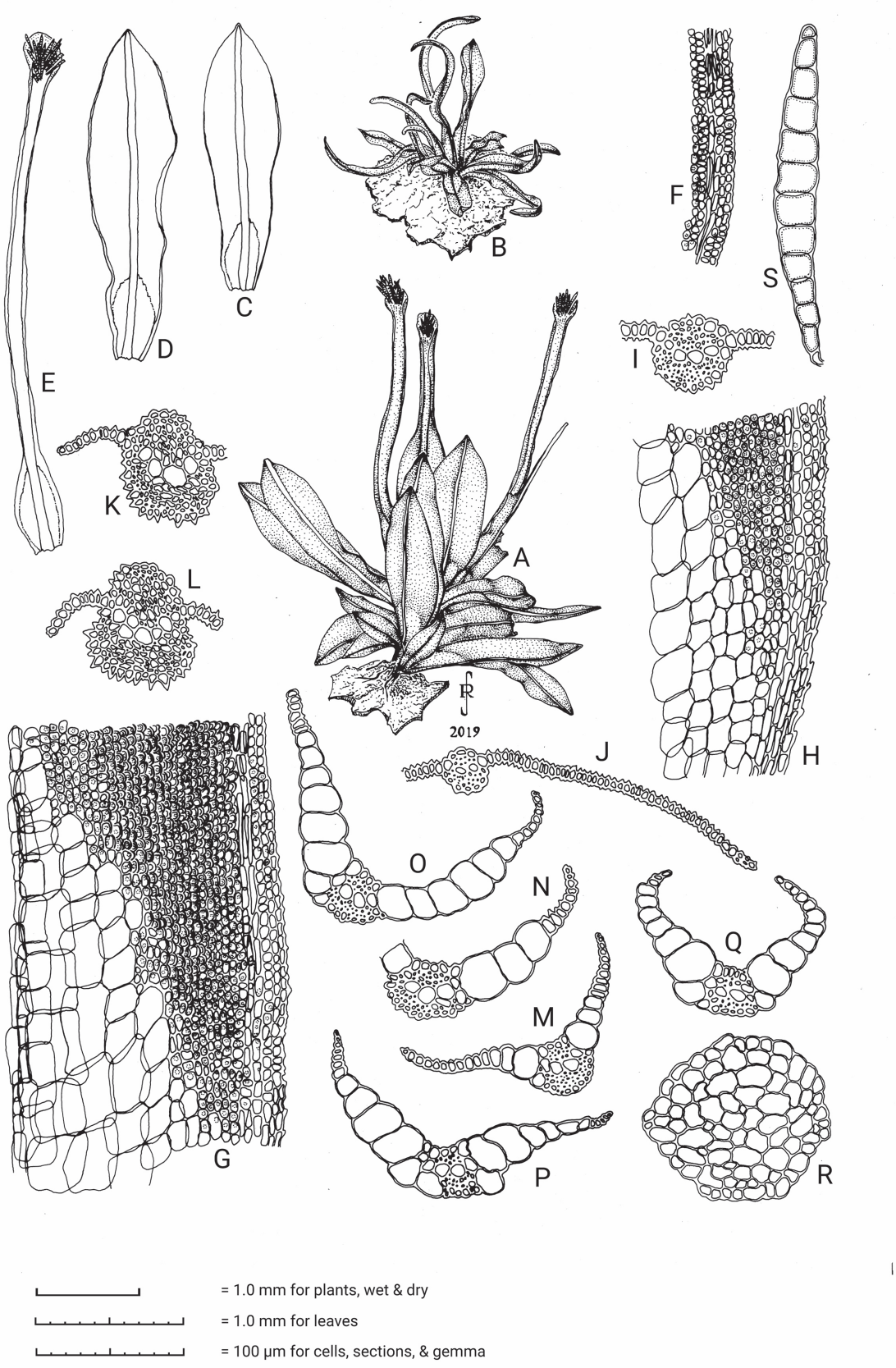

Fig. 13. *Calymperes subintegrum* (Mitt.) G.Roth. **A:** Habit of plant, drawn moist. **B:** Habit of plant, drawn dry. **C, D:** Non-gemmiferous leaves. **E:** Gemmiferous leaf. **F:** Cells of mid lamina margin of non-gemmiferous leaf, with intramarginal cells. **G:** Cells of hyaline lamina and leaf margin in shoulder region of leaf base. **H:** Marginal cells of lower sheathing base of leaf. **I:** Section of costa of non-gemmiferous leaf. **J:** Section of non-gemmiferous leaf with intramarginal cells. **K, L:** Sections of limb of gemmiferous leaf. **M–Q:** Sections of sheathing leaf base. **R:** Stem section. **S:** Gemma. Drawn from: *A.J.Franks AJF1411003*.

