

Liverwort and hornwort collections of Heinar Streimann from Vanuatu

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Abstract

From the rich Vanuatu bryophyte collections of the late Heinar Streimann, 29 liverworts and one hornwort species were identified. One genus (*Schiffneriolejeunea*) and 16 species proved to be new records for the islands, 6 of them new to the whole Pacific realm.

Introduction

Vanuatu (formerly New Hebrides) is an archipelago consisting of 83 islands, with a total area of more than 12,000 km², and is part of the East Melanesian Islands hotspot. The Y-shaped archipelago extends in a length of 800 km from the 13th to the 20th latitude, south to the Tropic of Capricorn (see Fig. 1). Its nearest neighbours are the Santa Cruz Islands to the north, New Caledonia 400 km to the southwest, and the Fiji Islands about 800 km to the east (Munzinger 2009). The Vanuatu Islands are of Tertiary volcanic origin, now partly covered by Pleistocene and more recent coral limestone terraces, volcanic activity and island building continues to this day. The climate is wet tropical, receiving 4000 mm rain per year in the north to 2000 mm in the south. The precipitation is more or less seasonal with 3 months dry season in the north, to 6 months in the south. The mean annual temperature at sea level varies from 26°C in the north to 23°C in the south. Accordingly, the islands were covered by wet and mesic tropical forests, a great part of them already cut over, with the exception of smaller islands and higher mountains (Mueller-Dombois and Fosberg 1998).

Mitten (1868) published the first moss records and Stephani (1906–1917) published a good number of liverworts from the New Hebrides in his *Species Hepaticarum* and also in his publication *Hepaticae Australes* (Stephani 1914). Tixier (1973, 1974) published a further 50 liverwort species, from the collections of Royal Society Expedition in 1971. Even so, our knowledge on the bryophytes, especially on the liverworts of Vanuatu is very deficient. This is demonstrated by the fact that about half of the species in any unidentified collection prove to be new records for the islands. And if we compare this, for example, to the liverwort flora of New Caledonia, only 400 km away, the difference is even more apparent (Vitt 1991). Interestingly, the biota of the islands is more closely related to that of Fiji than it is to New Caledonia, which is only half the distance away (Chew 1975). These facts can be explained partly by their different geology, and partly by our more limited knowledge on the biota of Vanuatu.

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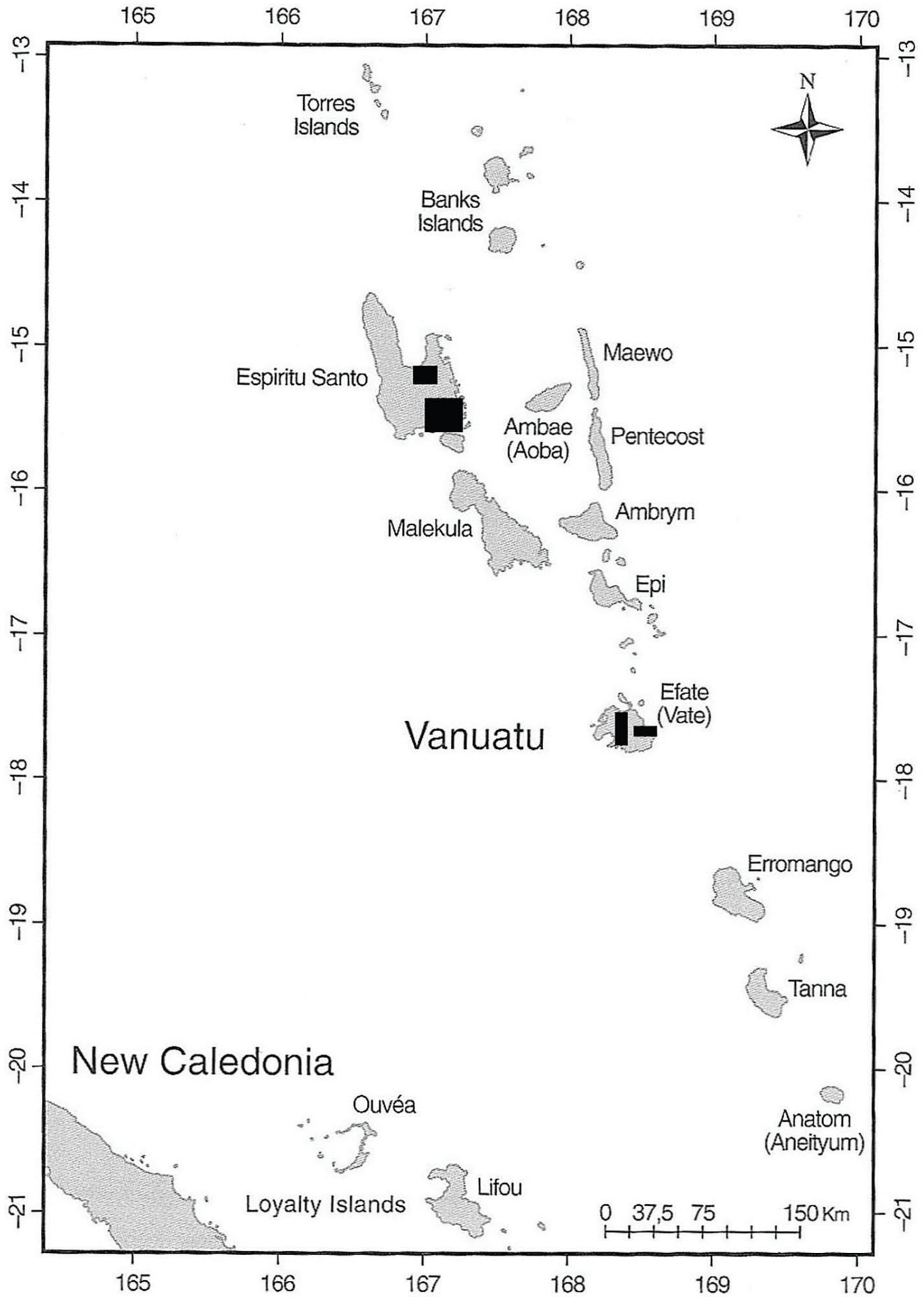


