

***Diobelonella rotundata* comb. nov., a new generic record for Taiwan (Aongstroemiaceae, Bryopsida)**

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Alishan National Forest Recreation Area, *Cryptomeria* forest along the historic logging Alishan Railroad, where *Diobelonella rotundata* was found for the first time in Taiwan (Photo: Kuei-Yu Yao).

Abstract: Schäfer-Verwimp, A., Winter, G., Yao, K.-Y. (2021). *Diobelonella rotundata* comb. nov., a new generic record for Taiwan (Aongstroemiaceae, Bryopsida). *Frahmia* 25:1-10.⁴ *Anisothecium rotundatum* Broth. (= *Dicranella rotundata* [Broth.] Takaki) is newly combined under *Diobelonella*, and the latter genus is reported from Taiwan for the first time. Description of the plants from Taiwan along with photo plates and line drawings of the stem and leaf cross sections of the genera *Diobelonella* and *Dichodontium* are provided. *Dicranella papua-palustris* from Papua New Guinea is considered to be a synonym of *Diobelonella rotundata*.

Key words: new combination, new record, *Dicranella*, *Dichodontium*, new synonym, Taiwan

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1. Introduction

For its size at only 35,980 km², Taiwan is extraordinarily rich in bryophytes and one of the bryological hotspots in Southeast Asia. Redfearn et al. (1996) mentioned 907, Chiang et al. (2001) 900 taxa of mosses among these two Aongstroemiaceae De Not. (*Aongstroemia orientalis* Mitt., *Dichodontium pellucidum* (Hedw.) Schimp. and four Dicranellaceae M.Stech (*Campylopodium medium* (Duby) Giese & J.-P. Frahm, *Dicranella coarctata* (Müll. Hal.) Bosch. & Sande-Lac., *Dicranella heteromalla* (Hedw.) Schimp. and *Microcampylopus laevigatus* (Thér.) Giese & J.-P. Frahm).

During two visits in Taiwan in 2016 and 2018 (Shevock et al. 2017; Schäfer-Verwimp & Winter 2017), a peculiar and highly distinctive moss could be collected which later turned out to belong to *Dicranella rotundata* (Broth.) Takaki.

Dicranella rotundata has been described from Yunnan as *Anisothecium rotundatum* (Brotherus 1929), the holotype specimen has been re-investigated and firstly illustrated by Takaki (1968). He combined the species under *Dicranella*. Further illustrations and descriptions are also found in Gao (1994) and (identical figures) in Gao et al. (1999). So far, it is known only from the type collection from Yunnan where it has been collected at 3150 m altitude (Gao et al. 1999).

2. Morphology

Plants up to 2.5 cm high, light-green to yellowish-green, in loose turfs or tufts (fig. 1A).

Stems erect, simple or sparsely branched, more or less radiculose from base to middle, rhizoids long, olive-brownish (fig. 1A), stem in cross section slightly flattened to short oval, ca. 300 µm wide and 240 µm high, central strand present, flattened, inner cells thin-walled with minute trigones, towards margins with single spots of smaller cells, 1(-2) marginal cell rows slightly differentiated being somewhat smaller and moderately thick-walled but not forming a delineated cortex (fig. 3A).

Leaves sheathing at base and divergent distally, flexuose to crispate when dry, lingulate to oblong-ovate, subacute-obtuse to bluntly rounded at apex, up to 2 mm long and 0.85 mm wide, lower ones smaller, up to 1.4 mm long (fig. 1A). **Leaf cells** smooth, thin-walled, occasionally irregularly bulging or with depressions on both abaxial and adaxial surface (see cross sections: fig. 3B-E), in living condition strongly guttulate, near costa more regularly rectangular, towards margins and apex becoming smaller and more irregular in outline, subquadrate to polygonal (from 10 x 45 µm and 16 x 40 µm to 12 x 32 µm and 20 x 20 µm, fig. 1B, 2A,B). **Marginal and apical cells** ±rhomboidal, ca. 8-10 x 10-16 µm (fig. 2 A). Central **basal cells** ±rectangular, sometimes with acute or oblique ends, 10-16 x 80-120 µm; marginal cell row near base consisting of long rectangular cells (15 x 40-50 µm) mixed with short rectangular ones (10-12 x 20 µm) (fig. 1B). **Costa** usually ending several cells below apex, in cross section with 2-3 ventral and 4-5 dorsal cells similar to laminal cells (somewhat smaller near base of leaf), and a central stereid band of (4-)6-8(-9) cells (fig. 3B-E), near base only 2 smaller ventral, 4 smaller dorsal cells and a partly reduced central stereid band (fig. 3B-C). **Margin** at least in some leaves decurrent for several cells, plane throughout, with sharp teeth at least in apical part (fig. 2A) to crenulate farther down on divergent portion of leaf.

