TRACHYPODACEAE

A CRITICAL REVISION

by

B. O. VAN ZANTEN

(Botanical Laboratory, Groningen)

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INTRODUCTION

The present study was started as a revision of the *Trachypodaceae* of the Malaysian region. It proved, however, necessary to include the extra-malaysian species of the Malaysian genera in order to solve the taxonomic problems satisfactorily. I also included the extra-malaysian genera of the family (*Pseudospiridentopsis, Duthiella* and *Pseudotrachypus*) in this work, this finally resulted in a complete revision of the family of the *Trachypodaceae* all over the world.

All literature and specimens mentioned in this work have been examined by me, if not, this has been specially indicated.

To locate the collecting localities, The Times Survey Atlas of the World (1920) proved a great help and for Indonesia the Atlas van Tropisch Nederland (Nijhoff, 1938) was used. The same spelling of the names in these works has largely been followed.

The material studied was mainly obtained from the following herbaria:

BM Department of Botany, British Museum (Natural History), London.
BR Herbier du Jardin Botanique de l'État, Brussels.
FH Farlow Library and Herbarium of Cryptogamic Botany, Harvard University, Cambridge, Mass. U. S. A.
FI Erbario del Instituto Botanico dell'Università, Florence.
GRO Botanisch Laboratorium der Rijksuniversiteit, Afdeling Plantensystematiek, Groningen.
H Botanical Museum, Helsinki.

K Herbarium, Royal Botanic Gardens, Kew, Surrey.
L Rijksherbarium, Leyden.
PC Laboratoire de Cryptogamie du Muséum National d'Histoire Naturelle, Paris.
U Botanisch Museum en Herbarium, Utrecht.
W Naturhistorisches Museum, Vienna.

I here wish to express my indebtedness to the directors and keepers of these herbaria for their valuable help in placing their specimens at my disposal. Also E. B. Bartram, Dr. A. Noguchi, Dr. R. Potier de la Varde and Prof. Dr. K. Sakurai have greatly obliged me for sending me material from their private herbaria.

My most sincere thanks are due to Prof. Dr. R. van der Wijk for his support and to W. D. Margadant for his help with regard to the literature.

The figures are by the able hand of draughtsman R. Hoeksema.

GENERAL SECTION

Trachypodaceae Fleisch.

Fleischer, Hedwigia 45(1905)63; Brotherus, Nat. Pfl. 1, 3(1906)827 (as the subfamily Trachypodeae of the family of the Neckeraceae); Fleischer, Musci Fl. Buitenzorg 3(1908)727; Brotherus, Nat. Pfl. ed. 2, 11(1925)117; Bartram, Philipp. J. Sc. 68(1939)193.

Very slender to very robust, greenish, yellowish or blackish plants (sometimes the lower parts blackish and yellowish-green at the tips) in dull or somewhat glossy, dense to lax mats. Primary stems creeping with tufts of blackish rhizoids and more or less scale-like lower leaves. Secondary stems from 1 up to 30 cm long, procumbent, ascending or hanging down, densely to remotely, regularly or irregularly, pinnately or bipinnately branched, rarely almost simple or somewhat arborescently branched. Central strand present or wanting, but never well-developed. Occasionally few to numerous, longer or shorter flagelliform, rather laxly foliate branches present. Paraphyllia absent. Leaves up to 9 mm long, appressed to horizontally spreading, rarely strongly recurved when dry, sometimes falcate-second, plane to strongly longitudinally plicate (branch leaves occasionally very hollow and carinate), often crisped near apex, rarely strongly undulate in the upper part, from an ovate or broadly ovate, not to strongly auriculate base gradually to abruptly, short- to very long- and narrowly acuminate, either ending in a hairpoint or not; leaf margin almost entire to very strongly toothed or serrate, sometimes crenulate. Leaves isophyllous or heterophyllous, then the branch leaves mostly smaller, shorter and more gradually acuminate than the stem leaves. Leaf rib single, ending below apex or about midleaf, in the branch leaves sometimes faint or nearly absent. Leaf cells isodiametric to linear (up to 12 times as long as wide), towards base mostly more elongate, on both sides unipapillate over lumen or seriately papillate over lumen or on the cell walls, rarely smooth; border cells either differentiated or not; alar cells mostly few, sometimes hardly developed or numerous and large, quadrate to rectangular, smooth; cell walls rather thin to very incrassate and pitted.

Sporophyte lateral on the secondary stems or branches. Seta from

2 mm up to 5 cm long, smooth to strongly papillose. Capsule erect to inclined or horizontal, globular to oblong-cylindrical, sometimes curved, up to 3 mm long. Lid conical, obliquely rostrate. Peristome double. Exostome teeth 16, lanceolate-subulate, on a low basal membrane, mostly yellowish, with a median line, more or less trabeculate, papillose towards the ends. Endostome teeth 16, on a high or rather low, smooth to strongly papillose basal membrane, in most genera of about the same length or somewhat shorter than the exostome teeth, in *Trachypus* however short and more or less rudimentary. Cilia present or absent. Calyptra cucullate and naked or mitriform with numerous hairs. Spores mostly subglobular, more or less papillose, small to large, up to 45 μ in diameter.

History of the family up to the present paper.

The first description of the *Trachypodaceae* was made by Fleischer, Hedwigia 45(1905)63, with 3 genera: *Trachypus* Reinw. et Hornsch., *Trachypodopsis* Fleisch. and *Diaphanodon* Ren. et Card.

Brotherus, Nat. Pfl. 1, 3(1906)827, regards the present family within the family of the *Neckeraceae* as a subfamily, *viz.* the *Trachypodeae*. Afterwards, Nat. Pfl. ed. 2, 11(1925)117, he follows the conception of Fleischer and regards the taxon as to be a separate family.

The section *Pseudo-Spiridentopsis* Broth. of the genus *Trachypodopsis* was raised to generic rank by Fleischer, Musci Fl. Buitenzorg 3(1908)730, and as a genus was called *Pseudospiridentopsis* (Broth.) Fleisch.

In 1923 Fleischer transfers the genus *Duthiella* Broth. (before mostly grouped within the family of the *Leskeaceae* or *Thuidiaceae*) to the family of the *Trachypodaceae*, Musci Fl. Buitenzorg 4(1923)1495, and in 1940 Potier de la Varde and Thériot add the new genus *Pseudotrachypus* P. Vard. et Thér. to the family, Mem. Soc. Nat. Fel. Poey Cubana 14, 4(1940)357.

Up to the present paper the family of the *Trachypodaceae* consisted consequently of the following 6 genera:

1 **Trachypus** Reinw. et Hornsch.
2 **Trachypodopsis** Fleisch.
3 **Diaphanodon** Ren. et Card.
4 **Pseudospiridentopsis** (Broth.) Fleisch.
5 **Duthiella** Broth.
6 **Pseudotrachypus** P. Vard. et Thér.

Relationships.

Fleischer, Hedwigia 45(1905)63; Fleischer, Musci Fl. Buitenzorg 3 (1908)728; ibid. 4(1923)1495; Reimers, Hedwigia 76(1937)211, 212.

Fleischer says about the relationships of the *Trachypodaceae* (l. c. 1905 and 1908, consequently exclusive of the genus *Duthiella*!) the following: "Diese characteristische Gruppe kann (wie auch z. B. die *Lepyrodonteen* und *Cyrtopodeen*) nicht ohne Zwang bei einer der bestehenden Familien eingereiht werden, auch nicht bei den *Neckeraceen*, wie es bis jetzt üblich war; sie ist vielmehr durch *Trachypodopsis* mit den *Prionodontaceen* ver-

wandt. Die Sporogone sowie der Blattcharacter der typischen *Trachypus*-Arten, (*T. bicolor* etc.) sind ganz eigenartig; durch die in dichten Reihen auf den Zellpfeilern stehenden Papillen haben sie einige Analogieen zu gewissen *Papillarien*, die doch wieder erheblich durch die Sporogone und Tracht abweichen. Die Gattungen dieser Familie repräsentieren zwei verschiedene Entwicklungsreihen; die verwandtschaftlichen Beziehungen gehen einerseits von den *Leucodonten* und *Prionodontaceen* über die Gattung *Trachypodopsis* durch *Diaphanodon* zu den *Leskeaceen*, andererseits fehlen bei *Trachypus* nicht Andeutungen, die es wahrscheinlich machen, dass der Ursprung der Familie auf die *Macromitrieen* zurückzuführen ist."

About the genus *Duthiella* Fleischer remarks (l. c. 1905 and 1908): "Die im Himalaya vorkommende Gattung *Duthiella* Geh. et C. Muell. nähert sich im Blattcharacter sehr den *Trachypodaceen*, doch ist sie habituell durch den sporogontragenden Hauptstengel und durch die geneigte Kapsel, die lange Seta und das Hypnumperistom so abweichend, dass sie besser in die Nähe der *Leskeeen* gestellt wird." Afterwards however (l. c. 1923) Fleischer transfers the genus *Duthiella* to the family of the *Trachypodaceae:* "Die Gattung *Duthiella* aus dem Himalaya und Ostasien ist doch richtiger aus den *Leskeaceen* oder *Thuidiaceen* ganz auszuscheiden und den *Trachypodaceen* anzuschliessen, da sie sich z. B. durch *Duthiella Wallichii* direct an die *Trachypodopsis*-arten anschliesst." Whether the place of the genus *Duthiella* within the family of the *Trachypodaceae* is the right one is difficult to ascertain (*cf.* Reimers, l. c. p. 212 and *Duthiella*, relationships).

The hanging habit and the shape of the auricles of some *Trachypodopsis* species may argue relationships with the family of the *Meteoriaceae.*

Relationships within the family.

See the various genera.

Geographical distribution.

The family has its geographical centre in South-East Asia, with radiations into Australia, Oceania, Central and South Africa and into Central and South America (Plate I, Map 1).

Three of the genera, *viz. Diaphanodon, Pseudospiridentopsis* and *Duthiella* are restricted to South-East Asia.

Ecology.

On trees, rocks or growing terrestrial from low up to high altitude.

Key to the genera

1. Leaf cells unipapillate or seriately papillate over lumen, rarely smooth.
   2. Plants robust to very robust; stems simple or remotely, irregularly branched; leaves from a sheathing, auriculate base strongly reflexed, up to 9 mm long; seta up to 3 mm long, smooth; capsule ovoidal, erect
      4. Pseudospiridentopsis (Broth.) Fleisch.

2. Plants very slender to robust; stems remotely to densely, irregularly of regularly pinnately or bipinnately branched; leaves up to 7 mm long.
   3. Stem and branch leaves strongly dimorphous; stems densely, more or less regularly pinnately or bipinnately branched.
      4. Leaf cells subisodiametric to elongate (up to 6 times as long as wide); stems mostly bipinnately branched (*D. blandus*) **3. Diaphanodon** Ren. et Card.
      4. Leaf cells linear (up to 12 times as long as wide); stems pinnately branched . . . . . **6. Pseudotrachypus** P. Vard. et Thér.
   3. Stem and branch leaves not or faintly dimorphous; stems irregularly pinnately branched.
      5. Plants with capsules.
         6. Seta smooth, up to 5 cm long; capsule curved, oblong-cylindrical; endostome with a high basal membrane; cilia 3 **5. Duthiella** Broth.
         6. Seta papillose, up to 18 mm long; capsule erect, subglobular to ovoidal; endostome with a low or rather well-developed basal membrane; cilia absent.
            7. Seta up to 2 mm long; basal membrane of the endostome rather well-developed; leaves not auriculate **3. Diaphanodon** Ren. et Card.
            7. Seta up to 18 mm long; basal membrane of the endostome low; leaves mostly auriculate . . . . **2. Trachypodopsis** Fleisch.
      5. Plants without ripe capsules.
         8. Leaf cells subisodiametric; leaves not auriculate; leaf margin faintly to moderately serrate.
            9. Leaves rather long-acuminate; leaf border clearly differentiated, mostly recurved (*D. procumbens*) . . **3. Diaphanodon** Ren. et Card.
            9. Leaves mostly rather short-acuminate; leaf border not or faintly differentiated, plane . . . . . **5. Duthiella** Broth.
         8. Leaf cells elongate to linear (3—10 times as long as wide); leaves either auriculate or not; leaf margin faintly to strongly serrate.
            10. Leaves not auriculate. rather short- to rather long-acuminate, not or faintly longitudinally plicate.
               11. Leaf cells up to 10 times as long as wide, unipapillate over lumen; cell walls somewhat incrassate (*T. serrulata var. serrulata*) . . . . . **2. Trachypodopsis** Fleisch.
               11. Leaf cells up to 6 times as long as wide, unipapillate over lumen or up to 10 times as long as wide, but then the leaf cells seriately papillate over lumen; cell walls rather thin (rarely incrassate: *Duthiella robusta*) . . **5. Duthiella** Broth.
            10. Leaves strongly to faintly auriculate, rather long- to very long-acuminate, faintly to strongly longitudinally plicate.
               12. Leaves faintly auriculate, faintly to moderately longitudinally plicate.
                  13. Leaf cells up to 10 times as long as wide; cell walls somewhat incrassate (*T. serrulata var. serrulata*) **2. Trachypodopsis** Fleisch.
                  13. Leaf cells up to 6 times as long as wide; cell walls rather thin (*D. speciosissima*) . . . **5. Duthiella** Broth.
               12. Leaves strongly to rather strongly auriculate, mostly strongly longitudinally plicate . . . . **2. Trachypodopsis** Fleisch.

1. Leaf cells seriately papillate on the cell walls; seta up to 2.5 cm long, strongly papillose; capsule erect, globular to ovoidal; endostome teeth more or less rudimentary **1. Trachypus** Reinw. et Hornsch.

1. **Trachypus** Reinw. et Hornsch.

Reinwardt et Hornschuch, Nov. Act. Leop. Car. 14, 2 Suppl. (1829) 708; Brotherus, Nat. Pfl. 1, 3(1906)829; Fleischer, Musci Fl. Buitenzorg 3(1908)736; Brotherus, Nat. Pfl. ed. 2, 11(1925)118; Bartram, Philipp. J. Sc. 68(1939)193.

Dioicous; very slender to robust, greenish, brownish or blackish plants (often the whole plant blackish but yellowish-green at tips) in dull, dense to lax mats. Primary stems creeping, with tufts of blackish rhizoids and more or less scale-like lower leaves. Secondary stems from 1 up to 20 cm long, procumbent, ascending or somewhat hanging down, densely to remotely, irregularly or more or less regularly pinnately branched, rarely almost simple. Secondary stems and branches mostly densely foliate all around stem, sometimes more or less laxly, somewhat complanately foliate. Occasionally with few to numerous, longer or shorter flagelliform, rather laxly foliate branches, which break off easily. Central strand absent. Leaves appressed to horizontally spreading when dry, erect spreading to horizontally spreading when moist, rarely strongly recurved when dry, up to 5 mm long, plane to longitudinally plicate, sometimes crisped near apex or strongly undulate in the upper half, from an ovate or broadly ovate, *mostly not auriculate* base gradually or somewhat abruptly, short- to very long- and narrowly acuminate, neither ending in a hyaline hairpoint or not; leaf margin almost entire to moderately serrate in the upper half of the leaf, mostly crenulate. Leaves isophyllous or heterophyllous, then the stem leaves larger and longer acuminate than the branch leaves. Leaf rib single, rather strong and ending above midleaf or rather faint and ending in or below midleaf, branch leaves sometimes without rib. Leaf cells hexagonal to elongate or linear (2—12 times as long as wide), cells towards base mostly more elongate, *border cells mostly not differentiated*; alar cells few, quadrate to rectangular; cell walls *incrassate to very incrassate,* mostly *strongly crenulate by numerous papillae;* basal cells and rarely also the border cells in the upper half of the leaf smooth and more pellucid.

Sporophyte lateral on the secondary stems. Male gametoecia lateral on the secondary stems and branches, bud-shaped; perigamial leaves ovate, hollow, more or less blunt, short-apiculate, without rib; paraphyses few, shorter than the antheridia; antheridia thick, short-stalked. Female gametoecia lateral on the secondary stems, elongate-bud-shaped, large; inner perigamial leaves lanceolate, rather long-acuminate, faintly denticulate in the upper half, rib faint or absent; the outer leaves shorter acuminate; paraphyses rather numerous, of about the same length as the archegonia; archegonia bottle-shaped. Cells of the male and the female perigamial leaves elongate to linear, pellucid or somewhat opaque; cell walls incrassate and more or less crenulate by numerous papillae. Seta *1.5—2.5 cm* long, erect, sometimes somewhat flexuose, *strongly papillose,* reddish-brown or rather pale, contorted when dry. Vaginula cylindrical, smooth, with numerous rather long paraphyses and often with old, stalked archegonia. Perichaetial leaves large, from a sheating base somewhat abruptly or gradually long- and narrowly acuminate; rib faint, ending about midleaf; the outer perichaetial leaves smaller and more abruptly acuminate than the inner ones; aerolation as in the perigamial leaves. *Capsule globular to ovoid, erect,* up to 3 mm long, mostly with a more or less distinct neck, contracted below the mouth when dry, brownish or reddish; exothecium cells roundish to hexagonal or rectangular, in longitudinal rows, mostly somewhat incrassate, smaller towards the mouth, with small stomata near the neck. Lid conical, obliquely and long-rostrate. Peristome double. Exostome teeth 16, lanceolate-subulate,

with a median line, more or less trabeculate, papillose, pale-greenish or yellowish. Endostome processes on a rather low, papillose membrane, *more or less rudimentary,* without median line, papillose, much shorter than the exostome teeth; *cilia absent.* Calyptra *mitriform* or cucullate (*T. humilis,* fid. Bartram), with *numerous,* long, yellowish, somewhat nodose *hairs.* Spores medium sized, globular, papillose, about 20—25 μ in diameter, yellowish.

History of the genus up to the present paper.

The first description of the genus *Trachypus* was made by Reinwardt and Hornschuch when they described the new species *T. bicolor* Reinw. et Hornsch. from Java, Nov. Act. Leop. Car. 14, 2 Suppl. (1829)708. The authors did not indicate a family, but the genus was afterwards mostly placed within the family of the *Neckeraceae.* In 1905 Fleischer transferred the genus to the new family of the *Trachypodaceae,* Hedwigia 45(1905)64 and Musci Fl. Buitenzorg 3(1908)727, first described by him. Most authors follow this conception *e. g.* Brotherus in Nat. Pfl. ed. 2, 11(1925)118. Other authors however, among them Dixon, J. of Bot. 53(1915)290, maintain that the taxonomical position of the genus is within the *Neckeraceae.*

The following species and varieties have successively been added to the genus:

T. atratus Mitt. J. Linn. Soc. Bot. Suppl. 1(1859)129.
= **Aërobrydium punctulatum** (C. Muell.) Dix.

T. auriculatus Mitt. J. Linn. Soc. Bot. Suppl. 1(1859)129.
= **Trachypodopsis auriculata** (Mitt.) Fleisch.

T. blandus (Harv.) Mitt. J. Linn. Soc. Bot. Suppl. 1(1859)127.
= **Diaphanodon blandus** (Harv.) Ren. et Card.

T. brevirameus (C. Muell.) Mitt. J. Linn. Soc. Bot. Suppl. 1(1859)129.
= **Meteorium brevirameum** (C. Muell.) Broth.

T. buchanani (Brid.) Mitt. J. Linn. Soc. Bot. Suppl. 1(1859)129.
= **Meteorium buchanani** (Brid.) Broth.

T. cerinus Mitt. J. Linn. Soc. Bot. 4(1859)91.
= **Papillaria cerina** (Mitt.) Par.

T. crispatulus (Hook.) Mitt. J. Linn. Soc. Bot. Suppl. 1(1859)129.
= **Trachypodopsis crispatula** (Hook.) Fleisch.

T. cuspidiferus Mitt. J. Linn. Soc. Bot. Suppl. 1(1859)128.
= **Papillaria crocea** (Hamp.) Jaeg.

T. declinatus Mitt. J. Linn. Soc. Bot. Suppl. 1(1859)129.
= **Trachypodopsis declinata** (Mitt.) Fleisch.

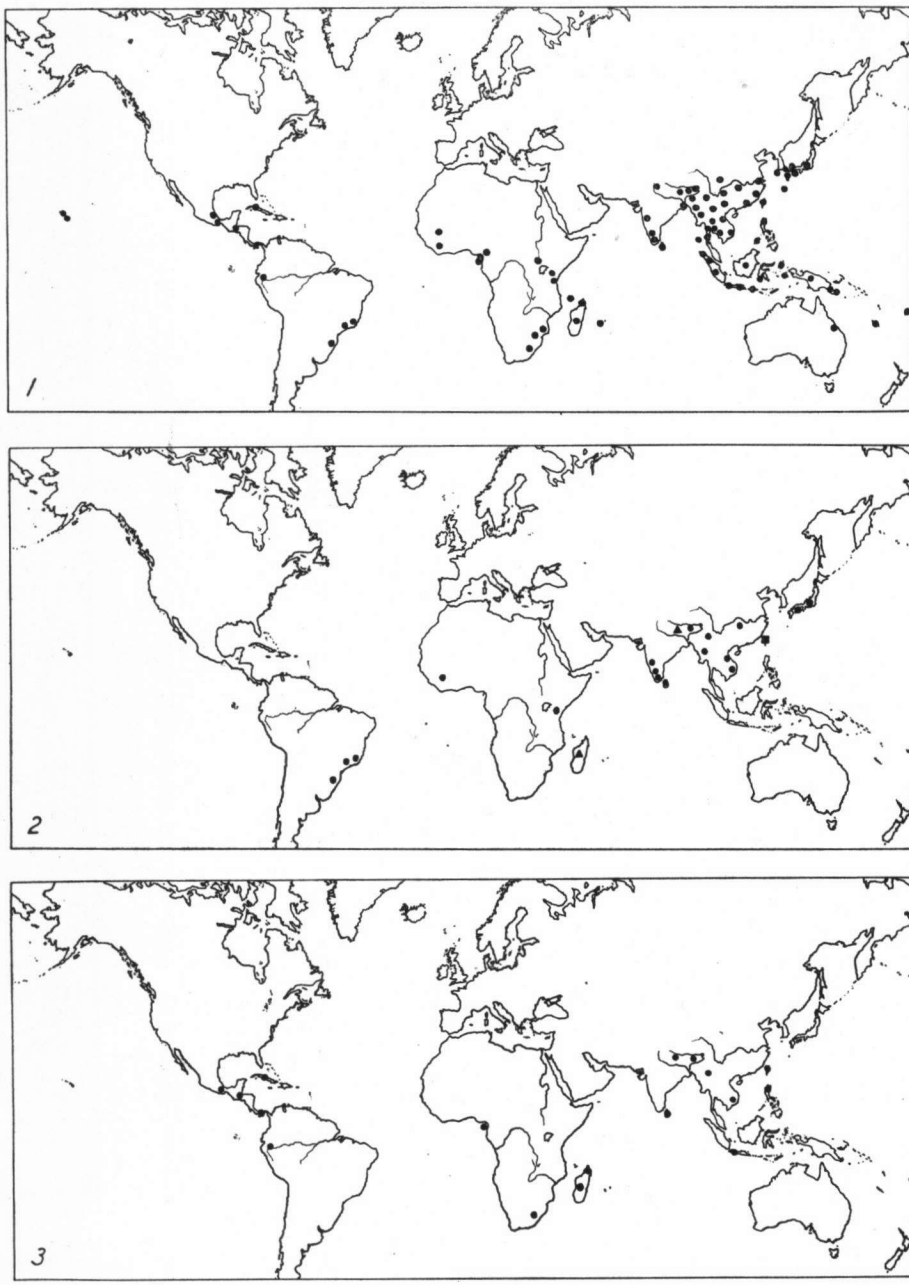


Plate I. — Map 1: Area of the family of the *Trachypodaceae*; Map 2: Area of *Trachypus bicolor* Reinw. et Hornsch. var. *hispidus* (C. Muell.) Card. (●), var. *scindifolius* (Sak.) Nog. (■) and of *Trachypus appendiculatus* (Ren. et Card.) Broth. (▲) (Madagascar and Himalaya, both without definite locality); Map 3: Area of *Trachypus bicolor* Reinw. et Hornsch. var. *viridulus* (Mitt.) Zant.

T. flexicaulis (Tayl.) Mitt. = **Papillaria flexicaulis** (Tayl.) Jaeg.	J. Linn. Soc. Bot. 4(1859)91.
T. fuscescens (Hook.) Mitt. = **Papillaria fuscescens** (Hook.) Jaeg.	J. Linn. Soc. Bot. Suppl. 1(1859)128.
T. harveyi Mitt. (orthogr. orig.: *harveii*) = **Papillaria semi-torta** (C. Muell.) Jaeg.	J. Linn. Soc. Bot. Suppl. 1(1859)128.
T. hornschuchii Mitt. = **Papillaria crocea** (Hamp.) Jaeg.	J. Linn. Soc. Bot. 4(1859)90.
T. plicaefolius (C. Muell.) Mitt. = **Meteorium miquelianum** (C. Muell.) Fleisch.	J. Linn. Soc. Bot. Suppl. 1(1859)129.
T. procumbens (C. Muell.) Mitt. = **Diaphanodon procumbens** (C. Muell.) Ren. et Card.	J. Linn. Soc. Bot. Suppl. 1(1859)127.
T. helictophyllus Mitt. = **Meteorium intricatum** Mitt.	Bonpl. 9(1861)366.
T. blandus (Harv.) Mitt. var. *thuiodes* Bosch. et Lac. = **Diaphanodon javanicus** Ren. et Card. f. **robustior** Ren. et Card.	Bryol. Jav. 2(1864)101.
T. nigrescens (Hedw.) Mitt. = **Papillaria nigrescens** (Hedw.) Jaeg.	J. Linn. Soc. Bot. 8(1864)45.
T. rugosus Lindb. = **Neolindbergia rugosa** (Lindb.) Fleisch.	Oefv. K. Vet. Akad. Foerh. 21, 10(1865)602.
T. humilis Lindb.	Act. Soc. Sc. Fenn. 10(1872)230.
T. nodicaulis (C. Muell.) Besch. (sometimes spelled: *nudicaulis*) = **Trachypodopsis nodicaulis** (C. Muell.) Fleisch.	Ann. Sc. Nat. Bot. 6, 10(1880)270.
T. perichaetiale (Hamp.) Besch. = **Papillaria perichaetialis** (Hamp.) Jaeg.	Ann. Sc. Nat. Bot. 6, 10(1880)270.
T. serrulatus (P. Beauv.) Besch. = **Trachypodopsis serrulata** (P. Beauv.) Fleisch.	Ann. Sc. Nat. Bot. 6, 10(1880)269.
T. rutenbergii C. Muell. = **Trachypodopsis rutenbergii** (C. Muell.) Fleisch.	Abh. Naturw. Ver. Bremen 7, 2(1881)209.
T. baviensis Besch.	J. de Bot. 4(1890)203.
T. massarti Ren. et Card.	Rev. Bryol. 23(1896)103.

T. ornans (Reich.) C. Muell. = **Trachypodopsis ornans** (Reich.) Fleisch.	Fl. 82(1896)465.
T. nietneri (C. Muell.) Par.	Ind. Bryol. (1898)1303.
T. hispidus (C. Muell.) Par. = **Trachypus bicolor** Reinw. et Hornsch. var. **hispidus** (C. Muell.) Card.	Ind. Bryol. (1898)1303.
T. himantophyllus Ren. et Card. = **Trachypodopsis himantophylla** (Ren. et Card.) Fleisch.	Bull. Soc. Roy. Bot. Belg. 38, 1(1900)22.
T. rigidus Broth. et Par. = **Trachypus bicolor** Reinw. et Hornsch. var. **rigidus** (Broth. et Par.) Card.	Bull. Herb. Boiss. 2, 2(1902)926.
T. normandi Broth. et Par. = **Trachypodopsis normandi** (Broth. et Par.) Fleisch.	Rev. Bryol. 29(1902)68.
T. flaccidus Card. = **Duthiella flaccida** (Card.) Broth.	Beih. Bot. Centralbl. 19, 2(1905)117.
T. subbicolor Card.	Beih. Bot. Centralbl. 19, 2(1905)117.
T. bicolor Reinw. et Hornsch. var **rigidus** (Broth. et Par.) Card.	Beih. Bot. Centralbl. 19, 2(1905)116.
T. bicolor Reinw. et Hornsch. var. **hispidus** (C. Muell.) Card.	Beih. Bot. Centralbl. 19, 2(1905)116.
T. viridulus (Mitt.) Broth.	Nat. Pfl. 1, 3(1906)830.
T. appendiculatus (Ren. et Card.) Broth.	Nat. Pfl. 1, 3(1906)829.
T. molleri (C. Muell.) Broth.	Nat. Pfl. 1, 3(1906)830.
T. laetus (Ren. et Card.) Broth.	Nat. Pfl. 1, 3(1906)829.
T. paulensis (Broth.) Broth.	Nat. Pfl. 1, 3(1906)830.
T. sinensis (C. Muell.) Par. = **Trachypus bicolor** Reinw. et Hornsch. var **sinensis** (C. Muell.) Broth.	Ind. Bryol. ed. 2, 5(1906)64.
T. appressus Fleisch.	Musci Fl. Buitenzorg 3(1908)737.
T. bicolor Reinw. et Hornsch. var. **pilifer** Fleisch.	Musci Fl. Buitenzorg 3(1908)741.
T. bicolor Reinw. et Hornsch. var. **tenellus** Fleisch.	Musci Fl. Buitenzorg 3(1908)741.
T. cuspidatus Fleisch.	Musci Fl. Buitenzorg 3(1908)741.
T. cuspidatus Fleisch. var. **brevifolia** Fleisch.	Musci Fl. Buitenzorg 3(1908)743.
T. massarti Ren. et Card. var. **brachyphyllus** Fleisch.	Musci Fl. Buitenzorg 3(1908)745.
T. novae-caledoniae Thér.	Bull. Acad. Int. Géogr. Bot. 20(1910)101.

T. tenerrimus Herz.	Hedwigia 50(1910)135.
T. tenerrimus Herz. var. **flagelliferus** Herz.	Hedwigia 50(1910)136.
T. humilis Lindb. var. **brevifolius** Card.	Bull. Soc. Bot. Genève 3, 2(1911)276.
T. molliculus Broth. et Par.	Rev. Bryol. 38(1911)30.
T. rhacomitrioides Broth.	Sitzungsber. Akad. Wiss. Wien 1, 131(1922)214.
T. subpiliferus Card. ex P. Vard. nom. inval. = **Trachypus bicolor** Reinw. et Hornsch. var. **hispidus** (C. Muell.) Card.	Rev. Bryol. 50(1923)73.
T. bicolor Reinw. et Hornsch. var. **sinensis** (C. Muell.) Broth.	Nat. Pfl. ed. 2, 11(1925)119.
T. mauiensis Broth.	Bish. Mus. Bull. 40(1927)20 (erroneously as Trachypodopsis mauiensis Broth.).
T. dimorphus Dix. et P. Vard.	Ann. Crypt. Exot. 1, 1(1928)42.
T. bicolor Reinw. et Hornsch. var. **brevifolius** Broth.	Symb. Sin. 4(1929)76.
T. humilis Lindb. var. **major** Broth.	Symb. Sin. 4(1929)76.
T. pendulus Dix.	J. Bombay Nat. Hist. Soc. 39, 4(1937)780.
T. scindifolius Sak. = **Trachypus cuspidatus** Fleisch. var. **scindifolius** (Sak.) Nog.	Bot. Mag. Tokyo 55(1941)208.
T. obtusus Dix. et Thér. = **Anomodon giraldii** C. Muell.	Rev. Bryol. Lich. 13(1942)13.
T. perplicatus Dix.	Farl. 1, 1(1943)35.
T. bicolor Reinw. et Hornsch. var. **simplicicaulis** Dix.	Bryol. 46(1943)20.
T. longifolius Nog.	J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)55.
T. cuspidatus Fleisch. var. **scindifolius** (Sak.) Nog.	J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)53.
T. humilis Lindb. var. **gracilis** Nog.	J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)55.
T. bicolor Reinw. et Hornsch. var. **floribundarioides** Nog.	J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)53.

The species and varieties printed in italics have again been transferred to other genera or have become a variety of another *Trachypus* species.

Up to the present paper the genus *Trachypus* consisted also of 22 validly published species with 15 varieties.

Type species is *T. bicolor* Reinw. et Hornsch.

Notes.

1. *Trachypus feae* C. Muell. nom. nud., Nuov. Giorn. Bot. Ital. 23, 4(1891)601, has been described and transferred to the genus *Papillaria* as *P. feae* C. Muell. ex Fleisch. by Fleischer, Musci Fl. Buitenzorg 3(1908)761.
2. *Trachypus grossiserratus* C. Muell. nom. nud., Nuov. Giorn. Bot. Ital. 23, 4(1891) 601, has been transferred to the genus *Trismegistia* as *T. grossiserrata* (C. Muell.) Fleisch. nom. nud. by Fleischer, Hedwigia 61(1920)404.
3. *Trachypus eriocladioides* C. Muell. nom. nud. (= *Trachypodopsis eriocladioides* (C. Muell.) Fleisch. nom. nud.; Fleischer, Hedwigia 45(1906)68), has been transferred to the genus *Aërobryopsis* as *A. eriocladioides* (C. Muell.) Fleisch. nom. nud. by Fleischer, Hedwigia 61(1920)404.
4. *Trachypus funiformis* C. Muell. nom. nud. is conspecific with *Papillaria bamforthiae* Broth. ex Dix., fid. Dixon, J. of Bot. 50(1912)148.
5. I have not been able to get any material of *Trachypus maisorensis* Broth. nom. nud., mentioned by Paris, Ind. Bryol. Suppl. (1900)322.

Relationships.

Fleischer, Hedwigia 45(1905)63; Fleischer, Musci Fl. Buitenzorg 3(1908)728.

The genus *Trachypus* is clearly distinguished from most other genera on account of its numerous seriate papillae *on the cell walls.* As far as I know only in some species of the genus *Papillaria, e. g. P. fuscescens* (Hook.) Jaeg. and some allied species, this also occurs. These species differ however on account of their pendulous habit and their strongly auriculate leaf base. Moreover the sporophytes are quite different.

Relationships within the genus.

Fleischer, Musci Fl. Buitenzorg 3(1908)737, 744; Brotherus, Nat. Pfl. ed. 2, 11(1925)119.

The genus was divided into 2 sections by Fleischer (l. c.) with the following key.

1. Plants robust, in lax mats; secondary stems remotely pinnately branched, up to 15 cm long, occasionally hanging down; stem and branch leaves not or slightly differentiated . . . . . Section **Eutrachypus** Fleisch.
1. Plants slender, with the habit of *Leskea*, in dense mats; secondary stems densely pinnately branched, procumbent, short, with numerous flagellae; stem and branch leaves rather strongly differentiated . . . . Section **Microtrachypus** Fleisch.

To the section *Eutrachypus* there belonged, according to Fleischer, 4 species: *viz. T. appressus* Fleisch., *T. bicolor* Reinw. et Hornsch., *T. cuspidatus* Fleisch. and *T. nietneri* (C. Muell.)Par. and to the section *Microtrachypus* 2 species: *viz. T. massarti* Ren. et Card. and *T. laetus* (Ren. et Card.)Broth.

Type species of the section *Microtrachypus* was *T. massarti.*

According to Brotherus (l. c.) the following species belonged to the section Microtrachypus:

T. massarti Ren. et Card.
T. novae-caledoniae Thér.

and to the section Eutrachypus:

T. paulensis (Broth.) Broth.
T. viridulus (Mitt.) Broth.

T. tenerrimus Herz.
T. subhumilus Broth. nom. nud.
T. humilis Lindb.
T. laetus (Ren. et Card.) Broth.
T. appendiculatus (Ren. et Card.) Broth.
T. molliculus Broth. et Par.
T. molleri (C. Muell.) Broth.
T. bicolor Reinw. et Hornsch.
T. nietneri (C. Muell.) Par.
T. appressus Fleisch.
T. cuspidatus Fleisch.
T. rhacomitrioides Broth.

Sakurai added *T. scindifolius* Sak. to the secion *Eutrachypus,* Bot. Mag. Tokyo 55(1941)208, and Noguchi *T. longifolius* Nog. to the section *Microtrachypus,* J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)55.