Fig.1. The collecting sites of Heinar Streimann on Vanuatu Islands (marked in black). Derived from the maps of Streimann and Reese (2001) and Munzinger (2009).

Heinar Streimann (1938–2001), was born in Estonia, then escaped to Germany, grew up and lived in Australia from 1950. He first worked in Papua New Guinea then became a well-known botanist as the curator of cryptogamic plants in the Australian National Botanic Gardens Herbarium in Canberra (CANB). He was an enthusiastic collector of bryophytes and lichens and developed the minuscule cryptogamic herbarium into the largest in the Southern Hemisphere. He also published numerous papers, mostly on the mosses and to a lesser extent on the lichens of Australia, New Guinea and the neighbouring islands (Fulwood 2001; Elix 2001). He had a plan, in cooperation with Vanuatu authorities, to investigate the imperfectly known bryoflora of these Pacific islands. He made a very effective two-week collecting trip to Vanuatu in October 1998 and returned with large number of bryophyte specimens (his collecting areas are marked on the map of fig. 1). He prepared a draft checklist of Vanuatu bryophytes (Streimann 1999) and asked me to update the Hepaticae part of the manuscript. Later he sent me large number of Vanuatu liverworts for identification. He published his first Vanuatu moss records (Streimann and Reese 2001), but his untimely death prevented him from continuing this project. Even his bulky new Catalogue of Australian Mosses, enumerating more than one thousand species, was published only after his death, in collaboration with Niels Klazenga (Streimann and Klazenga 2002).

In the meantime, the Department of Botany in the National Science Museum, Amakubo, Tsukuba, Japan, also initiated a project to explore the bryophyte flora of Vanuatu. They organized several collecting trips there and, as a result, produced a Checklist of the Mosses of Vanuatu (Higuchi 1996). This was followed by a 12-part series on the bryoflora of Vanuatu, beginning with an introduction (Higuchi 2002) with other parts mostly dealing with mosses, but also liverworts (Furuki 2002, Yamada and Hayashi 2003, Higuchi 2005) and hornworts (Hasegawa 2002).

In our herbarium (EGR), Andrea Sass-Gyarmati (2002) published the members of Ptychanthoideae subfamily of Lejeuneaceae from Streimann's collection, including a species new to science, *Caudalejeunea streimannii* Gyarmati. We intend to continue the identification of Streimann's legacy and begin with this further publication to deal with certain families from the rest of his liverwort collections. In this work, 59 specimens comprising 30 species, of which one genus and a total of 16 species proved to be new records for Vanuatu, 6 of which are new also to the Pacific realm.

List of the records

The asterisk before the species name indicates records new to Vanuatu. Two asterisks means that the genus is new for the islands, and three that they are new for the whole Pacific. The name of each species is followed by the list of localities, including elevation, latitude, longitude, a short indication of the habitat and the substrate, Streimann's collecting number and herbarium acronyms, where samples are deposited. Streimann was always accompanied by Mr. P. Ala as a local guide and co-collector. Finally, the Vanuatu and worldwide distributions are indicated.

Abbreviations used for the islands: **EF**: Efate, **ESP**: Espiritu Santo.