Dioicous. Only male plants seen, androecia terminal, overgrown by 1(-2) innovations, perigonal leaves not differentiated.

Specimens examined: TAIWAN: Chiayi County, Alishan National Forest Recreation Area, *Cryptomeria* forest along the Mianyue section of the historic logging Alishan Railroad paralleling Tashan Trail between the 1 and 2 km marker, 2300 m, 23°31.1' N, 120°48.9' E, on gravel beside



Fig. 1A. *Diobelonella rotundata*. Habitus with leaf inserted (from G. Winter 22/3 [Taiwan])

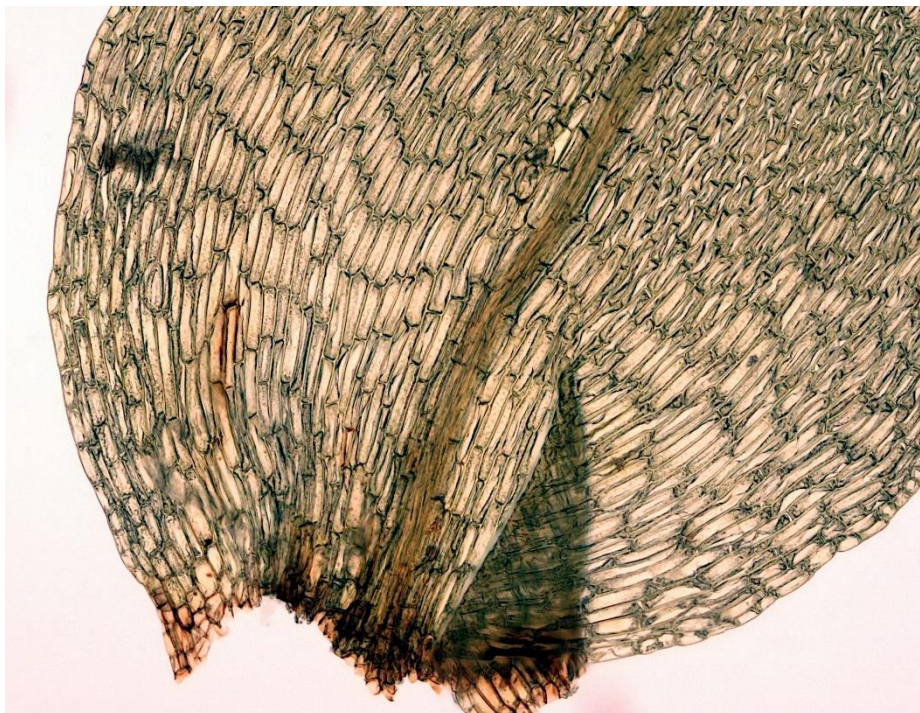


Fig. 1B. *Diobelonella rotundata*. Leaf base (from G. Winter 22/3 [Taiwan])