Although the differences between the two sections in general are clear enough it is in my opinion not practical to divide the genus into the two sections, because they more or less gradually pass into each other. There occur for instance plants with the slender habit of section *Microtrachypus,* whereas the stem and branch leaves are hardly differentiated, and medium sized plants with strongly differentiated stem and branch leaves (*cf. T. humilis* Lindb. var. *humilis.* note 1a and 1c).

Note.

According to nomenclatural rules the name *Eutrachypus* is illegitimate and must be replaced by the sectional name *Trachypus.*

Excluded species.

Trachypus baviensis Besch. J. de Bot. 4(1890)203.
= **Chrysocladium spec.**
Trachypus pendulus Dix. J. Bombay Nat. Hist. Soc. 39, 4(1937)780.
= **Papillaria semitorta** (C. Muell.) Jaeg.
Trachypus erosus Besch. nom. nud.
= **Aërobryopsis longissima** (Doz. et Molk.) Fleisch.
Trachypus pilifolius Dix. nom. nud.
= **Floribundaria floribunda** (Doz. et Molk.) Fleisch.

Geographical distribution.

Herzog, Geogr. Moose (1926) 142, 268, 269, 340, 345, 346, 389.

The genus *Trachypus* is distributed over all the tropical regions of the world, but its geographical centre lies in South-East Asia. Only *T. bicolor* Reinw. et Hornsch. (the most variable species of the genus) occurs, besides in South-East Asia, also in the tropical regions of Africa and America. Besides in South-East Asia, *T. humilis* Lindb. is also found in the Hawaiian Islands and *T. appendiculatus* (Ren. et Card.) also in Madagascar.

T. bicolor is a very common species in the mountain forests of South-

East Asia; in tropical Africa and America the species appears to be much less common.

T. humilis is found much less frequently, but may often have been overlooked.

The other *Trachypus* species have been found only once or just a few times.

Ecology.

On trees, sometimes on rocks or growing terrestrial, from low altitudes up to 3300 m.

Key to the species

1. Plants fairly slender to robust; stem and branch leaves not or scarcely differentiated; leaf rib rather strong, ending above midleaf; plants with or without any black colouring.
   2. Leaves strongly undulate in the upper half.
      3. Leaves strongly falcate-second; plants without any black colouring **1d. T. bicolor** Reinw. et Hornsch. var. **scindifolius** (Sak.) Nog.
      3. Leaves not or faintly falcate-second; plants with black colouring **2. T. perplicatus** Dix.
   2. Leaves not or faintly undulate.
      4. Leaves strongly recurved when dry, with small, but distinct auricles; leaf margin in the upper half of the leaf moderately serrate; plants medium sized **3. T. appendiculatus** (Ren. et Card.) Broth.
      4. Leaves not strongly recurved, not or very rarely auriculate; leaf margin entire to faintly denticulate; plants fairly slender to robust **1. T. bicolor** Reinw. et Hornsch.

1. Plants slender to very slender; stem and branch leaves mostly sharply differentiated; leaf rib rather faint, ending in or below midleaf or absent; plants rarely with black colouring.
   5. Leaves very long- and narrowly acuminate; branches attenuate; plants with numerous, long, flagelliform branches . . . . . **5. T. longifolius** Nog.
   5. Leaves longer or shorter, but never very long- and narrowly acuminate; branches often hamate by crowded apical leaves; plants without or with rather few, fairly short flagelliform branches . . . . . **4. T. humilis** Lindb.

1. **Trachypus bicolor** Reinw. et Hornsch.

For literature and type specimens see below.

Dioicous; fairly slender to robust, greenish, brownish or blackish plants (often the whole plant *blackish*, but *yellowish-green at tips*) in dull, rather dense to lax mats. Primary stems creeping, with tufts of blackish rhizoids and more or less scale-like lower leaves. Secondary stems from 2 up to 20 cm long, procumbent, hanging down or somewhat ascending, rather densely pinnately to remotely, irregularly pinnately branched, sometimes almost simple. Central strand absent. Secondary stems and branches mostly densely foliate all around stem, sometimes more or less laxly, somewhat complanately foliate. Often with rather long, flagelliform, mostly laxly foliate branches with small, horizontally spreading leaves without or with a short rib. Leaves appressed to horizontally spreading when dry, erect spreading to horizontally spreading when moist, from *1.5 up to 5 mm* long, sometimes distinctly falcate-second, plane to longitudinally plicate, occasion-

ally crisped near apex, from an ovate or broadly ovate, not or rarely faintly auriculate base gradually or somewhat abruptly longer or shorter acuminate, either ending in a hyaline hairpoint or not; leaf margin *entire to faintly denticulate,* crenulate. Branch leaves often somewhat shorter than the stem leaves and sometimes with a somewhat less distinct hairpoint (if present). Leaf rib single, ending *above midleaf* or towards apex. Leaf cells hexagonal to elongate, 2—8 times as long as wide, more elongate towards base, border cells not differentiated, alar cells few, quadrate to rectangular; cell walls incrassate to strongly incrassate, mostly very strongly crenulate by numerous low, flat papillae; cell walls of the basal cells mostly smooth.

Sporophyte as in the diagnosis of the genus.

This species is a very variable one with 4 varieties which may be distinguished by the following key:

1. Plants fairly slender to medium sized, greenish or brownish, not blackish; stems flaccid, mostly rather laxly foliate; leaves horizontally spreading when dry, up to 3 mm long . . . . . **1c. var. viridulus** (Mitt.) Zant.
1. Plants fairly slender to robust, mostly blackish below, yellowish-green at tips, occasionally the whole plant brownish-green or green; stems rigid, densely foliate; leaves appressed to horizontally spreading, occasionally distinctly falcate-second when dry, up to 5 mm long.
   2. Plants fairly slender to medium sized; stems rather short, up to 6 cm long; leaves mostly more or less appressed, up to 3 mm long **1b. var. hispidus** (C. Muell.) Card.
   2. Plants medium sized to robust; stems up to 20 cm long; leaves appressed to horizontally spreading, occasionally distinctly falcate-second, up to 5 mm long.
      3. Leaves undulate in the upper part, distinctly falcate-second; easily tearing; plants without any black colouring . . **1d. var. scindifolius** (Sak.) Nog.
      3. Leaves not or faintly undulate, mostly not falcate second and less easily tearing; plants with or without black colouring . . . **1a. var. bicolor**

There occur many plants which are more or less intermediate between these varieties.

1a. Trachypus bicolor Reinw. et Hornsch. var. **bicolor.** — Plate II, Fig. 1. Plate III, Map 1.

Trachypus bicolor Reinw. et Hornsch., Nov. Act. Leop. Car. 14, 2, Suppl. (1829)708; Schwaegrichen, Spec. Musc. Suppl. 4(1842) tab. 318; Mitten, J. Linn. Soc. Bot. Suppl. 1(1859)127; van den Bosch and van der Sande Lacoste, Bryol. Jav. 2(1864)98; Geheeb, Rev. Bryol. 21(1894)83; Paris, Ind. Bryol. (1898)1302; Warburg, Monsunia 1(1899)50; Cardot, Rev. Bryol. 28(1901)115; Salmon, J. of Bot. 40(1902)3; Cardot, Beih. Bot. Centralbl. 19, 2(1905)116; Brotherus, Nat. Pfl. 1, 3(1906)830; Paris, Ind. Bryol. ed. 2, 5(1906)63; Fleischer, Musci Fl. Buitenzorg 3(1908)738; Okamura, J. Coll. Sc. Imp. Univ. Tokyo 36(1915)19; Moeller, Hedwigia 60(1919)321; Brotherus, Nat. Pfl. ed. 2, 11(1925)119; Brotherus, Bish. Mus. Bull. 40(1927)20 (erroneously as Trachypodopsis); Brotherus, Symb. Sin. 4(1929)76; Dixon and Greenwood, Proc. Linn. Soc. New S. Wales 55(1930)285; Bruehl, Rec. Bot. Surv. India 13, 1(1931)67; Bartram, Bish. Mus. Bull. 101(1933)162; Sakurai, Bot. Mag. Tokyo 47(1933)335; Dixon, J. Bombay Nat. Hist. Soc. 39(1937)780; Bartram, Philipp. J. Sc. 68(1939)194; Bartram, Farl. 1, 2 (1943)179; Noguchi, J. Hattori Bot. Lab. 5(1951)16; Froehlich, Ann. Naturh. Mus. Wien 59(1953)90; Bartram, Rev. Bryol. Lich. 23(1954)250; Froeh-

lich, Arch. Hydrobiol. Suppl. 21, 3/4(1955)322; Bartram, Britt. 9, 1(1957) 45; Noguchi and Hattori, J. Hattori Bot. Lab. 19(1958)130.

Pilotrichum trachypus C. Muell. nom. illeg.: C. Mueller, Syn. 2 (1851)162.

Neckera trachypus (C. Muell.) C. Muell. nom. illeg.: C. Mueller, Syn. 2(1851)672.

Papillaria bicolor (Reinw. et Hornsch.) Jaeg.: Ber. S. Gall. Naturw. Ges. 1875/76(1877)273 = Ad. 2(1877)177.

Neckera nietneri C. Muell., Linn. 36(1869)25.

Papillaria nietneri (C. Muell.) Jaeg., Ber. S. Gall. Naturw. Ges. 1875/76 (1877)273 = Ad. 2(1877)177.

Trachypus nietneri (C. Muell.) Par. syn. nov.: Paris, Ind. Bryol. (1898) 1303; Brotherus, Nat. Pfl. 1, 3(1906)830; Paris, Ind. Bryol. ed. 2, 5(1906) 64; Fleischer, Musci Fl. Buitenzorg 3(1908)744; Dixon, J. of Bot. 53(1915) 290; Brotherus, Nat. Pfl. ed. 2, 11(1925)119; Bruehl, Rec. Bot. Surv. India 13, 1(1931)67.

Papillaria sinensis C. Muell., Nuov. Giorn. Bot. Ital. 5, 2(1898)191; Fleischer, Musci Fl. Buitenzorg 3(1908)739.

Trachypus sinensis (C. Muell.) Par., Ind. Bryol. ed. 2, 5(1906)64; Cardot, Beih. Bot. Centralbl. 19, 2(1905)116; Brotherus, Nat. Pfl. 1, 3 (1906)829.

Trachypus bicolor Reinw. et Hornsch. var. *sinensis* (C. Muell.) Broth., Nat. Pfl. ed. 2, 11(1925)119; Brotherus, Symb. Sin. 4(1929)76; Sakurai, Bot. Mag. Tokyo 52(1938)131; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)52; Sakurai, Musc. Jap. (1954)100.

Trachypus appressus Fleisch. syn. nov.: Fleischer, Musci Fl. Buitenzorg 3(1908)737; Brotherus, Nat. Pfl. 1, 3(1909)1228; ibid. ed. 2, 11(1925)119; Bruehl, Rec. Bot. Surv. India 13, 1(1931)67.

Trachypus cuspidatus Fleisch. syn. nov.: Fleischer, Musci Fl. Buitenzorg 3(1908)741; Brotherus, Nat. Pfl. ed. 2, 11(1925)119; Bruehl, Rec. Bot. Surv. India 13, 1(1931)67; Noguchi, J. Hattori Bot. Lab. 5(1951)16; Bartram, Rev. Bryol. Lich. 23(1954)250.

Trachypus bicolor Reinw. et Hornsch. var. *pilifer* Fleisch. syn. nov.: Fleischer, Musci Fl. Buitenzorg 3(1908)741; Potier de la Varde, Rev. Bryol. Lich. 10(1938)141.

Trachypus bicolor Reinw. et Hornsch. var. *tenellus* Fleisch. syn. nov.: Fleischer, Musci Fl. Buitenzorg 3(1908)741; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)52.

Trachypus bicolor Reinw. et Hornsch. var. *simplicicaulis* Dix. syn. nov.: Dixon, Bryol. 46(1943)20.

Trachypus bicolor Reinw. et Hornsch. var. *floribundarioides* Nog. syn. nov.: Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)53.

Papillaria apophysata C. Muell. nom. nud.: Jaeger, Ber. S. Gall. Naturw. Ges. 1875/76(1877)274 = Ad. 2(1877)178; Paris, Ind. Bryol. (1897)901.

Neckera apophysata (C. Muell.)? nom. nud.

Trachypus apophysata (C. Muell.) Lac. nom. nud.

Brachydon patens Hornsch. nom. nud.: Fleischer, Musci Fl. Buitenzorg 3(1908)738.

Type specimens: *Trachypus bicolor* Reinw. et Hornsch.: Java,

leg. Zip(p)elius, 2-1827; neotype in L. — *Trachypus nietneri* (C. Muell.) Par.: Ceylon, leg. ?; type probably lost. — *Trachypus sinensis* (C. Muell.) Par.: China, Shen-si, Mt. Kuan-tou-san, leg. Giraldi, 5-11-1896; lectoisotype in PC. — *Trachypus appressus* Fleisch.: West-Java, Mt. Pangerango, leg. Fleischer, 19-7-1898, No. 374a; lectotypes in L and U. — *Trachypus cuspidatus* Fleisch.: West-Java, Mt. Gedeh, Kandang Badak, leg. Fleischer, 28-3-1902, No. 426; holotype in FH, isotypes in GRO, L and U. — *Trachypus bicolor* Reinw. et Hornsch. var. *pilifer* Fleisch.: Java, Mt. Praoe, Diëngplateau, leg. Fleischer, 22-4-1901; holotype in FH. — *Trachypus bicolor* Reinw. et Hornsch. var. *tenellus* Fleisch.: West-Java, Mt. Gedeh, Tjibeurum, leg. Fleischer; holotype in FH. —*Trachypus bicolor* Reinw. et Hornsch. var. *simplicicaulis* Dix.: West-Java, Mt. Patoeha, leg. Verdoorn, 7-1930, isotype in L. — *Trachypus bicolor* Reinw. et Hornsch. var. *floribundarioides* Nog.: Japan, Honshiu, Mt. Hakone, leg. Bo, 6-1931, No. 4178; isotype in herb. Noguchi.

Medium sized to *robust* plants, mostly *black* or dark brown below, *yellowish-green at tips.* Stems rather densely pinnately to remotely, irregularly pinnately branched or almost simple, mostly *rigid* and *densely foliate*, up to *20 cm* long. Leaves appressed to horizontally spreading when dry, occasionally slightly falcate-second, up to *5 mm* long.

INDONESIA: Java: Mt. Pangerango and Gedeh: leg. Beccari, 1872, No. 14, c.fr. and No. 23 (FI); leg. Beccari, 1875, No. 52 (FI); leg. Docters van Leeuwen, 6-1919, No. 149, c.fr. (GRO, L); leg. Docters van Leeuwen, 9-1921, No. 5585, c.fr. (GRO, L); leg. Docters van Leeuwen, 12-1929, No. 12995, c.fr. (GRO, L); leg. Fleischer, 14-7-1898, No. 45 (GRO, L, U); leg. Fleischer, 19-7-1898, No. 374a (L, U, T. appressus, lectotype); Kandang Badak, leg. Fleischer, No. 1992 (L); Kandang Badak, leg. Fleischer, 28-3-1902, No. 426 (FH, c.fr., T. cuspidatus, holotype; GRO, L, U, isotypes); Tjibodas, leg. Fleischer (FH); Tjibeurum, leg. Fleischer (FH, T. bicolor var. tenellus holotype); leg. van Gesker (L); leg. Kurz, 19-2-1861, No. 437 (L, c.fr. and H); above Tugu, leg. Meyer, 3/4-10-1952, No. B 3394 (GRO, L); Mandalawangi, leg. Meyer, 20-3-1953, No. B 918, c.fr. (GRO, L); Mandalawangi, leg. Meyer, 30-3-1953, No. B 890 (L); Kandang Badak, leg. Meyer, 29-7-1953, No. B 4247, c.fr. (L); leg. Moeller, 26-4-1897, No. 133, c.fr. (H); Kandang Badak, leg. Noerta, 12-5-1949, No. 411 (GRO); Natural Reserve, leg. Noerta, 13-5-1949, No. 495, c.fr. (GRO); Natural Reserve, leg. Noerta, 13-5-1949, No. 467, 488, 547, 567 and 614 (GRO); Natural Reserve, leg. Noerta, 14-5-1949, No. 651 (GRO); Natu, leg. Noerta, 13-5-1949, No. 567 (GRO); leg. van der Sande Lacoste, 1873 (L); above Tjibodas, leg. Schiffner, 24-4-1894, No. 10843 (L); above Tjibeurum, leg. Schiffner, 28-4-1894, No. 10844 (L); above Tjibeurum, leg. Schiffner, 2-5-1894, No. 10860 (L); above Kandang Badak, leg. Schiffner, 4-7-1894, No. 10849 (L); Tjibodas-Tjibeurum, leg. Verdoorn, 6-8-1930, No. 30 (L, c.fr. and GRO); leg. Wichura, 5-12-1861, No. 2439c, c.fr. (H); Kandang Badak, leg. van der Wijk, 19-3-1952, No. 483 and 510 (GRO); above Kandang Badak, leg. van der Wijk, 6-5-1952, No. 1031, 1052 and 1054 (GRO); leg. Zip(p)elius, 2-1827, c.fr. (L, neotype); coll. de Vriese, c.fr. (L); ex herb. van Hall (L); ex herb. Bondam (L). Buitenzorg: leg. Treub, 3-1897 (L); Miquel, c.fr. (L). Rawa Denok: leg. Noerta and Soekar, 8-9-1949, No. 2396 (GRO); Mt. Masigit: leg. Noerta and Soekar, 9-9-1949, No. 2464, 2510 and 2543 (GRO); Mt. Patoeha: leg. Verdoorn, 7-1930, No. 49 (L, U, T. bicolor var. simplicicaulis, isotypes). Mt. Malabar: leg. Pulle, 6-1906, No. 9, c.fr. (U); leg. Verdoorn, 7-1930, No. 61 (GRO, L); leg. Wichura, c.fr. (FH, T. bicolor var. tenellus). Mt. Wayang: leg. Junghuhn, c.fr. (L). Mt. Praoe: Diëngplateau, leg. Fleischer, 22-4-1901, No. 374b (L); Diëngplateau, leg. Fleischer, 22-4-1901 (FH, T. bicolor var. pilifer, holotype); Wonosobo, leg. Fleischer, (FH, T. cuspidatus). Mt. Meraboe: leg. Junghuhn, c.fr. (L). Mt. Lawoe: leg. Verdoorn, 6-1930, No. 40 (GRO, L). Mt. Ardjoeno: leg. Skottsberg, 9-6-1929 (FH). And many specimens from Java without definite locality. — Lombok: Mt. Rindjani: leg. Elbert, 3-5-1909, No. 959 (L); leg. Elbert, 11-5-1909, No. 1294 (L); leg. Elbert, 19-6-1909, No. 2306 (L). — Ceram: leg. de Vriese (L).

— Celebes: Mt. Bonthain, leg. Warburg, c.fr. (FH, H); Bua Kraeng (one of the summits of Mt. Bonthain), leg. Fruhstorfer, 1895 (PC). — Borneo: leg. Korthals, No. 50 (L); leg. Korthals, c.fr. (L). — Sumatra: Mt. Singgalang, leg. Beccari, 7-1878 (L); Mt. Singgalang, leg. Schiffner, 25-7-1894, No. 10852 (L); Mt. Marapi, leg. van der Wijk, 10-6-1952, No. 1464 (GRO); Berastagi, leg. Arens, 20-4-1930, No. 387 (GRO, L); Berastagi, leg. Staal, 23-3-1950, No. 372 (GRO); Padang, leg. Wiltens, 1859 (L).

PHILIPPINE ISLANDS: Luzon: Subprov. of Benguet: Mt. Pauai, leg. Merrill, 10/11-1905, No. 4955, c.fr. (H, L); Mt. Pauai, leg. Merrill, 5-1909, No. 6679 (H); leg. Santos, 6-1918, No. 32055 (GRO, L); Distr. of Lepanto: Mt. Data, leg. Merrill, 11-1905, No. 4902, c.fr. (GRO, L); Mt. Data, leg. Merrill, 11-1905, No. 4971, c.fr. (L); Mt. Data, leg. Bacani, 1-1909, For. Bur. No. 16013, c.fr. (H); Mt. Lamunan, leg. Micholitz, 4-1910 (L).

HAWAIIAN ISLANDS: Maui: leg. Baldwin, 12-1876, No. 170 (H); Mt. Haleakala, leg. Baldwin, 1885, No. 284 (H, T. haleakalae).

JAPAN: Honshiu: Prov. of Kotsuke: Mt. Akagi, leg. T(s)unoda, 1-4-1910, No. 1344 and 1548 (H); Mt. Myogi, leg. Sakurai, 12-7-1912, No. 504 (H); Prov. of Sagami: Mt. Hiru, leg. Sasaoka, 3-10-1926, No. 2605 (H); Prov. ?, Mt. Hakone, leg. Bo, 6-1931, No. 4178 (herb. Noguchi, T. bicolor var. floribundarioides, isotype). — Kiushiu: Kumamoto, leg. Mayebara, 3-1952, ser. 7 No. 350 (GRO, L).

CHINA: Shen-si: Mt. Kuan-tou-san, leg. Giraldi, 5-11-1896, No. 2271 (PC, T. sinensis, lectoisotype); Mt. Thae-pei-san, leg. Giraldi, 8-9-1897, No. 1654 (H, T. sinensis); leg. Giraldi (FH, T. sinensis, probably one of the last named specimens).

NEPAL: near Khatmandu, leg. Rana, 2/3-1900, No. 2165 (H).

INDIA: Sikkim: leg. Kurz, 18-10-1868, No. 2243 (H); Tangloo, leg. Kurz, No. 2096 (H, c.fr. and L, respectively Neckera apophysata and T. apophysatus). — N.W. Himalaya: herb. Falcour (H); Sinchul, leg. Wichura, 19-4-1862, No. 2891b, c.fr. (H). — Himalaya without definite locality: ex herb. Ind. Or. Hook. f. et Thoms., No. 842 (H, L) and No. 845 (L). — Nilgiris: ex herb. Ind. Or. Hook. f. et Thoms., No. 36, c.fr. (L); ex herb. van den Bosch (L). — Madura: Palni Hills: Kodaikanal, leg. Foreau, 1911, No. 37 (PC, T. hispidus); Kodaikanal, leg. Foreau, 1953, No. 63 (GRO).

CEYLON: leg. Boswelt, 1878 (H); Horton Plaines, Pedrotallagalla, leg. Fleischer, 18-2-1898, No. 375 (L, U, T. nietneri); Horton Plaines, Pedrotallagalla, leg. Herzog, 1-1906, No. 72, c.fr. (H, T. bicolor var. hispidus); Horton Plaines, leg. Fleischer, 2-1898, No. 194 (GRO, L, U, T. hispidus); Kirigalpota, leg. Herzog, 2-1906, No. 74a (L); Wattacalla near Kandy, leg. Fleischer, No. 1993 (L, T. bicolor var. hispidus).

Distribution: Ceylon; India (Sikkim, N.W. Himalaya, Assam, Nilgiris, Madura); Nepal; Burma (Chin Hills, Karenni State, Kengtun State, Mang Loen State); Siam; China (Yuennan, Shen-si, Anhwei); Japan; Luzon; Indonesia (Java, Sumatra, Borneo, Celebes, Lombok, Ceram); Australian New Guinea; Fiji Islands; Hawaiian Islands. Common.

Ecology: On trees, sometimes on rocks or terrestrial, from low altitudes up to 3300 m.

Notes. 1. The present variety is a quite variable one. The characters which vary are the following: a) the size, b) the mode of branching, c) the colour, d) the direction of the leaves, e) the shape of the leaves, f) the shape of the leaf cells, g) the colour and the thickness of the seta, h) the shape of the capsule. The structural details of the leaves however are quite uniform.

a) Most plants are robust, but there are also many plants which are more slender. The majority of the plants from Indonesia are more robust than most plants from the other regions. The more slender plants, which therefore incline somewhat towards var. *hispidus* (C. Muell.) Card. also occur in Indonesia, but only rarely and were described by Fleischer as *T. bicolor* var. *tenellus* Fleisch. (l. c. 1908).

b) The plants are mostly irregularly pinnately branched, but may vary from almost simple (var. *simplicicaulis* Dix.) to rather densely pinnately branched.

c) Most plants of this variety are blackish or dark brown below and yellowish-green at tips, but there occur, all over its area many plants which are entirely green or brownish-green. Sometimes these plants are at the same time less robust and vary therefore towards var. *viridulus* (Mitt.) Zant. The colour of the leaves is not a very important character, for there often occur plants which are mainly green or brownish-green, but which have a few branches or only a number of leaves which are black.

d) The leaves are mostly spreading to horizontally spreading when dry, but there occasionally occur plants with appressed leaves, *e. g.* the specimen described by Fleischer as *T. appressus* Fleisch. (l. c. 1908). Fleischer himself says of this species: "Von *T. bicolor*, dem *T. appressus* sehr nahe steht, durch gedrungeneren Habitus und lebhaft gelbe Astspitzen sowie weichere, anliegende Blätter verschieden, welche aus schmälerem, fast ovalem Grunde zugespitzt sind." These characters are however by no means stable ones and fit *T. bicolor* var. *bicolor* equally well as *T. appressus*. The yellowish branch tips for instance are characteristic for var. *bicolor* too (hence the name *bicolor*). The main difference with the majority of var. *bicolor* are the more appressed leaves; this character is mostly not concomitant with the other differences mentioned by Fleischer. The specimens from Ceylon for instance, identified as *T. nietneri* (C. Muell.) Par., have also got rather a narrow leaf base, but horizontally spreading leaves as contrasted with *T. appressus*.

Many plants from the Philippine Islands and Japan are characterized in having more or less appressed, somewhat longer acuminate stem leaves, but the plants are less robust than the type of *T. appressus*.

e) The shape of the leaves is very variable. The leaf base is mostly broadly ovate, but there also occur plants with a narrowly ovate leaf base (*cf.* d). The stem leaves are often somewhat abruptly, rather long-acuminate and pass gradually into the branch leaves, which are mostly somewhat shorter and more gradually acuminate. Very often however the slight difference between the stem and the branch leaves is hardly visible. The leaf apex sometimes ends in a longer or shorter hyaline hairpoint. This for instance is the case in all Philippine plants, which fact was remarked on by Bartram where he writes (l. c. 1939): "The Philippine plants have finely attenuated, almost hairlike points, often hyaline at the tips." But this occurs just as well in many plants from Indonesia, Ceylon and the South-East Asian continent. Fleischer described those plants as the new variety *T. bicolor* var. *pilifer* Fleisch. (l. c. 1908).

f) The structural details of the leaves are quite uniform, only the length of the leaf cells vary from 2—8 times as long as wide (often also on the same plant).

g) and h) The seta is mostly rather thick and brownish-red, but sometimes more or less pale and thinner. The capsule is mostly shortly ovoid with a short neck, sometimes however somewhat more elongate and without a distinct neck. The variation in the seta and in the capsule are independent of each other.

The variability was remarked on by Fleischer where he writes (l. c. 1908): "Diese Art ist in Grösse und Habitus ziemlich veränderlich; ausserdem sind auch die Blätter sehr variabel, wie meistens bei allen weit verbreiteten und massenhaft auftretenden Arten", and Bartram writes (l. c. 1939): "The Philippine plants vary toward *T. cuspidatus* Fleisch. in the leaves which have finely attenuated, almost hairlike points, often hyaline at the tips. I feel that it is more practical to group the local forms under *T. bicolor,* in a broad sense. The varietal forms and some of the allied species are too subtile for my understanding."

2. There occur many intermediate forms between var. *bicolor,* var. *hispidus* (C. Muell.) Card. and var. *viridulus* (Mitt.) Zant. I incorporated all these intermediates in the variety *bicolor* for practical reasons.

3. The similarity between *T. bicolor* and *T. sinensis* (C. Muell.) Par. was remarked on by Cardot where he writes (l. c. 1905): "..... *T. sinensis,* du Schen-Si, qui, d'après les échantillons originaux ne diffère pas du *T. bicolor.*" Later authors (Brotherus, 1925 and 1929; Sakurai, 1938 and 1954; Noguchi, 1947) however considered this species to be the variety *sinensis* (C. Muell.) Broth. of *T. bicolor.*

4. Fleischer describes a new species *T. cuspidatus* Fleisch. (l. c. 1908) saying: "Unsere Art unterscheidet sich von dem in der Blattform sehr ähnlichen *T. bicolor* ausser durch eine Summe kleiner Merkmale, besonders durch etwas sparrigen Habitus." This "Summe kleiner Merkmale" (= a number of little characters) consists, according to the diagnosis, of: a) plants not blackish, b) leaves mostly horizontally spreading, crisped when dry, c) perichaetial leaves shorter acuminate, d) papillae on the seta shorter, e) capsule slightly more elongate and with a indistinct neck.

The differences mentioned under a) and b) are in general correct, but are of little importance (*cf.* note 1c and 1d), moreover they are not always concomitant with the differences mentioned under c), d) and e). In my opinion it is more practical to group the plants identified as *T. cuspidatus* Fleisch. under *T. bicolor* (except for *T. cuspidatus* var. *brevifolia* Fleisch., which plant belongs to var. *viridulus* (Mitt.) Zant.).

5. Somewhat less robust plants with less densely foliate stems and branches and with horizontally spreading leaves from Japan were described by Noguchi as *T. bicolor* var. *floribundarioides* Nog. (l. c. 1947).

1b. Trachypus bicolor Reinw. et Hornsch. var. **hispidus** (C. Muell.) Card. — Plate I, Map 2.

Trachypus bicolor Reinw. et Hornsch. var. *hispidus* (C. Muell.) Card., Beih. Bot. Centralbl. 19, 2(1905)116; Fleischer, Musci Fl. Buitenzorg 3(1908)740; Herzog, Hedwigia 50(1910)135; Dixon, J. of Bot. 53(1915)290; Brotherus, Nat. Pfl. ed. 2, 11(1925)119; Foreau, J. Madras Univ. ? (about 1931)?; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947) 53; Sakurai, Musc. Jap. (1954)100.

Neckera hispida C. Muell., Bot. Zeit. 12, 33(1854)570; C. Mueller, Linn. 36(1869)24.

Meteorium hispidum (C. Muell.) Mitt., J. Linn. Soc. Bot. Suppl. 1 (1859)89.

Papillaria hispida (C. Muell.) Jaeg., Ber. S. Gall. Naturw. Ges. 1875/76 (1877)273 = Ad. 2(1877)177.

Trachypus hispidus (C. Muell.) Par., Ind. Bryol. (1898)1303; Cardot, Beih. Bot. Centralbl. 19, 2(1905)116; Brotherus, Nat. Pfl. 1, 3(1906)830; Williams, Bull. New York Bot. Gard. 8, 31(1914)357; Potier de la Varde, Rev. Bryol. 50(1923)73; Brotherus, Philipp. J. Sc. 31, 3(1926)288; Reimers and Sakurai, Bot. Jahrb. 64(1932)543.

Trachypus rigidus Broth. et Par., Bull. Herb. Boiss. 2, 2(1902)926; Brotherus, Nat. Pfl. 1, 3(1906)829.

Trachypus bicolor Reinw. et Hornsch. var. *rigidus* (Broth. et Par.) Card., Beih. Bot. Centralbl. 19, 2(1905)116; Brotherus, Nat. Pfl. 2, 11 (1925)119; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2 (1947)52; Sakurai, Musc. Jap. (1954)100.

Papillaria paulensis Broth., Bih. K. Svensk. Vet. Akad. Handl. 21, 3, 3(1895)49; Paris, Ind. Bryol. (1897)907; ibid. ed. 2, 3(1905)358.

Trachypus paulensis (Broth.) Broth. syn. nov.: Brotherus, Nat. Pfl. 1, 3(1906)830; ibid. ed. 2, 11(1925)119; Brotherus, Denkschr. Akad. Wiss. Wien 83(1926)316.

Trachypus molliculus Broth. et Par. syn. nov.: Brotherus and Paris, Rev. Bryol. 38(1911)30; Brotherus, Nat. Pfl. ed. 2, 11(1925)119.

Trachypus rhacomitrioides Broth. syn. nov.: Brotherus, Sitzungsber. Akad. Wiss. Wien 1, 131(1922)214; Brotherus, Nat. Pfl. ed. 2, 11(1925)119; Brotherus, Symb. Sin. 4(1929)76.

Trachypus bicolor Reinw. et Hornsch. var. *brevifolius* Broth. syn. nov.: Brotherus, Symb. Sin. 4(1929)76.

Trachypus subpiliferus Card. ex P. Vard. nom. inval.: Potier de la Varde, Rev. Bryol. 50(1923)73.

Trachypus annamensis Broth. nom. nud.: Naveau, Rev. Bryol. n. ser. 1(1928)40.

Trachypus decolyi Broth. nom. nud.: Bruehl, Rec. Bot. Surv. India 13, 1(1931)127.

Trachypus micro-bicolor Broth. nom. nud.

Papillaria nana C. Muell. nom. nud.

Trachypus pterigonocaulos C. Muell. nom. nud.

Trachypus usambaricus Broth. nom. nud.

Trachypus hispidus (C. Muell.) Par. var. *appressus* Card. nom. nud.

Type specimens: *Trachypus bicolor* Reinw. et Hornsch. var. *hispidus* (C. Muell.) Card.: India, Madura, Kodaikanal, leg. Foreau, 20-1-1912, No. 36; neoholotype in FH. — *Trachypus rigidus* Broth. et Par.: Japan, Shikoku, Mt. Tsurugi-zan, leg. Faurie, No. 1394; type not seen. — *Trachypus paulensis* (Broth.) Broth.: Brazil, Prov. of Sao Paulo, distr. Apiahy, Chapeu, leg. Puiggari, 8-1880, No. 615; lectoholotype in H. — *Trachypus molliculus* Broth. et Par.: French Guinea, Fouta Jalon, leg. Pobeguin, 8-1909, No. 1848; holotype in H, isotype in PC. — *Trachypus rhacomitrioides* Broth.: China, Hunan, near Hsinhwa, leg. Handel-Mazzetti, 25-5-1918, No. 11940; holotype in H. — *Trachypus bicolor* Reinw. et Hornsch. var. *brevifolius* Broth.: China, Yuennan, Golo, leg. Handel-Mazzetti, 30-8-1915, No. 7926; holotype in H.

Fairly slender to *medium sized* plants, greenish or brownish, often

black or dark brown below and *yellowish-green at tips*. Stems rather densely pinnately to remotely, irregularly pinnately branched, *rigid, densely foliate,* up to *6 cm* long. Leaves *appressed to erect spreading* when dry, up to *3 mm* long.

INDIA: Sikkim: near Kurseong, Punkabari, leg. Decoly and Schaul, 16-12-1899, No. 2312 (FH, H, PC, T. decolyi). — Mangalore: South Canara, leg. Pfeiderer, 1904, No. 6492 (H); South Canara, Western Ghats, leg. Pfeiderer, 5-1905, No. 28, c.fr. (H). — Nilgiris: Hohenacker (L); ex herb. Montagne (L); Avalanche, leg. Gambler, 11-1883, No. 13310, c.fr. (H). — Madura: Palni Hills: Kodaikanal, leg. Decoly, 1898, No. 818 (H, T. micro-bicolor); Kodaikanal, leg. André, 5-1909, No. 146 (PC, T. subpiliferus); Kodaikanal, leg. Foreau, 1911, No. 41 (PC, T. hispidus var. appressus); Kodaikanal, leg. Foreau, 20-1-1912, No. 36 (FH, neoholotype); Shembaganur, leg. Foreau, 5-1956, No. 211 and 211a (GRO).

CEYLON: Nuwara Elyia, leg. Queste, 1910, No. 2 (H, T. nietneri).

CHINA: Hunan: Hsinhwa, leg. Handel-Mazzetti, 25-5-1918, No. 11940 (H, T. rhacomitrioides, holotype). — Yuennan: Golo, leg. Handel-Mazzetti, 30-8-1915, No. 7926, c.fr. (H, T. bicolor var. brevifolius, holotype).

JAPAN: Honshiu: Prov. of Sagami, Mt. Hiru, leg. Sasaoka, 3-10-1926, No. 2607 (H). — Shikoku: Prov. of Iyo, Mt. Ishizuchi, leg. Cono, 5-9-1906, No. 23 (H, T. rigidus).