Abbreviations of common localities: **BBL**: Big Bay – Luganville Road, 26 km NW of Luganville, 15°19'S, 167°01'E,

380–410 m. Forest and regrowth on limestone ridge. **FDB**: Forestry Demonstration area, Butmas, 25 km NW of Luganville. 15°22'S, 167°00'E, 620 m. Tropical forest on moderate slope with *Myristica fatua* dominant. **FLA**: Forari logging area, 17 km ENE of Port Vila, 17°38'S, 168°27'E, 300 m. Lowland rainforest on broad undulating ridge. **McD**: Track to Mt McDonald, 14 km N of Port Vila, 17°36'S, 168°19'E, 450–600 m. Lowland tropical forest on narrow limestone ridge. **TAN**: Track to Mt Tanakar Plateau, Butmas, 26 km NW of Luganville, 15°22'S, 169°59'E, 700–720 m. Tropical forest on gentle limestone slopes.

ANTHOCEROTOPHYTA

1. *Folioceros appendiculatus* (Steph.) Haseg. [Anthocerotaceae] (Figs 2, 3)

ESP: Big Bay Road (near Sale River), 47 km NW of Luganville, 15°13'S, 166°52'E, 50 m. Exposed, sandy road cutting with seepage, with many globular gemmae, *H. Streimann 62711*, CANB. The mammilliform protrusion of gemma cells seems to be unusual (Fig. 3). **Distribution**: Malesian-Pacific species. Hasegawa (2002) published it under the name of *Anthoceros appendiculatus* Steph. From the same island. According to an earlier publication of Piippo (1993) the species is identical with the more widespread *Folioceros glandulosus* (Lehm. & Lindenb.) Bharadw. Based on the synonymy of Meijer (1957) and studies of the types.

MARCHANTIOPHYTA

2. *Ceratolejeunea cornuta* (Lindenb.) Schiffn. [Lejeuneaceae]

ESP: **FDB**, on branches of *Hibiscus tiliaceus*. *H. Streimann 62369 p.p.*, CANB. **EF**: **McD** on trunk. *H. Streimann 63219 p.p.* CANB. **Distribution**: It is known from Vanuatu, Aoka Island, under the name of *Ceratolejeunea maritima* (Spruce) Steph. (Müller et al. 1983). According to my opinion *Ceratolejeunea cornuta* is a Pantropical species, hardly distinguishable from *Ceratolejeunea belangeriana* (Pócs 2011), which is known from Madagascar to the Pacific islands.

3. **Cheilolejeunea trapezia* (Nees) Kachroo & R.M.Schust. [Lejeuneaceae]

ESP: **BBL** On semi-exposed *Macaranga* stem. *H. Streimann 62272 p.p.*, CANB, EGR. **EF**: **McD**, *H. Streimann 63219 p.p.* CANB. **Distribution**: Palaeotropical species rare in Africa and widespread in Indomalaya and the Pacific (Pócs et al. 2019).

4. *Chiastocaulon dendroides* (Nees) Carl. [Plagiochilaceae]

EF: **McD**, on shaded tree trunk. *H. Streimann 63302*, CANB; **ESP**: **TAN**, On shaded vine. *H. Streimann 62620*, CANB, EGR; **FDB**, *H. Streimann 62456*, CANB. **Distribution**: In Vanuatu only known from Nanua Lava Island. Widespread from Southeast Asia to Fiji and Tahiti (Inoue 1984; Renner et al. 2016).