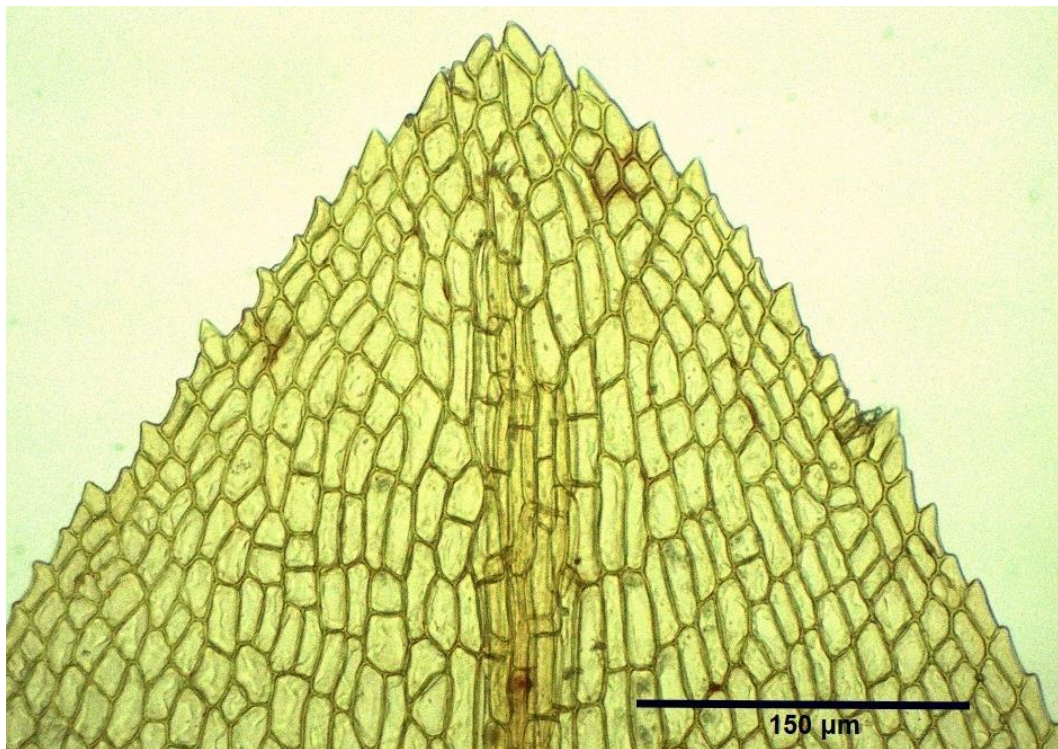


Fig. 2A. *Diobelonella rotundata*. Apical leaf cells (from G. Winter 22/3 [Taiwan]). Leaves treated with potassium hydroxide.

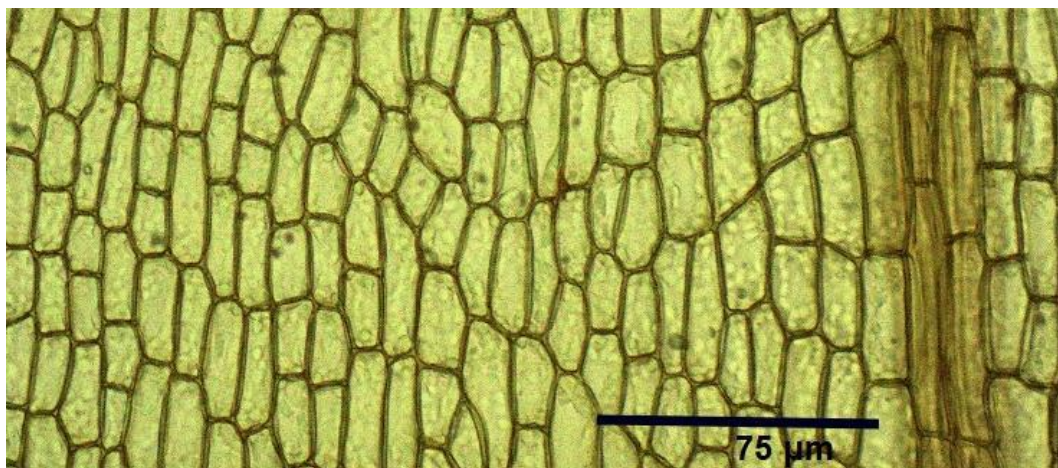


Fig. 2B. *Diobelonella rotundata*. Central leaf cells (from G. Winter 22/3 [Taiwan]). Leaves treated with potassium hydroxide.