14. *Calymperes taitense* (Sull.) Mitt., *J. Linn. Soc., Bot.* 10: 172 (1868). *Syrrhopodon taitensis* Sull., *U.S. Expl. Exped., Musci* 18, pl. 4A (1859)

Original material: 'Hab. Tahiti, Society Islands.'

Type: French Polynesia: Tahiti, Aug–Oct 1839, *W. Sullivant s.n.* holotype: FH01146523, not seen; isotypes: BM000851987!d, BM000518493!d, BM000518474!d.

Illustrations: Sullivant (1859: plate 4A), Eddy (1990: 113), Reese and Lin (1991: 336), Ellis and Tan (1999: 19).

Plants robust, dark green to blackish, 10–25 mm tall, forming loose tufts or mats. Stems uncinate, simple or forked, often sprawling; rhizoids brown to reddish brown or dark purple. Leaves ± uniform, spreading ascending when moist, loosely contorted-curled when dry, linear with ± parallel sides in limb from a slightly broader base, 3.5–7.0 mm long, 0.35–0.5 mm wide in limb, abruptly narrowed to a rounded-obtuse to mucronate or proboscid apex; margins thickened, often conspicuously toothed above, rounded-triangular in section, without an internal stereome; leaf shoulder with distinct intramarginal cells, pellucid, 2–4 cells wide, continuing as a broad unistratose band in the sheathing base; hyaline lamina sharply delimited, distal margins ± rounded scalariform, with the lamina shortly decurrent down the costa, upper margin irregular, often with files of hyaline cells extending upwards, interlocking with the cells of the chlorophyllose lamina. Chlorocysts small, irregularly rounded, about 5 μm wide in upper limb, slightly larger near hyaline lamina, smooth abaxially, rounded-mammillose adaxially. Costa smooth or nearly so, ending below the apex; in section with 5–10 guide cells and occasional secondary guide cells adaxially, adaxial and abaxial stereid bands and an epidermal layer of chlorophyllose lamina cells. Gemmiferous leaves with a well-developed proboscis with narrowly revolute margins; gemmae borne adaxially on leaf tips. Sporophytes not seen in Australian collections. (Fig. 14)

Diagnostic characters: *Calymperes taitense* is very distinctive by its large size, dark colour and (in Australia) its mostly streamside habitat. Confusion may occur with *C. afzelii*, but that is a smaller species with acutely mammillose chlorophyllose lamina cells, and the distal margins of the hyaline lamina in *C. afzelii* are scalariform and do not interlock with the cells of the chlorophyllose lamina. Australian plants agree in leaf length with specimens described by Ellis and Tan (1999) from the Philippines, although Sullivant gave the length as 4–5 lines (8.5–10.5 mm).

Distribution: In Australia, known from north-eastern Queensland from Bloomfield River south to Ingham (Fig. 16.14). Elsewhere known from Central West Africa, Comoros Islands, Madagascar, Réunion, Andaman Islands, Seychelles, southeast and east Asia, China, Philippines, Malesia, Polynesia, Oceania.

Habitat: Grows on tree trunks and boulders in rainforests, particularly along streams, up to about 1000 m.

Selected specimen seen: Queensland: Cassowary Coast: Mount Mackay State Forest, near Tully. 22 June 1984, *I.G.Stone 22511* (BRI AQ0873537).

Etymology: Taiti + *–ense* (coming from), after Taiti (Tahiti), the location of the type collection. The epithet is often rendered incorrectly as *tahitense*. However, it is based on the legitimate spelling Taiti that was in common use in the 19th century, and therefore must not be altered.

Typification: This species was not listed by Sayre (1984) in her index to William Sullivant's moss herbarium, but it is listed in the online database of the Harvard University herbaria (HUH 2020), which indicates that it was identified as the holotype by Bill Reese. The US Exploring Expedition was at Tahiti from 13 August to 10 October 1939. BM000851987, ex herb. Bescherelle, is annotated 'U.S. Ex. Ex. Wilkes 1838–1842' and '*Syrrhopodon Taitense* Sp. Nov. Tahiti, Society Islands' and is annotated as an isotype by Bill Reese, although the collector is not stated. BM000518493 is a fragment taken from BM000851987 by Zen Iwatsuki for drawing. BM000518474 is also annotated as an isotype by Bill Reese, and the other annotations are identical to BM000851987.