BURMA: Pegu, leg. Kurz, No. 2926 (H, Papillaria nana).

ANNAM: Lang Biang, leg. Micholitz, 27-11-1903, No. 289 (H, T. annamensis).

LAOS: Tran-niuh, leg. Micholitz, 3-1909 (L, T. annamensis).

TANGANYIKA: Usambara, leg. Pandarang Joshi, 12-1903, No. 5630 (H, T. usambaricus).

FRENCH GUINEA: Fouta Jalon, leg. Pobeguin, 8-1909, No. 1848 (H, T. molliculus, holotype and PC, isotype).

BRAZIL: Prov. of Santa Catharina: Serra Geral, leg. Ule, 3-1891, No. 1147 (H, T. pterygonocaulos); Serra do Itatiaia, near Rio de Janeiro, leg. Dusin, 22-7-1902, No. 1576 (H, T. paulensis). — Prov. or Sao Paulo: distr. Apiahy, Chapeu, leg. Puiggari, 8-1880, No. 615 (H, T. paulensis, lectoholotype).

Distribution: Ceylon; India; Lower Burma; China (Hunan, Yuennan); Laos; Annam; Japan; Tanganyika; French Guinea; South-East Brazil. Rather common.

Ecology: On trees and on rocks. Alt.: 900—2500 m.

Notes. 1. This variety is very closely allied to var. *bicolor* and differs mainly in being more slender, with shorter stems and branches and with smaller leaves.

The variation in the colour, in the shape of the leaves and in the sporophyte is the same as in var. *bicolor*.

There occur many intermediate forms with var. *bicolor* and with var. *viridulus* (Mitt.) Zant.

2. The close alliance between var. *hispidus* and var. *bicolor* was remarked on by Cardot where he writes (l. c. 1905): "Je considère le *T. bicolor* comme un type très polymorphe, englobant le *Papillaria sinensis* C. Muell. (*T. sinensis* Par.), le *T. hispidus* (C. Muell.) Par. et le *T. rigidus* Broth. et Par. Les différences qui existent entre ces diverses formes sont peu importantes et très peu stables, et n'affectent guère que les dimensions et le port des plantes. Le *T. hispidus*, des Nilgherris et de Ceylan, diffère du *T. bicolor* type, de Java, par ses dimensions plus faibles, ses tiges et ses rameaux plus courts, ses feuilles plus courtes et moins larges à la base; il n'y a pas de différence appréciable dans le tissu. Certains échantillons restent indécis entre le *T. hispidus* et le *T. bicolor*."

3. *T. molliculus* Broth. et Par. from French Guinea and *T. subpiliferus* P. Vard. nom. inval. from Madura (India) incline somewhat towards var. *viridulus* (Mitt.) Zant. in having flaccid stems and branches, but the direction of the leaves and — with respect to *T. molliculus* the colouration too — are exactly the same as in var. *hispidus*.

4. *T. rhacomitrioides* (Hunan), *T. decolyi* (Sikkim), *T. micro-bicolor* (India), *Papillaria nana* (Burma), *T. usambaricus* (Usambara) and *T. paulensis* (Brazil) differ from the typical form of var. *hispidus* in being even more slender, but there is not any other difference, with the exception of *T. decolyi*, which has also got small, but distinct auricles and therefore inclines somewhat towards *T. appendiculatus* (Ren. et Card.) Broth.

Of *T. paulensis* only the type specimen is somewhat more slender than the typical form of var. *hispidus*, the other specimens from Brazil (also identified as *T. paulensis*, or as *T. pterygonocaulos*) are of the same size as *T. bicolor* var. *hispidus*.

1c. Trachypus bicolor Reinw. et Hornsch. var. **viridulus** (Mitt.) Zant. comb. nov. — Plate I, Map 3.

Trachypus viridulus (Mitt.) Broth., Nat. Pfl. 1, 3(1906)830; ibid. ed. 2, 11(1925)119; Leon, Ann. Crypt. Exot. 6, 2(1933)193; Thériot, Mem. Soc. Hist. Nat. Fel. Poey Cubana 14, 4(1940)356; Bartram, Field. Bot. 25(1949)248.

Neckera viridula Mitt., Kew J. of Bot. 3(1851)351.

Meteorium viridulum (Mitt.) Mitt., J. Linn. Soc. Bot. 12(1869)443.

Papillaria viridula (Mitt.) Jaeg., Ber. S. Gall. Naturw. Ges. 1875/76(1877)267 = Ad. 2(1877)171; Paris, Ind. Bryol. (1897)909; ibid. ed. 2, 3(1905)361.

Papillaria molleri C. Muell., Fl. 69(1886)283; Paris, Ind. Bryol. (1897) 907; ibid. ed. 2, 3(1905)357.

Trachypus molleri (C. Muell.) Broth. syn. nov.: Brotherus, Nat. Pfl 1, 3(1906)830; ibid. ed. 2, 11(1925)119.

Papillaria laeta Ren. et Card., Bull. Soc. Roy. Bot. Belg. 30, 2(1892) 192; Paris, Ind. Bryol. (1897)906.

Trachypus laetus (Ren. et Card.) Broth. syn. nov.: Brotherus, Nat. Pfl. 1, 3(1906)829; Paris, Ind. Bryol. ed. 2, 5(1906)64; Fleischer, Musci Fl. Buitenzorg 3(1908)746; Renauld, Prodr. Fl. Bryol. Madagascar Suppl. (1909)65; Thériot, Bull. Soc. Havraise Etud. Div. 1932(1932)145.

Trachypus subbicolor C. Muell. ex Card. syn. nov.: Paris, Ind. Bryol. (1898)1304 (as nom. nud.); ibid. Suppl. (1900)322; Cardot, Beih. Bot. Centralbl. 19, 2(1905)116; Fleischer, Musci Fl. Buitenzorg 3(1908)743; Brotherus, Philipp. J. Sc. 3, 1, C, Bot. (1908)24; ibid. 5, 2, C, Bot. (1910) 154; ibid. 8, 2, C, Bot. (1913)79.

Papillaria subbicolor (C. Muell.) Jaeg. nom. nud.: Jaeger, Ber. S. Gall. Naturw. Ges. 1875/76(1877)273 = Ad. 2(1877)177.

Trachypus cuspidatus Fleisch. var. *brevifolia* Fleisch. syn. nov.: Fleischer, Musci Fl. Buitenzorg 3(1908)743.

Trachypus bicolor Reinw. et Hornsch. var. *hispidus* (C. Muell.) Card. f. *flagelliformis* Fleisch. syn. nov.: Fleischer, Musci Fl. Buitenzorg 3(1908) 741; Herzog, Hedwigia 50(1910)135 (erroneously as f. flagelli*fera* Fleisch.).

Trachypus subbicolor Card. f. *robusta* Broth. syn. nov.: Brotherus, Symb. Sin. 4(1929)76.

Trachypus haleakalae Broth. nom. nud.: Brotherus, Bull. Soc. Bot. Ital. 1904(1904)24; Bartram, Bish. Mus. Bull. 101(1933)162.

Trachypus mexicanus Broth. nom. nud.

Trachypus mollis Broth. nom. nud.

Trachypus subhumilis Broth. nom. nud.: Brotherus, Nat. Pfl. ed. 2, 11(1925)119.

Trachypus sublaetus Broth. nom. nud.

Type specimens: *Trachypus viridulus* (Mitt.) Broth.: Ecuador, near Quito, leg. Jameson; type not seen. — *Trachypus molleri* (C. Muell.) Broth.: Africa, Isle of S. Thomé, leg. Moller, 1885, No. 21; holotype in H. — *Trachypus laetus* (Ren. et Card.) Broth.: Madagascar, Diego Suarez, leg. Chenagon; isotype in H. — *Trachypus subbicolor* Card.: Himalaya, ex herb. Ind. Or. Hook. f. et Thoms. No. 843; lectotype in L. — *Trachypus cuspidatus* Fleisch. var. *brevifolia* Fleisch.: West-Java, Tjibodas, Huis ten Bosch, leg. Fleischer; holotype in FH. — *Trachypus bicolor* Reinw. et Hornsch. var. *hispidus* (C. Muell.) Card. f. *flagelliformis* Fleisch.: Ceylon, Horton Plaines, leg. Fleischer; holotype in FH. — *Trachypus subbicolor* Card. f. *robusta* Broth.: China, Yuennan, Djiou-djiang (upper course of the river Irrawady), leg. Handel-Mazzetti, 9-7-1916, No. 9474; type probably lost.

Fairly slender to *medium sized* plants, greenish or brownish, *not blackish*. Stems rather densely pinnately to remotely, irregularly branched, mostly *flaccid, rather laxly to more or less densely*, sometimes somewhat complanately foliate, up to *15 cm* long. Leaves mostly *horizontally spreading* when dry, up to *3 mm* long, either ending in a hyaline hairpoint or not; leaf margin entire or finely denticulate.

INDONESIA: Java: Mt. Pangerango and Gedeh: Tjibodas, Huis ten Bosch, leg. Fleischer (FH, T. cuspidatus var. brevifolia, holotype); above Tjibodas, leg. Schiffner, 4-1894, No. 10856 and 10758 (L, T. cuspidatus); Mt. Telaga Bodas: leg. Schiffner, 15-2-1894, No. 10842 (L, T. bicolor); Mt. Tjikoeraj: leg. Nyman, 6-11-1898, No. 328 (H, T. cuspidatus).

PHILIPPINE ISLANDS: Luzon: Prov. of Nueva Vizcaya, leg. MacGregor, 1-1913, No. 212, For. Bur. No. 20222 (H, T. subhumilis).

FORMOSA: leg. Faurie, 6-1903 (PC, T. bicolor var. rigidus).

NEPAL: Khatmandu, leg. Rana, 1900 (FH, T. subbicolor).

INDIA: Sikkim: leg. Kurz, No. 208b (L, T. subbicolor); Darjeeling, leg. Long, 18-11-1907, No. 7624 (H, T. subbicolor); Kurseong, leg. Decoly and Schaul, 10-1898, c.fr. (FH, T. subbicolor). — Himalaya without definite locality: ex herb. Ind. Or. Hook. f. et Thoms. No. 843 (L, T. subbicolor, lectotype).

CEYLON: Horton Plaines, leg. Fleischer (FH, T. bicolor var. hispidus f. flagelliformis, holotype).

UPPER BURMA: leg. Fraser, 1896 (H, T. subbicolor).

ANNAM: Lang Biang, leg. Micholitz, 3-1911 (PC, T. mollis).

MADAGASCAR: Diego Suarez, leg. Chenagon (H, T. laetus, isotype); Prov. of Betafo, leg. ? 1901, ex herb. Paris (L, Papillaria laeta).

TRANSVAAL: Lydenburg, leg. Wilms, 12-1890, No. 2486 (L, T. sublaetus).

ISLE OF S. THOMÉ: leg. Moller, 1885, No. 21 (H, L, T. molleri, holotype).

MEXICO: Zacuapan, Vera Cruz, leg. Purpus, 12-1918, No. 8319 (H, T. mexicanus).

GUATEMALA: San Marcos, leg. Sharp, 25-2-1946, No. 5487 (herb. Bartram, T. viridulus).

Distribution: Java, Luzon, Formosa, Nepal, Himalaya, Ceylon, Burma, Annam, Madagascar, Transvaal, Isle of S. Thomé, Mexico, Guatemala, Costa Rica, Cuba, Ecuador.

Ecology: On trees and on rocks, from low altitude up to 3000 m.

Notes. 1. This variety differs from var. *hispidus* (C. Muell.) Card. in the following characters:

a. not blackish,
b. stems mostly flaccid,
c. leaves mostly horizontally spreading, crisped near apex,

and from var. *bicolor*, in addition to the above mentioned characters, in its less robust habit.

Moreover the stems and branches are sometimes somewhat complanately, laxly foliate, which is not the case in var. *bicolor* or var. *hispidus*.

2. This variety may vary somewhat in size. The specimens identified as *T. molleri* (C. Muell.) Broth., *T. laetus* (Ren. et Card.) Broth. and *T. subhumilis* Broth. nom. nud. for instance are slightly less robust than the typical form.

The variation in the shape of the leaves and the leaf cells is the same as in var. *bicolor*.

3. One specimen, described by Fleischer as *T. bicolor* var. *hispidus* f. *flagelliformis* Fleisch. (l. c. 1908), from Ceylon is distinguished in having rather long, flagelliform branches, which are laxly foliate with small leaves, but, although in a less extreme manner, this also occurs in many other specimens, so that in my opinion it is not practical to separate those plants.

4. Some plants of this variety have small, but distinctly denticulate leaf margins (Nepal, leg. Rana, 1900 and Sikkim, Kurseong, leg. Decoly and Schaul, 10-1898, both in FH; *cf.* Fleischer, l. c. 1908 p. 743, Bemerkung).

5. For practical reasons I grouped the many intermediate forms between var. *viridulus* and var. *bicolor* mostly among var. *bicolor*.

1d. Trachypus bicolor Reinw. et Hornsch. var. **scindifolius** (Sak.) Nog. — Plate I, Map 2.

Trachypus bicolor Reinw. et Hornsch. var. *scindifolius* (Sak.) Nog., J. Hattory Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)53.

Trachypus scindifolius Sak., Bot. Mag. Tokyo 55(1941)208.

Type specimen: Formosa, Prov. of Taityu, Eki-ju-kei, leg. Koizumi, 8-1938; holotype in herb. Sakurai, No. 13948 (not seen).

Robust plants without any black colouring. Stems irregularly pinnately branched, *densely foliate.* Leaves distinctly *falcate-second,* undulate in the upper part, *easily tearing,* up to *4 mm* long.

Distribution: Formosa only.

Ecology: On trees.

I have not seen this variety.

Notes. 1. According to the description by Sakurai (l. c. 1941) the main differences with the closely allied var. *bicolor* are:

a. leaves undulate in the upper part,
b. leaves strongly falcate-second, easily tearing,
c. plant without any black colouring.

However all these characters occasionally also occur in var. *bicolor*,

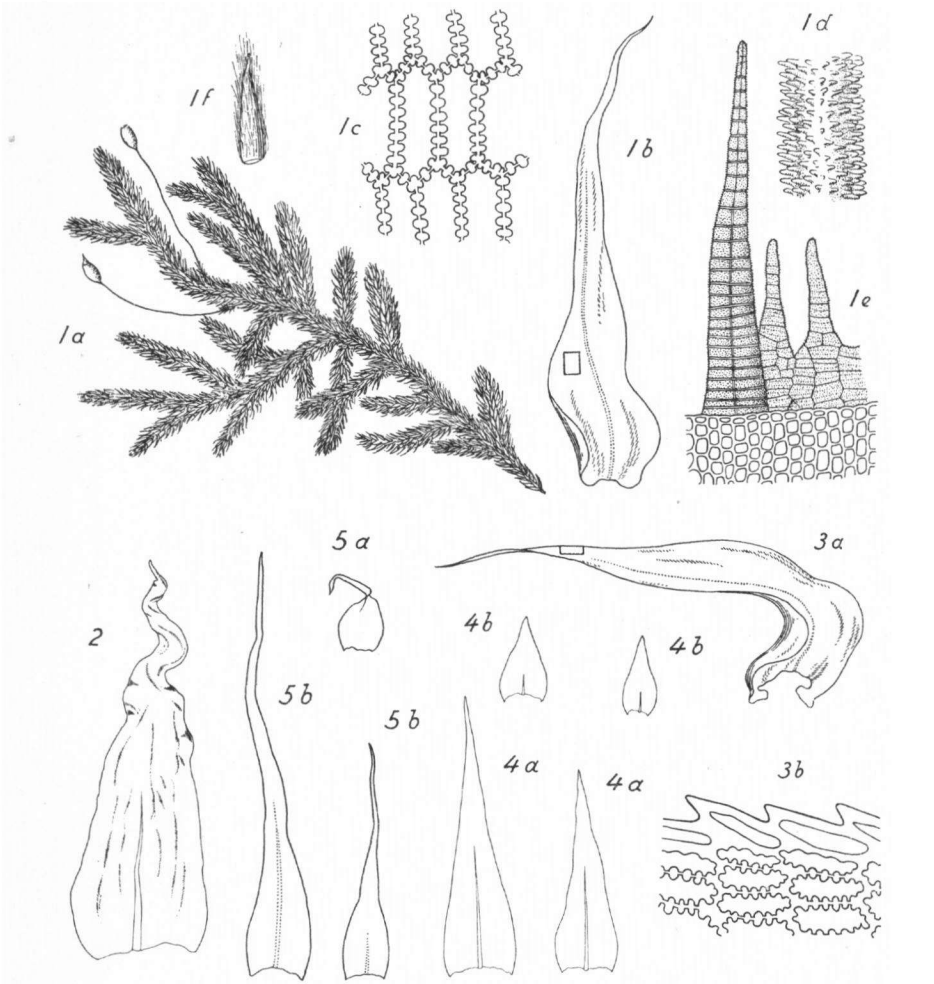
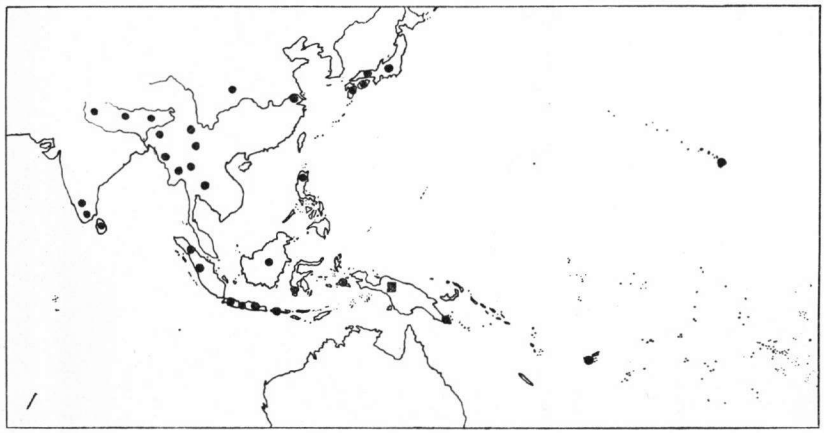
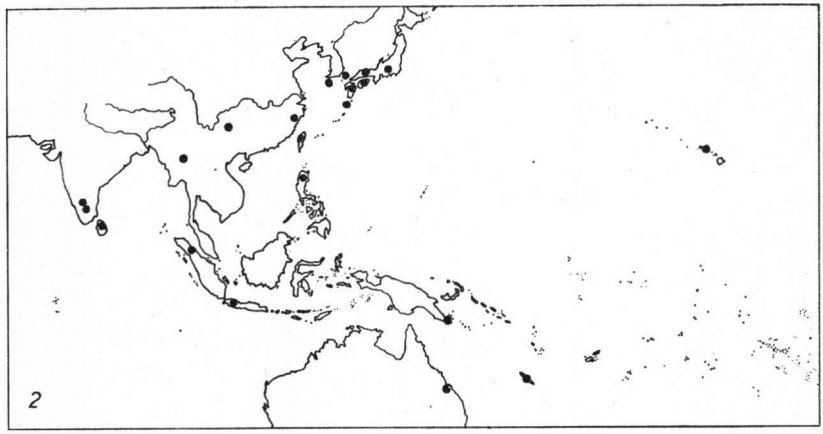


Plate II. — Fig. 1: *Trachypus bicolor* Reinw. et Hornsch. var. *bicolor*, 1a habit (1/1), 1b leaf (20/1), 1c leaf cells (300/1), 1d part of seta (30/1), 1e peristome (100/1), 1f calyptra (5/1); Fig. 2: *Trachypus perplicatus* Dix., leaf (20/1); Fig. 3: *Trachypus appendiculatus* (Ren. et Card.) Broth., 3a leaf (25/1), 3b leaf cells (300/1); Fig. 4: *Trachypus humilis* Lindb. var. *humilis*, 4a stem leaves (25/1), 4b branch leaves (25/1); Fig. 5: *Trachypus longifolius* Nog., 5a lower stem leaf (35/1), 5b upper stem or branch leaf (35/1). (Fig. 1a, b, d, e, f after Bryol. Jav. 2(1864) Tab. 211, Fig. 5 after Noguchi, J. Hattori Bot. Lab. 2(1947)55, Fig. 1c, 2, 3 and 4 original).

Plate III. — Map 1: Area of *Trachypus bicolor* Reinw. et Hornsch. var. *bicolor* (●); (Borneo without definite locality) and of *Trachypus perplicatus* Dix. (■); Map 2: Area of *Trachypus humilis* Lindb. var. *humilis*; Map 3: Area of *Trachypus humilis* Lindb. var. *tenerrimus* (Herz.) Zant. (●) and of *Trachypus longifolius* Nog. (■).


1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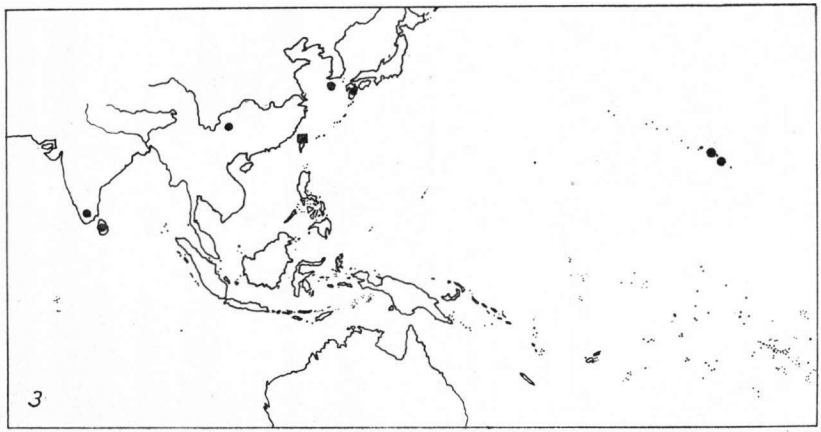

3

although mostly in a less extreme manner and whether this variety is a stable one will have to be investigated with the help of further material.

2. On account of the undulate leaves this variety inclines somewhat towards *T. perplicatus* Dix. from Dutch New Guinea, which species has however not got falcate-second leaves and is tinged with black.

2. Trachypus perplicatus Dix. — Plate II, Fig. 2. Plate III, Map 1.

Dixon, Farl. 1, 1(1943)35.

Type specimen: Dutch New Guinea, Mt. Carstensz, Meerendal, leg. Wissel, 11-12-1936, No. 14; holotype in BM, isotypes in GRO and L.

Fairly robust, yellowish-brown plants, *tinged with black,* in dull mats. Stems rather densely pinnately branched, up to 6 cm long. Stems and branches densely foliate, rigid. Leaves erect spreading to spreading when dry, spreading to horizontally spreading when moist, up to *4 mm* long, *strongly longitudinally plicate and strongly undulate in the upper half,* from an ovate, not auriculate base, gradually, rather long-acuminate, ending in a hairpoint; leaf margin minutely denticulate, crenulate. Leaf rib single, *ending far below apex.* Leaf cells elongate to linear, about 6—12 times as long as wide, more elongate towards base, border cells not differentiated; alar cells absent or hardly developed; cell walls incrassate, strongly crenulate by numerous papillae; papillae towards base less distinct.

Sporophyte not known.

Dutch New Guinea: Mt. Carstensz, Meerendal, leg. Wissel, 11-12-1936, No. 14 (GRO, L, isotypes).

Distribution: Dutch New Guinea only.

Ecology: Alt.: 4000—4100 m.

Note. This species is closely allied to *T. bicolor* Reinw. et Hornsch. var. *bicolor,* but is clearly differentiated in having leaves which are, dry as well as moist, strongly undulate in the upper part. Moreover the leaf cells are somewhat more elongate and the leaf rib slightly shorter.

Whether these differences are stable ones will have to be investigated with the help of further material, but the undulate leaves are such a striking feature that in my opinion it is justified to consider this plant to be a separate species, unless many intermediate forms should become known (*cf. T. bicolor* var. *scindifolius* (Sak.) Nog., note 2).

3. Trachypus appendiculatus (Ren. et Card.) Broth. — Plate II, Fig. 3. Plate I, Map 2.

Trachypus appendiculatus (Ren. et Card.) Broth., Nat. Pfl. 1, 3(1906) 829; Renauld, Prodr. Fl. Bryol. Madagascar Suppl. (1909)65; Brotherus, Nat. Pfl. ed. 2, 11(1925)119.

Papillaria appendiculata Ren. et Card., Bull. Soc. Roy. Bot. Belg. 32, 1(1894)108; Paris, Ind. Bryol. (1897)901; ibid. ed. 2, 3(1905)351.

Type specimen: Madagascar, between Fianarantsoa and Manandjary, leg. Besson; type probably lost. Neotype: Himalaya, ex herb. Bescherelle (PC).

Medium sized, yellowish-brown plants, scarcely tinged with black, in dull mats. Secondary stems procumbent or somewhat ascending, up to 6 cm long, rather densely to remotely pinnately branched. Secondary stems

and branches densely, not complanately foliate, rigid, branches up to 1 cm long. Leaves horizontally spreading, *strongly recurved when dry,* up to *3 mm* long, somewhat longitudinally plicate, from an ovate or broadly ovate, *auriculate* base, gradually or somewhat abruptly, rather long-acuminate, not ending in a hairpoint; leaf margin plane, *entire or faintly denticulate, crenulate in the lower half and moderately serrate and not crenulate in the upper half.* Auricles small, but distinct, mostly somewhat protruding. Branch leaves somewhat smaller and with smaller auricles than the stem leaves. Leaf rib single, ending below apex. Leaf cells elongate-hexagonal, 2.5—6 times as long as wide, more elongate towards base, cells in the auricles smaller; alar cells absent or few, quadrate to hexagonal; cell walls incrassate to very incrassate, very strongly crenulate by numerous low papillae, towards base gradually passing into smooth cell walls (cell walls of the cells near the auricles however crenuate), *cell walls of the border cells in the upper half of the leaf smooth.*

Sporophyte not known.

INDIA: Himalaya, ex herb. Bescherelle (PC, T. subbicolor; neoholotype of T. appendiculatus).

Distribution: Himalaya, Madagascar.

Ecology: On trunks.

Notes. 1. This species bears resemblance to *T. bicolor* Reinw. et Hornsch. var. *hispidus* (C. Muell.) Card., but differs by the following characters:

a. leaves strongly recurved when dry,
b. leaves with small, but distinct auricles,
c. leaf margin in the upper half moderately serrate,
d. cell walls of the border cells in the upper part of the leaf smooth, not crenulate.

Rarely however small auricles also occur in *T. bicolor* var. *hispidus* (see there, note 4).

2. I have not received the type specimen from PC (probably lost), but another specimen (ex herb. Bescherelle, Himalaya, under the name of *T. subbicolor*) which in general fits the description by Renauld and Cardot. I made the above description by means of this specimen.

4. Trachypus humilis Lindb.

For literature and type specimens see below.

Dioicous; *slender to very slender,* yellowish-green or brownish, sometimes blackish plants in dull, dense mats. Secondary stems up to 3 cm long, procumbent or ascending, mostly densely pinnately, occasionally somewhat bipinnately branched. Secondary stems and branches densely foliate all around stem, leaves occasionally faintly to distinctly falcate-second. Plants often with rather few to numerous, mostly rather short, more or less laxly foliate flagelliform branches, which easily break off. Branches attenuate or hamate at tips by crowded apical leaves. *Leaves dimorphous.* Stem leaves appressed to horizontally spreading when dry, erect spreading to horizontally spreading when moist, up to *2 mm* long, from an ovate or broadly ovate, not or faintly auriculate base, mostly gradually, rather long-acuminate, plane or longitudinally plicate, either ending in a hyaline hair-

point or not; leaf margin plane or more or less recurved, mostly *faintly denticulate,* crenulate. Leaf rib single, *rather faint, ending about midleaf.* Branch leaves up to 1.4 mm long, sometimes somewhat hollow and carinate, shorter acuminate than the stem leaves; leaf rib single, faint, ending below midleaf or scarcely developed; further like the stem leaves. Leaves of the flagelliform branches small, often very narrow, entire to very faintly denticulate, without rib. Leaf cells hexagonal to elongate, sometimes more or less linear, about 2—10 times as long as wide, more elongate towards base; border cells not differentiated; alar cells few or scarcely developed, quadrate to rectangular; cells walls incrassate, strongly crenulate by numerous papillae, cell walls of basal cells smooth.

Sporophyte as in the diagnosis of the genus.

Peristome not known. Calyptra *cucullate,* pilose, with long, erect spreading hairs (fid. Bartram, l. c. 1939).

This species is rather variable with 2 varieties which may be distinguished by the following key:

1. Slender plants; stem leaves up to 2 mm long; branches often hamate at tips **4a. var. humilis**
1. Very slender plants; stem leaves up to 1 mm long; branches mostly attenuate at tips . . . . . **4b. var. tenerrimus** (Herz.) Zant.

There occur some plants which are intermediate between the 2 varieties.

4a. Trachypus humilis Lindb. var. **humilis.** — Plate II, Fig. 4. Plate III, Map 2.

Trachypus humilis Lindb., Act. Soc. Sc. Fenn. 10(1872)230; Paris, Ind. Bryol. (1898)1303; Paris, Bull. Herb. Boiss. 2, 2(1902)926; Paris, Ind. Bryol. ed. 2, 5(1906)64; Brotherus, Nat. Pfl. 1, 3(1906)829; Brotherus, Philipp. J. Sc. 8, 2, C, Bot. (1913)80; Williams, Bull. New York Bot. Gard. 8, 31(1914)357; Okamura, J. Coll. Sc. Imp. Univ. Tokyo 38(1916)37; Brotherus, Nat. Pfl. ed. 2, 11(1925)119; Brotherus, Symb. Sin. 4(1929)76; Bruehl, Rec. Bot. Surv. India 13, 1(1931)67; Thériot, Ann. Crypt. Exot. 5, 3/4(1932)177; Potier de la Varde, Rev. Bryol. Lich. 10(1938)141; Sakurai, Bot. Mag. Tokyo 52(1938)472; Bartram, Philipp. J. Sc. 68(1939)194; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)54; Noguchi, J. Hattori Bot. Lab. 5(1951)16; Sakurai, Musc. Jap. (1954)100; Amakawa and Osada, J. Hattori Bot. Lab. 17(1956)48.

Papillaria humilis (Lindb.) Broth., Hedwigia 38(1899)227.

Trachypus massarti Ren. et Card. syn. nov.: Renauld et Cardot, Rev. Bryol. 23(1896)103; Cardot, Ann. Jard. Bot. Buitenzorg Suppl. 1(1897)17; Paris, Ind. Bryol. (1898)1303; ibid. ed. 2, 5(1906)64; Brotherus, Nat. Pfl. 1, 3(1906)829; Fleischer, Musci Fl. Buitenzorg 3(1908)744; Dixon, J. of Bot. 53(1915)290; Potier de la Varde, Rev. Bryol. 50(1923)73; Moeller, Hedwigia 60(1919)321; Brotherus, Nat. Pfl. ed. 2, 11(1925)119; Bruehl, Rec. Bot. Surv. India 13, 1(1931)67; Foreau, J. Madras Univ. ? (about 1931)?; Bartram, Britt. 9, 1(1957)45.

Trachypus novae-caledoniae C. Muell. ex Thér. syn. nov.: Thériot, Bull. Acad. Int. Géogr. Bot. 20(1910)101; Brotherus, Oefv. Finsk. Vet. Soc. Foerh. 53, A, 11(1911)27; Brotherus, Nat. Pfl. ed. 2, 11(1925)119.

Trachypus dimorphus Dix. et P. Vard. syn nov.: Dixon and Potier de la Varde, Ann. Crypt. Exot. 1, 1(1928)42.

Claopodium kiusiense Sak., Bot. Mag. Tokyo 46(1932)378; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)54 (fid. Noguchi).

Anomodon rostratus (Hedw.) Schimp. var. *japonicus* Sak., Bot. Mag. Tokyo 46(1932)743; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)54; Sakurai, Musc. Jap. (1954)100 (fid. Noguchi and Sakurai).

Claopodium undulatifolium Sak., Bot. Mag. Tokyo 47(1933)338; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)54 (fid. Noguchi).

Trachypus massarti Ren. et Card. var. *brachyphyllus* Fleisch. syn. nov.: Fleischer, Musci Fl. Buitenzorg 3(1908)745.

Trachypus humilis Lindb. var. *brevifolius* Card. syn. nov.: Cardot, Bull. Soc. Bot. Genève 3, 2(1911)276; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)54; Sakurai, Musc. Jap. (1954)100.

Trachypus humilis Lindb. var. *major* Broth. syn. nov.: Brotherus, Symb Sin. 4(1929)76.

Trachypus humilis Lindb. f. *secundus* Nog. syn. nov.: Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)54; Sakurai, Musc. Jap. (1954) 100.

Type specimens: *Trachypus humilis* Lindb.: Japan, Kiushiu, Nagasaki, leg. ?, 5-4-1863; type not seen. — *Trachypus massarti* Ren. et Card.: Indonesia, Java, leg. Massart, 1895, No. 1501; isotype in L. — *Trachypus novae-caledoniae* Thér.: New Caledonia, leg. Vieillard; holotype in PC. — *Trachypus dimorphus* Dix. et P. Vard.: India, Nilgiris, Kotagiri, leg. Sedgwick, 5-1915, No. 706; type in PC. — *Trachypus massarti* Ren. et Card. var. *brachyphyllus* Fleisch.: Indonesia, Java, Tjibodas, leg. Fleischer; type probably lost. — *Trachypus humilis* Lindb. var. *brevifolius* Card.: Korea, Isle of Quelpart, leg. Faurie, 1906, No. 235; holotype in PC. — *Trachypus humilis* Lindb. var. *major* Broth.: China, Prov. of Kwei-Chow, Dodjie, leg. Handel-Mazzetti, 13-7-1917, No. 10738; holotype in H. — *Trachypus humilis* Lindb. f. *secundus* Nog.: Japan, Kiushiu, Prov. of Kumamoto, leg. Noguchi, 10-8-1930, No. 4423; type in herb. Noguchi.

Slender plants, without or with rather few flagelliform branches. Branches often *hamate* at tips by crowded apical leaves. Stem leaves up to *2 mm* long.

JAPAN: Honshiu: Prov. of Ise, Sakamoto, leg. Kawasuki, No. 72 (H). — Shikoku: Prov. of Tosa, Hogasho, leg. Yoshinaga, 10-1903, No. 1 (H); Mt. Osugi, leg. Oda, 29-3-1913, No. 1557 (H). — Kiushiu: Nagasaki, leg. Wichura, 18-1-1861, No. 1473a (H); Prov. of Kumamoto, leg. Noguchi, 10-8-1930, No. 4423 (herb. Noguchi, T. humilis f. secundus, isotype); Miyazaki, Kitago, leg. Noguchi and Hattori, 4-1950, No. 177 (GRO, L, T. humilis f. secundus); Miyazaki, Minaminaka, Sakatani, leg. Noguchi and Hattori, 4-1946, No. 2 (GRO, L, T. humilis var. brevifolius). — Riu-Kiu Islands: Yaku Shima, leg. Faurie, No. 1225 (PC).

KOREA: Isle of Quelpart, leg. Faurie, 1906, No. 235 (H, T. humilis var. brevifolius, holotype).

PHILIPPINE ISLANDS: Luzon, Subprov. of Benguet, leg. Merrill, 5-1911, No. 7839 (K).

INDONESIA: Java: Tjibodas, leg. Massart, 1895, No. 1501 (L, T. massarti, isotype); Tjibodas, leg. Dadi and Noerta, 28-3-1949, No. 53 (GRO); Mt. Tjikoeraj, Priangan, leg. Verdoorn, 7-1930, No. 740 (GRO, T. massarti var. brachyphyllus); Mt. Tjikoeraj,

leg. Verdoorn, 7-1930, No. 59 (GRO, L, T. massarti var. brachyphyllus); Tjibodas, leg. van der Wijk, 4-5-1952, No. 976 (GRO); Mt. Salak, leg. Moeller, 1-6-1897 (H, T. massarti). — Sumatra: Bandarbaroe, leg. Staal, 29-11-1949, No. 213 (GRO); Berastagi, leg. Staal, 23-3-1950, No. 370 (GRO); Mt. Pisopiso, Karo plateau, leg. van der Wijk, 21-6-1952, No. 1789 (GRO).