track, exposed to sunlight, 19 Oct. 2016, leg. A. Schäfer-Verwimp 37794, with Jia-Dong Yang, Kuei-Yu Yao & James R. Shevock (TAIE, JE, CAS, FR); - dito, leg. K.-Y. Yao 7160b (TAIE); -, Nantou County, Yushan National Park, highway 18 near km marker 107. Mixed conifer forest of *Chamaecyparis formosana* and *Picea morrissonicola*, 2540 m, 23°28'46'' N, 120°52'52'' E, on dripping concrete wall along highway 18 just above Tataka park housing area, 23 Oct 2018, leg. Schäfer-Verwimp 39004, with Kuei-Yu Yao, James R. Shevock & Gerhard Winter (TAIE, TAIM, JE, CAS, FR); - dito, leg. G. Winter 22/3, with Alfons Schäfer-Verwimp, Kuei-Yu Yao & James R. Shevock (FR).

3. Notes on Ecology and Associated Species

So far, ecological or sociological data on *Dicranella rotundata* are scarce. Concerning the two actual collections, it seems obvious that this species prefers humid environments and at least temporarily waterlogged sites or dripping cliffs in high montane forests between 2300 and 2540 m in Taiwan and 3150 m elevation in Yunnan. Astonishingly, both collections in Taiwan have been done from anthropogene sites, one from a dripping concrete wall, the other one from gravelly ground beside a (historical) railway track. Both collections do not contain any associated (bryophyte or lichen) species indicating that *Dicranella rotundata* usually grows in pure stands; however, different species of hygrophilous genera like *Sphagnum*, *Philonotis* and *Riccardia* have been seen growing nearby.

4. Discussion

Dicranella palustris (Dicks.) Crundw. ex Warb. is “at a glance distinct from all congeners in its robust appearance and squarrose leaves which are decurrent and end in a broad, often rounded and cucullate apex” (Ochyra et al. 2003: 109). According to molecular data, Stech (1999) found a close affinity of *Dicranella palustris* with *Dichodontium pellucidum*, whereas no close relationship was observed between *Dicranella palustris* and *Dicranella cerviculata*/*D. heteromalla*. Consequently, he transferred *Dicranella palustris* to *Dichodontium*. However, as Ochyra et al. (2003) pointed out, the genus *Dichodontium* is defined by (1) a costa in cross section with a median row of large guide cells separating the dorsal and ventral stereid bands, (2) short, ±subquadrate distal laminal leaf cells which are thick-walled and coarsely conic-papillose or mamilllose, and (3) leaf margins which are irregularly dentate above. Santos et al. (2021) presented a maximum likelihood tree of Dicranidae representatives where *Diobelonella palustris* is well separated from *Dichodontium*.

Dicranella rotundata agrees very well with *Diobelonella palustris* not only in its overall appearance (as already mentioned in the protologue by Brotherus 1929) but also in its smooth laminal cells and a very similar – if not to say identical – cross section of costa which is different from that of *Dichodontium*. Compare also the figures of leaf cross sections of *Dichodontium flavescens* (Dicks.) Lindb., *D. pellucidum* and *Diobelonella palustris* (as *Dichodontium*) in Lüth (2019: 409-411). Comparing the leaf cross sections the difference in leaf cell areolation is also conspicuous and another difference is seen in stem cross section – see table 1 summarizing the distinguishing characters of *Dicranella rotundata*/*Diobelonella palustris* and *Dichodontium*.

Consequently, we combine *Dicranella rotundata* under *Diobelonella* (see Taxonomic conclusions). The genus *Diobelonella* is placed together with the genera *Aongstroemia* and *Dichodontium* in the Aongstroemiaceae by Frey & Stech (2009), and subsequently also by Hodgetts et al. (2020). Now, three genera of presently five accepted in this family (Santos et al. 2021) are known to occur in Taiwan (Chiang et al. 2001).