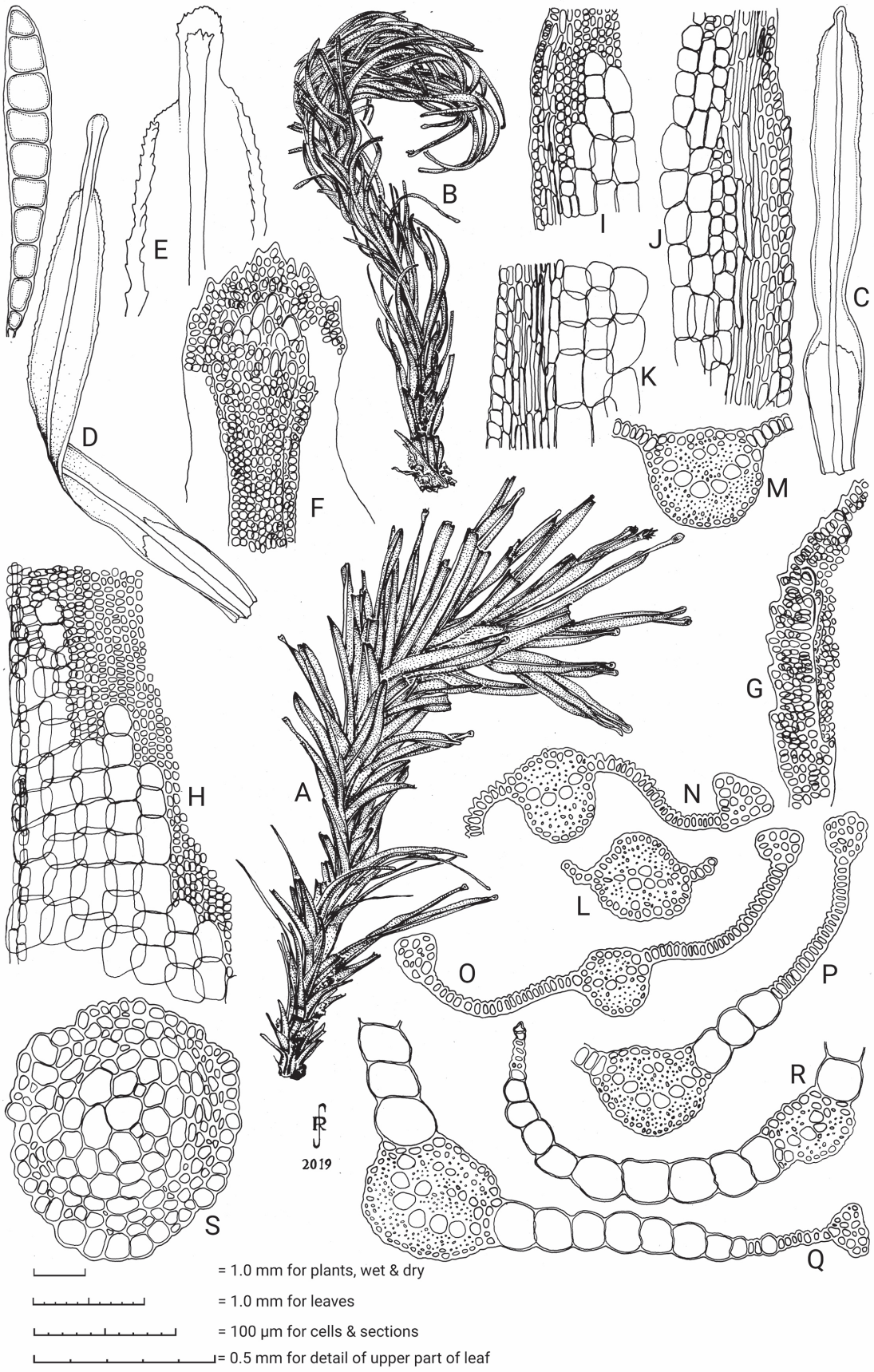

Fig. 14. *Calymperes taitense* (Sull.) Mitt. **A:** Habit of plant, drawn moist. **B:** Habit of plant, drawn dry. **C, D:** Leaves with proboscid apices. **E:** Leaf apex, adaxial view. **F:** Cells of leaf apex, adaxial view. **G:** Cells of leaf margin near apex. **H:** Cells of hyaline lamina. **I–K:** Marginal cells of hyaline lamina. **L:** Section of leaf proboscis. **M–O:** Sections of costa and chlorophyllose lamina. **P–R:** Sections of hyaline lamina. **S:** Stem section. **T:** Gemma. Drawn from: *I.G.Stone 22511*.