AUSTRALIA: Queensland, leg. Watts, 29-7-1913, No. 633 (H, T. novae-caledoniae).

HAWAIIAN ISLANDS: Kauai, leg. Degener, 31-12-1957, No. 21615, ex herb. Schallert (GRO).

NEW CALEDONIA: leg. Vieillard (PC, T. novae-caledoniae, holotype).

INDIA: Nilgiris, Kotagiri, leg. Sedgwick, 5-1915 (PC, T. dimorphus, holotype).

CHINA: Prov. of Kwei-Chow, Dodjie, leg. Handel-Mazzetti, 13-7-1917, No. 10738 (H, T. humilis var. major, holotype).

UPPER BURMA: Nam Tamai Valley, leg. Kaulbach, 14-8-1938, herb. Dixon, ref. No. 2a (BM, T. pilifolius).

Distribution: Japan; Isle of Quelpart (Korea); Luzon; China (Kwei-Chow, Che-Kiang); Formosa; Upper Burma; India (Nilgiris, Madura); Ceylon; Indonesia (Java, Sumatra); Australian New Guinea; Australia (Queensland); New Caledonia; Hawaiian Islands.

Not found very frequently, but may often have been overlooked.

Ecology: On rocks and on trees, from low altitudes up to 2300 m.

Notes. 1. This variety is a rather variable one, and may vary in a) the colour, b) the direction and the aspect of the leaves, c) the shape of the leaves and d) the shape of the leaf cells.

a) The colour is mostly yellowish-green or brownish, but there occur some plants which are more or less blackish in the lower parts. One specimen from China (Kwei-Chow, leg. Handel-Mazzetti, 13-7-1917, No. 10738, *T. humilis* var. *major*) for instance is blackish in the lower parts whereas the upper parts of the branches are yellowish-green. Moreover this plant is somewhat more robust and, on account of these facts inclines somewhat towards *T. bicolor* var. *hispidus*, but the leaves are distinctly dimorphous and the leaf rib ends about midleaf as it does in *T. humilis*.

b) The leaves are mostly appressed to spreading when dry (occasionally horizontally spreading), not falcate-second. There occur some plants however all or part of the leaves of which are falcate-second, *viz.* the plant from China mentioned under a) and the plants from Japan identified as *T. humilis* var. *secundus* Nog. In my opinion it is not practical to separate these plants, because the difference is not essential, and because the form with the falcate-second leaves gradually passes into the normal form.

The branches are often hamate at the ends, but on the same plant may also occur branches which are attenuate. In some specimens all branches are attenuate.

c) The shape of the leaves is rather variable. The stem leaves are mostly rather long-acuminate; the branch leaves vary however from rather long- to short-acuminate. A plant from Korea (Isle of Quelpart) with rather short-acuminate leaves was described by Cardot as *T. humilis* var. *brevifolius* Card. (l. c. 1911). The long- and the short-acuminate leaves gradually pass into each other, sometimes even on the same plant.

There occur some plants (*e. g.* Upper Burma, Nam Tamai Valley, leg. Kaulbach, 14-8-1938 (BM)) which incline somewhat towards *T. bicolor* Reinw. et Hornsch. var. *hispidus* (C. Muell.) Card. or towards *T. bicolor* var. *viridulus* (Mitt.) Zant. on account of their having scarcely dimorphous

leaves. The stems leaves are only slightly longer acuminated than the branch leaves, as it does sometimes in var. *hispidus* or var. *viridulus*, but the slender habit and the short leaf rib are the same as in *T. humilis* Lindb. var. *humilis*.

d) The shape of the leaf cells varies from 2—10 times as long as wide. The cells of the stem leaves are often slightly more elongate than those of the branch leaves. Some plants from New Caledonia (described by Thériot as *T. novae-caledoniae* Thér., l. c. 1910) are characterized by having larger leaf cells, up to about 50 μ long (normal length up to 35 μ).

2. The type specimen of *T. massarti* Ren. et Card. var. *brachyphyllus* Fleisch. did not appear to be present in FH and has probably been lost, but according to the diagnosis (l. c. 1908) this variety falls within the limits of *T. humilis*.

3. The very close resemblance between *T. massarti* Ren. et Card. and *T. humilis* was remarked on by Fleischer where he writes (l. c. 1908): "Die Varietät (= *T. massarti* var. *brachyphyllus*) kommt durch die auffällig kurz gespitzten Blätter, welche durch Uebergänge mit der langblättrigen Form verbunden sind, dem *Trachypus humilis* Lindb. aus Japan äusserst nahe, welches aber dicht papillöse, undurchsichtige Blattzellen und fast faltenlose Blätter hat."

The differences between *T. massarti* and *T. humilis* mentioned by Fleischer are not stable ones and not essential.

4. Mitten mentions the name *Meteorium humilis* Mitt. as a synonym of *Trachypus humilis* Lindb., Trans. Linn. Soc. Bot. 2, 3(1891)173. This is however an error. The plant, wrongly identified as *Meteorium humile* (= *Trachypus humilis*) by Mitten, was actually the species *Thuidium mittenii* Broth., afterwards described for the first time by Brotherus, Hedwigia 38(1899)246. In 1912 Cardot transferred this species to the new genus *Boulaya* as *B. mittenii* (Broth.) Card., Rev. Bryol. 39(1912)2.

4b. Trachypus humilis Lindb. var. **tenerrimus** (Herz.) Zant. comb. nov. — Plate III, Map 3.

Trachypus tenerrimus Broth. ex Herz.: Herzog, Hedwigia 50(1910)135; Dixon, J. of Bot. 53(1915)290; Brotherus, Nat. Pfl. ed. 2, 11(1925)119; Bruehl, Rec. Bot. Surv. India 13, 1(1931)67.

Trachypus mauiensis Broth. ex Broth. syn nov.: Brotherus, Bish. Mus. Bull. 40(1927)20 (erroneously as Trachypodopsis); Bartram, Bish. Mus. Bull. 101(1933)163.

Papillaria mauiensis Broth. nom. nud.: Brotherus, Bull. Soc. Bot. Ital 1904(1904)21.

Trachypus tenerrimus Herz. var. *flagelliferus* Broth. ex Herz. syn. nov.: Herzog, Hedwigia 50(1910)136.

Trachypus humilis Lindb. var. *gracilis* Nog. syn. nov.: Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)55; Sakurai, Musc. Jap. (1954)101.

Claopodium laevicaule Broth. nom. nud.: Bartram, Bish. Mus. Bull 101(1933)163.

Type specimens: *Trachypus tenerrimus* Herz.: Ceylon, Nuwara Eliya, leg. Herzog, 1-1906, No. 140; type in L. — *Trachypus mauiensis* Broth.: Hawaiian Islands, Maui, leg. Baldwin, 12-1875, No. 204; holotype

in H. — *Trachypus tenerrimus* Herz. var. *flagelliferus* Herz.: Ceylon, Horton Plaines, leg. Herzog, 2-1906, No. 140a; type in H. — *Trachypus humilis* Lindb. var. *gracilis* Nog.: Japan, Kiushiu, Kumamoto, Mt. Shiraga, leg. Noguchi, 31-7-1931, No. 7844; type in herb. Noguchi.

Very slender plants, often for the greater part consisting of *flagelliform branches,* which break off easily. Branches mostly attenuate, *not hamate.* Branch leaves up to *1 mm* long.

Sporophyte not known.

INDIA: Madura: Tiger Shola near Shembaganur, leg. Foreau, 15-1-1912, No. 140 (PC, T. massarti); Palni Hills, Kodaikanal, leg. Foreau, 1912, No. 212 (GRO, T. massarti).

CEYLON: Nuwara Eliya, leg. Herzog, 1-1906, No. 140 (L, T. tenerrimus, type); Horton Plaines, leg. Herzog, 2-1906, No. 140a (H, T. tenerrimus var. flagelliferus, type).

CHINA: Prov. of Kwei-Chow, near Lungtsu, leg. Handel-Mazzetti, 7-7-1917, No. 10581 (H. T. humilis).

KOREA: Isle of Quelpart ?; Mt. Hallasan, leg. Taquet, 12-1909, No. 142, PC, T. humilis var. brevifolius).

JAPAN: Kiushiu, Kumamoto, Mt. Shiraga, leg. Noguchi, 31-7-1931, No. 7844 (herb. Noguchi, T. humilis var. gracilis, isotype).

HAWAIIAN ISLANDS: Maui: leg. Baldwin, 12-1875, No. 204 (H, T. mauiensis, holotype). — Kauai: leg. Degener and Greenwell, 7-1-1952, No. 21613, ex herb. Schallert (GRO).

Distribution: Southern India (Madura); Ceylon; Kwei-Chow; Korea (Isle of Quelpart?); Kiushiu; Hawaiian Islands.

Ecology: On rocks, trees or decayed wood, from low altitudes up to 2100 m.

Note. This variety is closely allied to var. *humilis,* but is distinguished in being slenderer and having numerous flagelliform branches. The branches are hamate at tips.

There occur some intermediate forms with var. *humilis,* but the two varieties are in general clearly recognizable.

The variability in the colour, the aspect and shape of the leaves, and in the shape of the leaf cells is about the same as in var. *humilis.*

5. Trachypus longifolius Nog. — Plate II, Fig. 5. Plate III, Map 3.

Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)55.

Type specimen: Formosa, Prov. of Tainan, Mt. Niitaka (Morrison), leg. Ozaki, 20-8-1932, No. 8487; holotype in herb. Noguchi.

Slender, brownish-green, dull plants. Stems pinnately branched, hanging down?, more or less densely foliate all around stem, up to 5 cm long, with *numerous long, flagelliform,* more or less laxly foliate branches. Middle and upper stem leaves and branch leaves from an ovate, not auriculate base gradually, *narrowly and very long-acuminate,* often ending in a hyaline, sometimes somewhat flexuose hairpoint, slightly longitudinally plicate, up to *1.8 mm* long; leaf margin faintly denticulate, often somewhat recurved, faintly crenulate; leaf rib *faint,* ending *in or below midleaf.* Lower stem leaves from a broadly ovate, not auriculate base, abruptly rather long-acuminate; leaf margin very faintly denticulate; leaf rib absent. Lower leaves gradually passing into the middle and upper stem leaves. Leaf cells elongate to linear, about 3—10 times as long as wide; border cells not differentiated; alar cells few, quadrate to rectangular;

cell walls incrassate, strongly crenulate by numerous papillae; basal cells, especially those near the rib more *pellucid* than the other cells and with smooth cell walls; cell walls of the alar cells faintly crenulate.

Sporophyte not known.

FORMOSA: Prov. of Tainan, Mt. Niitaka (Morrison), leg. Ozaki, 20-8-1932, No. 8487 (herb. Noguchi, isotype).

Distribution: Formosa only.

Ecology: No data.

Note. This species is allied to *T. humilis* Lindb., but is clearly differentiated by the following characters:

a. numerous long, flagelliform branches occur (the flagelliform branches in *T. humilis*, if present, are mostly rather short and easily breaking off),
b. branches attenuate, never hamate by crowded apical leaves,
c. leaves very long- and narrowly acuminate,
d. leaf cells mostly somewhat more elongate.

2. **Trachypodopsis** Fleisch.

Fleischer, Hedwigia 45(1905)64; Brotherus, Nat. Pfl. 1, 3(1906)830; Fleischer, Musci Fl. Buitenzorg 3(1908)729; Brotherus, Nat. Pfl. ed. 2, 11(1925)120; Bartram, Philipp. J. Sc. 68(1939)196.

Dioicous; moderately slender to fairly robust, greenish, yellowish, in herb. often brownish, *never blackish* plants in dull or somewhat glossy, lax to rather dense mats, or hanging down. Primary stems creeping, with tufts of blackish rhizoids and more or less scale-like lower leaves. Secondary stems from 2 up to 30 cm long, procumbent or hanging down, mostly rather remotely, irregularly pinnately, occasionally dichotomously branched. Central strand present or wanting, but never well developed. Secondary stems and branches densely or laxly, either complanately foliate or not. Leaves appressed to horizontally spreading when dry, spreading to horizontally spreading when moist, from 1 up to 7 mm long, occasionally very distinctly falcate-second (and then mostly asymmetrical) or in longitudinal rows, plane to very strongly longitudinally plicate, often crisped near apex, from an ovate or broadly ovate, *faintly to strongly auriculate* base gradually or somewhat abruptly, rather short- to very long-acuminate; leaf margin rather faintly to strongly serrate or toothed; teeth themselves occasionally finely denticulate. Auricles small to very large and shaped like a snail-shell. Branch leaves sometimes somewhat shorter acuminate than the stem leaves. Leaf rib single, ending below apex. Leaf cells almost isodiametric to linear (1—10 times as long as wide), on both sides *unipapillate over lumen or smooth*; border cells either more elongate and forming a leaf border or not; cells towards base more elongate, smooth; cells in the auricles mostly quadrate to rectangular, smooth; alar cells mostly present, occasionally large, quadrate to rectangular; cell walls mostly somewhat incrassate and pitted.

Sporophyte lateral on the secondary stems and (rarely) on the branches. Male gametoecia bud-shaped, with few antheridia and paraphyses; outer

perigamial leaves small, short-acuminate, inner perigamial leaves somewhat larger, rather abruptly ending in a narrow point, both of them without rib, entire; antheridia club-shaped, reddish. Female gametoecia bud-shaped with a number of archegonia and paraphyses; female perigamial leaves like the male perigamial leaves, but the inner ones ending in a rather long and narrow, somewhat denticulate point; archegonia bottle-shaped, long-necked, reddish. Seta up to *18 mm* long, erect, *papillose*, brownish, contorted when dry. Vaginula cylindrical, smooth, with a number of archegonia and numerous rather long paraphyses. Perichaetial leaves pale, the outer leaves rather small, short-acuminate, faintly denticulate, without rib, the inner ones large, long- and narrowly acuminate, faintly denticulate, rib present; cells elongate, smooth; cell walls incrassate, pitted. *Capsule erect, subglobular to ovoid*, up to 3 mm long, brownish, with a short neck; exothecium cells quadrate or hexagonal to rectangular, in longitudinal rows, smaller towards mouth; cell walls somewhat incrassate. Lid conical, obliquely rostrate. Peristome double. Exostome teeth 16, on a low basal membrane, lanceolate-subulate, yellowish, with a median line, trabeculate, papillose at base, strongly papillose towards the ends. Endostome teeth 16, on a low basal membrane, somewhat shorter than the exostome teeth, narrowly lanceolate, hyaline, papillose, often carinate and perforated along the median line. *Cilia absent.* Calyptra small, *cucullate*, naked or with a few hairs (not seen). Spores medium sized, up to 25 μ in diameter, subglobular, strongly papillose, yellowish.

History of the genus up to the present paper.

The genus *Trachypodopsis* Fleisch. was described for the first time by Fleischer in 1905, Hedwigia 45(1905)64, with 20 species, which before mostly belonged to the genus *Trachypus* Reinw. et Hornsch. These 20 species were:

T. rugosa (Lindb.) Fleisch.
T. rigida (Bosch et Lac.) Fleisch.
T. declinata (Mitt.) Fleisch.
T. crispatula (Hook.) Fleisch.
T. subcrispatula (C. Muell.) Fleisch. nom. nud.
T. macrodontis Fleisch.
T. serrulata (P. Beauv.) Fleisch.
T. pintasiana (C. Muell.) Fleisch. nom. nud. (= ? *T. quintasiana* (C. Muell.) Fleisch. nom. nud.)
T. sumatrana (C. Muell.) Fleisch. nom. nud.
T. auriculata (Mitt.) Fleisch.
T. himantophylla (Ren. et Card.) Fleisch.
T. lacridens (C. Muell.) Fleisch. nom. nud.
T. feae (C. Muell.) Fleisch. nom. nud.
T. bohnhofii (C. Muell.) Fleisch. nom. nud.
T. flaccida (Card.) Fleisch.
T. craspedophylla (C. Muell.) Fleisch. nom. nud.
T. rutenbergii (C. Muell.) Fleisch.
T. eriocladioides (C. Muell.) Fleisch. nom. nud.

T. normandi (Broth. et Par.) Fleisch.
T. ornans (Reich.) Fleisch.

The species *T. nodicaulis* (C. Muell.) Fleisch., according to Fleischer, Hedwigia 45(1906)67, is conspecific with *T. serrulata* (P. Beauv.) Fleisch.

Among these 20 species there are 8 nomina nuda and 2 species have been transferred by Fleischer, Musci Fl. Buitenzorg 3(1908)727, to the new genus *Neolindbergia* Fleisch., namely *T. rugosa* (Lindb.) Fleisch. and *T. rigida* (Bosch et Lac.) Fleisch.

According to Brotherus, Nat. Pfl. 1, 3(1906)832, the species *T. rutenbergii* (C. Muell.) Fleisch., *T. nodicaulis* (C. Muell.) Fleisch. and *T. quintasiana* (C. Muell.) Fleisch. nom. nud. are not specifically different from *T. serrulata* (P. Beauv.) Fleisch. There thus remain 9 validly published species, namely:

T. declinata (Mitt.) Fleisch.
T. crispatula (Hook.) Fleisch.
T. macrodon Fleisch. (before erroneously cited by Fleischer as *T. macrodontis* Fleisch.).
T. serrulata (P. Beauv.) Fleisch.
T. auriculata (Mitt.) Fleisch.
T. himantophylla (Ren. et Card.) Fleisch.
T. flaccida (Card.) Fleisch.
T. normandi (Broth. et Par.) Fleisch.
T. ornans (Reich.) Fleisch.

The following species, subspecies and varieties have successively been added to the genus:

T. laxoalaris Broth.	Wiss. Erg. Deut. Zentr. Afr. Exp. 2, 1(1910)160.
T. otiophylla (Card.) Card.	Rev. Bryol. 38(1911)39.
T. densifolia Broth.	Symb. Sin. 4(1929)77.
T. crispatula (Hook.) Fleisch. ssp. *longifolia* Reim.	Hedwigia 71(1931)56.
T. plicata Dix.	Ann. Bryol. 9(1936)65.
T. angustiretis Dix.	Ann. Bryol. 12(1939)53.
T. crispatula (Hook.) Fleisch. var. *longifolia* Nog.	J. Sc. Hiroshima Univ. B, 2, 3(1939) 214.
T. formosana Nog.	J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)59.
T. tereticaulis Froehl.	Ann. Naturh. Mus. Wien 59(1953)90.
T. subulata Chen	Fedd. Rep. 58(1955)29.

In 1931, Hedwigia 71(1931)56, Reimers transferred the species *T. macrodon* Fleisch. to *T. crispatula* (Hook.) Fleisch. as *T. crispatula* ssp. *macrodon* (Fleisch.) Reim. and he divided *T. crispatula* into 3 subspecies *viz.* the above mentioned ssp. *macrodon* and ssp. *longifolia* Reim. and *eucrispatula* Reim.

When Fleischer described the genus *Trachypodopsis* he did not indicate a type species. I propose the species *Trachypodopsis serrulata* (P. Beauv.) Fleisch. as the lectotype of the genus.

Relationships.

Fleischer, Hedwigia 45(1905)64; Fleischer, Musci Fl. Buitenzorg 3 (1908)730; ibid. 4(1923)1495.

The genus *Trachypodopsis* is in general easily distinguishable from the other genera. There are some arguments that the genus might be related to the *Meteoriaceae*. *T. serrulata* (P. Beauv.) Fleisch. and *T. auriculata* (Mitt.) Fleisch. for instance have sometimes got the same hanging habit, which is characteristic for most *Meteoriaceae*. The shape of the leaf auricles too is the same as it is in many species of that family. Moreover the sporophyte resembles some *Meteoriaceae, e. g.* many species of the genus *Papillaria* in having a short seta, ovoid capsule, low basal membrane of the endostome with narrowly lanceolate teeth and in the absence of cilia.

The gametophyte of *Trachypodopsis* bears close resemblance to that of the genus *Duthiella* (for the differences with this genus see *Duthiella*, relationships).

All *Trachypodopsis* species used, before 1905, to be incorporated within the genus *Trachypus*, which genus is however clearly distinguished in having many papillae *on the cell walls*, as contrasted with *Trachypodopsis* where only one papilla occurs over the lumina of the leaf cells, or the leaf cells are smooth.

Relationships within the genus.

All *Trachypodopsis* species are rather closely allied. The most variable, and at the same time most wide-spread species is *T. serrulata* (P. Beauv.) Fleisch.

T. auriculata (Mitt.) Fleisch. differs from *T. serrulata* mainly in having very large, snail-shell shaped auricles and smooth leaf cells.

T. formosana Nog. stands somewhat between these two species in having large, snail-shell shaped auricles and part of the leaf cells papillose.

T. laxoalaris Broth. is very closely allied to *T. serrulata* and differs only in having numerous large alar cells.

T. normandi (Broth. et Par.) Fleisch. differs in having small, faintly auriculate leaves and aberrant alar cells.

The sporophytes, of which only those of *T. serrulata* and *T. auriculata* are known, are almost identical. *T. auriculata* has only got a somewhat longer seta and a slightly larger capsule.

Excluded species.

Trachypodopsis declinata (Mitt.) Fleisch. has been transferred to the genus *Duthiella* as **D. declinata** (Mitt.) Zant.

Trachypodopsis tereticaulis Froehl.
= **Diaphanodon blandus** (Harv.) Ren. et Card.

Trachypodopsis warburgii Broth. nom. nud.
= **Aërobryopsis longissima** (Doz. et Molk.) Fleisch.

Geographical distribution.

Herzog, Geogr. Moose (1926) 143, 268, 306, 340, 343, 346, 389.

The genus *Trachypodopsis* is found in South-East Asia, South and Central Africa, Central America and in the Hawaiian Islands.

Trachypodopsis serrulata (P. Beauv.) Fleisch.: all regions mentioned with the exception of the Hawaiian Islands. Very abundant in South-East Asia, in the other regions found less frequently.

Trachypodopsis auriculata (Mitt.) Fleisch.: Himalaya, Yuennan, Ceylon, Formosa and the Hawaiian Islands.

Trachypodopsis formosana Nog.: Formosa.

Trachypodopsis laxoalaris Broth.: Ruwenzori.

Trachypodopsis normandi (Broth. et Par.) Fleisch.: French Guinea, Sierra Leone.

Ecology.

Mostly on trees, sometimes on calcareous rocks, sandstone etc. or growing terrestrial, from low altitudes up to 3500 m.

Trachypodopsis serrulata (P. Beauv.) Fleisch. is one of the most important mosses of the mass vegetation in the mountain forests of South-East Asia (Herzog, Geogr. Moose (1926)143).

Note. It was impossible for me to get any material of one of the following nomina nuda from herb. C. Mueller, mentioned by Fleischer, Hedwigia 61(1920)404:

Trachypodopsis bohnhofii (C. Muell.) Fleisch. nom. nud.,

Trachypodopsis lacridens (C. Muell.) Fleisch. nom. nud.,

Trachypodopsis cavernosa (C. Muell.) Fleisch. nom. nud.

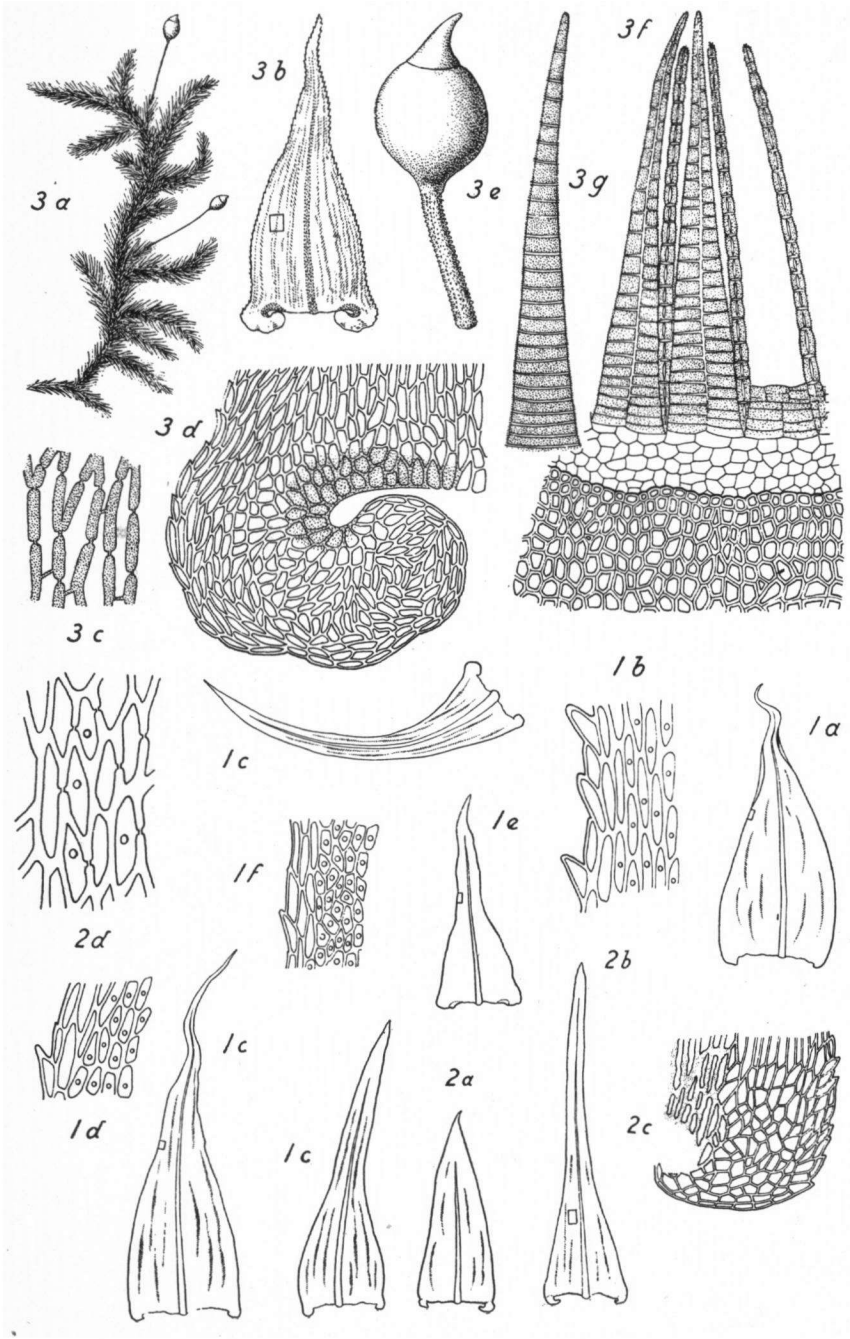
Key to the species

1. Plants fairly robust; auricles large to very large, shaped like a snail-shell (sometimes breaking off easily); leaves strongly longitudinally plicate.
   2. All leaf cells smooth; leaves long-acuminate; auricles very large **3. T. auriculata** (Mitt.) Fleisch.
   2. Part of the leaf cells unipapillate over lumen, the others smooth; leaves very long-acuminate; auricles large . . . . . **2. T. formosana** Nog.
1. Plants moderately slender to fairly robust; auricles small to rather large, not or faintly shaped like a snail-shell; leaves plane or longitudinally plicate; all leaf cells (except the border cells and the basal cells) unipapillate over lumen.
   3. Alar cells hardly developed to more or less distinct, but never large and numerous . . . . . **1. T. serrulata** (P. Beauv.) Fleisch.
   3. Alar cells large.
      4. Alar cells 5—10, abruptly passing into the other leaf cells; leaf border more or less distinct; leaves up to 1.5 mm long **5. T. normandi** (Broth. et Par.) Fleisch.
      4. Alar cells numerous, more or less gradually passing into the other leaf cells; leaf border absent; leaves up to 3.5 mm long **4. T. laxoalaris** Broth.

1. Trachypodopsis serrulata (P. Beauv.) Fleisch.

For literature and type specimens see below.

Dioicous; moderately slender to fairly robust, greenish, in herb. often brownish, never blackish plants in dull or somewhat glossy, dense to lax mats or hanging down. Secondary stems from 2 up to *25 cm* long, procumbent or hanging down, irregularly pinnately branched, occasionally dichotomously or somewhat arborescently branched. Secondary stems and branches densely or laxly, often somewhat complanately foliate. Leaves appressed to horizontally spreading when dry, spreading to horizontally spreading when moist, up to *4 mm* long, occasionally very distinctly falcate-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second (and then mostly asymmetrical) or in longitudinal rows, plane to very strongly longitudinally plicate, mostly more or less crisped near apex, from an ovate or broadly ovate, more or less auriculate base gradually or somewhat abruptly *rather short to very long- and narrowly acuminate*; leaf margin rather faintly to strongly serrate or toothed, teeth themselves sometimes finely denticulate. *Auricles small to rather large,* sometimes faintly shaped like a snail-shell. Branch leaves sometimes somewhat shorter acuminate and with smaller auricles than the stem leaves. Leaves of the lower parts of the secondary stems mostly shorter acuminate. Leaf rib single, ending below apex. Leaf cells subisodiametric to linear (1—10 times as long as wide), on both sides *unipapillate* over lumen; border cells either more elongate and forming a leaf border or not, smooth, cells towards base more elongate, smooth, cells in the auricles quadrate to rectangular, smooth; alar cells *hardly developed to more or less distinct,* but never large and numerous, quadrate to rectangular; cell walls mostly somewhat incrassate, pitted.

Sporophyte as in the diagnosis of the genus. Seta up to *8 mm* long and capsule up to *2.5 mm*.

An exceedingly variable species with 3 varieties which may be distinguished by the following key:

1. Moderately slender to medium-sized plants; stems 1—4 cm long; leaf border distinct; median leaf cells 1—3 times as long as wide
   1c. var. **guilbertii** (Thér. et P. Vard.) Zant.
1. Medium sized to fairly robust plants; stems up to 25 cm long; leaf border either differentiated or not; median leaf cells 2—10 times as long as wide.
   2. Auricles distinct, often more or less protruding; leaves mostly long-acuminate, mostly strongly longitudinally plicate; leaf border more or less distinct
      1b. var. **crispatula** (Hook.) Zant.
   2. Auricles small to fairly small, never protruding; leaves rather short- to rather long-acuminate, not or faintly longitudinally plicate; leaf border absent
      1a. var. **serrulata**

There occur many intermediate forms.

1a. Trachypodopsis serrulata (P. Beauv.) Fleisch. var. **serrulata.** — Plate IV, Fig. 1a and 1b. Plate V, Map 1.

Trachypodopsis serrulata (P. Beauv.) Fleisch., Hedwigia 45(1906)67; Brotherus, Nat. Pfl. 1, 3(1906)831; Fleischer, Musci Fl. Buitenzorg 3(1908) 734; Dixon, S. Afr. J. Sc. 18(1922)325; Potier de la Varde, Bull. Soc. Bot. France 71(1924)1058; Brotherus, Nat. Pfl. ed. 2, 11(1925)122; Sim, Trans. Roy. Soc. S. Afr. 15(1926)397; Potier de la Varde, Bull. Mus. Hist. Nat. 15, 2, 3(1943)129; Demaret, Bull. Jard. Bot. Et. Bruxelles 18, 1 (1946)40; Potier de la Varde, Ark. Bot. 2, 3, 8(1955)178; Potier de la

Plate IV. — Fig. 1a, b: *Trachypodopsis serrulata* (P. Beauv.) Fleisch. var. *serrulata,* 1a leaf (12/1), 1b leaf cells (150/1); Fig. 1c, d: var. *crispatula* (Hook.) Zant., 1c leaves (12/1), 1d leaf cells (150/1); Fig. 1e, f: var. *guilbertii* (Thér. et P. Vard.) Zant., 1e leaf (12/1), 1f leaf cells (150/1); Fig. 2: *Trachypodopsis formosana* Nog., 2a lower stem leaf (12/1), 2b upper stem or branch leaf (12/1), 2c auricle (150/1), 2d leaf cells (300/1); Fig. 3: *Trachypodopsis auriculata* (Mitt.) Fleisch., 3a habit (1/1), 3b leaf (12/1), 3c leaf cells (300/1), 3d auricle (150/1), 3e capsule (8/1), 3f peristome (125/1), 3g exostome tooth, inner face (125/1). (Fig. 1 and 2 original, Fig. 3 after Brotherus, Nat. Pfl. ed. 2, 11(1925)121).

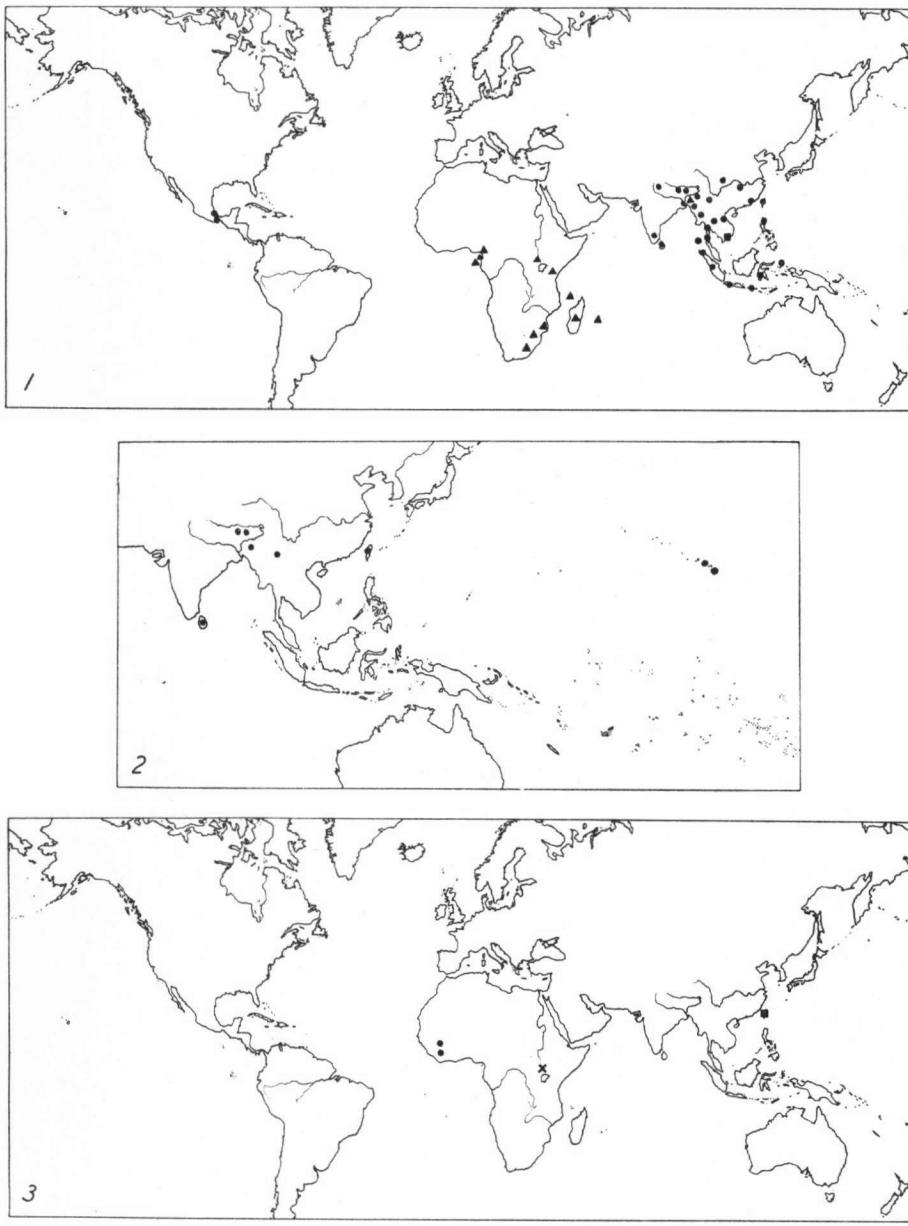


Plate V. — Map 1: Area of *Trachypodopsis serrulata* (P. Beauv.) Fleisch. var. *serrulata* (▲), var. *crispatula* (Hook.) Zant. (●) and var. *guilbertii* (Thér. et P. Vard.) Zant. (■); Map 2: Area of *Trachypodopsis auriculata* (Mitt.) Fleisch.; Map 3: Area of *Trachypodopsis formosana* Nog. (■), *Trachypodopsis laxoalaris* Broth. (×) and of *Trachypodopsis normandi* (Broth. et Par.) Fleisch. (●).