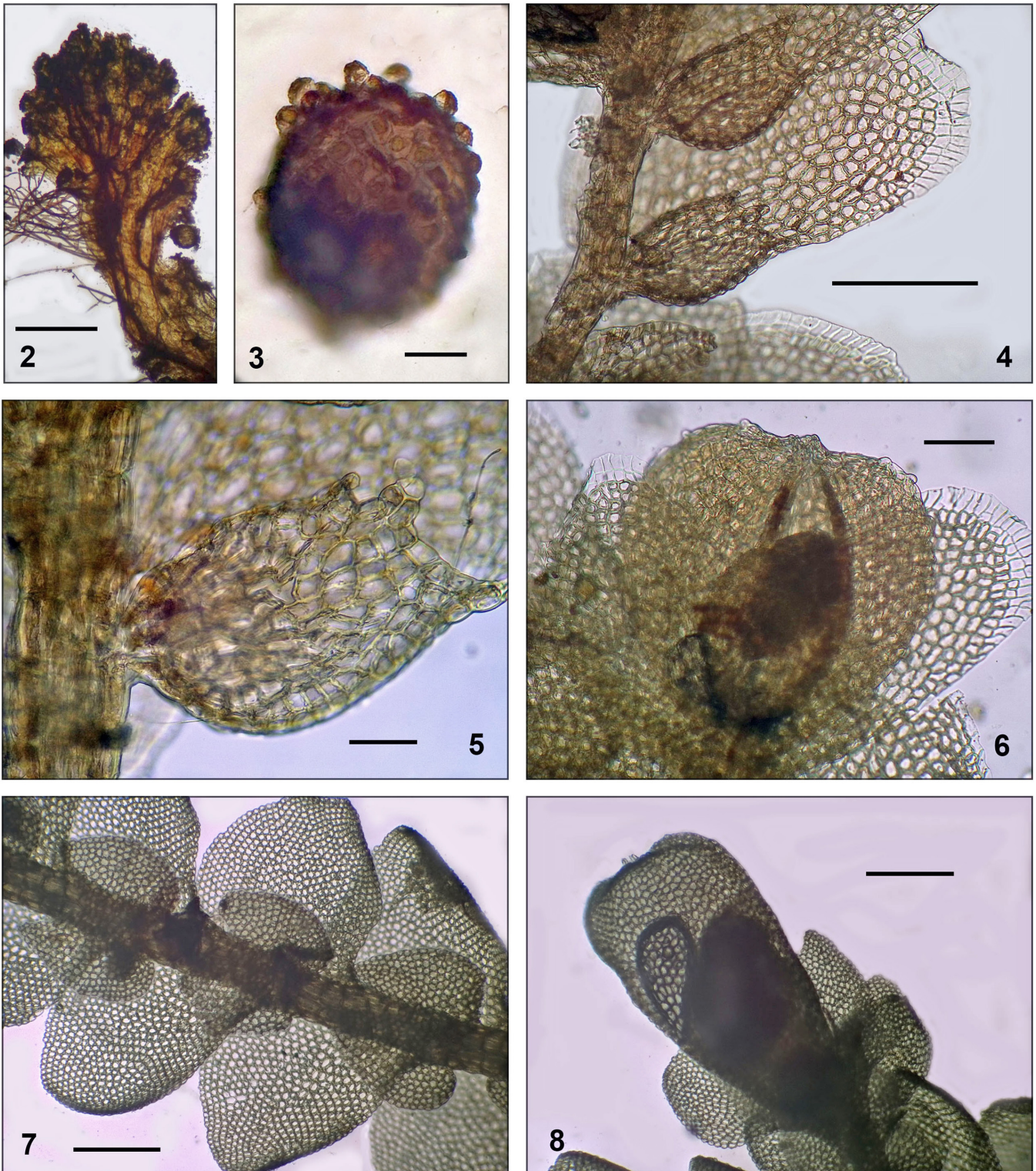
5.Cololejeunea cocoscota*** Tixier [Lejeuneaceae] (Figs 4–6).

ESP: Luganville – Hog Harbour Road (over river) past Matevala Plantation, 16 km N of Luganville. 15°22'S, 167°11'E, 1 m. *Calophyllum inophyllum*, *Barringtonia asiatica* dominated strand vegetation. On shaded *Barringtonia* bark, *H. Streimann 62940 p.p.* **Distribution**: Hitherto known only from Tonga (Tixier 1993)

and from Fiji Islands (Pócs et al. 2011). Tixier described and depicted only sterile plants. Streimann's collection has perianths, which are cordate, flattened with a ventral fold and with very short, conical, one cell high beak. The bracts are almost as long as the perianth, lanceolate-ovate with rounded apex and hyaline margin. Usually, one subloral innovation is present.

6. *Cololejeunea hebridensis* Tixier [Lejeuneaceae]

EF: *McD*, epiphyllous on treelet leaves. *H. Streimann 63416*, CANB, PVV, TAL, EGR. **Distribution:** Hitherto known only from Vanuatu: Efate (Tixier 1975).



Figs 2–3: *Folioseros appendiculatus* (Steph.) Haseg.: 2. Habit, ventral view. Scale bar 500 µm. 3. Gemma. Scale bar 25 µm. **Figs 4–6:** *Cololejeunea cocoscola* Tixier: 4. Habit, ventral view. Scale bar 200 µm. 5. Lobulus, ventral view. Scale bar 50 µm. 6. Perianth with bracts. Scale bar 100 µm. **Figs 7–8:** *Lejeunea umbilicata* (Nees) Nees in Gottsche: 7. Habit, ventral view. 8. Perianth. Scale bar 250 µm.

7. *Dumortiera hirsuta* (Swartz) Nees [Dumortieraceae]

ESP: *TAN*, tropical forest surrounding a narrow seasonal stream with limestone banks. On shaded calcareous bank, *H. Streimann* 62682, CANB, EGR. **Distribution:** Widespread in Vanuatu Islands (Furuki 2002). Oceanic Sub-cosmopolitan.

8. *Frullania nodulosa* (Reinw. et al.) Nees [Frullaniaceae]

EF: *FLA*, On fallen branch, *H. Streimann* 63010, CANB, EGR. **Distribution:** In Vanuatu known only from Espiritu Santo. Pantropical lowland rainforest species (Pócs 2008).