15. *Calymperes tenerum* Müll.Hal., *Linnaea* 37: 174 (1872)

Original material: 'Patria. Bengalia, Calcutta ad truncos arborum inter Lejeuniam: S. Kurz legit.'

Type: India: Kolkata, 1864–1873, *S. Kurz s.n.* holotype: ?B (presumably destroyed); isotype: BM000518466!d.

Illustrations: Eddy (1990: fig. 249); Reese and Lin (1991: fig. 53–58); Ellis and Tan (1999: fig. 10m–q).

Plants small, mostly less than 5 mm tall, pale to dark green, in thin to compact turfs. Leaves almost uniform, oblong to lanceolate, lingulate, (1.5–)2–3 mm long, not or scarcely widened in sheathing base; straight when moist, involute and curved and often ± secund when dry; leaf margins unistratose to slightly thickened with 1–2 rows bistratose, entire, composed of small quadrate chlorophyllose cells along margins of sheathing base, the cells with marked corner thickenings; chlorophyllose lamina cells thin-walled, 6–8 μm wide in upper limb, smooth or typically papillose abaxially with a small central papilla, bulging convex adaxially; intramarginal cells lacking; hyaline lamina small, narrow, rectangular, truncate or rounded distally, with 4–7 rows of large hyaline cells; gemmiferous leaves similar to non-gemmiferous leaves but costa shortly excurrent as a proboscis which bears gemmae all around the tip; gemmae smooth, green, clavate-fusiform, in pale globular clusters at leaf tips. Sporophytes infrequent in Australian collections. Calyptra 2.5–3.0 mm long, the base not or scarcely exceeding tips of perichaetial leaves. Seta reddish-yellow, short, 1.5–2.0 mm long. Capsule emergent, about 2.0 mm long; operculum 0.5 mm long. Spores 30–52 μm in diameter, finely granular or ± smooth. (Fig. 15)

Diagnostic characters: The small size of the plants, absence of intramarginal cells, narrow and truncate hyaline lamina, ± quadrate marginal cells in the leaf sheath, and dense globular clusters of pale gemmae borne all around the tip of the costa are diagnostic. Even when the gemmae are shed, the naked excurrent tip of the costa of gemmiferous leaves is distinctive. The only other species in Australia bearing gemmae all around a naked excurrent costa tip is *Calymperes erosum*, but in that species the leaves have rows of intramarginal cells. There is some similarity to *C. graeffeanum* and *C. motleyi*, but both have gemmae only on the adaxial surface of the gemmiferous leaf tips. If gemmiferous leaves are lacking, the hyaline lamina in *C. graeffeanum* is broader and has a scalariform apex, rather than a truncate apex as in *C. motleyi* and *C. tenerum*, and the leaf shoulders of *C. graeffeanum* are often somewhat toothed. *C. graeffeanum* also has row of intramarginal cells in the leaf base. Non-gemmiferous plants of *C. motleyi* and *C. tenerum* without sporophytes and gemmiferous plants lacking gemmae are almost indistinguishable, but such plants are very uncommon.

Distribution: In Australia, known from the Kimberley region of Western Australia, the northern Northern Territory, and north-eastern Queensland from Cape York to north of Rockhampton (Fig. 16.15). Elsewhere a pantropical species widespread around coastal regions of tropical Asia, lowland Malesia.

Habitat: Grows on trees, including mangroves, palms and shrubs, primarily in low coastal vegetation, but also inland, to about 500 m altitude.

Selected specimens seen: Queensland: South Kennedy: Yuibera Trail on way to Hidden Valley, Cape Hillsborough National Park, 03 July 2014, *A.J.Franks AJF1407033* (BRI AQ0910247); Cassowary Coast: Planted shoreline vegetation, Cardwell foreshore, 19 Sept 2012, *D.A.Meagher & A.Cairns WT-098A* (BRI AQ1016583).

Etymology: Latin *tenerum* (thin), referring to the narrow cells of the leaf lamina.

Typification: The holotype was probably destroyed in the bombing of the Berlin museum in 1943. BM000518466 is ex herb. Hampe and has annotations in ink that agree with the protologue. It is annotated as an isotype by Bill Reese.