Varde, Mém. Inst. Sc. Madagascar B, 6(1955)216.

Pilotrichum ? serrulatum P. Beauv., Prodr. (1805)83 (not seen).

Neckera serrulata (P. Beauv.) Brid., Spec. Musc. 2(1812)29; Schwaegrichen, Spec. Musc. Suppl. 1, 2(1816)148; Bridel, Mant. Musc. (1819)138; Bridel, Bryol. Univ. 2(1827)237; C. Mueller, Syn. 2(1851)140.

Meteorium serrulatum (P. Beauv.) Mitt., J. Linn. Soc. Bot. 7(1863)156.

Papillaria serrulata (P. Beauv.) Jaeg., Ber. S. Gall. Naturw. Ges. 1875/76(1877)274 = Ad. 2(1877)178.

Trachypus serrulatus (P. Beauv.) Besch., Ann. Sc. Nat. Bot. 6, 10(1880) 269; Mitten, J. Linn. Soc. Bot. 22(1887)314; Paris, Ind. Bryol. (1898)1303; ibid. ed. 2, 5(1906)64; Wager, Check List Moss. S. Afr. (1917)13 (as T. serr*atul*us P. Beauv.).

Neckera nodicaulis C. Muell., Linn. 40(1876)269.

Papillaria nodicaulis (C. Muell.) Jaeg., Ber. S. Gall. Naturw. Ges. 1875/76(1877)274 = Ad. 2(1877)178.

Trachypus nodicaulis (C. Muell.) Besch., Ann. Sc. Nat. Bot. 6, 10(1880) 270; Paris, Ind. Bryol. (1898)1303; ibid. ed. 2, 5(1906)64.

Trachypodopsis nodicaulis (C. Muell.) Fleisch., Hedwigia 45(1906)67; Brotherus, Nat. Pfl. 1, 3(1906)832; Fleischer, Hedwigia 61(1920)404; Brotherus, Nat. Pfl. ed. 2, 11(1925)122.

Trachypus rutenbergii C. Muell. in C. Muell. et Geh.: C. Mueller, Abh. Naturw. Ver. Bremen 7, 2(1881)209; Paris, Ind. Bryol. (1898)1303; ibid. ed. 2, 5(1906)64.

Trachypodopsis rutenbergii (C. Muell.) Fleisch., Hedwigia 45(1908)68; Brotherus, Nat. Pfl. 1, 3(1906)832; Fleischer, Hedwigia 61(1920)404; Brotherus, Nat. Pfl. ed. 2, 11(1925)122.

Papillaria rutenbergii (C. Muell.) Par., Ind. Bryol. (1897)908; ibid. ed. 2, 3(1905)359.

Hypnum ericetorum Brid., Spec. Musc. 2(1812)97; Schwaegrichen, Spec. Musc. Suppl. 1, 2(1816)148; Bridel, Mant. Musc. (1819)138. (fid. Bridel and Schwaegrichen).

Papillaria pintasiana C. Muell. nom. nud.: Fleischer, Hedwigia 45 (1906)67.

Trachypus pintasianus (C. Muell.) C. Muell. nom. nud.: Fleischer, Hedwigia 61(1920)404.

Trachypodopsis pintasianus (C. Muell.) Fleisch. nom. nud. = ? T. quintasiana (C. Muell.) Fleisch.: Fleischer, Hedwigia 45(1906)67; Brotherus, Nat. Pfl. 1, 3(1906)832; Fleischer, Hedwigia 61(1920)404; Brotherus, Nat. Pfl. ed. 2, 11(1925)122.

Neckera macleana Rehm. nom. nud.: Paris, Ind. Bryol. (1897)852; Wager, Check List Moss. S. Afr. (1917)13; Dixon and Gepp, Kew Bull. 1923(1923)230; Sim, Trans. Roy. Soc. S. Afr. 15(1926)397.

Type specimens: *Trachypodopsis serrulata* (P. Beauv.) Fleisch.: Mascarene Islands, Bourbon, leg. Bory St. Vincent; isotype in L, No. 910.120—212. — *Trachypodopsis nodicaulis* (C. Muell.) Fleisch.: Comoro Islands, Johanna, leg. Hildebrandt, June—Aug. 1875, No. 1833; type probably lost. — *Trachypodopsis rutenbergii* (C. Muell.) Fleisch.: Madagascar, Ambatondrazaka, leg. Rutenberg, 6-12-1877; type probably lost.

Medium sized to fairly robust plants in dull or somewhat glossy, lax

or more or less dense mats. Secondary stems up to *15 cm* long, procumbent, more or less irregularly, mostly rather remotely branched. Leaves spreading to horizontally spreading when dry, up to *3 mm* long, *plane to faintly longitudinally plicate,* mostly crisped near apex, from an ovate or broadly ovate, mostly *faintly auriculate* base *rather short- to rather long-acuminate.* Auricles *small to fairly small,* not protruding. Leaf cells *4—10* times as long as wide, border cells *not differentiated.*

Sporophyte not known.

MASCARENE ISLANDS: Bourbon: leg. Bory St. Vincent (L, No. 910.120—212, isotype and No. 910.120—213); leg. Rodriguez (PC); ex herb. Montagne, 1839 (L).

MADAGASCAR: Mt. Ankaratra, leg. Borgen, 1877-79, No. 37 (L); Imorina orient, Andrangotoaka, leg. Hildebrandt, 2-1880 (H, T. rutenbergii).

COMORO ISLANDS: Great Comoro: leg. Macé, 1900 (H); leg. Humblot, No. 1528 (H, T. nodicaulis).

TRANSVAAL: Mt. supra Lydenburg, leg. MacLea, No. 616 (H, Neckera macleana).

NIGERIA: Cameroon Mountains, leg. Jungner, 6-1891, No. 157 (H, T. quintasi).

INDIA: Assam: Manipur, leg. Fraser, 1899 (H, T. auriculatus).

Distribution: *Africa:* Mascarene Islands, Madagascar, Comoro Islands, Gazaland, Transvaal, Southern Rhodesia, Kilimanjaro, Ruwenzori, Ruanda-Urundi, Cameroon Mountains (Nigeria), Fernando Po, St. Thomas. *Asia:* Assam.

Intermediate forms with var. *crispatula* (Hook.) Zant. occur in South-East Asia.

Ecology: On trees in the rain forest from 1300 up to 2300 m altitude.

Notes. 1. This variety is somewhat variable, but much less so than the following one from which it is mainly distinguished by the following characters:

a. leaves not or faintly longitudinally plicate, mostly rather strongly crisped near apex, never appressed and shorter acuminate,
b. auricles mostly smaller, not protruding,
c. leaf cells mostly slightly more elongate, border cells not differentiated.

There occur however intermediate forms with var. *crispatula* (Hook.) Zant., especially in South-East Asia, *e. g.* in the Himalaya, Ceylon, Java and Luzon, but in my opinion all these plants are closer related to var. *crispatula* than to var. *serrulata.*

2. Some specimens from Africa are distinguished in having laxly foliate stems and branches and a less crisped leaf apex. These plants were described by C. Mueller as the new species *Neckera nodicaulis* C. Muell. (l. c. 1876). About this species he says: "Ich hätte diese neue Art am liebsten zu dem Mascarenen Moose gezogen, wenn die angegebenen Unterschiede nicht constant aufträten." However intermediates do occur, *e. g.* the specimens identified as *Trachypus rutenbergii* C. Muell. and as *Trachypus pintasianus* (C. Muell.) C. Muell. nom. nud. According to Brotherus (l. c. 1906 and 1925) the three species mentioned are hardly specifically different from *Trachypodopsis serrulata* (P. Beauv.) Fleisch., which is in accordance with my opinion.

3. The specimen from Assam, Manipur differs from the typical form of var. *serrulata* in having a less strongly serrate leaf margin and larger

auricles, which are faintly shaped like a snail-shell, the reason why this specimen was originally identified as *T. auriculata* (Mitt.) Fleisch., but the latter has even larger auricles. Moreover the habit of the specimen from Manipur is exactly the same as in var. *serrulata*, the leaves are not longitudinally plicate and the leaf cells are distinctly papillate, as contrasted with *T. auriculata*.

4. *Trachypodopsis serrulata* (P. Beauv.) Fleisch. var. *serrulata* bears very close resemblance to *Duthiella speciosissima* Card. (when not in fruit) and these two species are undistinguishable with the naked eye. The microscopical differences with *D. speciosissima* are:

a. auricles slightly larger,
b. leaf cells somewhat more elongate,
c. cells walls more incrassate.

The sporophytes of the two genera are quite different; of var. *serrulata* however the sporophyte is not known and in my opinion it is not quite impossible that, when the sporophyte of this variety does become known it might be that these plants belong to the genus *Duthiella*. Notwithstanding its close resemblance to *Duthiella speciosissima* Card. it is much more likely though var. *serrulata* actually belongs to the genus *Trachypodopsis* for the following reasons:

a. its close resemblance to *Trachypodopsis serrulata* var. *crispatula* (Hook.) Zant. (the sporophyte of which is known) and the occurrence of intermediate forms,

b. the genus *Duthiella* is only found in South-East Asia.

5. In herb. L there are three specimens of *Trachypodopsis serrulata* (P. Beauv.) Fleisch. gathered by Bory St. Vincent in the isle of Bourbon (Mascarene Islands). The type specimen of *Pilotrichum serrulatum* P. Beauv. (= *T. serrulata*) of the herb. of Palisot de Beauvois has probably been lost, but one of the specimens in herb. L (No. 910.120—212) was originally identified as *Pilotrichum serrulatum* P. Beauv. and it is very likely that this specimen is an isotype of *P. serrulatum*. Whether the other two specimens of herb. L are also isotypes is impossible to ascertain.

The specimen from which Bridel described *Hypnum ericetorum* Brid. (l. c. 1812), also gathered by Bory St. Vincent in the isle of Bourbon (may be the same gathering as the type specimen of *Pilotrichum serrulatum* P. Beauv.), has probably been lost, but according to Schwaegrichen (l. c. 1816) and Bridel (l. c. 1819) this species is identical with *Neckera serrulata* (P. Beauv.) Brid. = *Trachypodopsis serrulata* (P. Beauv.) Fleisch.

1b. Trachypodopsis serrulata (P. Beauv.) Fleisch. var. **crispatula** (Hook.) Zant. comb. nov. — Plate IV, Fig. 1c and 1d. Plate V, Map 1.

Trachypodopsis crispatula (Hook.) Fleisch., Hedwigia 45(1906)65; Brotherus, Nat. Pfl. 1, 3(1906)831; Fleischer, Musci Fl. Buitenzorg 3(1908) 734; Brotherus, Philipp. J. Sc. 5, 2, C, Bot. (1910)154; Herzog, Hedwigia 50(1910)136; Brotherus, Philipp. J. Sc. 8, 2, C, Bot. (1913)79; Williams, Bull. New York Bot. Gard. 8, 31(1914)357; Dixon, Rec. Bot. Surv. India 6, 3(1914)64; Dixon, J. of Bot. 53(1915)290; Brotherus, Philipp. J. Sc. 13, 4, C, Bot. (1918)211; Fleischer, Hedwigia 61(1920)404; Potier de la Varde, Rev. Bryol. 50(1923)73; Brotherus, Nat. Pfl. ed. 2, 11(1925)121;

Brotherus, Symb. Sin. 4(1929)77; Reimers, Hedwigia 71(1931)56; Bruehl, Rec. Bot. Surv. India 13, 1(1931)68; Dixon, Hong Kong Nat. Suppl. 2 (1933)19; Dixon, J. Siam Soc. Nat. Hist. Suppl. 10, 1(1935)12; Noguchi, Trans. Nat. Hist. Soc. Formosa 25(1935) 63; Herzog, Ann. Bryol. 12(1939) 91; Noguchi, J. Sc. Hiroshima Univ. B, 2, 3(1939)214; Bartram, Philipp. J. Sc. 68(1939)196; Bartram, Farl. 1, 2(1943)180; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)58; Froehlich, Ann. Naturh. Mus. Wien 59(1953)90; Bartram, Rev. Bryol. Lich. 23(1954)250; Bartram, Bull. Torr. Bot. Cl. 82, 1(1955)26.

Hypnum crispatulum Hook., Trans. Linn. Soc. London 9(1808)321; Schwaegrichen, Spec. Musc. Suppl. 1, 2(1816)302; Bridel, Mant. Musc. (1819)181.

Neckera crispatula (Hook.) Hook., Musci Exot. 2(1819) tab. 152; Bridel, Bryol. Univ. 2(1827)236; Schwaegrichen, Spec. Musc. Suppl. 3, 5(1827) tab. 229; C. Mueller, Syn. 2(1851)140.

Trachypus crispatulus (Hook.) Mitt., J. Linn. Soc. Bot. Suppl. 1(1859) 129; van den Bosch and van der Sande Lacoste, Bryol. Jav. 2(1864)99; Paris, Ind. Bryol. (1898)1302; Brotherus, Rec. Bot. Surv. India 1, 12(1899) 323; Cardot, Rev. Bryol. 28(1901)115; Paris, Ind. Bryol. ed. 2, 5(1906)63.

Papillaria crispatula (Hook.) Jaeg., Ber. S. Gall. Naturw. Ges. 1875/76 (1877)274 = Ad. 2(1877)178.

Cyrtopus crispatulus Brid., Bryol. Univ. 2(1827)237.

Trachypodopsis crispatula (Hook.) Fleisch. ssp. *eucrispatula* Reim. nom. illeg.: Reimers, Hedwigia 71(1931)56.

Trachypus himantophyllus C. Muell. ex Ren. et Card.: Paris, Ind. Bryol. (1898)1303 (as nom. nud.); ibid. Suppl. (1900)322; Renauld and Cardot, Bull. Soc. Roy. Bot. Belg. 38, 1(1900)22; ibid. 41, 1(1905)74; Paris, Ind. Bryol. ed. 2, 5(1906)63.

Trachypodopsis himantophylla (Ren. et Card.) Fleisch., Hedwigia 45 (1906)67; Brotherus, Nat. Pfl. 1, 3(1906)831; Fleischer, Hedwigia 61(1920) 404; Brotherus, Nat. Pfl. ed. 2, 11(1925)121; Reimers, Hedwigia 71(1931) 56; Bruehl, Rec. Bot. Surv. India 13, 1(1931)68; Dixon, J. Bombay Nat. Hist. Soc. 39(1937)781.

Trachypodopsis macrodon Fleisch. syn. nov.: Fleischer, Hedwigia 45 (1906)67 (erroneously named T. macrodon*tis* Fleisch., without description); Fleischer, Musci Fl. Buitenzorg 3(1908)733; Brotherus, Nat. Pfl. ed. 2, 11 (1925)121; Bruehl, Rec. Bot. Surv. India 13, 1(1931)68; Froehlich, Ann. Naturh. Mus. Wien 59(1953)90.

Trachypodopsis crispatula (Hook.) Fleisch. ssp. *macrodon* (Fleisch.) Reim. syn. nov.: Reimers, Hedwigia 71(1931)56.

Prionodon otiophyllus Card., Rev. Bryol. 37(1910)7.

Trachypodopsis otiophylla (Card.) Card., Rev. Bryol. 38(1911)39; Brotherus, Nat. Pfl. ed. 2, 11(1925)121; Bartram, Field. Bot. 25(1949)247.

Trachypodopsis densifolia Broth. syn. nov.: Brotherus, Symb. Sin. 4(1929)77.

Trachypodopsis plicata Dix. syn. nov.: Dixon, Ann. Bryol. 9(1936)65.

Trachypodopsis angustiretis Dix. syn. nov.: Dixon, Ann. Bryol. 12 (1939)53.

Trachypodopsis subulata Chen syn. nov.: Chen, Fedd. Rep. 58(1955)29.

Trachypodopsis crispatula (Hook.) Fleisch. ssp. *longifolia* Reim. syn. nov.: Reimers, Hedwigia 71(1931)56.

Trachypodopsis crispatula (Hook.) Fleisch. var. *longifolia* Nog. homonym illeg.: Noguchi, J. Sc. Hiroshima Univ. B, 2, 3(1939)214; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)58.

Trachypus crispatulus (Hook.) Mitt. f. *gracilior* Mitt. nom. nud.: Mitten, J. Linn. Soc. Bot. Suppl. 1(1859)129.

Trachypus subcrispatulus C. Muell. nom. nud.: Fleischer, Hedwigia 45 (1906)67; ibid. 61(1920)404.

Trachypodopsis subcrispatula (C. Muell.) Fleisch. nom. nud.: Fleischer, Hedwigia 45(1906)67; ibid. 61(1920)404.

Papillaria feae C. Muell. nom. nud.: Paris, Ind. Bryol. (1897)904.

Trachypus feae (C. Muell.)? nom. nud.: C. Mueller, Nuov. Giorn. Bot. Ital. 1891(1891)601; Fleischer, Hedwigia 45(1906)67; ibid. 61(1920)404.

Trachypodopsis feae (C. Muell.) Fleisch. nom. nud.: Fleischer, Hedwigia 45(1906)67; ibid. 61(1920)404.

Trachypus sumatranus C. Muell. nom. nud.: Fleischer, Hedwigia 45 (1906)67; ibid. 61(1920)404.

Trachypodopsis sumatrana (C. Muell.) Fleisch. nom. nud.: Fleischer, Hedwigia 45(1906)67; ibid. 61(1920)404.

Type specimens: *Trachypodopsis crispatula* (Hook.) Fleisch.: Nepal, leg. Buchanan; holotype in K. — *Trachypodopsis himantophylla* (Ren. et Card.) Fleisch.: Sikkim, Darjeeling, leg. Determes 1896; isolectotype in PC. — *Trachypodopsis macrodon* Fleisch.: Java, Tjibeurum, leg. Fleischer, 9-1902; lectoholotype in FH. — *Trachypodopsis otiophylla* (Card.) Card.: Mexico, Morelos, Cuernavaca, leg. Pringle, 1908, No. 15184; type not seen. — *Trachypodopsis densifolia* Broth.: China, Yuennan, leg. Handel-Mazzetti, 28-5-1915, No. 6116; type probably lost. — *Trachypodopsis plicata* Dix.: Laos, Mt. Pu Bia, Chieng Khuang, leg. Kerr, 1932, No. 506; holotype in BM. — *Trachypodopsis angustiretis* Dix.: Sumatra, Mt. Goh Lemboeh, leg. van Steenis, 2-1937, No. 10212; holotype in BM. — *Trachypodopsis subulata* Chen, Szechwan, Hwayun-schan, leg. Chen, 11-7-1937, No. 634a; type not seen. — *Trachypodopsis crispatula* (Hook.) Fleisch. var. *longifolia* Nog. homonym illeg.: Formosa, Prov. of Tainan, Mt. Kodama, leg. Noguchi, 8-1932, No. 6803; holotype in HIRO (not seen).

Medium sized to fairly robust plants in mostly somewhat glossy, lax or more or less dense mats or hanging down. Secondary stems up to *25 cm* long, procumbent or hanging down, more or less irregularly pinnately branched, rarely rather densely pinnately branched, occasionally dichotomously branched. Leaves appressed to horizontally spreading when dry, up to *4 mm* long, mostly *strongly longitudinally plicate,* more or less crisped near apex, from an ovate or broadly ovate, *auriculate base long- to very long- and narrowly acuminate.* Auricles *medium sized* to *rather large,* often somewhat protruding, sometimes faintly shaped like a snail-shell. Leaf cells *2—8* times as long as wide, rarely up to *10* times as long as wide, border cells mostly *more or less differentiated.*

Sporophyte as in the diagnosis of the genus.

India: Simla: leg. Determes, 5-1897, c.fr. (L, No. 910.132—943 and No. 912.304—145); leg. Doulea, 19-11-1900, No. 3047 (PC, T. subcrispatula); leg. Doulea, 20-11-1900,

No. 3047 (H, the same as the previous specimen ?). — Mussoorie: leg. Duthie, 2-1-1892, No. 635, c.fr. (H, T. subcrispatulus); Dhanoulti, leg. Bahadru, 10-12-1903, No. 5861 (H); Arnigadh, leg. Gollan, 15-12-1895, Levier No. 82 (K, T. subcrispatula). — Sikkim: Lachung, herb. Ind. Or. Hook. f. et Thoms. No. 853 (K); Jonglo, herb. Ind. Or. Hook. f. et Thoms. No. 875 (K); Silake, leg. Gammie, 1-1898, No. 11435 p.p. (H); Darjeeling, leg. Determes, 1896 (PC, T. himantophyllus, isolectotype). — Assam: Naga Hills, leg. Micholitz, 12-1910 (L). — Calcutta: leg. Griffith, No. 72 (PC). — Kumaon: Gori Valley, Parbhu, leg. Inayat, 12-8-1900 (H). — Madura: Palni Hills, leg. Foreau, 1953, No. 213 (GRO). — Himalaya without definite locality: leg. Determes (PC). — India without definite locality: herb. Ind. Or. Hook. f. et Thoms. No. 867, c.fr. (K); ibid. No. 849 (H, L), No. 850, c.fr. (L) and No. 858 (L); Bababoodaus, Kulhutty, leg. Meebotch, 10-1908 (H).

Nepal: leg. Buchanan (K, holotype); leg. Wallich, herb. Hookerianum, No. 2125, (K); leg. Gardner, herb. Hookerianum, No. 2124, c.fr. (K); leg. Wallich (L); leg ?, c.fr. (L, No. 910.132—935 and No. 910.132—940).

Ceylon: Horton Plaines, leg. Fleischer, 2-1898, No. 198 (L); between Horton Plaines and Pattipola, leg. Herzog, 2-1906, No. 300 (L).

Burma: Yuennan frontier, leg. Micholitz, 10-1911 (L); Tenasserim, Mt. Moolegit, leg. Fea, 3-1887 (PC, T. feae).

China: Yuennan, near Tengyueeh, leg. Rock, No. 2991, c.fr. (L).

Laos: Mt. Pu Bia, Chieng Khuang, leg. Kerr, 1932, No. 506 (BM, T. plicata, holotype).

Formosa: Prov. of Tainan, Mt. Kodama, leg. Noguchi, 18-8-1932, No. 6809 (herb. Noguchi, T. crispatula var. longifolia).

Philippine Islands: Luzon: Subprov. of Ifugao, Mt. Polis, leg. MacGregor, 2-1913, Bur. Sc. No. 19926 (L); Subprov. of Benguet, leg. Mearns, 5-1907, No. 3386 (GRO, L); Subprov. of Benguet, leg. Santos, 4-6-1918, No. 32055 (K); Prov. of Abra, Mt. Posuey, leg. Ramos, 2-1917, Bur. Sc. No. 27097 (L).

Indonesia: Java: Tjibeurum, leg. Fleischer, 9-1902 (FH, T. macrodon, lectoholotype); Djati-Kalangan, leg. Junghuhn, No. 875 (L); leg. Junghuhn (L, No. 910.132—941); leg. Junghuhn (FH, T. macrodontis); Limbangan, leg. Korthals (L); leg. Korthals (L, No. 910.132—1018); comm. van der Sande Lacoste (L); Mt. Patoeha, leg. Verdoorn, 7-1930, No. 60 (GRO, L, T. macrodon); ibid. No. 701 (GRO, T. macrodon); leg. de Vriese (L, No. 910.132—1015); leg. de Vriese, 1858/60 (L, No. 910.132—1013 and No. 910.132—939); Tjibeurum, leg. van der Wijk, 18-3-1952, no. 404 (GRO). — Sumatra: Mt. Singgalang, leg. Beccari, 7-1878 (L, T. sumatrana); Padang, leg. Beccari, 1878, No. 69 (K, T. sumatrana); Atjeh, Mt. Goh Lemboeh, leg. van Steenis, 2-1937, No. 10212 (BM, T. angustiretis, holotype). — Lombok: Kalimati near Sambalun, leg. Elbert, 19-5-1909, No. 1449 (L, No. 943.8—84 and No. 943.5—41). — Halmaheira: leg. de Vriese, 1858/60 (H, L, No. 910.132—936, 910.132—1014 and No. 940.118—8).

Mexico: State of Hidalgo, near Honey Station, leg. Pringle, 7-10-1909, No. 1565—7 (PC, T. otiophylla).

Distribution: *Asia:* Himalaya, Southern India, Assam, Calcutta, Burma (Chin Hills, Tenasserim, Kengtung State, Mang Loen State); Andaman Islands, Yuennan, Szechwan, Laos, Formosa, Philippine Islands, Java, Sumatra, Celebes, Lombok, Halmaheira. *Central America:* Mexico, Guatemala.

Perhaps also Hong Kong (*cf.* Dixon, l. c. 1933).

Very common in South-East Asia.

Ecology: On trees, calcareous rocks, sandstone etc. or growing terrestrial from low altitudes up to 3400 m.

According to Herzog, Geogr. Moose (1926)143, this variety is one of the most important mosses of the mass vegetation of the mountain forests of South-East Asia.

Notes. 1. The present variety is a very variable one. The characters which may vary are a) the mode of branching and the length of the stems and branches, b) the aspect of the stems and branches, c) the direction

of the leaves, d) the shape of the leaves, e) the degree of toothing of the leaf margin, f) the distinctness of the leaf border, g) the shape of the leaf cells.

a) The secondary stems and branches are mostly rather long, irregularly pinnately branched, procumbent or hanging down, but occasionally there occur plants which are more compact and with short stems (only a few cm long) and therefore inclining somewhat towards var. *guilbertii* (P. Vard.) Zant.

b) The aspect of the stems and branches varies from complanately foliate to foliate all around stem. The leaves are mostly irregularly inserted, but there also occur plants which have their leaves partially inserted in distinct longitudinal rows (*e. g.* India, Bababoodaus, Kulhutty, leg. Meebotch, 10-1908 (H)).

c) The direction of the leaves varies from appressed to horizontally spreading when dry. The stem leaves are often somewhat more appressed than the branch leaves. There occasionally occur plants (among them the type specimen of *T. crispatula* (Hook.) Fleisch.) that have strongly falcate-second leaves on some stems or branches (these leaves then mostly asymmetrical), whereas the leaves on other stems or branches are not falcate-second.

d) The leaves are mostly rather long-acuminate, but there also occur plants that have very long- and narrowly acuminate leaves. These plants were described by Reimers as *T. crispatula* ssp. *longifolia* Reim. (l. c. 1931) and by Noguchi as *T. crispatula* var. *longifolia* Nog. homonym illeg. (l. c. 1939).

e) The degree of toothing varies from faintly to strongly serrate or toothed. Sometimes the teeth themselves are finely denticulate.

f) The distinctness of the leaf border may vary from wholly lacking to fairly distinct. This variability is sometimes found on the same plant.

g) The shape of the median leaf cells may vary from almost isodiametric to linear (1—10 times as long as wide). The cells towards the apex are mostly shorter (not always!) and those towards base mostly longer than the median leaf cells. On an average they are 3—8 times as long as wide.

Plants with short leaf cells (1—3 times as long as wide) are rather rare (*e. g.* the specimens identified as *T. subcrispaluta* (C. Muell.) Fleisch. nom. nud. and as *T. feae* (C. Muell.) Fleisch.) and incline towards var. *guilbertii* (P. Vard.) Zant.

The type specimen of *T. angustiretis* Dix. has linear leaf cells (about 10 times as long as wide).

2. In 1905 Renauld and Cardot say concerning the species *Trachypus himantophyllus* Ren. et Card. (l. c. 1905), they described before: "Il nous semble même maintenant impossible d'y voir autre chose qu'une simple forme verte et grêle du *Trachypus crispatulus*, à feuilles moins denses, non homotropes, non ou à peine crispée, à rameaux plumeux, à capsule plus petite et plus courte; de plus, les cellules basilaires sont généralement très poreuses, et les cellules supérieures sont plus courtes; mais tous ces caractères sont peu stables et on rencontre des échantillons qui restent indécis entre les deux formes."

Dixon says of this species (l. c. 1937): "It is quite a marked plant, but I doubt whether it is more than a variety of *T. crispatula.*"

From the above it follows that *T. himantophylla* must be very closely allied to var. *crispatula,* and comparing the type specimen of *T. himantophylla* with var. *crispatula* it turned out that *T. himantophylla* fell entirely within the limits of *T. serrulata* var. *crispatula.*

3. In 1908 Fleischer described a new species *Trachypodopsis macrodon* Fleisch. (l. c. 1908) saying: "Diese Art unterscheidet sich von *Trachypodopsis crispatula* (Mitt.) vom indischen Festland, der sie sehr ähnlich ist und mit der sie in Bryol jav. l. c. vermengt ist, durch etwas gedrungneren Habitus, regelmässiger gefiederte Stengel, deutlicher gescheitelte, herabgebogene und etwas dichter gestellte Blätter mit deutlicheren Saumzellen, kürzeren Blattzellen und grösser gezähntem Blattrand.

Alle mir bekannten Exemplare aus Java, auch die Originalexemplare (Junghuhn) aus Java, gehören nicht zu *T. crispatula,* welche auf Java nicht vorzukommen scheint, sondern zu dem oben beschriebenen *T. macrodon* n. sp."

All the differences mentioned by Fleischer are characters in which *T. serraluta* var. *crispatula* may vary and when I compared the type specimen of *T. macrodon* with var. *crispatula* it turned out that *T. macrodon* fell entirely within the limits of var. *crispatula.*

Froehlich too states that he cannot affirm the differences between *T. macrodon* Fleisch. and *T. crispatula* (Hook.) Fleisch. mentioned by Fleischer, where the former writes (l. c. 1953): "Nach Fleischer gehören die Exemplare aus Java zu seiner *Trachypodopsis macrodon* und sollen die Autoren der Br. jav. diese seine Art mit *T. crispatula* vermengt haben. Möglicherweise gehört unsere Pflanze zur Fleischerschen Art, von der ich keinen Beleg habe, doch kann ich die von Fleischer angegebenen Unterschiede — abgesehen von der um eine Nuance etwas stärkeren Zähnung des Blattrandes — nicht herausfinden, insbesondere stimmen nicht die kürzeren Blattzellen, die ich übrigens auch bei *T. crispatula* ab und zu getroffen habe (Baumgartner)."

4. I have not seen the type specimen of *Trachypodopsis otiophylla* (Card.) Card., but I did see another specimen of herb. Cardot from Mexico. All the characters of this specimen fall entirely within the limits of *T. serrulata* var. *crispatula.*

Of this species Cardot (l. c. 1911) says: "C'est une *Trachypodopsis,* très voisin du *T. crispatula* (Hook.) Fl. de l'Inde s'en distinguant toutefois par sa teinte plus verte, ses rameaux comprimes, ses feuilles pourvues d'oreillettes plus grandes et plus accusées, et son tissu plus chlorophylleux, formé de cellules plus courtes, à parois beaucoup moins épassies."

According to Bartram too this species hardly differs from *T. crispatula* (Hook.) Fleisch., where he writes (l. c. 1949): "In vegetative features these plants differ little if any from the widespread *T. crispatula* (Hook.) Fleisch. of southeastern Asia and Malaysia. Unless there is some distinction in the sporophyte I doubt if they can be separated."

5. The type specimen of *Trachypodopsis densifolia* Broth. has probably been lost (the capsule is present in H, but without moss), but judging from the diagnosis and the figure given by Brotherus (l. c. 1929) it is almost certain that this species belongs to *T. serrulata* var. *crispatula.*

6. In his original description of *Trachypodopsis plicata* Dix. (l. c. 1936) Dixon writes: "Intermediate between *T. auriculata* and *T. crispatula*; it has the robust habit and plicate leaves of the former, and the leaves usually but little crisped, while the auricles are much smaller and often only slightly developed; the marginal toothing is very coarse, the teeth irregular in size and direction, often almost ciliate, and frequently themselves shortly denticulate."

The leaves of *T. serrulata* var. *crispatula* however are mostly also strongly plicate and the habit may be fairly robust. In fact the type specimen of *T. plicata* Dix. is hardly to be distinguished from most plants belonging to *T. serrulata* var. *crispatula.*

7. Chen described a new species *Trachypodopsis subulata* Chen (l. c. 1955), which I have not seen, but which species was said to be distinguished from the other *Trachypodopsis* species mainly by its arborescent branching. This mode of branching however also occurs in plants belonging to *T. serrulata* var. *crispatula.* although in a less extreme manner. The further differences (according to the description by Chen) were said to be the very long-acuminate leaves and the larger auricles. These characters however also fall entirely within the limits of var. *crispatula.* In fact, in my opinion *T. subulata* is only an extreme case of var. *crispatula* with an arborescent branching and very long-acuminate leaves. The auricles are not larger than in most plants belonging to var. *crispatula* (according to the figure given by Chen).

8. The robust specimens with long-acuminate, strongly longitudinally plicate leaves of *T. serrulata* var. *crispatula,* in habit much resemble *T. auriculata,* but are always recognizable in having smaller, not or faintly snail-shell-shaped auricles and papillose leaf cells.

1c. Trachypodopsis serrulata (P. Beauv.) Fleisch. var. **guilbertii** (Thér. et P. Vard.) Zant. comb. nov. — Plate IV, Fig. 1e and 1f. Plate V, Map 1.

Duthiella guilbertii Thér. et P. Vard.: Potier de la Varde, Rev. Bryol. Lich. 15(1946)146.

Type specimen: *Duthiella guilbertii* Thér. et P. Vard.: Cambodia, near Saigon, leg. Guilbert, 5-1935, herb. Potier de la Varde, No. 6366; holotype in PC.

Moderately slender to medium sized plants in dull mats. Secondary stems *short,* only a few cm long, procumbent, remotely, irregularly branched. Leaves spreading to horizontally spreading when dry, up to *2.5 mm* long, *crisped when dry, not or faintly longitudinally plicate,* from an ovate, *faintly auriculate* base rather long- and narrowly acuminate. Auricles small, slightly protuding. Median leaf cells *1—3* times as long as wide, border cells more elongate, forming a *distinct border,* cells in the lower part of the leaf more elongate, up to 6 times as long as wide; alar cells few, but distinct.

Sporophyte not known.

CAMBODIA: near Saigon, leg. Guilbert, 5-1935, herb. Potier de la Varde, No. 6366 (PC, Duthiella guilbertii, holotype).

Distribution: Cambodia only.

Ecology: No data extant.

Notes. 1. This variety is in general clearly distinguished from the other varieties, there occur however some intermediate forms with var. *crispatula* (see there, note 1a and 1g).

The main differences with var. *crispatula* are the following:

a. less robust, with shorter stems and smaller leaves,
b. leaves not or faintly longitudinally plicate,
c. leaf border more distinct,
d. leaf cells shorter,
e. auricles smaller,

and those with var. *serrulata:*

a. less robust, with shorter stems and smaller leaves,
b. leaf border distinct,
c. leaf cells shorter,
d. auricles slightly protruding.

2. When Potier de la Varde and Thériot described this new species (l. c. 1946) they incorporated it within the genus *Duthiella,* but although the sporophyte is not known, it is more likely that this plant should belong to the genus *Trachypodopsis* for the following reasons:

a. The species belonging to the genus *Duthiella* are in general not auriculate, but if auricles do occur (*D. speciosissima* Card.) they are not protruding and the leaf margin passes gradually into the leaf base; the auricles of *D. guilbertii* are somewhat protruding and the leaf margin passes more or less abruptly into the leaf base, exactly as is the case in all *Trachypodopsis* species (with the only exception of *T. serrulata* var. *serrulata*).

b. The occurence of intermediate forms between *D. guilbertii* and *T. serrulata* var. *crispatula.*

3. This variety also bears a slight resemblance to *Duthiella declinata* (Mitt.) Zant. (this species hitherto used to belong to the genus *Trachypodopsis*!), but is *i. a.* clearly distinguishable by the presence of leaf auricles.

2. Trachypodopsis formosana Nog. — Plate IV, Fig. 2. Plate V, Map 3. Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)59.

Type specimen: Formosa, Prov. of Taichu, Mt. Noko, leg. Suzuki, 8-1929, No. 575.