Due to the inclusion of *Dicranella rotundata* in the genus *Diobelonella*, the latter one also includes species with markedly serrate leaf margins.

	<i>Dicranella rotundata</i> and <i>Diobelonella palustris</i>	<i>Dichodontium</i>
leaf cross section	very thin-walled and irregularly bulging cells	rather thick-walled regular cells
cross section of costa	only a few stereid cells (fig. 3B-E)	central band of large guide cells separates a dorsal and a ventral band of stereid cells (fig. 3H-I)
stem cross section	interior cells are very thin-walled and large becoming smaller towards the margin, and 1(-2) marginal cell rows have slightly thicker walls than the central ones forming an inconspicuous hardly delineated cortex (fig. 3A).	large and rather thin-walled interior cells becoming gradually smaller and more thick-walled towards the margin where several rows of very thick-walled small cells form a conspicuous cortex (fig. 3G).
central strand	present (flattened in <i>D. rotundata</i> , round in <i>D. palustris</i>)	present

Tab. 1. Comparison of distinguishing characters of *Dicranella rotundata* / *Diobelonella palustris* and *Dichodontium*

5. On the identity of *Dicranella papua-palustris* Norris & T.Kop.

We investigated the type specimen of *Dicranella papua-palustris*. Norris & Koponen (1990) compared their new species (only) with *Dicranella palustris* which they found remarkably similar, the former only differing in larger cells throughout the leaf, leaf apex relatively broader and the distal leaf margin markedly more serrate. This description, however, fits well the characteristics of *D. rotundata*, and in fact, we could not find any reliable difference to keep the two as separate species. Despite the smaller size (plants to 1 cm high) given in Norris & Koponen (1990) for *D. papua-palustris*, there are also plants up to at least 1.7 cm present in the type collection, and we could not find any significant difference even in size and robustness between *D. papua-palustris* and *D. rotundata*. Furtheron, the teeth of the upper leaf margin (Norris & Koponen 1990, fig. 4k) most often are sharp as in our Taiwanese plants shown in fig. 2B and in best accordance with the sharp teeth seen in the type of *D. rotundata*. Cross sections of leaf and costa of *D. papua-palustris*, the type of *D. rotundata* from Yunnan and our plants from Taiwan are in perfect accordance. Therefore, *Dicranella papua-palustris* is synonymized under *Diobelonella rotundata*.

6. Taxonomic conclusions

Diobelonella rotundata (Broth.) Schäf.-Verw., G.Winter bis & K.-Y.Yao, **comb. nov.**

Basionym: *Anisothecium rotundatum* Broth., Symb. Sin. 4: 15. 1929.

Lectotype nov.: Yunnan bor.-occid.: In pluviisilvis mixtis temperatis vallis Doyonlumba ad fluvium Lu-djiang (Salween), ca. 28°2', ad marginem viae. Substr. schistaceo. alt. s. m. ca. 3150 m. Leg. 23.IX.1915 Dr. Heinr. Frh. v. Handel-Mazzetti (Diar. Nr. 1536). Handel-Mazzetti, Iter Sinense 1914-1918, sumptibus Academiae scientiarum Vindobonensis susceptum. Nr. 8418. Herb. V. F. Brotherus, WU 0045557! Consisting of five patches, only one patch marked as B is the lectotype.