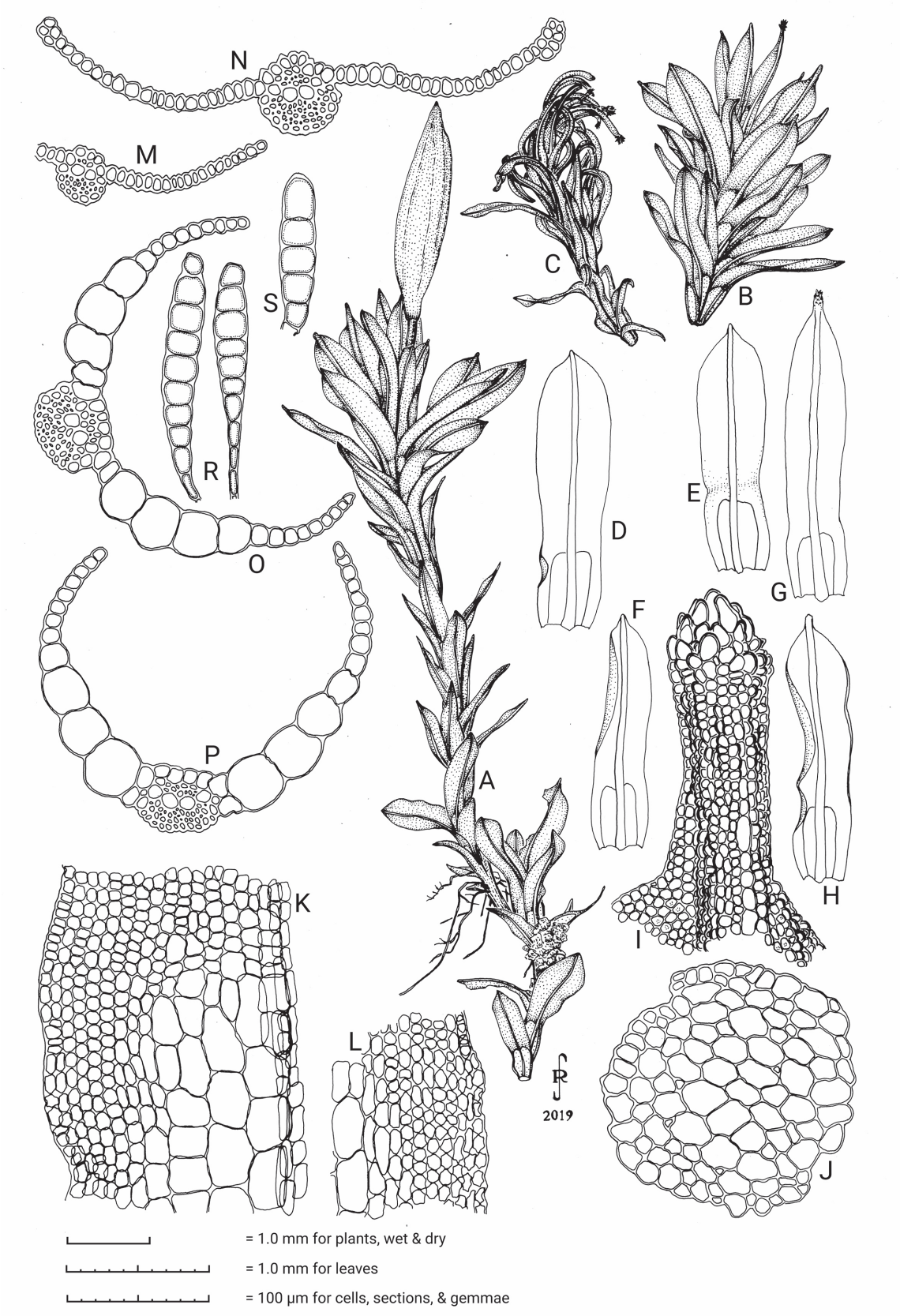

Fig. 15. *Calymperes tenerum* Müll.Hal. **A:** Habit of plant with sporophyte, drawn moist. **B:** Gemmiferous plant, drawn moist. **C:** Gemmiferous plant, drawn dry. **D-F:** Non-gemmiferous leaves. **G, H:** Gemmiferous leaves. **I:** Cells of leaf apex, abaxial view. **J:** Cross-section of stem. **K:** Upper cells of hyaline lamina. **L:** Cells of margin of leaf sheath. **M, N:** Sections of chlorophyllose lamina. **O, P:** Sections of sheathing leaf base. **Q:** Stem section. **R, S:** Gemmae. Drawn from: *A.J.Franks AJF1407033*.