Fairly robust plants in rather dense, yellowish-green or brownish, dull-glossy mats. Secondary stems up to about *15 cm* long, irregularly pinnately branched, rigid, densely foliate. Leaves erect spreading to horizontally spreading when dry, spreading to horizontally spreading when moist, up to *7 mm* long, from an ovate, auriculate base more or less gradually *long- to very long-acuminate, strongly longitudinally plicate,* crisped near apex when dry; leaf margin rather faintly serrate. *Auricles large,* often somewhat protruding, more or less shaped like a *snail-shell, breaking off easily.* Leaves of the lower parts of the secondary stems shorter acuminate and more or less deltoid. Leaf rib single, ending below apex. Leaf cells elongate to sublinear (3—8 times as long as wide), *part of them unipapillate* over lumen (rarely with 2 papillae), *the others smooth,* border cells not differentiated, cells towards base more elongate, smooth; alar cells present, *rather large,*

filling the greater part of the auricles, quadrate to rectangular, smooth; cell walls mostly moderately incrassate, pitted.

Sporophyte as in the diagnosis of the genus (capsule not known).

FORMOSA: Prov. of Taichu, Mt. Noko, leg. Suzuki, 8-1929, No. 575 (herb. Noguchi, holotype).

Distribution: Formosa only.

Ecology: No data.

Note. The present species is somewhat intermediate between *T. serrulata* (P. Beauv.) Fleisch. and *T. auriculata* (Mitt.) Fleisch.

From the latter it is mainly distinguished by the following characters:

a. leaves longer acuminate,
b. auricles somewhat smaller,
c. alar cells more distinct, filling the greater part of the auricles,
d. part of the leaf cells unipapillate over lumen (rarely with 2 papillae),

and from the former by:

a. leaves longer acuminate,
b. auricles larger, always more or less shaped like a snail-shell,
c. alar cells more distinct, filling the greater part of the auricles,
d. only part of the leaf cells unipapillate over lumen (rarely with 2 papillae), the others smooth.

3. Trachypodopsis auriculata (Mitt.) Fleisch. — Plate IV, Fig. 3. Plate V, Map 2.

Trachypodopsis auriculata (Mitt.) Fleisch., Hedwigia 45(1906)67; Brotherus, Nat. Pfl. 1, 3(1906)832; Herzog, Hedwigia 50(1910)136; Dixon, J. of Bot. 50(1912)151; Fleischer, Hedwigia 61(1920)404; Brotherus, Nat. Pfl. ed. 2, 11(1925)122; Sasaoka, Trans. Nat. Hist. Soc. Formosa 18(1928) n. 97 (not seen); Brotherus, Symb. Sin. 4(1929)77; Bruehl, Rec. Bot. Surv. India 13, 1(1931)68; Dixon, J. Bombay Nat. Hist. Soc. 39(1937)781; Herzog, Ann. Bryol. 12(1939)91; Horikawa in Asahina, Nippon Inkwasyokubutu Dukan (1939)937 (not seen); Noguchi, J. Hattori Bot. Lab. 5(1951)23.

Trachypus auriculatus Mitt., J. Linn. Soc. Bot. Suppl. 1(1859)129; Paris, Ind. Bryol. (1898)1303; ibid. ed. 2, 5(1906)63; Fleischer, Hedwigia 61(1920)404.

Papillaria auriculata (Mitt.) Jaeg., Ber. S. Gall. Naturw. Ges. 1875/76 (1877)274 = Ad. 2(1877)178.

Pilotrichum auriculatum Wils. nom. nud.: Mitten, J. Linn. Soc. Suppl. 1(1859)129; Jaeger, Ber. S. Gall. Naturw. Ges. 1875/76(1877)274 = Ad. 2(1877)178.

Hemiragis ornans Reich, Beitr. (?)577 (not seen).

Hookera ornans (Reich.) Par., Ind. Bryol. (1896)581.

Trachypus ornans (Reich.) C. Muell., Fl. 82(1896)465; Paris, Ind. Bryol. (1898)1303; Brotherus, Bull. Soc. Bot. Ital. 1904(1904)24; Paris, Ind. Bryol. ed. 2, 5(1906)64; Fleischer, Hedwigia 61(1920)404.

Trachypodopsis ornans (Reich.) Fleisch. syn. nov.: Fleischer, Hedwigia 45(1906)68; Brotherus, Nat. Pfl. 1, 3(1906)832; Fleischer, Hedwigia 61 (1920)404; Brotherus, Nat. Pfl. ed. 2, 11(1925)122; Brotherus, Bish. Mus. Bull. 40(1927)20.

Trachypus ornans (Reich.) C. Muell. f. *simplex* Broth. syn. nov.: Brotherus, Bull. Soc. Bot. Ital. 1904(1904)24.

Trachypodopsis auriculata (Mitt.) Fleisch. f. *pendula* Herz. syn. nov.: Herzog, Ann. Bryol. 12(1939)91.

Trachypus craspedophyllus C. Muell. nom. nud.: Fleischer, Hedwigia 45 (1906)68; ibid. 61(1920)404.

Trachypodopsis craspedophylla (C. Muell.) Fleisch. nom. nud.: Fleischer, Hedwigia 45(1906)68; ibid. 61(1920)404.

Type specimens: *Trachypodopsis auriculata* (Mitt.) Fleisch.: India, Sikkim, leg. Hooker, No. 863; lectoholotype in K. — *Trachypodopsis ornans* (Reich.) Fleisch.: Hawaiian Islands, Maui, leg. Wawra, No. 2147; lectoholotype in W (under the name of Hemiragis ornans). — *Trachypus ornans* (Reich.) C. Muell. f. *simplex* Broth.: Hawaiian Islands, Maui, leg. Baldwin, 1875; type probably lost. — *Trachypodopsis auriculata* (Mitt.) Fleisch. f. *pendula* Herz.: India, Sikkim, Darjeeling, Tsomgo Lake, leg. Troll; type not seen.

Dioicous; fairly robust, greenish (in herb. mostly brownish), never blackish plants in dull-glossy or somewhat glossy, lax mats or hanging down. Secondary stems up to *30 cm* long, procumbent or hanging down, rather remotely, irregularly pinnately, occasionally dichotomously branched. Secondary stems and branches fairly densely, mostly somewhat complanately foliate. Leaves mostly spreading (stem leaves occasionally appressed) when dry, spreading to horizontally spreading when moist, up to *5 mm* long, from a broadly ovate, strongly auriculate base, mostly gradually, *long-acuminate, strongly longitudinally plicate,* often crisped near apex; leaf margin faintly to strongly toothed or serrate, teeth themselves sometimes finely denticulate. *Auricles very large,* shaped like a *snail-shell.* Leaf rib single, ending below apex. Leaf cells elongate to linear (4—10 times as long as wide), *smooth,* border cells not differentiated; cells in the auricles shorter and irregular in shape; alar cells *hardly developed;* cell walls rather thin to incrassate and pitted.

Sporophyte as in the diagnosis of the genus. Seta up to *18 mm* long and capsule up to *3 mm.*

India: Sikkim: Phaluth, leg. Kurz, No. 2410, c.fr. (L); Kurseong, leg. Decoly, 22-9-1898, No. 449, c.fr. (H); Darjeeling, leg. Wichura, 16-4-1862, No. 2892b (H); Jonglo, herb. Ind. Or. Hook. f. et Thoms. No. 864 (K); Mainamcha, herb. Ind. Or. Hook. f. et Thoms. No. 863, c.fr. (K, lectoholotype); leg. Kurz, No. 2078 (H, Trachypus craspedophyllus). — Bhutan: leg. Griffith (PC). — Himalaya without definite locality: herb. Ind. Or. Hook. f. et Thoms. No. 952 (L); Cusriang, leg. Wichura, 7-4-1862, No. 2892d, c.fr. (H).

Hawaiian Islands: Maui: leg. Wawra, No. 2147 (W, Hemiragis ornans, lectoholotype); Haleakala, Kula pipe line, leg. Skottsberg, 18-10-1922, No. 1176 (H, T. ornans). — Oahu: leg. Wawra (W, Hemiragis ornans).

Distribution: India: (Sikkim, Bhutan, Assam); Yuennan (fid. Brotherus, l. c. 1929); Ceylon (fid. Herzog, l. c. 1910); Formosa (fid. Noguchi, l. c. 1947); Hawaiian Islands.

Ecology: On trees. Alt.: Hawaiian Islands 700—1600 m; Himalaya 2000—3500 m; Ceylon 1700 m.

Notes. 1. This species, which is very easily recognizable in having

smooth leaf cells and very large, snail-shell-shaped auricles, may vary somewhat in the length of the leaf cells.

All the plants I saw from the Hawaiian Islands have got rather long leaf cells (up to 10 times as long as wide), whereas on the continent there also occur plants with shorter leaf cells, besides those with leaf cells up to 10 times as long as wide. Sometimes more elongate leaf cells are concomitant with more incrassate cell walls.

2. Herzog mentions a forma *pendula* Herz. (l. c. 1939) saying: "Sie wächst in ca. 30 cm langen Bärten von rötlicher Färbung offenbar an Baumästen der Waldgrenze, während die Normalform in tieferen Berglagen beheimatet sein dürfte." Although I have not seen the type specimen it is in my opinion not practical to name those forms.

3. According to Herzog, Geogr. Moose (1926)143, the natives of the Hawaiian Islands use this species as ornaments in their dance-crowns.

4. Trachypodopsis laxoalaris Broth. in Mildbr. — Plate XI, Fig. 1, Plate V, Map 3.

Brotherus, Wiss. Erg. Deut. Zentr. Afr. Exp. 2, 1(1910)160; Brotherus, Nat. Pfl. ed. 2, 11(1925)122; Demaret, Bull. Jard. Bot. Et. Bruxelles 16, 1(1940)75; Potier de la Varde, Ark. Bot. 2, 3, 8(1955)178.

Type specimen: Ruwenzori, Butagu Valley, leg. Mildbraed, 2-1908, No. 2660; holotype in H.

Fairly robust, yellowish-green plants in dull-glossy mats. Secondary stems up to *20 cm* long, procumbent or hanging down, remotely, irregularly pinnately branched. Secondary stems and branches densely, somewhat complanately foliate. Leaves spreading to horizontally spreading when dry, up to *3.5 mm* long, *not or rather faintly longitudinally plicate,* crisped near apex, from a broadly ovate, auriculate base more or less gradually, rather long-acuminate; leaf margin moderately toothed, teeth irregular in size and direction. Leaves of the lower parts of the secondary stems shorter acuminate. *Auricles moderately developed,* not or faintly protruding. Leaf rib single, ending below apex. Leaf cells elongate to linear (5—10 times as long as wide), on both sides *unipapillate* over lumen, border cells not differentiated, mostly smooth, cells towards base more elongate (basal cells however rather short and wider), smooth; *alar cells numerous, large,* more or less *gradually* passing into the lamina cells, quadrate to rectangular, smooth; cell walls somewhat incrassate, pitted.

Sporophyte not known.

RUWENZORI: Butagu Valley, leg. Mildbraed, 2-1908, No. 2660 (H, holotype).

Distribution: Ruwenzori only.

Ecology: On dry precipice at 2700 m altitude.

Note. The present species is closely allied to *Trachypodopsis serrulata* (P. Beauv.) Fleisch. var. *serrulata,* but is clearly distinguished in having numerous, large alar cells, which fill almost the whole auricles. Hitherto no intermediate forms have been found.

5. Trachypodopsis normandi (Broth. et Par.) Fleisch. — Plate VI, Fig. 3 Plate V, Map 3.

Trachypodopsis normandi (Broth. et Par.) Fleisch., Hedwigia 45

(1906)68; Brotherus, Nat. Pfl. 1, 3(1906)831; ibid. ed. 2, 11(1925)121; Taylor and Potier de la Varde, Kew Bull. 4(1954)510.

Trachypus normandi Broth. et Par., Rev. Bryol. 29(1902)68; Paris, Bull. Soc. Bot. France 8, 4, 14(1908)35.

Type specimen: French Guinea, Fouta Jalon, leg. Normand, 5-4-1901; lectoholotype in H.

Dioicous ♀; *moderately slender to medium sized,* green or yellowish-green plants in dull or dull-glossy mats. Stems irregularly pinnately, to fairly regularly pinnately branched, branches up to *1,5 cm* long. Leaves spreading, recurved near apex when dry, erect spreading when moist, up to *1.5 mm* long, *more or less longitudinally plicate,* undulate near apex, from an ovate, somewhat auriculate base gradually acuminate; leaf margin partially recurved, faintly to moderately serrate. Leaves of the lower parts of the secondary stems shorter acuminate. *Auricles rather small,* the leaf margin mostly somewhat abruptly passing into the leaf base. Leaf rib single, ending below apex. Leaf cells elongate to sublinear (2—8 times as long as wide) on both sides unipapillate over lumen, border cells more elongate, forming *a more or less distinct border,* mostly smooth, cells towards base more elongate, smooth; *alar cells well developed,* consisting of about 5—10 large, rectangular to quadrate cells, *abruptly* passing into smaller, more or less quadrate leaf cells which gradually pass into the elongate lamina cells; cell walls rather thin to moderately incrassate.

Male gametioecia as in the diagnosis of the genus.

Sporophyte not known.

FRENCH GUINEA: Fouta Jalon, leg. Normand, 5-4-1901 (H, lectoholotype).

Distribution: French Guinea and Sierra Leone.

Ecology: On trees, rocks, or terrestrial. Alt. 800—1800 m.

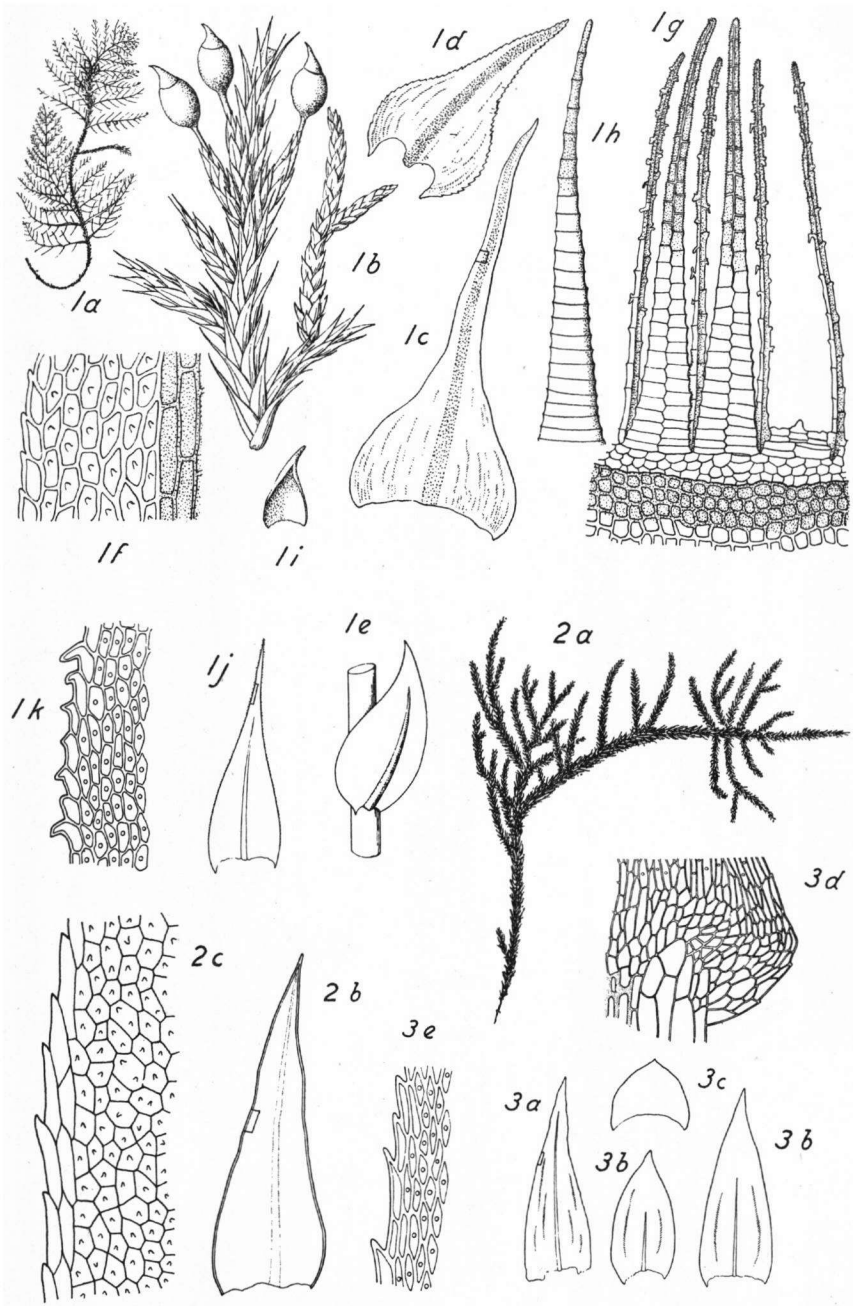
Note. *T. normandi* (Broth. et Par.) Fleisch. is the smallest species of the genus and always easily recognizable by its aberrant alar cells.

3. **Diaphanodon** Ren. et Card.

Renauld and Cardot, Rev. Bryol. 22(1895)33; ibid. Bull. Soc. Roy. Bot. Belg. 34, 2(1896)67; ibid. 38, 1(1900)23; Brotherus, Nat. Pfl. 1, 3(1906)828; Fleischer, Musci Fl. Buitenzorg 3(1908)746; Brotherus, Nat. Pfl. ed. 2, 11(1925)117.

Dioicous; *slender to medium sized,* green or brownish-green plants in more or less dense, dull mats, older parts often blackish. Primary stems

Plate VI. — Fig. 1a–i: *Diaphanodon blandus* (Harv.) Ren. et Card. var. *blandus,* 1a habit (1/1), 1b part of stem with capsules (8/1), 1c stem leaf (40/1), 1d branch leaf (80/1), 1e hollow branch leaf (100/1), 1f leaf cells (275/1), 1g peristome (150/1), 1h exostome tooth, inner face (150/1), 1i calyptra (8/1); Fig. 1j, k: var. *recurvedentatus* Zant., 1j branch leaf (80/1), 1k leaf cells (200/1); Fig. 2: *Diaphanodon procumbens* (C. Muell.) Ren. et Card., 2a habit (2/1), 2b leaf (25/1), 2c leaf cells (275/1); Fig. 3: *Trachypodopsis normandi* (Broth. et Par.) Fleisch., 3a stem or branch leaf (20/1), 3b stem leaves (20/1), 3c leaf of primary stem (20/1), 3d auricle and alar cells (150/1), 3e leaf cells (150/1). (Fig. 1a–d and f–i after Brotherus, Nat. Pfl. ed. 2, 11(1925)118, Fig. 1e, 1j, 1k and Fig. 2 and 3 original).


1a
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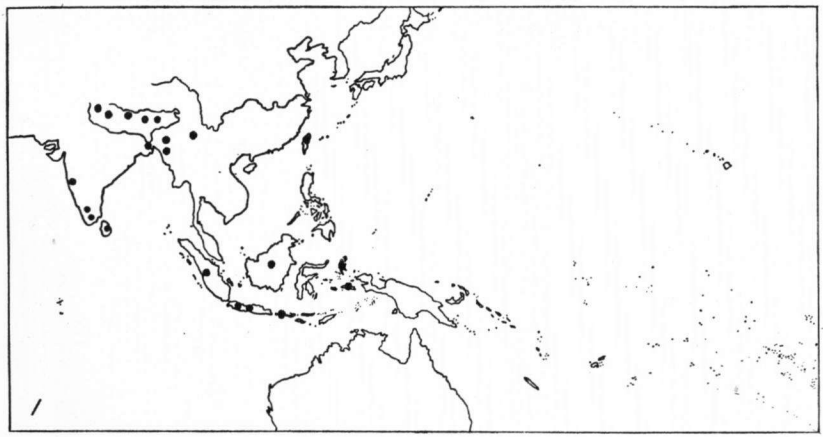
creeping, with tufts of blackish rhizoids and more or less scale-like lower leaves. Secondary stems rather short or up to 15 cm long, mostly procumbent, *densely bipinnately* or pinnately branched or rather remotely more or less pinnately, occasionally slightly paniculately branched, often with innovations. Plants occasionally with flagelliform, rather laxly foliate stems. Central strand mostly wanting, never well developed. *Paraphyllia absent.* Stems and branches mostly densely foliate, branches sometimes hamate or filiform at tips. Leaves either dimorphous or not, up to 1.5 mm long, appressed to erect spreading when dry, erect spreading to horizontally spreading when moist, from an ovate or broadly ovate, *not auriculate,* somewhat decurrent base gradually or somewhat abruptly acuminate, plane or more or less concave; leaf margin almost entire to strongly toothed or serrate, often partly recurved. If dimorphous the branch leaves smaller, shorter and more gradually acuminate than the stem leaves. Leaf rib single, ending below apex or passing into the border cells. Leaf cells *isodiametric to elongate* (up to 6 times as long as wide), on both sides *unipapillate* over lumen (rarely with two papillae); border cells either more elongate and forming a distinct border or not, mostly smooth; cells towards base more elongate, smooth; alar cells present, but sometimes few and inconspicuous, quadrate to rectangular, smooth; cell walls rather thin to incrassate.

Sporophyte lateral on the secondary stems or branches. Female gametoecia numerous, lateral on the secondary stems or branches, bud-shaped, with a number of archegonia, without paraphyses. Perigamial leaves from an ovate base long-acuminate, often tortuous at tips, the outer leaves small and very short-acuminate; leaf margin almost entire; rib present, but often indistinct; leaf cells elongate (3—10 times as long as wide), more or less incrassate, mostly unipapillate over lumen. Archegonia bottle-shaped, long-necked, brownish-red. Male gametoecia not known. Seta about *2 mm* long, *mamillose,* especially in the upper part, reddish, not contorted when dry. Vaginula short-cylindrical, smooth, with a number of archegonia, without paraphyses. Perichaetial leaves like the perigamial leaves, but longer and narrower acuminate, enveloping the greater part of the seta, papillae on the leaf cells less distinct. Capsule *subglobose to ovoid, erect,* about 1.5—2 mm long, without neck, somewhat contracted below the mouth when dry, reddish, with stomata; exothecium cells quadrate or rectangular to hexagonal, in longitudinal rows, towards the mouth smaller, slightly incrassate. Lid conical, somewhat obliquely rostrate. Peristome double. Exostome teeth 16, on a low basal membrane, lanceolate-subulate, with a zigzag median line, trabeculate, especially in the upper part, smooth, in the upper part papillose, yellowish. Endostome disappearing with the spore-sac. Endostome teeth 16, on a rather well developed, papillose basal membrane, narrowly lanceolate, towards the ends more or less filiform, somewhat shorter than the exostome teeth, carinate, papillose. *Cilia absent.* Calyptra small, *cucullate,* naked. Spores large, 30—45 μ in diameter, globular, faintly papillose, yellowish.

Plate VII. — Map 1: Area of *Diaphanodon blandus* (Harv.) Ren. et Card. var. *blandus*; Map 2: Area of *Diaphanodon blandus* (Harv.) Ren. et Card. var. *recurvedentatus* Zant. (×), var. *ceylonensis* Zant. (■) and of *Diaphanodon procumbens* (C. Muell.) Ren. et Card. (●); Map 3: Area of *Pseudospiridentopsis horrida* (Card.) Fleisch.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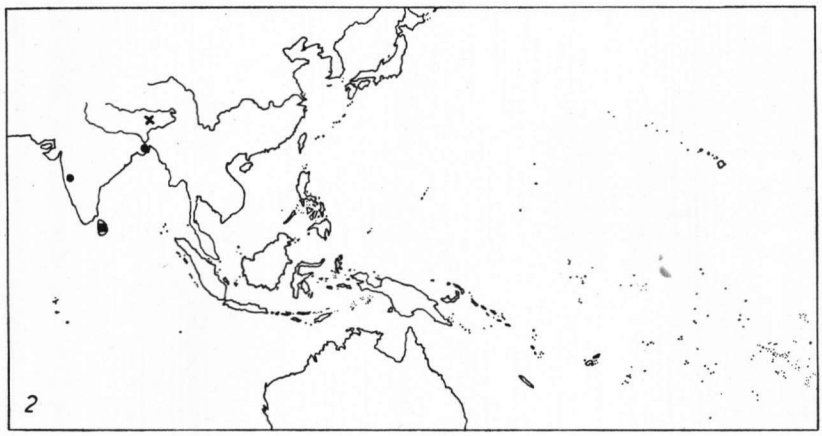
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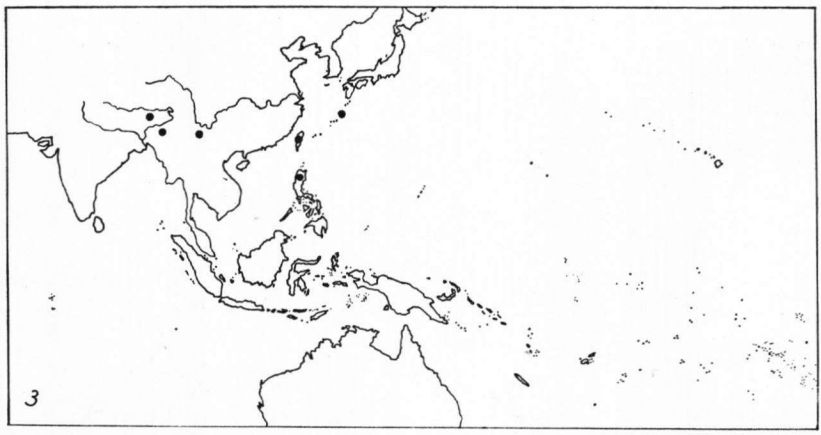

3

History of the genus up to the present paper.

The genus *Diaphanodon* was described for the first time by Renauld and Cardot, Rev. Bryol. 22(1895)33, without indication within which family.

Type species was *D. thuidioides* Ren. et Card., but now becomes *D. blandus* (Harv.) Ren. et Card. as discussed below (*D. blandus*, note 7).

The following species and forms have successively been added to the genus:

D. procumbens (C. Muell.) Ren. et Card.	Bull. Soc. Roy. Bot. Belg. 38, 1(1900)24.
D. blandus (Harv.) Ren. et Card.	Bull. Soc. Roy. Bot. Belg. 38, 1(1900)23.
D. brotheri Ren. et Card.	Bull. Soc. Roy. Bot. Belg. 38, 1(1900)24.
D. javanicus Ren. et Card.	Rev. Bryol. 28(1901)117.
D. javanicus Ren. et Card. f. *gracilior* Ren. et Card. nom. illeg.	Rev. Bryol. 28(1901)117.
D. javanicus Ren. et Card. f. *robustior* Ren. et Card. ex Fleisch.	Musci Fl. Buitenzorg 3(1908)749.
D. ? gracillimus Card. et Thér.	Bull. Ac. Int. Géogr. Bot. 18, 219 (1908)II.

Fleischer incorporated the genus within the new family of the *Trachypodaceae* Fleisch., Hedwigia 45(1905)64.

Relationships.

Fleischer, Musci Fl. Buitenzorg 3(1908)728; ibid. 4(1923)1497; Reimers, Hedwigia 76(1937)210, 212.

Besides being related to the other genera of the family the genus *Diaphanodon* is, according to Fleischer (l. c. 1923), related to *Hylocomiopsis* and through this genus to *Tetrastichium, Helodium* and *Actinothuidium*. He writes: "Die polymorphe *Trachypodaceen*gattung *Diaphanodon* giebt uns den Schlüssel zur Entzifferung der phyletischen Herkunft der prächtigen Gattung *Actinothuidium* des Himalayagebietes und der stattlichen *Helodium* Arten. Unter den Arten von *Diaphanodon* ist besonders *D. thuidioides*, welches an die Gattung *Hylocomiopsis (Lescuraea) ovicarpa* anschliesst. Letztere Art ist auch mit der japanischen Gattung *Tetrastichium (Thuidium) Molkenboeri* (Lac.) und *Helodium paludosum* nahe verwandt."

Whether these relationships are of phylogenetical value is in my opinion doubtful.

According to Reimers (l. c. 1937, p. 212) the group of *Claopodium assurgens* (Sull. et Lesqu.) Card. closely resembles the genus *Diaphanodon* on account of the shape of the leaves and of the presence of papillae. The sporophytes are however quite different.

The genus *Diaphanodon* is in general easily distinguishable from the other genera. The gametophyte of *D. blandus* bears however close resemblance to some *Thuidiaceae* on account of the mode of branching, but it is mostly easily recognizable by the absence of paraphyllia. The sporophytes are quite different.

Relationships within the genus.

Although the sporophytes of the 2 species, *D. procumbens* (C. Muell.) Ren. et Card. and *D. blandus* (Harv.) Ren. et Card., which constitute the genus are wholly identical, the gametophytes are quite different.

D. procumbens is a stable species as contrasted with *D. blandus*, which species is a highly variable one and can be divided into a number of varieties, which are closely allied and connected by intermediate forms.

Excluded species.

Diaphanodon ? gracillimus Card. et Thér., Bull. Ac. Int. Géogr. Bot. 18, 219(1908)II; Brotherus, Nat. Pfl. 1, 3(1909)1227; ibid. ed. 2, 11(1925)118.

This species belongs probably to the family of the *Thuidiaceae* on account of the presence of numerous paraphyllia.

Geographical distribution.

Herzog, Geogr. Moose (1926)143, 340, 342, 351.

The distribution of the genus is restricted to South-East Asia: Himalaya, Southern India, Bombay, Calcutta, Ceylon, Indonesia and Formosa.

Diaphanodon blandus is found in all the above mentioned regions (except of Bombay and Calcutta) and belongs to the South-East Asian mountain forest flora.

Diaphanodon procumbens is only found in the surrounding of Bombay and Calcutta.

Ecology.

Mostly on trees, sometimes on rocks or growing terrestrial, from low up to high altitudes.

Note.

I have not seen any material of *Diaphanodon pfleideri* Broth. in Reim. nom. nud., mentioned by Reimers, Hedwigia 76(1937)217.

Key to the species

1. Stem and branch leaves not or faintly dimorphous; leaf border cells clearly differentiated; plants medium sized, mostly rather densely pinnately to somewhat bipinnately branched . . . . . **1. D. procumbens** (C. Muell.) Ren. et Card.
1. Stem and branch leaves clearly dimorphous; leaf border cells not or faintly differentiated; plants slender to fairly slender, mostly densely bipinnately branched (rarely stems long and rather remotely pinnately branched) **2. D. blandus** (Harv.) Ren. et Card.

1. Diaphanodon procumbens (C. Muell.) Ren. et Card. — Plate VI, Fig. 2. Plate VII, Map 2.

Diaphanodon procumbens (C. Muell.) Ren. et Card., Bull. Soc. Roy. Bot. Belg. 38, 1(1900)24; Paris, Ind. Bryol. ed. 2, 2(1904)2; Brotherus, Nat. Pfl. 1, 3(1906)829; Paris, Ind. Bryol. ed. 2, 5(1906)150; Dixon, J. of Bot. 50(1912)151; Bruehl, Rec. Bot. Surv. India 13, 1(1931) 67.

Neckera (sect. *Leptohymenium*) *procumbens* C. Muell., Syn. 2(1851)80.

Trachypus procumbens (C. Muell.) Mitt., J. Linn. Soc. Bot. Suppl. 1 (1859)127.

Leptodon procumbens (C. Muell.) Jaeg., Ber. S. Gall. Naturw. Ges.

1875/76(1877)203 = Ad. 2(1877)107; Paris, Ind. Bryol. (1897)729; ibid. ed. 2, 3(1905)146; Fleischer, Hedwigia 59(1917)212.

Dixon, J. of Bot. 47(1909)164 (under the name of Trachypodiopsis blanda (Mitt.) Fleisch., fid. Dixon, l. c. 1912).

Type specimen: India, Bombay, ex horto Dom. van Houtte, leg. Kegel; type in L (No. 910.95—106).

Dioicous; *medium sized*, green or brownish-green plants in fairly dense, dull mats. Secondary stems up to *4 cm* long, more or less regularly *pinnately to somewhat bipinnately* or slightly *paniculately* branched, densely foliate, *without innovations*. Stem and branch leaves *not or faintly dimorphous*. Leaves appressed to spreading when dry, spreading to horizontally spreading when moist, sometimes slightly falcate-second, from an ovate, not auriculate base more or less gradually, rather long-acuminate, *plane*. Leaf margin almost entire at base, moderately serrate towards apex, often recurved. Leaf rib single, near apex passing into the border cells. Leaf cells mostly hexagonal, *subisodiametric*, on both sides unipapillate over lumen (sometimes with two papillae); border cells more elongate, *forming a distinct border*, smooth; cells towards base quadrate to rectangular, smooth; alar cells inconspicuous, quadrate, smooth; cell walls rather thin, those of the basal cells somewhat more incrassate.

Sporophyte lateral on the secondary stems, further as in the diagnosis of the genus.

India: Bombay: leg. Kegel, c.fr. (L, No. 910.95—105); herb. Kegel, No. 10027, c.fr. (L, No. 910.95—106, type); leg. ? (L, No. 910.95—104); Elphingstone, misit Levier, 1897, c.fr. (FH); Elphingstone, ex herb. Kegel-Schliephacke, c.fr. (FH); Irimbakeshwar, leg. Sedgwick, 9-1908, ex herb. Dixon (FH, Trachypodopsis blanda); leg. ? c.fr. (FH). — Calcutta: com. Cardot, c.fr. (FH).

Distribution: India (Bombay, Western Ghats and Calcutta)

Ecology: On stones and on trees at low altitudes.

2. **Diaphanodon blandus** (Harv.) Ren. et Card.

Diaphanodon blandus (Harv.) Ren. et Card., Bull. Soc. Roy. Bot. Belg. 38, 1(1900)23; Paris, Ind. Bryol. ed. 2, 2(1904)2; Brotherus, Nat. Pfl. 1, 3(1906)829; Herzog, Hedwigia 50(1910)135; Dixon, J. of Bot. 50(1912)151; Dixon, J. of Bot. 53(1915)290; Fleischer, Hedwigia 61(1920)404; Brotherus, Nat. Pfl. ed. 2, 11(1925)118; Bruehl, Rec. Bot. Surv. India 13, 1(1931)67; Dixon, J. Bombay Nat. Hist. Soc. 39(1937)780; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)56.

Neckera blanda Harv., London J. Bot. 2(1840)14; Hooker, Ic. Pl. Rar. 1 (1936) fig. 22; C. Mueller, Syn. 2(1851)185.

Trachypus blandus (Harv.) Mitt., J. Linn. Soc. Bot. Suppl. 1(1859)127; van den Bosch and van der Sande Lacoste, Bryol. Jav. 2(1864)101; Fleischer, Hedwigia 61(1920)404.

Papillaria blanda (Harv.) Jaeg., Ber. S. Gall. Naturw. Ges. 1875/76 (1877)271 = Ad. 2(1877)175; Paris, Ind. Bryol. (1897)902.

Trachypodopsis blanda (Harv.) Sedgw., J. Bombay Nat. Hist. Soc. 19, 4(1910)941, as Trachypodiopsis blanda (Harv.) Sedgw.

Trachypus blandus (Bosch et Lac. non. Harv.) Mitt. var. *thuiodes* Bosch et Lac., Bryol. Jav. 2(1864)101.

Papillaria blanda (Bosch et Lac. non Harv.) Jaeg. var. *thui(y)odes* Bosch et Lac.: Paris, Ind. Bryol. (1897)902.

Diaphanodon thuidioides Ren. et Card. syn. nov.: Renauld and Cardot, Rev. Bryol. 22(1895)33; ibid. Bull. Soc. Roy. Bot. Belg. 34, 2(1896)67; ibid. 38, 1(1900)23, 24; Paris, Ind. Bryol. Suppl. (1900)114; ibid. ed. 2, 2(1904)2; Brotherus, Nat. Pfl. 1, 3(1906)829; Dixon, J. of Bot. 50(1912)151; Brotherus, Nat. Pfl. ed. 2, 11(1925)118; Brotherus, Symb. Sin. 4(1929)76; Bruehl, Rec. Bot. Surv. India 13, 1(1931)67; Dixon, J. Bombay Nat. Hist. Soc. 39(1937)780; Noguchi, J. Jap. Bot. 14(1938)27; Herzog, Ann. Bryol. 12(1939)91; Bartram, Farl. 1, 2(1943)180; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)56; Noguchi, J. Hattori Bot. Lab. 5 (1951)23.