9. **Lejeunea adpressa* Nees [Lejeuneaceae]

ESP: Luganville – Hog Harbour Road (over river) past Matevala Plantation, 16 km N of Luganville. 15°22'S, 167°11'E, 1 m. *Calophyllum inophyllum*, *Barringtonia asiatica* dominated strand vegetation. On shaded *Barringtonia* bark, *H. Streimann* 62940 *p.p.*, CANB, EGR; *FDB*, on shaded trunk. *H. Streimann* 62406 *p.p.*, CANB, EGR. **Distribution:** Widespread Pantropical species (Gradstein 2021).

10. **Lejeunea umbilicata* (Nees) Nees in Gottsche [Lejeuneaceae] (Figs 7, 8).

ESP: *FDB*, on shaded trunk. *H. Streimann* 62406 *p.p.*, CANB, EGR. **Distribution:** Malesian-Pacific species distributed from Sumatra to the Philippines and Samoa. (Pócs and Wei 2017).

11. *Mastigophora diclados* (Brid. ex Weber) Nees. [Mastigophoraceae]

EF: Ewor River, 26 km NE of Port Vila, 17°43'S, 168°33'E, 10 m. On streambed rocks (limestone), *H. Streimann* 63156, CANB. *McD*, *H. Streimann* 63310, 63311, 63313, 63316 *p.p.*, CANB. **Distribution:** Widespread Palaeotropical species.

12. *Metzgeria leptoneura* Spruce [Metzgeriaceae]

ESP: *FDB*, on shaded trunk. *H. Streimann* 62406 *p.p.*, CANB, EGR. **Distribution:** Worldwide, suboceanic (So 2002).

13. **Microlejeunea lunulatilobula* Horik [Lejeuneaceae]

ESP: *FDB*, on shaded trunk. *H. Streimann* 62406 *p.p.*, CANB. **EF:** *McD*, on trunk. *H. Streimann* 63219 *p.p.*, CANB. **Distribution:** Indomalayan-Pacific species (Miller et al. 1983).

14. **Neolepidozia disparata*** (J.J.Engel & G.L.Merr.) E.D.Cooper [Lepidoziaceae] (Fig. 19).

EF: *McD*, On shaded rotting log. *H. Streimann* 63410 *p.p. min.*, CANB, EGR. **Distribution:** Hitherto known only from Australia, Queensland (Engel & Merrill 2004). New to the Pacific realm.

15. **Plagiochila junghuhniana*** Sande Lac. [Plagiochilaceae] (Figs 9, 10).

EF: *FLA*, On semi-shaded vine. *H. Streimann* 63029, CANB; *McD*, On stem of thin shrub. *H. Streimann* 63371, CANB, EGR, PVV, NY. **Distribution:** Malayan-Pacific species (Inoue 1984).

16. **Plagiochila perserrata*** Herzog [Plagiochilaceae] (Syn.: *Plagiochila hottae* Inoue) (See figs.11–12)

ESP: *FDB*, on medium sized *Hibiscus tiliaceus* branches. *H. Streimann* 62371, CANB, EGR; *BBL*, On shaded vine. *H. Streimann*

62286 *p.p.* CANB. **EF:** *McD*, on shaded treelet. *H. Streimann* 6342, CANB. **Distribution:** Scattered from Himalaya to Sabah (Inoue 1984, So 2001), new to the Pacific.

17. **Plagiochila propinqua*** Sande Lac. [Plagiochilaceae]

EF: *McD*, on shaded tree roots and trunks. *H. Streimann* 63306, 63369, 63377, 63395, CANB, PVV, EGR, NY, TAL. **Distribution:** Malesian (Inoue 1984), new to the Pacific.

18. **Plagiochila sciophila*** Nees [Plagiochilaceae] (Figs 13, 14).

ESP: *FDB*, on bark and rotten logs. *H. Streimann* 62346, 62447, 62482, 62489, CANB, PVV, EGR; Mt Malel, 30 km NNW of Luganville, 15°15'S, 167°05'30"E, 180 m, disturbed forest on moderate slope with small limestone outcrops, on dead treelet stem, *H. Streimann* 62241, CANB; *BBL*, on semi-shaded prop roots of *Myristica fatua*, *H. Streimann* 62261, CANB, PVV, EGR; *TAN*, on shaded vine. *H. Streimann* 62583, 62619, 62650. CANB. **Distribution:** One of the most widespread Indomalayan-Pacific *Plagiochila* species (So 2001).