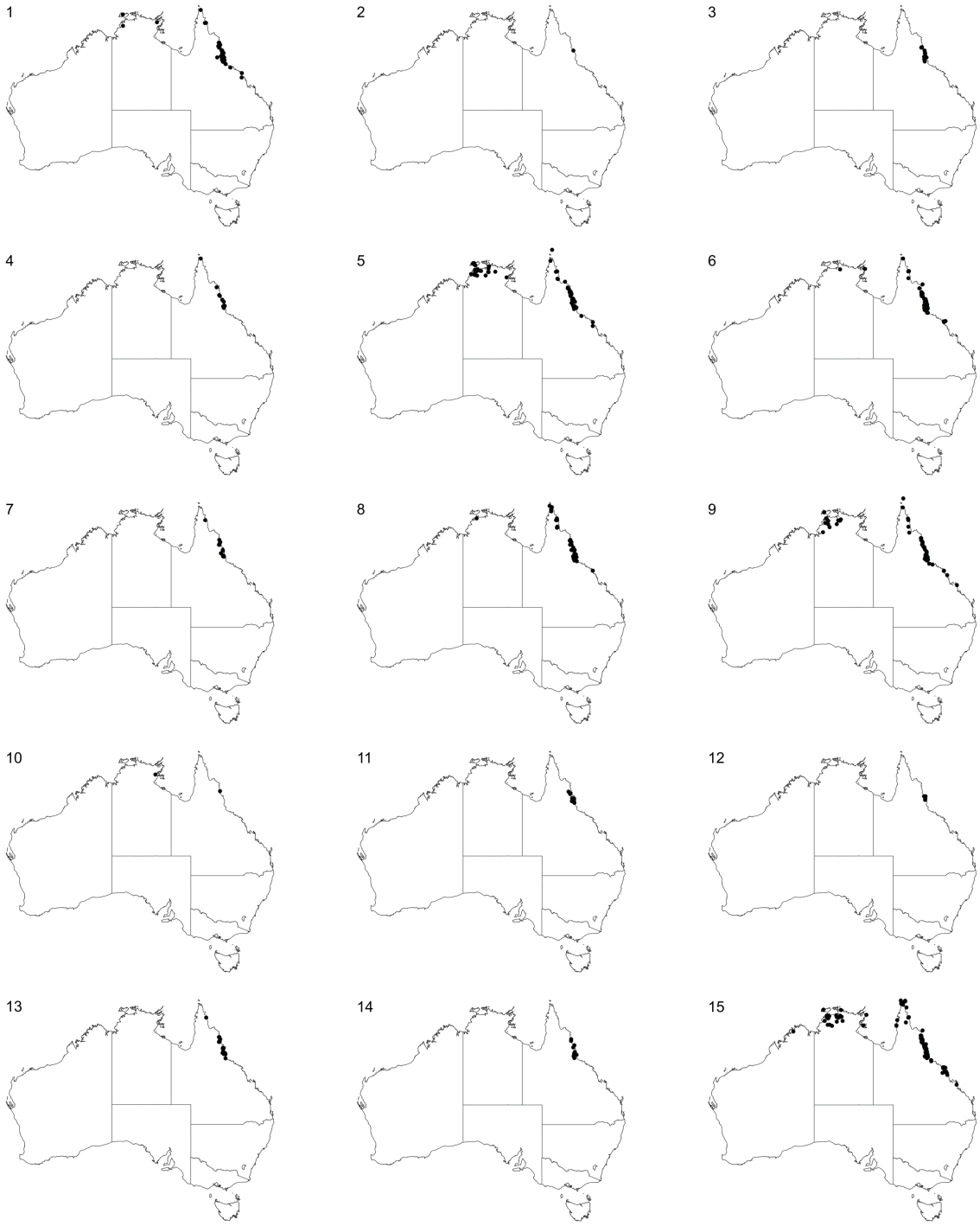

Fig. 16. Known distributions of *Calymperes* species in Australia. 1. *Calymperes afzelii*. 2. *Calymperes boulayi*. 3. *Calymperes couguiense*. 4. *Calymperes crassinerve*. 5. *Calymperes erosum*. 6. *Calymperes graeffeanum*. 7. *Calymperes lonchophyllum*. 8. *Calymperes moluccense*. 9. *Calymperes motley*. 10. *Calymperes porrectum*. 11. *Calymperes serratum*. 12. *Calymperes strictifolium*. 13. *Calymperes subintegrum*. 14. *Calymperes taitense*. 15. *Calymperes tenerum*.