Diaphanodon brotheri Ren. et Card., Bull. Soc. Roy. Bot. Belg. 38, 1(1900)23, 24; Paris, Ind. Bryol. ed. 2, 2(1904)2; Brotherus, Nat. Pfl. 1, 3(1906)829; Dixon, J. of Bot. 50(1912)151; Brotherus, Nat. Pfl. ed. 2, 11(1925)118; Bruehl, Rec. Bot. Surv. India 13, 1(1931)67; Herzog, Ann. Bryol. 12(1939)91.

Diaphanodon javanicus Ren. et Card. syn. nov.: Renauld and Cardot, Rev. Bryol. 28(1901)117; ibid. Bull. Soc. Roy. Bot. Belg. 41, 1(1905)75; Brotherus, Nat. Pfl. 1, 3(1906)829; Fleischer, Musci Fl. Buitenzorg 3(1908) 747; Moeller, Hedwigia 60(1919)321; Brotherus, Nat. Pfl. ed. 2, 11(1925) 118; Bruehl, Rec. Bot. Surv. Ind. 13, 1(1931)67; van Steenis, Bull. Jard. Bot. Buitenzorg 3, 13(1934)164; Froehlich, Ann. Naturh. Mus. Wien 59 (1953)90.

Diaphanodon javanicus Ren. et Card. f. *gracilior* Ren. et Card. nom. illeg.: Renauld and Cardot, Rev. Bryol. 28(1901)117; ibid. Bull. Soc. Roy. Bot. Belg. 41, 1(1905)75; Fleischer, Musci Fl. Buitenzorg 3(1908)750.

Diaphanodon javanicus Ren. et Card. f. *robustior* Ren. et Card. ex Fleisch.: Renauld and Cardot, Rev. Bryol. 28(1901)117; ibid. Bull. Soc. Roy. Bot. Belg. 41, 1(1905)75; Fleischer, Musci Fl. Buitenzorg 3(1908)749; Dixon, J. of Bot. 53(1915)290.

Pseudothuidium ceramicum Herz., Hedwigia 57(1916)239; Herzog, Hedwigia 61(1919)291; Brotherus, Nat. Pfl. ed. 2, 11(1925)117.

Trachypodopsis tereticaulis Froehl. syn. nov.: Froehlich, Ann. Naturh. Mus. Wien 59(1953)90.

Trachypus blandus (Harv.) Mitt. var. *flagellaris* Broth. nom. nud.: Renauld and Cardot, Bull. Soc. Roy. Bot. Belg. 38, 1(1900)23.

Thuidium javense Broth. nom. nud.: Fleischer, Musci Fl. Buitenzorg 3(1908)747.

Type specimens: *Diaphanodon blandus* (Harv.) Ren. et Card.: Nepal, leg. Wallich, herb. Hookerianum No. 2089; holotype in K. — *Trachypus blandus* (Bosch et Lac. non Harv.) Mitt. var. *thuiodes* Bosch et Lac.: Java, Mt. Gedeh, Tjibodas, leg. Teysmann; lectoholotype in L (No. 910.104—783). — *Diaphanodon thuidioides* Ren. et Card.: Himalaya, Bhutan, leg. Determes 1890; holotype in PC. — *Diaphanodon brotheri* Ren. et Card.: Sikkim. Kurseong, leg. Decoly and Schaul, 10-11-1898; holotype in FI. — *Diaphanodon javanicus* Ren. et Card. f. *gracilior* Ren. et Card. nom. illeg.: Java, Mt. Gedeh, Tjibodas, leg. Teysmann; lectoholotype in L (No. 910.104—

783; *cf. D. blandus* var. *blandus*, note 6). — *Diaphanodon javanicus* Ren. et Card. f. *robustior* Ren. et Card. ex Fleisch.: Java, Tjibodas, leg. Lefèbre; lectoholotype in FH. — *Pseudothuidium ceramicum* Herz.: Ceram, leg. *Stresemann*, 8-1911; holotype in L. — *Trachypodopsis tereticaulis* Froehl.: Java, Tjibodas, leg. Schiffner, 20-4-1894, No. 13331; holotype in W.

Dioicous; *slender or fairly slender*, green or brownish-green plants in more or less dense, dull mats, older parts often *blackish*. Secondary stems up to *8 cm* long, procumbent, *densely, bipinnately branched* (sometimes sparsely branched stems present), or stems up to *15 cm* long, hanging down and mostly *pinnately branched*, often *with innovations* and sometimes with flagelliform, rather laxly foliate stems. Branches mostly densely foliate, often hamate or filiform at the tips. Stem and branch leaves *dimorphous*. Stem leaves up to 1.5 mm long, appressed to erect spreading when dry, spreading to horizontally spreading when moist, from an ovate, not auriculate, somewhat decurrent base mostly somewhat abruptly, long- and narrowly acuminate, plane or slightly concave; leaf margin almost entire to strongly toothed or serrate, often partly recurved, mostly somewhat undulate; teeth erect, occasionally patent or strongly recurved. Branch leaves smaller, shorter and more gradually acuminate than the stem leaves, often *strongly concave* and carinate. Leaf margin of the branch leaves often somewhat stronger toothed or serrate than that of the stem leaves. Leaves of the flagelliform stems small, long-acuminate with a faint rib and elongate leaf cells. Leaf rib single, ending below apex. Leaf cells *isodiametric to elongate* (up to 6 times as long as wide), on both sides unipapillate over lumen (rarely with 2 papillae); border cells *not or faintly differentiated*, mostly smooth, cells towards base more elongate, smooth; alar cells present, quadrate to rectangular, smooth; cell walls rather thin to incrassate.

Sporophyte as in the diagnosis of the genus.

The present species is a highly variable one with 3 varieties which may be distinguished by the following key:

1. Leaf margin finely to moderately toothed or serrate; teeth mostly erect, rarely somewhat patent; plants either compact or not, without or with few flagelliform branches; leaf cells isodiametric to elongate.
   2. Stems up to 15 cm long, hanging down, mostly without innovations, rigid, rather sparsely pinnately or somewhat bipinnately branched **2c. var. ceylonensis Zant.**
   2. Stems mostly shorter, mostly procumbent and densely bipinnately branched (sometimes sparsely branched stems present), mostly with innovations **2a. var. blandus**
1. Leaf margin coarsely toothed; teeth patent to strongly recurved; the greater part of the plants consisting of long, flaccid branches; leaf cells somewhat elongate **2b. var. recurvedentatus Zant.**

2a. Diaphanodon blandus (Harv.) Ren. et Card. var. **blandus.** — Plate VI, Fig. 1a—1i. Plate VII, Map 1.

For literature and type specimens see above.

Plants mostly *compact*, in dense mats. Secondary stems up to about *8 cm* long, mostly densely *bipinnately* branched (sometimes less densely, pinnately branched stems present), procumbent, often *with innovations*. Branches densely foliate, often hamate at tips. Leaf margin almost entire

to fairly strongly toothed or serrate; teeth *erect to slightly patent.* Leaf cells *isodiametric to somewhat elongate*; cell walls rather *thin to incrassate.*

INDIA: Mussoorie: Arnigadh, Bot. Gard., Bryoth. Fleischer, 19-10-1903 (FH, D. thuidioides). — Bhutan: leg. Determes. 1890 (FH, PC, D. thuidioides, isotype resp. holotype). — Calcutta ?: leg. Determes, 1897 (PC, D. thuidioides); — Sikkim: Kurseong, leg. Decoly and Schaul, 10-11-1898, No. 447, c.fr. (FI, D. brotheri, holotype); Kurseong, Punkabari, leg. Decoly, 2-9-1898 (FI, D. brotheri); Kurseong, leg. Decoly and Schaul, 2-5-1899 (FI, D. brotheri); Kurseong, Chutlakpur, leg. Decoly and Schaul, 12-1899 (FH, D. thuidioides); Kurseong, Mahaldaram forest, leg. Decoly and Schaul, 1898 (FH, D. brotheri); Kurseong, leg. Decoly and Schaul, 4-1-1900, c.fr. (FI, D. brotheri); Darjeeling, leg. Weber and Bosse, 1-1899 (FI, D. brotheri); Darjeeling, leg. Miller, 1901 (PC); herb. Hook. f. et Thoms. No. 838 (L, PC). — Simla: leg. Gollan, 29-8-1904 (K, D. thuidioides); leg. Long, 15-5-1906 (K, D. thuidioides). — Nilgiris: Uti, Sharhamhill, leg. Fleischer, 11-2-1909; Mt. Dodabetta, leg. Fleischer, 12-2-1909 (FH, L).

NEPAL: leg. Wallich, herb. Hookerianum No. 2089, c.fr. (K, Neckera blanda, holotype).

CEYLON: leg. ? (PC).

BURMA: leg. Kurz (FH).

INDONESIA: Java: Mt. Pangerango and Gedeh, Tjibodas, leg. Fleischer, 7-1898, No. 376 (FH, GRO, L, PC, U); Tjibodas, leg. Fleischer, 6-7-1898, c.fr. (FH, f. gracilior); Tjibodas-Tjibeurum, leg. Fleischer, 6-7-1898 (FH); Tjibodas, leg. Fleischer, 12-2-1913 (FH); Tjibodas, leg. Fleischer, 3-3-1913 (FH, f. robustior); Tjibodas, leg. Iwamasa (GRO); Mt. Gedeh, leg. Kuntze (FH); Tjibodas, leg. Lefêbre (FH, f. robustior, lectoholotype); Tjibodas, leg. Meyer, 13-3-1954, No. B 5773 (GRO); Tjibodas, leg. Meyer, 26-61954, No. B 5915 (GRO); Tjibodas, leg. Noerta and Dadi, 26-3-1949, No. 13 (GRO); Tjibodas, leg. Noerta and Dadi, 29-3-1949, No. 97 (GRO); Tjipanas, leg. Noerta, 14-5-1949, No. 736 (GRO); Geberbintang, Hondje Warak, leg. Noerta and Soekar, 18-7-1949, No. 2037 and 2048 (GRO); Tjibodas, leg. Nyman, 9-7-1898, No. 250 (L); Tjibodas, leg. Nyman (FH, GRO, L, f. robustior); Tjibodas, leg. Schiffner, 4-1894, No. 10836 (L); Tjibodas, leg. Schiffner, 20-4-1894, No. 13331 (W, Trachypodopsis tereticaulis, holotype); Mt. Gedeh, leg. van Steenis, 7-1928, No. 2052 (GRO, L); Mt. Salak and Gedeh, leg. Teysmann (L, No. 910.104—783, var. thuiodes, lectoholotype and No. 909.190—40, var. thuiodes); Buitenzorg, leg. Treub, 3-1897 (L, Thuidium javense); Mt. Masigit, leg. Noerta and Soekar, 9-9-1949, No. 2463 (GRO); Rawa Denok, leg. Noerta and Soekar, 8-9-1949, No. 2389 (GRO); Tjibatoe Valley, leg. Noerta and Soekar, 10-9-1949, No. 2598; Mt. Kawi, leg. Docters van Leeuwen, 17-4-1929 (FH, GRO, L); Garut, leg. Schiffner, 12-2-1894, No. 10835 (L); Mt. Tengger, leg. ?, 3-7-1858, No. 68 (L); Mt. Paldeka, leg. Korthals (L); Mt. Ardjoeno, leg. Skottsberg, 9-7-1929 (FH); Lali-Djiwa, leg. Fleischer (FH, f. robustior); Mt. Merbaboe, leg. Fleischer, 15-6-1913 (FH, f. robustior). And many other specimens from Java without further data. — Borneo: leg. Korthals (L, var. thuiodes). — Sumatra: Padang, Mt. Marapi, leg. van der Wijk, 10-6-1952, No. 1506 (GRO). — Halmaheira: leg. de Vriese (L, var. thuiodes). — Ceram: leg. Stresemann, 8-1911 (L, Pseudothuidium ceramicum, holotype). — Lombok: leg. Elbert, 3-5-1909 (L, No. 943.14—50 and 943.14—77); leg. Elbert, 11-5-1909 (L); leg. Elbert, 19-5-1909 (L, No. 943.5—40 and 943.14—52).

All specimens from Indonesia were identified as *Diaphanodon javanicus* Ren. et Card. if not otherwise indicated.

Distribution: Nepal; India (Almora, Bhutan, Sikkim, Kumaon, Assam, Mussoorie, Simla, Calcutta, Bombay, Coorg, Nilgiris); Ceylon; Yuennan (fid. Brotherus, l. c. 1929); Formosa (fid. Noguchi, l. c. 1947); Burma; Indonesia (Java, Sumatra, Borneo, Lombok, Ceram, Halmaheira).

A common variety in the mountain forests of South-East Asia.

Ecology: Mostly on trees, sometimes on rocks or growing terrestrial. Alt.: from about 900 m (Coorg, Indonesia) up to 3000 m (Himalaya, Nilgiris, Ceylon, Burma, Indonesia).

Notes. 1. The present variety is a highly variable one. The characters which may vary are a) the habit, b) the branch leaves either concave or not, c) the toothing, d) the shape of the leaves, e) the shape of the leaf cells, f) the distinctness of the papillae.

a) The plants are mostly more or less compact and densely bipinnately branched, but there occur also plants which are much less compact. Some plants, which are in general densely bipinnately branched have offshoots which are rather sparsely pinnately branched. Occasionally numerous, rather long, flagelliform stems are present (*e.g.* Sumatra, leg. van der Wijk, 10-6-1952, No. 1506, GRO). These plants therefore incline towards var. *recurvedentatus* Zant., but are clearly distinguished in having erect teeth.

b) The stem leaves are plane or faintly concave. The branch leaves on the contrary may vary from plane to strongly concave. Although the appearance of the plane and the concave leaves is quite different it is impossible to base species or even varieties or forma on this character, for it occurs fairly often that the same plant has strongly concave leaves on some branches and plane leaves on other branches. Moreover there are many plants with branch leaves which are intermediate between the plane and the concave leaves.

c) The toothing of the leaf margin may vary from almost entire to rather strong. The branch leaves are mostly somewhat stronger serrate or toothed than the stem leaves. The teeth are mostly erect, sometimes somewhat patent, and very rarely slightly recurved, but never strongly recurved as in var. *recurvedentatus* Zant.

d) The shape of the leaves may vary much. The stem leaves are mostly abruptly, long- and narrowly acuminate, whereas the branch leaves are more gradually and shorter acuminate. Sometimes the stem and the branch leaves gradually pass into each other, especially at the ends of the stems. The leaves of the flagelliform stems are mostly very long-acuminate.

e) The leaf cells are mostly more or less isodiametric, but there are many plants with elongate leaf cells (up to 6 times as long as wide) and plants with both more or less isodiametric cells and elongate cells.

f. The leaf cells vary from strongly papillose to almost smooth, but in general the papillae are clearly developed. Fairly often inconspicuous papillae are concomitant with elongate, incrassate leaf cells (*D. javanicus* f. *robustior*), but there are many exceptions.

One specimen from Nilgiris (Mt. Dodabetta, leg. Fleischer, L) is distinguished in having very distinct, *forked* papillae.

2. The plants identified as *D. brotheri* Ren. et Card. are distinguished in having a somewhat stronger toothing (teeth sometimes patent or rarely slightly recurved) and sometimes by the presence of short, more or less flagelliform branches. These plants therefore incline towards var. *recurvedentatus* Zant., but in this variety the above mentioned characters are much stronger developed, so that the plants identified as *D. brotheri* are much closer allied to var. *blandus* than to var. *recurvedentatus*.

The plants identified as *D. brotheri* gradually pass into *D. blandus* var. *blandus*, so that it is not practical to separate these plants (*cf.* also the following note).

One plant from Sikkim (Darjeeling, leg. Miller, 1901, PC) has the

compact habit and the bipinnately branched stems of var. *blandus*, but there are a few rather long, flagelliform stems present and the teeth of the leaf margin are mostly patent or even somewhat recurved. This plant therefore inclines even more towards var. *recurvedentatus* than the plants identified as *D. brotheri*, but in my opinion this plant too is more allied to var. *blandus* than to var. *recurvedentatus*.

3. The somewhat slenderer plants with plane branch leaves and erect teeth from the Himalaya were described by Renauld and Cardot as the new species *D. thuidioides* Ren. et Gard. (l. c. 1895). These plants however gradually pass into *D. blandus* var. *blandus* and because the differences are not very important it is more practical not to separate these plants.

According to Herzog (l. c. 1939) *D. thuidioides* and *D. brotheri* are conspecific. He writes: "Durch die Vergleichung zahlreicher Exemplare habe ich den Eindruck gewonnen, dass die für die Trennung von *D. thuidioides* und *D. brotheri* geltend gemachten Unterschiede in Blattform und Randzähnelung sehr schwankend sind und an ein und der selben Pflanze neben einander auftreten. *D. brotheri* ist daher als Synonym zu *D. thuidioides* zu ziehen."

According to Noguchi (l. c. 1947) *D. brotheri* is conspecific with *D. blandus*.

The foregoing goes to show that the 3 species *D. blandus*, *D. thuidioides* and *D. brotheri* are conspecific which is in accordance with my opinion.

4. In their original description of *D. javanicus* (l. c. 1901) Renauld and Cardot mention the following differences with *D. thuidioides* a) the branch leaves concave and carinate, b) the branch leaves longer and narrower acuminate, and with *D. blandus* a) branching more regular, b) teeth erect, not patent or recurved.

These differences do indeed hold in extreme cases, but there are many intermediate forms. Moreover there occur plants having the characters of the as *D. javanicus* identified specimens on some parts of the plant as well as the characters of the as *D. thuidioides* or as *D. blandus* identified specimens on other parts.

The foregoing goes to show that it is much more practical to consider *D. javanicus*, *D. thuidioides*, *D. blandus* and *D. brotheri* (*cf.* the previous note) as one highly variable species.

Curiously Renauld and Cardot did not mention the fact that the type specimen of *D. thuidioides* is slenderer than their new species *D. javanicus*. Perhaps they did notice that this character is very unstable.

5. Within the species *D. javanicus* Renauld and Cardot distinguished 2 infraspecific taxa, *viz.* f. *gracilior* (=*Trachypus blandus* (Bosch et Lac. non Harv.) Mitt. var. *thuiodes* Bosch et Lac.) and f. *robustior* (= *Trachypus blandus* (Bosch et Lac. non Harv.) Mitt.).

The epithet *gracilior* is illegitimate because this forma is identical (according to the authors) with *D. blandus* (Bosch et Lac. non Harv.) Mitt. var. *thuiodes* Bosch et Lac. According to nomenclatural rules the name of this forma should be *D. javanicus* Ren. et Card. f. *thuiodes* (Bosch et Lac.) Ren. et Card.

The authors did not describe the f. *robustior* and it remained a nom. nud. up to 1908, when Fleischer described the forma (l. c. 1908) and the

name became: *D. javanicus* Ren. et Card. f. *robustior* Ren. et Card. ex Fleisch.

According to Fleischer (l. c. 1908) f. *robustior* differs from f. *gracilior* (= f. *thuiodes*) in the following characters: a) somewhat more robust and more compact, b) leaves somewhat larger, c) branch leaves slightly narrower and longer acuminate, d) leaf cells mostly more elongate and with more incrassate cells walls.

These differences hold only in extreme cases, many plants are more or less intermediate.

As differences van den Bosch and van der Sande Lacoste only mention that f. *thuiodes* is slenderer and has filiformly attenuate branches (l. c. 1864).

6. The type specimen of *D. javanicus* f. *thuiodes* (Bosch et Lac.) Ren. et Card. (= f. *gracilior* Ren. et Card. nom. illeg.) is not Java, Mt. Gedeh, leg. Lefèbre as mentioned in the description by Renauld and Cardot (l. c. 1901), but must be one of the specimens mentioned by van den Bosch and van der Sande Lacoste in Bryol. Jav. 2(1864)101. I propose: Java, Mt. Gedeh and Salak, leg. Teysmann (L).

The type specimen of *D. javanicus* f. *robustior* Ren .et Card. ex Fleisch. must be one of the specimens mentioned by Fleischer in Musci Fl. Buitenzorg 3(1908)750. I propose: Java, Tjibodas, leg. Lefèbre (FH).

7. The type species of the genus *Diaphanodon* has hitherto been *D. thuidiodes* Ren. et Card., but now becomes *D. blandus* (Harv.) Ren. et Card., because *D. thuidioides* is conspecific with *D. blandus* and the latter was the first species published.

2b. Diaphanodon blandus (Harv.) Ren. et Card. var. **recurvedentatus** Zant. var. nov. — Plate VI, Fig. 1j and 1k. Plate VII, Map 2.

Type specimen: India, Sikkim, Kurseong, leg. Decoly and Schaul, 8-8-1899, No. 2564; holotype in FI, isotypes in FH and PC (all as D. brotheri).

Latin diagnosis: Var. *blandus* similis sed differt: Planta laxe caespitosa non compacte, generatim constans ex caulibus longis flaccidis flagelliformis, sine innovationibus. Folii margo asperrime dentatus, dentes magni patentes vel fortiter recurvi.

Plants in lax mats, *not compact*, the greater part consisting of long, *flaccid, flagelliform* (hanging?) stems and branches, *without innovations*. Stems rather remotely, irregularly branched, towards tips rather laxly foliate, *not hamate*. Leaves of the flagelliform stems and branches plane, long-acuminate. Leaf margin *very coarsely* toothed; *teeth large, patent to strongly recurved*. Leaf cells more or less elongate.

I have only seen the type specimen.

Distribution: India: Sikkim only.

Ecology: Alt.: 2000 m.

Notes. 1. Although the present variety is well distinguished from the other varieties there occur some intermediate forms with var. *blandus* (see there, note 2).

Notwithstanding the occurrences of these intermediate forms it is in

my opinion justified to consider the present variety to be a separate one for the following reasons:

a. the very great difference in their habit and toothing,

b. because I have not found a gradual passing from the one variety into the other; the intermediate forms stand quite isolated and are easily recognizable.

2. In herb. FI there is a specimen present under the name of *Trachypus blandus* (Harv.) Mitt. var. *flagellaris* Broth. nom. nud., leg. Decoly and Schaul, 10-11-1898, No. 447, see also Renauld and Cardot, Bull. Soc. Roy. Bot. Belg. 38, 1(1900)23. The plant in the capsule however has no flagelliform stems or branches and cannot be separated from *D. blandus* var. *blandus*.

Perhaps the new variety *recurvedentatus* Zant. is the same plant Brotherus meant by var. *flagellaris* Broth. nom. nud. and the plants in the capsules may have been shifted.

2c. Diaphanodon blandus (Harv.) Ren. et Card. var. **ceylonensis** Zant. var. nov. — Plate VII, Map 2.

Fleischer, Musci Fl. Buitenzorg 3(1908)750, as Trachypus blandus (Harv.) Mitt.

Type specimen: Ceylon, Horton Plaines, Mt. Kirigalpota, leg. Herzog, 2-1906; holotype in L.

Latin diagnosis: Var. *blandus* similis sed differt: Planta laxe caespitosa non compacte; caules usque ad 12 cm longi, rigidi plerumque penduli pinnate ramosi, plerumque sine innovationibus. Folii margo leviter dentatus, dentes erecti.

Plants in rather lax mats, *not compact*. Stems rather long, up to *12 cm*, rigid, hanging down, rather *remotely pinnately* or hardly bipinnately branched, *mostly without innovations*. Leaf margin rather faintly toothed; *teeth erect*. Leaf cells somewhat elongate with incrassate cell walls.

CEYLON: Horton Plaines, Mt. Kirigalpota, leg. Herzog, 2-1906, c.fr. (L, holotype); leg. ?, ex herb. Peradeniyagarden (PC); without further data (FH, D. blandus, f. gracilior).

Distribution: Ceylon only.

Ecology: On shrubs at about 2500 m altitude.

Notes. 1. The present variety is closely allied to var. *blandus*, but differs mainly in having long, up to 12 cm, rigid, remotely pinnately or hardly pinnately branched stems.

2. Of the Ceylonese plants Fleischer says (l. c.): "Die Originalpflanzen von *Trachypus blandus* Mitt. aus Ceylon ex herb. Peradeniyagarden unterscheiden sich (from *D. javanicus*) durch sehr zerstreut einfach- oder fiedrig-beästete, bis 8 cm lange, hängende Stengel und festere Blätter mit dickwandigeren Blattzellen; ausserdem fehlen die charakteristischen, einfach sprossenden Stengelinnovationen. Diese Art ist aus Nepal, Sikkim-Himalaya, Khasia, Neilgherris, Süd-Indien bei Coorg bekannt. Die Sikkimpflanze unterscheidet sich von der Ceylonpflanze durch weniger papillöse Zellen (fid. Cardot)."

From the above it follows that, according to Fleischer, the plants from

Ceylon and those from the other regions mentioned were identical (apart from the difference in the distinctness of the papillae).

Most of the specimens from Ceylon I saw (among them the plant mentioned by Fleischer, ex Peradeniyagarden) deviate from the plants from the other regions, *e. g.* No. 838 of herb. Hook. f. et Thoms., which specimen Renauld and Cardot considered representative for *D. blandus*, *cf.* Bull. Soc. Roy. Bot. Belg. 38, 1(1900)23. The differences I found are mainly exactly those differences mentioned by Renauld and Cardot, Rev. Bryol. 28(1901)117, and by Fleischer (l. c.) between *D. blandus* and *D. javanicus*. From this fact it follows that Fleischer as well as Renauld and Cardot meant with *D. blandus* a plant which has the characters of the new variety *ceylonensis* Zant., which is not quite exact.

The reason why Fleischer and Renauld and Cardot made this mistake is probably the fact that none of these authors have seen the actual type of *D. blandus*. Fleischer probably considered the specimen from Ceylon, which afterwards became the type specimen of the new var. *ceylonensis* Zant., representative for *D. blandus*, and Renauld and Cardot the above mentioned No. 838 of herb. Hook. f. et Thoms., which plant was identified by Mitten as *Neckera blanda* (= *D. blandus*). In point of fact this is correct, but No. 838 of herb. Hook. f. et Thoms. has offshoots which are rather sparsely, mostly only pinnately branched and it therefore inclines towards var. *ceylonensis* Zant., but the greater part of the specimen is compact and bipinnately branched as contrasted with var. *ceylonensis*.

Unless there become many intermediate forms known I consider the less compact, mostly only pinnately branched specimens from Ceylon as to be a separate variety for the following reasons:

a. the very great difference in habit,

b. because var. *ceylonensis* is only found in Ceylon, although I saw many more specimens from the other regions than from Ceylon.

4. **Pseudospiridentopsis** (Broth.) Fleisch.

Brotherus, Nat. Pfl. 1, 3(1906)832 (as a section of the genus Trachypodopsis); Fleischer, Musci Fl. Buitenzorg 3(1908)730; Brotherus, Nat. Pfl. 1, 3(1909)1228; ibid. ed. 2, 11(1925)119; Bartram, Philipp. J. Sc. 68(1939)195.

Diocious ?; plants *robust or very robust*, yellowish-green to yellowish-brown, mostly *tinged with brown or black* (except at the tips). Stems rigid, up to *15 cm* long, mostly somewhat flexuose, ascending, *simple or remotely* branched, mostly densely foliate. Central strand present or wanting, but never well developed. Leaves up to *9 mm* long, *horizontally spreading*, from an *erect, sheathing*, broadly cordate, *auriculate* base *long- and narrowly*, gradually or somewhat abruptly acuminate; leaf margin plane, moderately serrate near apex, serrulate below down to base. Leaf rib single, ending some distance below apex, sometimes forked above. Leaf cells *oval to rhomboidal*, about 2—5 times as long as wide, on both sides *unipapillate* over lumen or smooth, border cells mostly somewhat more elongate, smooth, cells towards base linear, smooth, cells in the auricles shorter, smooth; alar cells absent; cell walls mostly *very incrassate*, strongly pitted.

Inner perichaetial leaves much smaller than the stem leaves. Seta *3 mm* long, thick, *smooth.* Capsule *ovoid,* erect, without neck, slightly contracted below the mouth when dry. Lid conical, obliquely rostrate. Peristome double. Exostome teeth 16, lanceolate-subulate, with a zigzag median line, papillose towards the ends. Endostome teeth on a high basal

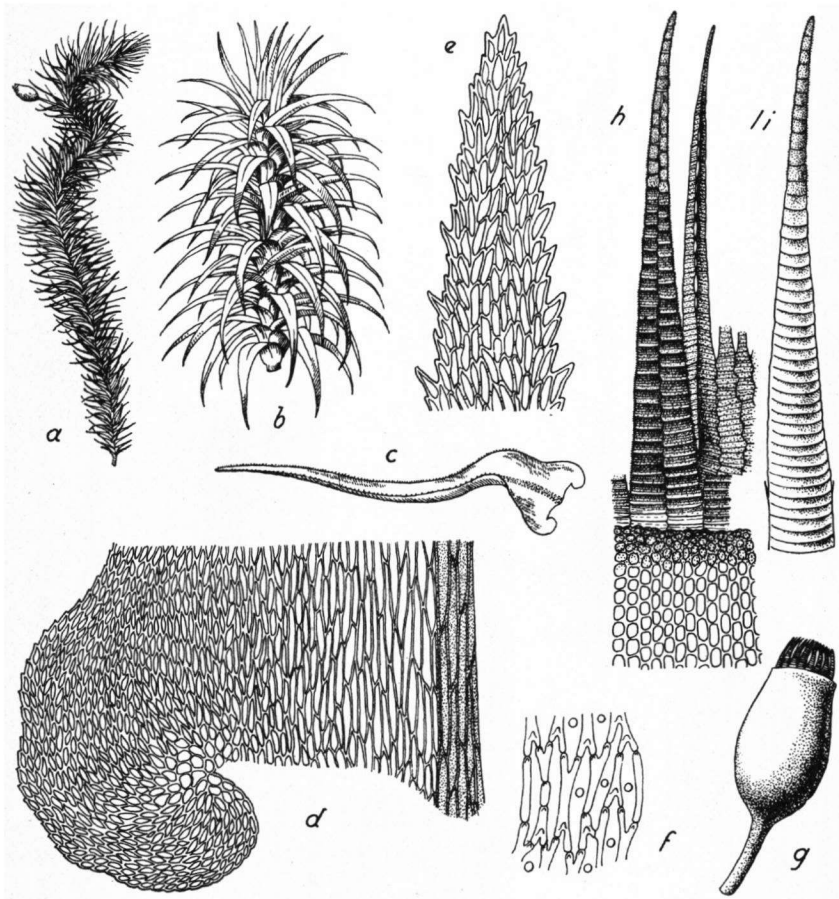


Plate VIII. — *Pseudospiridentopsis horrida* (Card.) Fleisch., a habit (1/3), b part of stem (3/1), c leaf (7/1), d auricle (75/1), e leaf apex (100/1), f leaf cells (200/1), g capsule (8/1), h peristome (100/1), i exostome tooth, inner face (100/1). (After Brotherus, Nat. Pfl. ed. 2, 11 (1925)120).

membrane, about the same length as the exostome teeth, lanceolate, papillose. *Cilia present.* Calyptra and spores not known.

History of the genus up to the present paper.

The genus was founded by Fleischer when he raised the section *Pseudo-Spiridentopsis* Broth. of the genus *Trachypodopsis* to a separate genus (l. c. 1908).

Type species is the only species *Pseudospiridentopsis horrida* (Card.) Fleisch.

In 1947 Noguchi added the forma *P. horrida* (Card.) Fleisch. f. *laxifolia* Nog. to the genus, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)56.

Relationships.

The genus *Pseudospiridentopsis* is quite different from the other genera of the family. The sporophyte is related to that of *Duthiella* on account of its having a smooth seta and because of the presence of cilia and a high basal membrane of the inner peristome; it has however a short seta as in *Diaphanodon*.

The gametophyte differs from the other genera of the family in its robust or very robust habit (except for *Trachypus bicolor* Reinw. et Hornsch. var. *bicolor*) and its long- and narrowly acuminate, reflexed leaves.

Geographical distribution and ecology.

Herzog, Geogr. Moose (1926)143, 266, 342, 351.

See further below.

Note. I have not seen the sporophyte but described it from the figure given by Brotherus (l. c. 1925) and the description by Cardot, Beih. Bot. Centralbl. 19, 2(1905)118, in so far as this was possible.

1. Pseudospiridentopsis horrida (Card.) Fleisch. — Plate VIII. Plate VII, Map 3.

Pseudospiridentopsis horrida (Card.) Fleisch., Musci Fl. Buitenzorg 3(1908)730; Brotherus, Nat. Pfl. 1, 3(1909)1228; Brotherus, Philipp. J. Sc. 5, 2, C, Bot. (1910)154; ibid. 8, 2, C, Bot. (1913)80; Brotherus, Nat. Pfl. ed. 2, 11(1925)120; Brotherus, Symb. Sin. 4(1929)77; Bruehl, Rec. Bot. Surv. India 13, 1(1931)68; van Steenis, Bull. Jard. Bot. Buitenzorg 3, 13(1936)164; Horikawa, Bot. Mag. Tokyo 50(1936)384; Dixon, Not. Roy. Bot. Gard. Edinburgh 19(1938)292; Bartram, Philipp. J. Sc. 68(1939)195; Horikawa in Asahina, Nippon Inkwasyokubutu Dukan (1939)953 (not seen); Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)55; Sakurai, Musc. Jap. (1954)101.

Meteorium horridum Mitt. ex Card.: Cardot, Beih. Bot. Centralbl. 19, 2(1905)118.

Trachypodopsis horrida (Card.) Broth., Nat. Pfl. 1, 3(1906)832.

Type specimen: Formosa, Mt. Taitum, leg. Faurie, 1903, No. 164; type probably lost. Neotype: Formosa, Prov. of Taihoku, Mt. Taikei, leg. Suduki, 16-8-1925 (H).

Diagnosis as in the description of the genus.

FORMOSA: Prov. of Taihoku, Mt. Taikei, leg. Suduki, 16-8-1925 (H, neotype).

PHILIPPINE ISLANDS: Luzon, Subprov. of Benguet, leg. Merrill, 5-1911, No. 7859 (H); Abra-Lepanto, Mt. Lamunan, leg. Micholitz, 6-4-1910 (H).

INDIA: Assam, herb. Griffith, No. 846 (PC).

Distribution: Himalaya (Bhutan); Assam; Yuennan (fid. Brotherus, l. c. 1929); Formosa; Luzon; Japan: isle of Yakushima (fid. Horikawa, l. c. 1936).

Ecology: On trees, limestone cliffs and granitic ground from 800 up to 2700 m altitude.

Note. The sporophyte is only known of one specimen from Bhutan which I have not seen.

Pseudospiridentopsis horrida (Card.) Fleisch. f. **laxifolia** Nog.

Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)56.

Type specimen: Formosa, leg. Noguchi, 8-1932, No. 6069 (not seen).

Differs from the typical form in being somewhat *less robust*, not tinged with brown or black and especially in being *laxly foliate*.

FORMOSA: Prov. of Taihoku, Mt. Taikei, leg. Noguchi, 23-8-1932, No. 6067 (herb. Noguchi).

Distribution: Formosa only.

Ecology: No data.

Notes. 1. I have not seen the type specimen, but another specimen which, according to Noguchi is identical with the type.

2. In how far the above mentioned differences with the typical form are stable ones or have been caused by an aberrant habitat will have to be investigated with the help of further material, but because hitherto no intermediate forms have been found it is in my opinion justified to consider the plants as to be a separate forma.

5. **Duthiella** C. Muell. ex Broth.

Brotherus, Nat. Pfl. 1, 3(1908)1009; ibid. ed. 2, 11(1925)122; Bartram, Philipp. J. Sc. 68(1939)197.

Dioicous; medium sized to fairly robust, green or yellowish-green (when old often brownish) plants in dull or somewhat glossy mats. Primary stems creeping, with tufts of blackish rhizoids and more or less scale-like lower leaves. Secondary stems procumbent or somewhat ascending, irregularly, more or less pinnately or slightly arborescently branched. Secondary stems and branches more or less densely, either complanately foliate or not. Central strand present or wanting, but never well developed. Leaves spreading to erect spreading, occasionally appressed when dry, horizontally spreading when moist, from 1 up to 4 mm long, plane or somewhat longitudinally plicate, often crisped near apex, from an ovate or broadly ovate, *not or faintly auriculate* base, more or less gradually, shorter or longer acuminate; leaf margin faintly, but distinctly to strongly serrate. Stem leaves sometimes slightly shorter acuminate than the branch leaves. Leaf rib single, ending below apex. Leaf cells more or less isodiametric to elongate-hexagonal or linear, on both sides *unipapillate* or *seriately papillate over lumen* (occasionally indistinctly papillate), more elongate and smooth towards base; border cells either differentiated or not, mostly smooth; alar cells present, but often few, quadrate to rectangular, smooth; cells walls mostly rather thin, often somewhat sinuose, occasionally incrassate and pitted.