19. **Plagiochila teysmannii*** Sande Lac. [Plagiochilaceae] (Figs 15, 16)

ESP: Nambauck Village (end of road), 12 km NW of Luganville. 15°27'S, 167°04'E, 170 m, disturbed forest on limestone, surrounding seasonal stream, on treelet branch, *H. Streimann* 62094, CANB. **Distribution:** Widespread in the Malayan archipelago (Inoue 1984) also in tropical Australia (So 2000): new to the Pacific realm.

20. *Plagiochila tjibodensis* Schifffn. [Plagiochilaceae]

ESP: *FDB*, on shaded trunk. *H. Streimann* 62457. CANB, PVV, EGR. **Distribution:** A rare Malayan species new to the Pacific. Rare Malesian species (Java, Inoue 1984); new to the Pacific realm.

21. **Plagiochila vitiensis*** Mitt. [Plagiochilaceae] (Figs 17, 18).

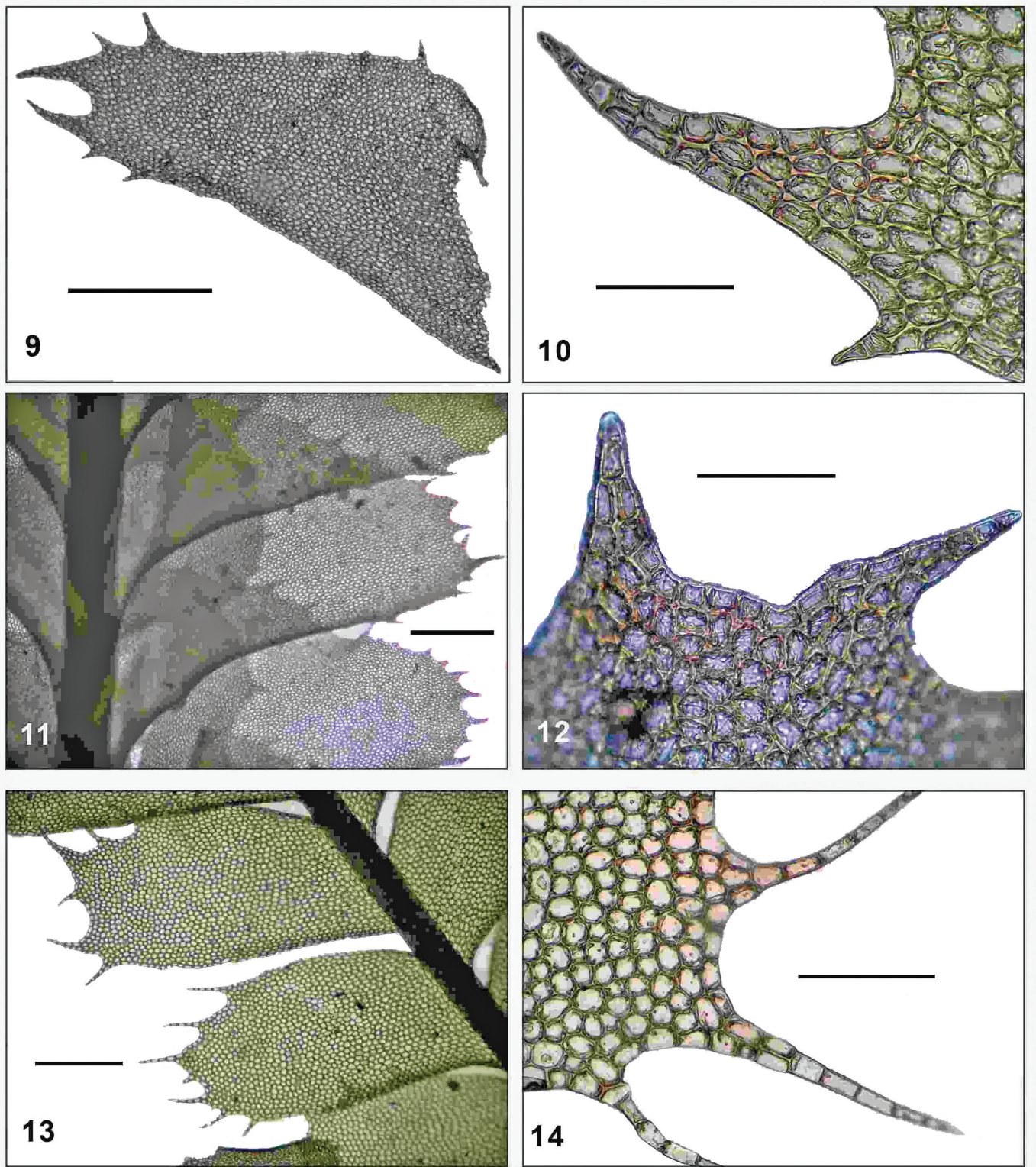
ESP: Track to Mt Tanakar, Butmas, 26 km NW of Luganville. 15°22'S, 169°59'E, 680 m, *Myristica fatua* and *Dysoxylum* dominated tropical forest on limestone, on shaded vine, *H. Streimann* 62540, CANB. **Distribution:** Widespread in Australasia and the Pacific Islands (Inoue 1981); no record from Vanuatu has been published.