Acknowledgments

We thank the curators of bryophytes at MEL, MELU and CANB for loans of specimens, and BRI for access to specimens. Digital images of specimens were accessed vis JSTOR Global Plants (plants.jstor.org) and the C. V. Starr Virtual Herbarium at the New York Botanical Garden (www.sweetgum.nybg.org/science/vh). We also thank Sarah Xu for annotating and digitising the figures.

References

Akiyama H, Reese WD (1992) Taxonomic studies of mosses of Seram and Ambon (Moluccas, East Malesia) collected by Indonesian-Japanese botanical expeditions. VI. Calymperaceae. *Acta Phytotaxonomica et Geobotanica* 43: 111–119.

Brotherus V (1909) Specieller Teil. In: Engler A & Prantl K, *Die natürlichen Pflanzenfamilien* 1(3): 277–700. https://www.biodiversitylibrary.org/item/56488#page/289/mode/1up

Cairns A, Seppelt RD, Meagher DA, Franks A (2021) The family Calymperaceae (Bryophyta) in Australia. Part 2: The genera *Arthrocormus*, *Exostratum* and *Leucophanes*. *Telopea* 24: 253–266. https://dx.doi.org/10.7751/telopea15013

Eddy A (1990) *A handbook of Malesian mosses. Volume. 2. Leucobryaceae to Buxbaumiaceae*. Natural History Museum Publications: London.

Edwards SR (1980) A revision of west tropical African Calymperaceae. 1. Introduction and *Calymperes*. *Journal of Bryology* 11: 49–93. https://doi.org/10.1179/jbr.1980.11.1.49

Ellis LT (1987) Taxonomic notes on *Calymperes*. *Journal of Bryology* 14: 681–690. https://doi.org/10.1179/jbr.1987.14.4.681

Ellis LT (1988) Taxonomic notes on *Calymperes* II. *Journal of Bryology* 15: 127–140. https://doi.org/10.1179/jbr.1988.15.1.127

Ellis LT (1989) A taxonomic revision of *Calymperes* in southern India and neighbouring islands. *Journal of Bryology* 15: 697–732. https://doi.org/10.1179/jbr.1989.15.4.697

Ellis LT (1991) *Calymperes schmidtii* Broth. *in* J.Schmidt and *C. subintegrum* Broth. *in* J.Schmidt, two distinct species from Malesia. *Journal of Bryology* 16: 589–593. https://doi.org/10.1179/jbr.1991.16.4.589

Ellis LT (2002) The typification, defining features and geographical range of *Calymperes couguiense* Besch. (Calymperaceae, Musci). *Bulletin of the Natural History Museum London (Botany)* 32: 153–156. https://doi.org/10.1017/S0968044602000075

Ellis LT (2011) Type specimens of taxa described by C. F. Schwägrichen in the moss genera *Calymperes* and *Syrrhopodon* (Musci: Calymperaceae). *Candollea* 66: 317–329. https://doi.org/10.15553/c2011v662a8

Ellis LT (2018) Taxonomic notes on *Calymperes erosum* Müll.Hal. (Calymperaceae), *C. palisotii* Schwägr. and related West African taxa. *Journal of Bryology* 40: 333–341. https://doi.org/10.1080/03736687.2018.1478652

Ellis LT (2020) Notes on *Calymperes* subg. *Calymperes* (Calymperaceae) in the Malesian-Pacific region, with special reference to *C. subulatum* E.B.Bartram, *C. beccarii* Hampe and a new species from Borneo. *Journal of Bryology* 42: 301–305. https://doi.org/10.1080/03736687.2020.1824880

Ellis LT, Pressel S (2020) Gemmae in the Calymperaceae, and their unique form in *Calymperes* Sw. subg. *Calymperes*. *Journal of Bryology* 42: 316 –325. https://doi.org/10.1080/03736687.2020.1828672

Ellis LT, Tan BC (1999) The moss family Calymperaceae (Musci) in the Philippines. *Bulletin of the Natural History Museum. Botany series. London* 29: 1–46. https://www.biodiversitylibrary.org/item/19420#page/3/mode/1up

Hughes SJ (1971). Percurrent proliferations in fungi, algae, and mosses. *Canadian Journal of Botany* 49: 215–231. https://doi.org/10.1139/b71-037

HUH (2020). Harvard University Herbaria & Libraries. Index of botanical specimens. https://kiki.huh.harvard.edu/databases/specimen_index.html, accessed 15 December 2020.