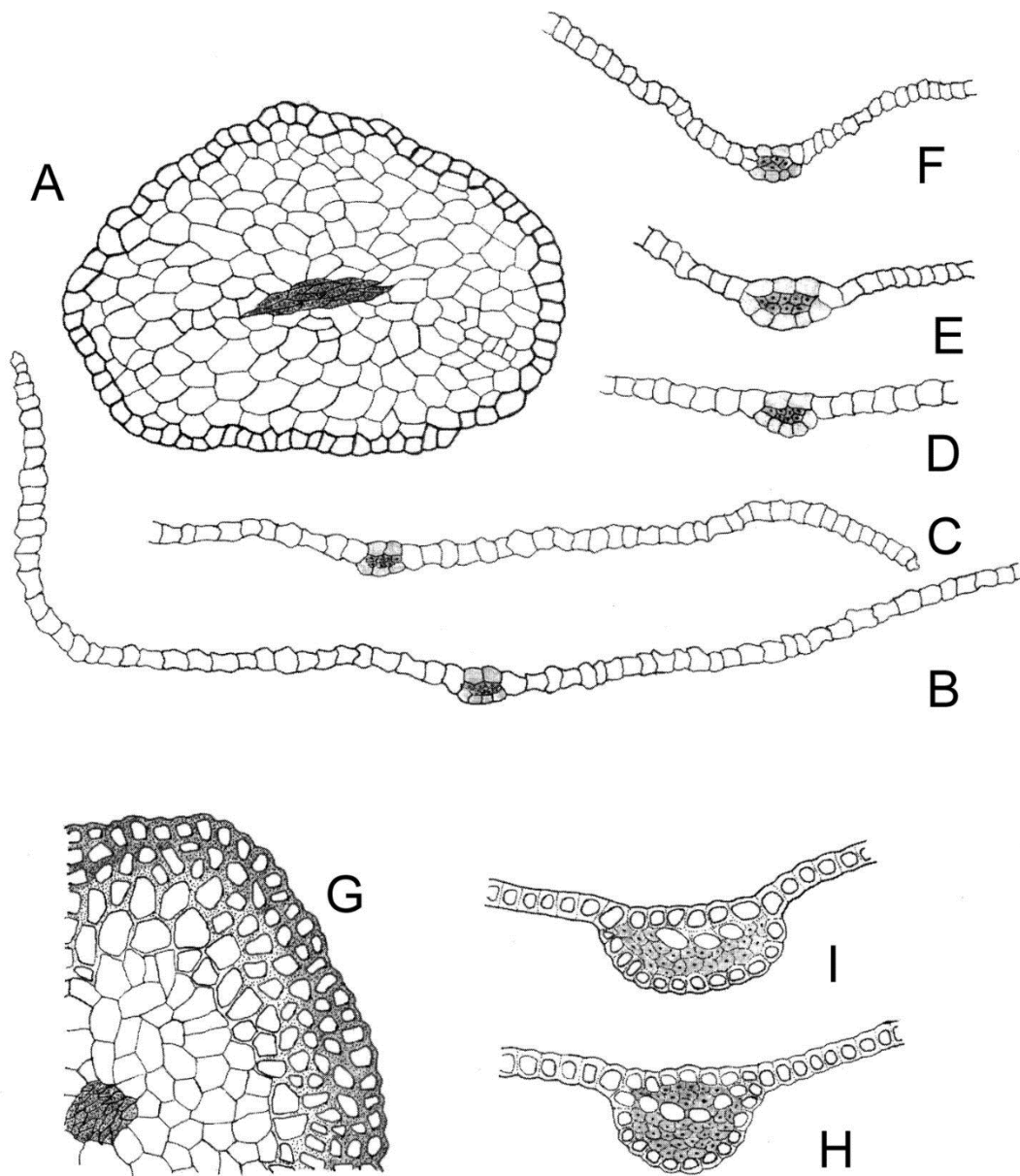


Fig. 3. **A-E:** *Diobelonella rotundata*. A cross section of stem, 300 μm wide, 240 μm high; B-E cross section of costa and lamina p.p., from lower half of leaf (B-C) to central part of leaf (D-E). **F:** *Diobelonella palustris*, leaf cross section. **G-I:** *Dichodontium flavescens*. G stem cross section. H, I cross section of costa, from lower half of leaf [all figures drawn with same magnification]. A-E from Schäfer-Verwimp 39004; F from Schäfer-Verwimp & Verwimp 39873 (Italy, South Tyrol, zwischen Staller Sattel und Rote Wand); G-I from Schäfer-Verwimp & Verwimp 38873 (Germany, Bavaria, Steigbachtobel bei Immenstadt).

The specimen of WU was selected as lectotype as Handel-Mazzetti gave the first, complete set of his collection to the Botanical Institute of the University of Vienna, all other are duplicates.