22. *Plicanthus hirtellus* (Brid. ex Weber) Nees [Anastrophyllaceae]

EF: *McD*, on trunks, *H. Streimann* 63300, 63316 *p.p.*, 63317, CANB. **EF:** Ewor River, 26 km NE of Port Vila, on exposed rock in stream, *H. Streimann* 63155, CANB. **Distribution:** Widespread in Vanuatu and from Southeast Asia to the Pacific. It rarely occurs also in North America: British Columbia (Miller et al. 1983).

23. *Ptychanthus striatus* (Lehm. & Linenb.) Nees [Lejeuneaceae]

ESP: *BBL*, on shaded vine, *H. Streimann* 62286 *p.p.*, CANB; *FDB*, on live and dead trunks. *H. Streimann* 62451, 62453, CANB, PVV, EGR, NICH, TAL, NY, LE; *TAN*, on shaded treelet, *H. Streimann* 62554, CANB, EGR. **Distribution:** Widespread in Vanuatu and in the whole tropical Asia to the Pacific (Ahonen et al. 2005).



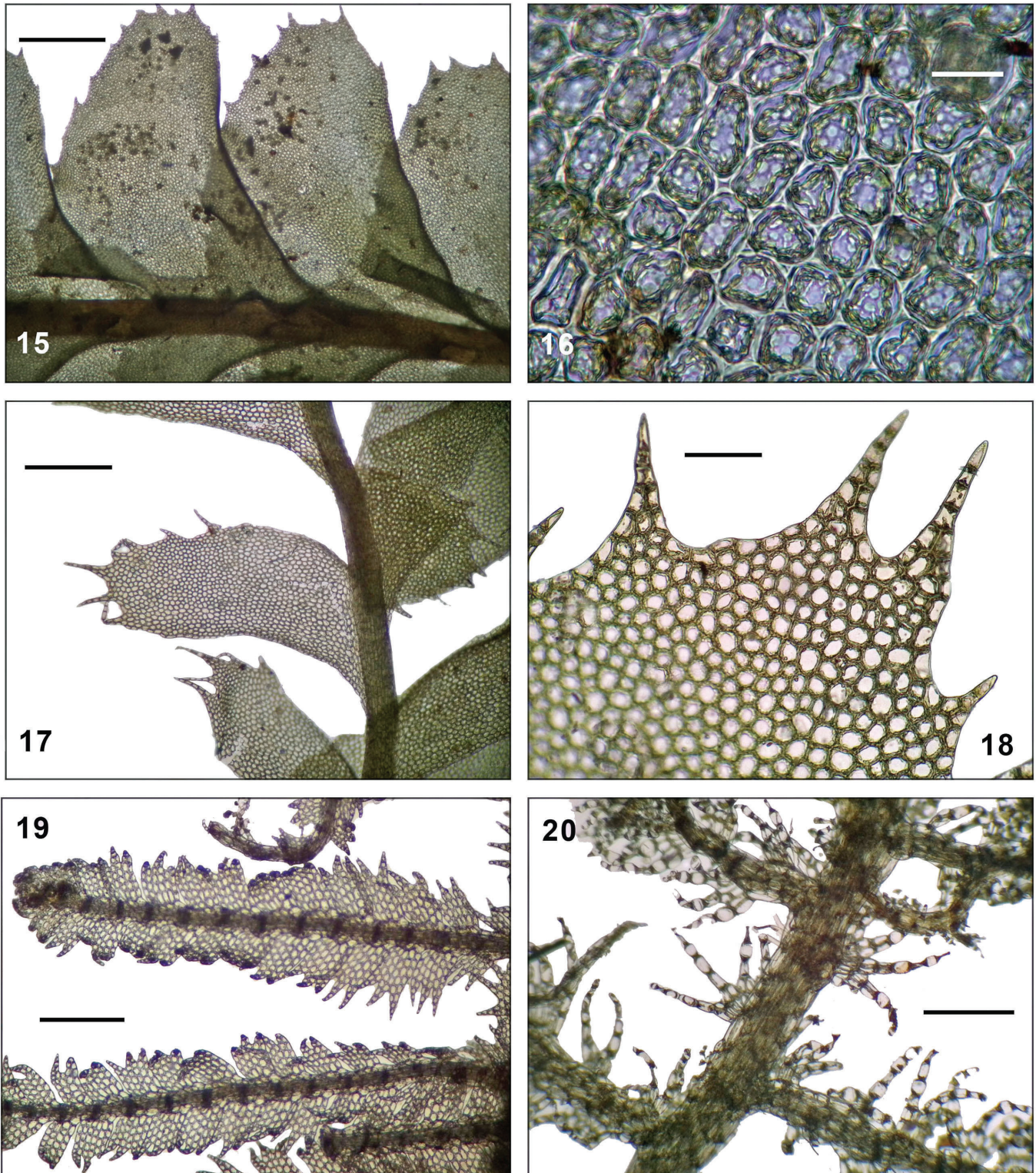
Figs. 9–10: *Plagiochila junghuhniana* Sande Lac.: 9. Leaf. Scale bar 500 μm . 10: Leaf apex. Scale bar 100 μm . **Figs. 11–12:** *Plagiochila perserrata* Herzog: 11. Habit, dorsal view. Scale bar 500 μm . 12. Leaf apex. Scale bar 50 μm . **Figs. 13–14:** *Plagiochila sciophila* Nees: 13. Habit, dorsal view. Scale bar 500 μm . 14: Leaf apex. Scale bar 100 μm .