Menzel M, Schultze-Motel W (1990) The bryophytes of Sabah (North Borneo) with special reference to the BRYOTROP transect of Mount Kinabalu. XI Calymperaceae (Bryopdsida). *Willdenowia* 19: 475–542. https://www.jstor.org/stable/3996656

Reese WD (1961) The genus *Calymperes* in the Americas. *The Bryologist* 64: 89–140. https://doi.org/10.2307/3240532

Reese WD (1993) Calymperaceae. *Flora Neotropica* 58: 1–102. https://www.jstor.org/stable/4393834

Reese WD (2001) Gemmipars in the Calymperaceae. *The Bryologist* 104: 299–302. https://doi.org/10.1639/0007-2745(2001)104[0299:GITC]2.0.CO;2

Reese WD (2007) Calymperaceae. *Flora of North America* 27: 654–662. http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=10150

Reese WD, Koponen T, Norris DH (1986) Bryophyte flora of the Huon Peninsula, Papua New Guinea. XIX. *Calymperes, Syrrhopodon* and *Mitthyridium* (Calymperes, Musci). *Acta Botanica Fennica* 133: 151–202.

Reese WD, Lin P-J (1991) A monograph of the Calymperaceae of China. *Journal of the Hattori Botanical Laboratory* 69: 323–372.

Reese WD, Mohamed H (1986) A synopsis of *Calymperes* (Musci: Calymperaceae) in Malaysia and adjacent regions. *The Bryologist* 88: 98–109. https://doi.org/10.2307/3242588

Reese WD, Stone IG (1987) New records of Australian Calymperaceae and keys to Australian species of *Calymperes, Mitthyridium,* and *Syrrhopodon*. *Journal of Bryology* 14: 487–493. https://doi.org/10.1179/jbr.1987.14.3.487

Reese WD, Stone IG (1995) The Calymperaceae of Australia. *Journal of the Hattori Botanical Laboratory* 78: 1–40. https://doi.org/10.18968/jhbl.78.0_1

Reese WD, Stone IG (2012) Australian Mosses Online. 13. Calymperaceae. (http://www.anbg.gov.au/abrs/Mosses_Online/Calymperaceae_family.pdf) (Accessed 20 September 2020).

Sayre G (1984) *Index to the moss herbarium of William Starling Sullivant (1803–1873)*. Farlow Herbarium, Harvard University, Cambridge, Massachussetts, USA.

Schwägrichen F (1824) *Species Muscorum Frondosum, Supplementum Secundum, 1(2)*. J.A. Barth: Leipzig, Paris. https://bibdigital.rjb.csic.es/records/item/9867-redirection

Seppelt RD, Meagher DA, Cairns A, Franks A (2021) The family Calymperaceae (Bryophyta) in Australia. Part 1: Introduction and key to genera. *Telopea* 24: 247–252. https://dx.doi.org/10.7751/telopea15012

Sullivant WS (1859) Musci. In Gray A (ed.) *United States Exploring Expedition during the years 1839, 1839, 1840, 1841, 1841, 1842 under the command of Charles Wilkes U.S.N. Vol. XVII. Botany. Cryptogamia. Phanerogamia of Pacific North America*. Sherman & Co.: Philadelphia, U.S.A. (pages 3–112).

Tixier P (1978) Le genre *Syrrhopodon* Schwägr. (Calymperaceae) en Indo Malaisie. *Nova Hedwigia* 29: 957–1023.

Touw A (2013) *Original specimens kept in the herbarium of Naturalis Biodiversity Center (section National Herbarium Nederland) of Asian and South American moss taxa published by F. Dozy, J.H. Molkenboer, R.B. van den Bosch and C.M. van der Sande Lacoste*. Naturalis Biodiversity Center, section NHN – Electronic Publication, updated 16 August 2013. https://repository.naturalis.nl/pub/472590

Tropicos (2021) Tropicos online database www.tropicos.org, accessed 25 January 2021.

Williams RS (1920) Calymperaceae of North America. *Bulletin of the Torrey Botanical Club* 47: 367–395.

Turland NJ, Wiersema JH, Barrie FR, Greuter W, Hawksworth DL, Herendeen PS, Knapp S, Kusber W-H, Li D-Z, Marhold K, May TW, McNeill J, Monro AK, Prado J, Price MJ, Smith GF (2018) (Eds) *International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. Regnum Vegetabile 159*. Koeltz Botanical Books: Glashutten. https://doi.org/10.12705/Code.2018

Manuscript recieved 10 Aug. 2021, accepted 18 May 2022