Isolectotype nov.: H-BR no. 0130039! This specimen has been annotated as lectotype in sched. by Ochyra 2008, but remained unpublished. Consisting of four mixed patches. Plants of *Diobelonella* have already been separated.

Isolectotype nov.: W-KRYPTO 1925-0004409! Consisting of seven patches A – G, patch A is selected as isolectotype; plants of *D. rotundata* were separated from mixed patches B, C, F, and the patches D, G, E contain different bryophytes intermingled without plants of *D. rotundata*.

Synonyms:

≡ *Dicranella rotundata* (Broth.) Takaki, J. Jap. Bot. 43: 467. 1968.

≡ *Dicranella rotundata* (Broth.) Gao, Flora Bryophyt. Sinic. 1: 144, 1994, nom superfl.

= *Dicranella papua-palustris* Norris & T.Kop., Ann. Bot. Fennica 139: 17, 1990, **syn. nov.**

Holotype: Papua New Guinea. Morobe Prov.: Mt. Sarawaket Southern Range 6 km SSW of Iloko. In upper montane rainforest approaching moss forest along trail between Iloko and Mt. Sarawaket, alt. 2700-2900 m, 147°10' E, 06°18,5' S, moist, diffusely lit limestone boulder, 10 July 1981, (collection site 6z), Daniel H. Norris 63431! (H).

7. Distribution

So far, *Diobelonella rotundata* is known from upper montane (rain-)forests of mainland China (Yunnan), Taiwan, and Papua New Guinea (fig. 4) from altitudes between 2300-2540 m in Taiwan, 2700-2900 m in Papua New Guinea and 3150 m in Yunnan. It may be expected to occur also at higher altitudes in regions lying in between as the Philippines or (West) Papua.

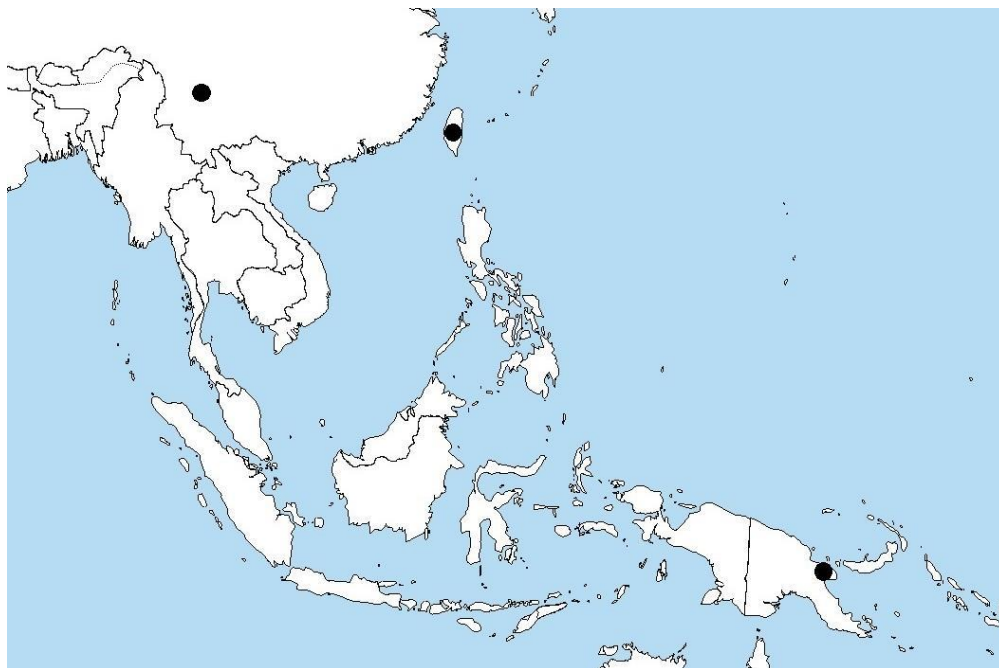


Fig. 4. Distribution of *Diobelonella rotundata*

8. Acknowledgements

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