24. *Radula javanica* Gottsche [Radulaceae]

EF: *McD*, on canopy branches. *H. Streimann* 63358, CANB, PVV, EGR, NY, TAL. **Distribution:** Known from Vanuatu: Futuna and Sanma. Widespread Indomalaysian-Pacific species (Miller et al. 1983).

25. *Radula reflexa* Nees & Mont. [Radulaceae]

ESP: *FDB*, on treelet stem, *H. Streimann* 62337, CANB, PVV, EGR; Sevua Village near Nambauck Village, 15 km NW of Luganville. 15°27'S, 167°04'E, 170 m, *H. Streimann* 62141, CANB, EGR. **Distribution:** Known from Vanuatu: Espiritu Santo, then from Amboina, Ceram, Borneo, New Guinea to Samoa (Miller et al. 1983).



Figs. 15–16: *Plagiochila teysmannii* Sande Lac.: 15. Habit, dorsal view. Scale bar 500 µm. 16: Median lobe cells. Scale bar 25 µm. **17–18: *Plagiochila vitiensis*** Mitt.: 17: Habit, dorsal view. Scale bar 500 µm. 18. Leaf apex. Scale bar 100 µm. **19: *Neolepidozia disparata*** (J.J.Engel & G.L.Merr.) E.D.Cooper: Side branches, ventral view. Scale bar 250 µm. **20: *Tricholepidozia quadriseta*** (Steph.) E.D.Cooper: Part of shoot with side branches, dorsal view. Scale bar 250 µm.

26. *Radula retroflexa* Taylor [Radulaceae]

EF: *FLA*, on shaded buttress, *H. Streimann* 62993, CANB, PVV, EGR, NY. **Distribution:** Widespread Indomalaysian-Pacific species known also from Vanuatu (Yamada 1979).

27. *Schistochila aligera* (Nees & Blume) J.B.Jack & Steph. [Schistochilaceae]

EF: *McD*, on trunk, *H. Streimann* 63261, 63303, 63304, 63382, CANB, PVV, EGR, NY. **Distribution:** Widespread Indomalaysian-Pacific species, known from Vanuatu: Vanua Lava (Miller et al. 1983).

28. *Schiffneriolejeunea pulopenangensis*** (Gottsche) Gradst. [Lejeuneaceae]

ESP: *BBL* on semi-exposed *Macaranga* stem, *H. Streimann* 62272 *p.p.*, CANB, EGR. **Distribution:** Widely distributed in Indomalaysia from Sri Lanka to New Caledonia (Gradstein 2015). There are map records also from Norfolk Island and Fiji (AVH 2024); the genus is new to Vanuatu.

29. **Spruceanthus planiusculus* (Mitt.) X.Q.Shi, R.L.Zhu & Gradst. [Lejeuneaceae]

ESP: Logging area near Lavatmas (N of Sara), 48 km NNW of Luganville, 15°07'S, 167°01'E, 300 m, poor lowland forest on flats dominated by *Endospermum medullosum*, *Antiaris toxicaria* and *Pometia pinnata*, on canopy branches of *Macaranga*, *H. Streimann* 62827, CANB, EGR. **Distribution:** Widespread Indomalayan-Pacific species (Wang et al. 2016), but new to Vanuatu.

30. **Tricholepidozia quadriseta*** (Steph.) E.D.Cooper [Lepidoziaceae]. (Fig. 20).

ESP: *TAN*, on shaded humus rich ground on track, *H. Streimann* 62591, CANB, EGR.

EF: *McD*, on shaded rotting log, *H. Streimann* 63409, x63410 *p.p. max.*, CANB, EGR. **Distribution:** Hitherto known only from Queensland and New South Wales in Australia, Queensland (Engel and Merrill 2004). New to the Pacific realm.

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