Sporophyte lateral on the secondary stems and branches. Seta *1.5*—

5 cm long, erect, *smooth* (rarely slightly mamillose in the upper part), brown, reddish or yellowish, contorted when dry. Vaginula cylindrical, smooth, with a number of archegonia and numerous paraphyses; archegonia bottle-shaped, long-necked, brownish-red. Perichaetial leaves pale, from a sheathing base long- and narrowly acuminate, margin entire to faintly toothed, rib indistinct, the outer leaves small, shorter acuminate, cells elongate to linear, about 4—10 times as long as wide, thin-walled, smooth, pellucid. Capsule curved, *oblong-cylindrical, inclined or horizontal,* about 2—2.5 mm long, with a short neck, slightly contracted below the mouth when dry, reddish, with stomata; exothecium cells quadrate or hexagonal to rectangular, in longitudinal rows, slightly incrassate, smaller towards mouth. Lid conical, obliquely rostrate. Peristome double. Exostome teeth 16, on a low basal membrane, lanceolate-subulate, yellowish, transversally striate on outer face, with a zigzag median line, trabeculate, especially in the upper part, papillose towards the ends. Endostome teeth 16, on a high, smooth to strongly papillose basal membrane, somewhat shorter than the exostome teeth, lanceolate-subulate, papillose. *Cilia 3,* nodose, papillose, somewhat shorter than the endostome teeth. Calyptra *cucullate, naked.* Spores *small,* globular, smooth, up to 12 μ in diameter, yellowish.

History of the genus up to the present paper.

From a nomenclatural point of view the genus *Duthiella* C. Muell. ex Broth. was founded by Brotherus, Nat. Pfl. 1, 3(1908)1009, within the family of the *Leskeaceae*, with two species *D. wallichii* (Mitt.) Broth. and *D. flaccida* (Card.) Broth. He did not indicate a type species. According to Reimers, Hedwigia 76(1937)288, the type species must be *D. emodi* C. Muell. ex Reim. described by himself and by Brotherus erroneously identified with *Hypnum wallichii* Hook. ex Schwaegr. = *D. wallichii* (Mitt.) Broth., and not one of the species mentioned by Brotherus (all according to Reimers), which is however in contravention of the nomenclatural rules and thus illegitimate. I propose *D. wallichi* as lectotype species of the genus, because for the description of the genus Brotherus used the sporophyte and very likely also the gametophyte of this species.

The genus has been transferred from the family of the *Leskeaceae* to the family of the *Trachypodaceae* by Fleischer in 1923, Musci Fl. Buitenzorg 4(1923)1495.

The following species and varieties have successively been added to the genus:

D. complanata Broth.	Philipp. J. Sc. 5, 2, C, Bot. (1910)157.
D. japonica Card.	Bull. Soc. Bot. Genève 2, 3(1911)283.
D. pellucens Thér.	Bull. Géogr. Bot. 21(1911)271.
D. speciosissima Card.	Bull. Soc. Bot. Genève 2, 5(1913)317.
D. rigida Broth.	Sitzungsber. Akad. Wiss. Wien 1, 131(1922)218.
D. perpapillata Broth.	Symb. Sin. 4(1929)78.
D. lacustris Reim. et Sak.	Bot. Jahrb. 64(1931)543.
D. formosana Nog.	Trans. Nat. Hist. Soc. Formosa 24(1934)469.

D. robusta Nog.	Trans. Nat. Hist. Soc. Formosa 24(1934)470.
D. rivicola Sak.	Bot. Mag. Tokyo 50(1936)264.
D. myuriiformis Sak.	Bot. Mag. Tokyo 50(1936)518.
D. emodi Reim.	Hedwigia 76(1937)289.
D. mussooriensis Reim.	Hedwigia 76(1937)289.
D. japonica Card. var. *pallida* Sak.	Bot. Mag. Tokyo 51(1937)796.
D. guilbertii Thér. et P. Vard.	Rev. Bryol. Lich. 15(1946)146.
D. flaccida (Card.) Broth. var. *gigantea* Nog.	J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)61.
D. media Nog.	J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)61.
D. brassii Bartr.	Britt. 9, 1(1957)45.

Relationships.

Fleischer, Hedwigia 45(1905)64; Fleischer, Musci Fl. Buitenzorg 3 (1908)729, 849; ibid. 4(1923)1495; Reimers, Hedwigia 76(1937)211.

When Brotherus founded the genus *Duthiella* he incorporated it within the family of the *Leskeaceae* (group of the *Thuidieae*; afterwards raised as a family by Fleischer (l. c. 1923)) on account of the resemblance of the sporophyte, probably mainly due to the presence of a high basal membrane of the endostome, well developed endostome teeth and cilia, elongate seta and inclined capsule. In agreement herewith Fleischer states (l. c. 1905 and 1908): "Die im Himalaya vorkommende Gattung *Duthiella* Geh. et C. Muell. nähert sich im Blattcharacter sehr den *Trachypodaceen*, doch ist sie habituell (durch Sporogontragenden Hauptstengel) und durch die geneigte Kapsel auf langer Seta mit Hypnumperistom so abweichend, dass sie besser zu den *Leskeaceen* gestellt wird."

There are however some objections to incorporating the genus *Duthiella* within the family of the *Leskeaceae*, *e. g.* on account of the great difference in the mode of branching and the absence of paraphyllia. Some species of *Duthiella* closely resemble some species of the genus *Trachypodopsis*, on account of which Fleischer included the genus *Duthiella* afterwards in the family of the *Trahypodaceae* (l. c. 1923). Brotherus, Nat. Pfl. ed. 2, 11(1925)122, and Herzog, Geogr. Moose (1926)143, follow Fleischer in this conception.

The preceding goes to show that the place which is given to the genus *Duthiella* depends on the question whether one gives greater importance to the gametophyte or to the sporophyte when separating the taxa.

The place of *Duthiella* given by Fleischer within the family of the *Trachypodaceae* is justified on account of the very close resemblance between some *Duthiella* and some *Trachypodopsis* species with regard to the gametophyte, but in my opinion it is doubtful whether this resemblance is of phylogenetical value.

In general the genus *Duthiella* is well distinguished from most other genera, also when not in fruit. There is however a slight resemblance to some *Meteoriaceae*, particularly to the *Aërobryopsis* species with oval-hexagonal leaf cells, *e. g. A. leptosigmata* (C. Muell.) Fleisch., but these

plants are distinguished in having longer acuminate, faintly toothed leaves. Moreover the sporophytes are quite different.

The gametophytes of the species which belong to the section *Duthiella* (see below) bear close resemblance to some species of the genus *Trachypodopsis*, but are always recognizable on account of the absence of leaf auricles, except for *D. speciosissima* Card. and *D. formosana* Nog. which species have mostly small auricles (*cf. Trachypodopsis serrulata* var. *serrulata*, note 4). Moreover the leaves in *Trachypodopsis* are mostly acuminate and stronger longitudinally plicate than in *Duthiella*. The sporophytes are quite different.

Relationships within the genus.

Within the genus *Duthiella*, two infrageneric taxa (sections) can be distinguished based on the number of papillae which occur over the lumina of the leaf cells, Reimers, Hedwigia 76(1937)289.

Section 1: Duthiella (= Unipapillatae Reim. nom. illeg.); leaf cells on both sides unipapillate over lumen, with 6 species:

1. *D. wallichii* (Mitt.) Broth.
2. *D. myuriiformis* Sak.
3. *D. declinata* (Mitt.) Zant.
4. *D. robusta* Nog.
5. *D. formosana* Nog.
6. *D. speciosissima* Card.

Section 2: Pluripapillatae Reim.; leaf cells seriately papillate over lumen, with 1 species:

7. *D. flaccida* (Card.) Broth.

Regarding the sporophyte there is also a difference between the two sections: the basal membrane of the endostome in the section *Duthiella* is smooth or faintly papillose and in the section *Pluripapillatae* Reim. strongly papillose.

In how far this character is a stable one will have to be investigated with the help of further material.

According to Reimers, Hedwigia 76(1937)289, *D. rigida* Broth. and *D. pellucens* Thér. belong to the section *Duthiella* (= Unipapillatae Reim. nom. illeg.), the two species are however conspecific with *D. flaccida* (Card.) Broth. (as will be shown below) and consequently do not belong to the section *Duthiella*, but to that of the *Pluripapillatae* Reim.

Excluded species.

Duthiella guilbertii Thér. et P. Vard. has been transferred to the genus *Trachypodopsis* as **T. serrulata** (P. Beauv.) Fleisch. var. **guilbertii** (Thér. et P. Vard.) Zant. comb. nov.

Geographical distribution.

Herzog, Geogr. Moose (1926)143, 266, 269, 342, 351.

The distribution of the genus is restricted to South-East Asia.

D. wallichii (Mitt.) Broth.	Himalaya, Yuennan ?, Java.
D. myuriiformis Sak.	Japan.

D. declinata (Mitt.) Zant.	Himalaya, Szechwan, Philippine Islands.
D. robusta Nog.	Formosa.
D. formosana Nog.	Formosa.
D. speciosissima Card.	Japan, Sikang (China).
D. flaccida (Card.) Broth.	Japan, Formosa, Philippine Islands, New Guinea, China.

Conspicuous is the absence of the genus in Southern India, Ceylon, Malay Peninsula, Burma, Siam, Laos etc. and the occurrence of only a few localities in Indonesia (Java).

Duthiella flaccida (Card.) Broth. (which is also the most variable species of the genus) seems to occur more frequently than the other species.

Ecology.

Mostly on trees or growing terrestrial, occasionally on rocks and rarely in running water. On the continent up to 3100 m altitude, of the other regions only a few data about the altitude: Japan 100 m; Java 750—1500 m; New Guinea 1370 m.

The genus belongs to the South-East Asian mountain forest flora, Herzog, Geogr. Moose (1926)266, with radiation into Japan, Formosa, Philippine Islands, Java and New Guinea.

Key to the species

1. Leaf cells unipapillate over lumen (rarely with 2 or 3 papillae or smooth).
   2. Plants medium sized; leaves 1—3 mm long, not auriculate.
      3. Cells in the upper part of the leaf more or less elongate, 1.5—6 times as long as wide; cell walls often somewhat sinuose; leaves distinctly bordered, margin strongly serrate . . . . **3. D. declinata** (Mitt.) Zant.
      3. Cells in the upper part of the leaf more or less isodiametric or up to 2.5 times as long as wide, but then the leaf base broadly ovate and the seta about 1.5 cm long; cell walls not sinuose; leaves either bordered or not, margin faintly to moderately serrate.
         4. Cells in the upper part of the leaf more or less isodiametric, 10—22 μ in diameter; leaf base ovate; seta 3—4 cm long, smooth **1. D. wallichii** (Mitt.) Broth.
         4. Cells in the upper part of the leaf 1.5—2.5 times as long as wide, 18—30 μ long; leaf base broadly ovate; seta about 1.5 cm long, in the the upper part faintly mamillose . . . . . **2. D. myuriiformis** Sak.
   2. Plants fairly robust; leaves 2.5—4 mm long, faintly auriculate or without auricles, but then the cell walls incrassate and pitted; leaf cell elongate to linear, 3—10 times as long as wide.
      5. Leaves not auriculate; leaf margin moderately serrate, border cells not differentiated; cell walls incrassate, pitted . . . . **4. D. robusta** Nog.
      5. Leaves mostly faintly auriculate; leaf margin moderately to rather strongly serrate, border cells more or less differentiated; cell walls not incrassate.
         6. Leaves not appressed when dry; alar cells few; seta about 5 cm long **6. D. speciosissima** Card.
         6. Leaves mostly appressed when dry; alar cells rather numerous; seta about 2.5 cm long . . . . . **5. D. formosana** Nog.
1. Leaf cells seriately papillate over lumen . . . **7. D. flaccida** (Card.) Broth.

1. Duthiella wallichii (Mitt.) Broth. — Plate IX, Fig. 1. Plate X, Map 1.

Duthiella wallichii (Mitt.) Broth., Nat. Pfl. 1, 3(1908)1010; ibid. ed. 2, 11(1925)123; Herzog, Hedwigia 65(1925)163; Bruehl, Rec. Bot. Surv.

India 13, 1(1931)68; Reimers, Hedwigia 76(1937)288; Dixon, Not. Roy. Bot. Gard. Edinburgh 19(1938)292.

Hypnum wallichii Hook. ex Schwaegr., homonym illeg. [non Hypnum wallichii Brid., Bryol. Univ. 2(1827)416] : Schwaegrichen, Spec. Musc. Suppl. 3, 1(1827) tab. 219; C. Mueller, Syn. 2(1851)464.

Leskea wallichii Mitt., J. Linn. Soc. Bot. Suppl. 1(1859)132.

Pseudoleskea wallichii (Mitt.) Jaeg., Ber. S. Gall. Naturw. Ges. 1877/78 (1880)475 = Ad. 2(1880)739; Paris, Ind. Bryol. (1898)1039; ibid. ed. 2, 4(1905)108.

Hypnum s(t)igmatodiction C. Muell. nom. nud.: van den Bosch and van der Sande Lacoste, Bryol. Jav. 2(1864)100; Fleischer, Musci Fl. Buitenzorg 3(1908)731.

Type specimen: Nepal, leg. Wallich, herb. Hookerianum No. 3508; holotype in K.

Dioicous; *medium sized,* green or yellowish-green plants in *dull* mats. Secondary stems procumbent or somewhat ascending, irregularly or more or less pinnately branched, not or somewhat complanately foliate. Leaves spreading when dry, horizontally spreading when moist, up to 3 mm long, plane or faintly longitudinally plicate, often crisped near apex, from an ovate, not auriculate base more or less gradually acuminate; leaf margin *faintly to moderately serrate.* Leaf rib single, ending below apex. Leaf cells *quadrate to rhomboic,* isodiametric to slightly elongate, *10—22* μ long, towards base more elongate, on both sides *unipapillate* over lumen, basal cells smooth; border cells either somewhat elongate or not, mostly smooth; alar cells few, quadrate to rectangular, smooth; cell walls rather thin, *not sinuose.*

Sporophyte as in the diagnosis of the genus. Seta about *3—4 cm* long. Basal membrane of the endostome *faintly papillose.*

NEPAL: leg. Wallich, herb. Hookerianum No. 3508, c.fr. (K, holotype).

INDIA: Himalaya: herb. Ind. Or. Hook. f. et Thoms. No. 1017, c.fr. (L, No. 910.132—956, Trachypus declinatus and No. 910.110—1357, Pseudoleskea wallichii).

INDONESIA: Java: Mt. Pangerango, Tugu, leg. Meyer, 13-3-1952, No. B 591 (L); Gegerbintang, Hondje Warak, leg. Noerta and Soekar, 18-7-1949 (GRO); leg. Zip(p)elius (H, Trachypodopsis declinata); leg. ? (L, Trachypodopsis declinata); leg. ? (L, No. 910.132—957 and No. 898.134—56, Trachypus declinatus).

WITHOUT LOCALITY: leg. Webster, No. 72b (BM).

Distribution: Nepal; Himalaya; Yuennan? (*cf.* Herzog, l.c. 1925); Java.

Ecology: On trees and on rocks. Alt.: 700—1500 m (Java) and 2400—3000 m (Himalaya).

Notes. 1. A fairly variable species concerning a) the shape of the leaves, b) the distinctness of the leaf border and c) the shape of the cells in the lower part of the leaf.

a) and c) Most plants from Java are distinguished in having a longer acuminate, more crisped leaf apex and more elongate cells in the lower part of the leaf. There occur however intermediates. All these plants incline therefore somewhat towards *D. declinata* (Mitt.) Zant., but confusion is impossible for *D. declinata* has an even longer acuminate leaf apex, more elongate leaf cells, especially in the upper part of the leaf and a

very distinct leaf border. Moreover the general aspect is quite different.

One specimen from Java (L, No. 910.132—957) has in addition to the above mentioned differences also small auricles and inclines therefore somewhat towards *D. speciosissima* Card. (and even towards *Trachypodopsis serrulata* (P. Beauv.) Fleisch. var. *serrulata*, see there, note 4), but is clearly differentiated in having almost isodiametric cells in the upper part of the leaf and a less strongly serrate leaf margin.

b) The distinctness of the leaf border may vary a great deal, also on leaves of the same plant. Most plants namely have at the same time scarcely bordered as well as strongly bordered leaves. It may happen that one half of a leaf is clearly bordered and the other half not or hardly so.

2. The plants which Fleischer described under the name of *Trachypodopsis declinata* (Mitt.) Fleisch., Musci Fl. Buitenzorg 3(1908)731, and those described by van den Bosch and van der Sande Lacoste under the name of *Trachypus declinatus* Mitt., Bryol. Jav. 2(1864)100, actually belong here. Van den Bosch and van der Sande Lacoste described the sporophyte from No. 1017 from herb. Ind. Or. Hook. f. et Thoms., which plant however is not *Trachypus declinatus* Mitt., but *Duthiella wallichii* (Mitt.) Broth. With the help of another specimen they described the gametophyte, which specimen belonged very likely also to *Duthiella wallichii* for the following reasons:

a. In the description the authors say nothing about the leaf border, which in *D. declinata* (Mitt.) Zant. is very distinct.

b. About the leaf cells they say: "cellulis minutis rotundis", which is true for *D. wallichii*, but not for *D. declinata*, which species has elongate leaf cells.

c. In herb. L there is a specimen (No. 910.132—957) under the name of *Trachypus declinatus* Mitt. from the herb. of van der Sande Lacoste, which is in reality *Duthiella wallichii* (Mitt.) Zant.

From these facts in my opinion it follows that van den Bosch and van der Sande Lacoste have confused *D. declinata* (Mitt.) Zant. (= *Trachypus declinatus* Mitt.) with *D. wallichii* (Mitt.) Broth.

The confusion about the sporophyte was observed by Fleischer where he writes, Musci Fl. Buitenzorg 3(1908)733: "Die Diagnose der Sporogone in Bryol. jav. II, p. 101, scheint auf einem Irrtum zu beruhen und bezieht sich vielleicht auf *Pseudoleskea (Leskea) Walichii* (Mitt.) Sieb., welches in herb. Ind. Or. Hook. f. et Thoms. unter No. 1017 liegt", but with regard to the gametophyte he makes the same mistake as van den Bosch and van der Sande Lacoste. Although I am not positively sure I have actually seen the specimens from which Fleischer described *Trachypodopsis declinata* (Mitt.) Fleisch. in my opinion it is certain that actually he had got to do with *D. wallichii* (Mitt.) Broth., for the following reasons:

a. In the description Fleischer says i. a.: "Secundäre Stengel locker, sehr zerstreut fiedrig beästet, — Fiederäste etwas verflacht beblättert. Blätter trocken wie feucht ausgebreitet abstehend, —", etc.

b. In the figure isodiametric cells have been drawn and the general habit of the plant and the leaf border cells in the figure are exactly the same as those of *D. wallichii* (Mitt.) Broth.

c. In herb. L there is a specimen (No. 898.134—56) which has been transferred by Fleischer from *Trachypus declinatus* Mitt. to the genus *Trachypodopsis,* which specimen is actually *D. wallichii* (Mitt.) Broth.

The characters mentioned under a and b apply to *D. wallichii* and not to *D. declinata.*

The confusion may have been caused by the fact that the plants of *D. wallichii* from Java incline slightly towards *D. declinata* (*cf.* note 1).

Which points even more clearly to the fact that the two species have got mixed up is that the true *D. declinata* has never been found in Indonesia.

3. *Duthiella wallichii* (Mitt.) Broth. has not only been confused with *D. declinata* (Mitt.) Zant. = *Trachypodopsis declinata* (Mitt.) Fleisch., but also with *D. flaccida* (Card.) Broth.

The specimens from herb. Strachey et Winterbottom No. 78 (K), also mentioned by Jaeger (l. c. 1880), Kumaon and those from herb. Griffith No. 53 (K), Bhutan, all identified as *Hypnum wallichii* Hook. ex Schwaegr. do not belong to *D. wallichii* but to *D. flaccida* (Card.) Broth.

The specimen from Tosa (Japan), ex coll. Cono, leg. 11-10-1904 (H), identified as *D. wallichii* (Mitt.) Broth. is actually *D. flaccida* (Card.) Broth.

4. The figure of *D. wallichii* (Mitt.) Broth. given by Brotherus (l. c. 1908 and 1925) is not characteristic since the cells of the leaf border are mostly much less distinctly differentiated than is drawn. According to Reimers (l. c. 1937) the above mentioned figure does not exactly fit *D. wallichii* but rather *D. mussooriensis* Reim. = *D. declinata* (Mitt.) Zant., which however cannot be true for *D. mussooriensis* has elongate leaf cells.

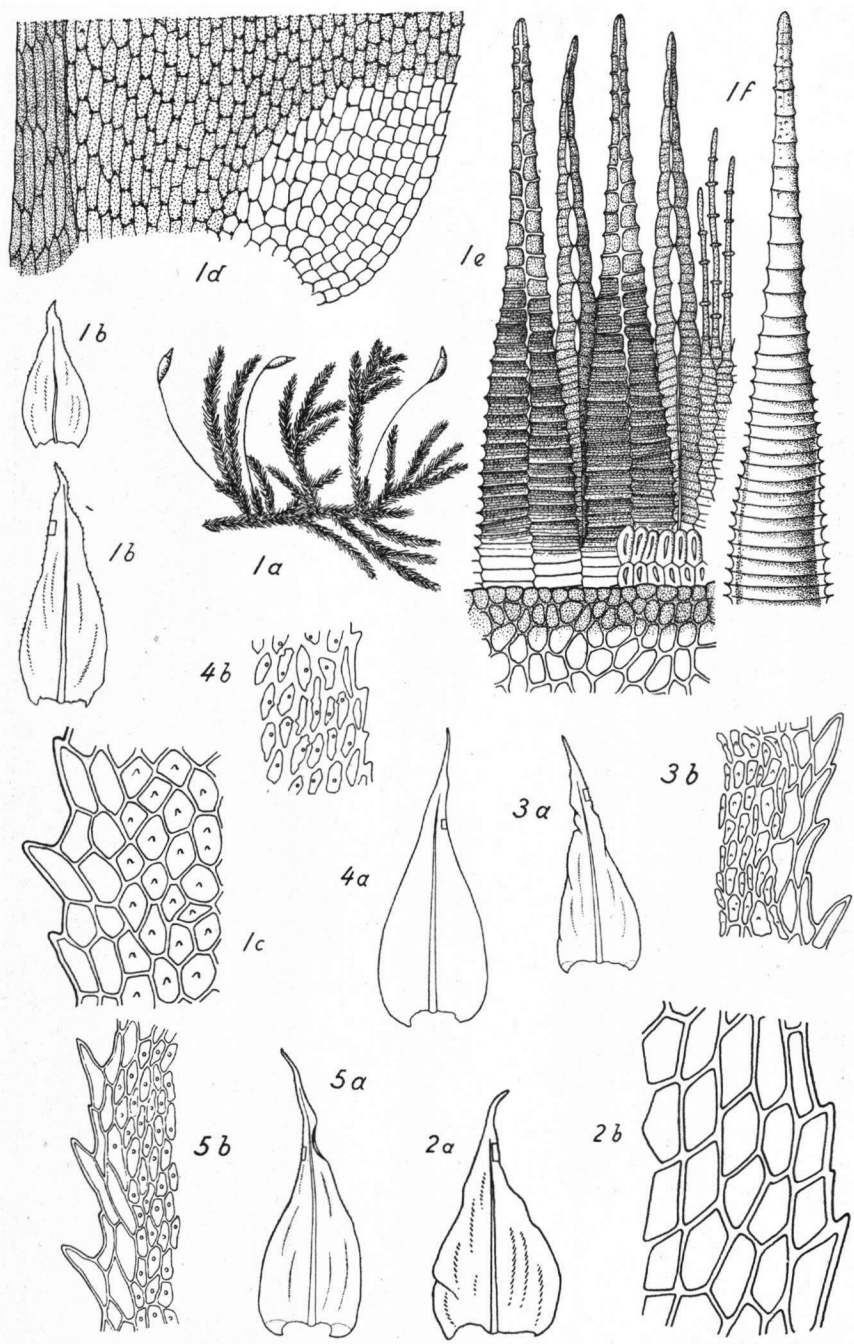
5. In his description of *D. wallichii* (Mitt.) Broth. Reimers says (l. c. 1937): "marginibus minute denticulatis" and Schwaegrichen in his original description says (l. c. 1827): "grosse et argute serrata". In reality the leaf margin is moderately serrate, so is the type specimen and the only other specimen seen by Reimers (*viz.* herb. Ind. Or. Hook. f. et Thoms. No. 1017).

Reimers probably used the term "minute denticulata" to indicate the difference with the other Himalayan species, *D. mussooriensis* Reim. = *D. declinata* (Mitt.) Zant., and *D. emodi* Reim. = *D. flaccida* (Card.) Broth. These two species have indeed got a stronger serrate leaf margin.

6. I have not seen the plant from Yuennan mentioned by Herzog (l. c. 1925) and because there has been a good deal of confusion about this species it is not certain that the plant is actually *D. wallichii* (Mitt.) Broth.

7. *Duthiella wallichii* (Mitt.) Broth. f. *robusta* Broth. nom. nud. mentioned by Brotherus in Symb. Sin. 4(1929)77 is actually *D. declinata* (Mitt.) Zant. (see there, note 2).

Plate IX. — Fig. 1: *Duthiella wallichii* (Mitt.) Broth., 1a habit (1/1), 1b leaves (12/1), 1c leaf cells (325/1), 1d leaf base (125/1), 1e peristome (125/1), 1f exostome tooth, inner face (125/1); Fig. 2: *Duthiella myuriiformis* Sak., 2a leaf (12/1), 2b leaf cells (325/1); Fig. 3: *Duthiella declinata* (Mitt.) Zant., 3a leaf (12/1), 3b leaf cells (150/1); Fig. 4: *Duthiella robusta* Nog., 4a leaf (10/1), 4b leaf cells (150/1); Fig. 5: *Duthiella formosana* Nog., 5a leaf (10/1), 5b leaf cells (150/1). (Fig. 1a, d–f after Brotherus, Nat. Pfl. ed. 2, 11(1925)122, Fig. 1b, c and Fig. 2, 3, 4 and 5 original).


1d
1e
1f
1b
1b
1a
4b
4a
3a
3b
1c
5a
5b
2a
2b

2. Duthiella myuriiformis Sak. — Plate IX, Fig. 2. Plate X, Map 1.

Sakurai, Bot. Mag. Tokyo 50(1936)518; Noguchi, J. Hattori Bot. Lab. (J. Hattori Shokub. Kenk.) 2(1947)63; Noguchi, J. Hattori Bot. Lab. 5 (1951)24; Sakurai, Musc. Jap. (1954)101.

Type specimen: Japan: Kiushiu, Prov. of Higo, Mt. Ryuhô, leg. Takahashi, 24-2-1935; holotype in herb. Sakurai, No. 7199.

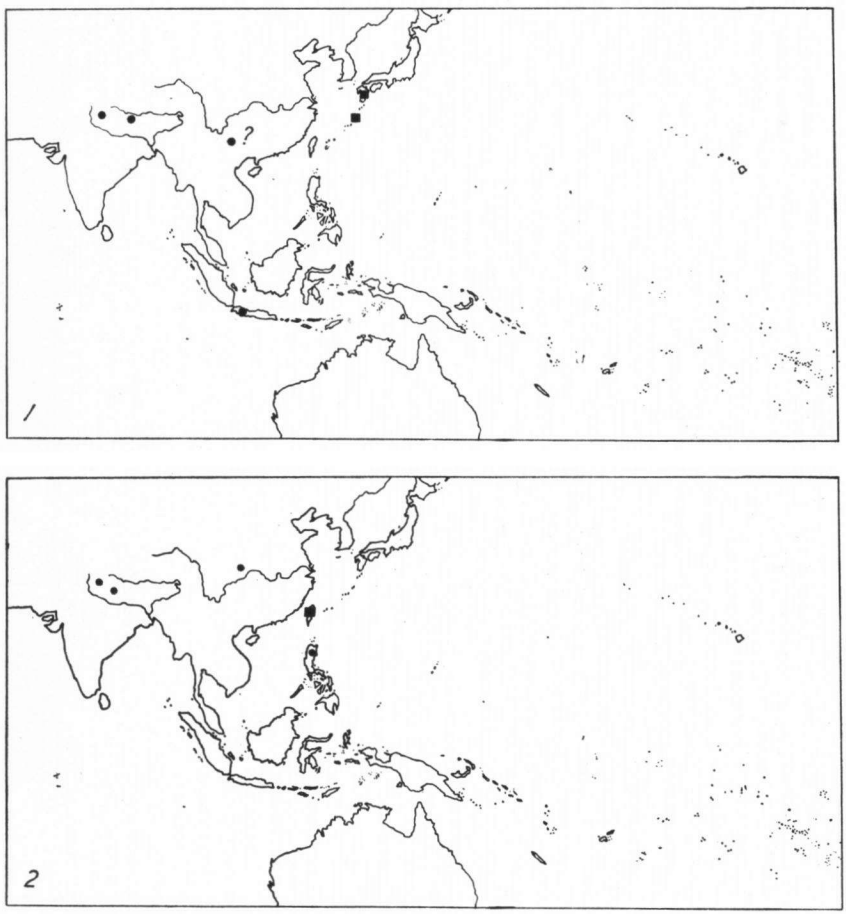


Plate X. — Map 1: Area of *Duthiella wallichii* (Mitt.) Broth. (●) and of *Duthiella myuriiformis* Sak. (■); Map 2: Area of *Duthiella declinata* (Mitt.) Zant. (●) and of *Duthiella robusta* Nog. (■).

Dioicous; *medium sized,* green or yellowish-green plants in *dull* mats. Secondary stems procumbent or somewhat ascending, irregularly or more or less pinnately branched, densely, not complanately foliate. Leaves spreading when dry, horizontally spreading when moist, up to 3 mm long, plane or faintly longitudinally plicate, often crisped near apex, from a broadly

ovate, not auriculate base gradually or somewhat abruptly acuminate; leaf margin faintly to moderately serrate. Leaf rib single, ending below apex. Leaf cells *somewhat elongate*, 1.5—2.5 times as long as wide, *18—30* μ long, towards base more elongate, on both sides *unipapillate* over lumen, *but in the upper part of the leaf mostly nearly smooth*; border cells not differentiated; alar cells quadrate to rectangular, smooth; cell walls rather thin, *not sinose.*

Seta about *1.5 cm* long, *in the upper part slightly mamillose.* Capsule horizontal, 2.5 mm long and 1 mm thick. Peristome not known.

JAPAN: Kiushiu: Prov. of Higo, Mt. Ryuhô, leg. Takahashi, 24-2-1935 (herb. Sakurai, No. 7199, isotype); Prov. of Higo, Kumamoto, Koonose, leg. Mayebara, 4-1948, ser. 3, No. 121 (GRO, L).

Distribution: Japan (Kiushiu and Riu-Kiu Islands).

Ecology: On calcareous rocks at about 100 m altitude.

Notes. 1. The present species is very closely allied to *D. wallichii* (Mitt.) Broth., but differs in the following characters:

a. leaf cells slightly more elongate and somewhat larger,
b. papillae in the upper part of the leaf less distinct or absent,
c. leaf base broader,
d. seta shorter, in the upper part slightly mamillose.

In how far these differences are stable ones will have to be investigated with the help of further material.

2. Although I saw an isotype I did not see the sporophyte.

3. Duthiella declinata (Mitt.) Zant. comb. nov. — Plate IX, Fig. 3. Plate X, Map 2.

Trachypus declinatus Mitt., J. Linn. Soc. Bot. Suppl. 1(1859)129; Paris, Ind. Bryol. (1898)1303; ibid. ed. 2, 5(1906)63; Fleischer, Hedwigia 61(1920)404. Excluded: van den Bosch and van der Sande Lacoste, Bryol. Jav. 2(1864)100.

Papillaria declinata (Mitt.) Jaeg., Ber. S. Gall. Naturw. Ges. 1875/76 (1877)273 = Ad. 2(1877)177.

Trachypodopsis declinata (Mitt.) Fleisch., Hedwigia 45(1906)65; Brotherus, Nat. Pfl. 1, 3(1906)831; Fleischer, Hedwigia 61(1920)404; Brotherus, Nat. Pfl. ed. 2, 11(1925)121; Bruehl, Rec. Bot. Surv. India 13, 1 (1931)68. Excluded: Fleischer, Musci Fl. Buitenzorg 3(1908)731.

Hypnum declinatum Wils. nom. nud.: Mitten, J. Linn. Soc. Bot. Suppl. 1(1859)129.

Duthiella complanata Broth. syn. nov.: Brotherus, Philipp. J. Sc. 5, 2, C, Bot. (1910)157; Brotherus, Nat. Pfl. ed. 2, 11(1925)123; van Steenis, Bull. Jard. Bot. Buitenzorg 3, 13(1934)164; Reimers, Hedwigia 76(1937) 289; Bartram, Philipp. J. Sc. 68(1939)197.

Duthiella mussooriensis Reim. syn. nov.: Reimers, Hedwigia 76(1937)289.

Duthiella wallichii (Mitt.) Broth. f. *robusta* Broth. nom. nud.: Brotherus, Symb. Sin. 4(1929)77; Reimers, Hedwigia 76(1937)289.

Type specimens: *Duthiella declinata* (Mitt.) Zant.: Himalaya, Simla, leg. Thomson, herb. Ind. Or. Hook. f. et Thoms. No. 1015; lectoholotype in K. — *Duthiella complanata* Broth.: Philippine Islands, Luzon, Subprov. of Benguet, Pauai, leg. MacGregor, 6-1909, Bur. Sc. No. 8706;

lectoholotype in H. — *Duthiella mussooriensis* Reim.: Himalaya, Mussoorie, Mt. Nag Tiba, leg. Bahadru, 23-12-1900, Levier, Bryoth. exot. 1(1907) No. 32; holotype in FI (under the name of D. wallichii (Mitt.) Broth.).

Dioicous ?; medium sized, yellowish-green plants, mostly in *slightly glossy* mats. Secondary stems procumbent or somewhat ascending, up to 6 cm long, irregularly pinnately or *slightly arborescently* branched, densely, either complanately foliate or not. Leaves erect spreading when dry, horizontally spreading when moist, up to 3 mm long, mostly faintly longitudinally plicate, undulate near apex, from an ovate, not auriculate base gradually rather long-acuminate; leaf margin *strongly serrate.* Leaf rib single, ending below apex. Leaf cells *elongate-hexagonal,* more elongate towards base, on both sides *unipapillate* over lumen (very rarely with two papillae), papillae occasionally more or less inconspicuous; border cells more elongate, larger, forming a *distinct border*; alar cells lax, quadrate, smooth; cell walls often more or less *sinuose,* mostly rather thin. Leaf cells often *greatly varying in width* and being of the same length.

Sporophyte as in the diagnosis of the genus. Seta about *2—3 cm* long. Basal membrane of the endostome *smooth.*

N.W. HIMALAYA: Jaunsi Deoban, leg. Duthie, 28-5-1899, c. seta (H, D. wallichii); Mussoorie, Mt. Nag Tiba, leg. Bahadru, 23-12-1900, c.fr. (FI, D. wallichii; holotype of D. mussooriensis); Simla, leg. Thomson, herb. Ind. Or. Hook. f. et Thoms. No. 1015, c.fr. (K, lectoholotype); Nubra, leg. Thomson, herb. Ind. Or. Hook. f. et Thoms. No. 1014 (K).

CHINA: Szechwan, Yenyen, near Kwapi castle, leg. Handel-Mazzetti, 30-5-1914, No. 2728 (H, D. wallichii var. robusta).

PHILIPPINE ISLANDS: Luzon: Subprov. of Benguet, Pauai, leg. MacGregor, 6-1909, Bur. Sc. No. 8706, c.fr. (H, D. complanata, holotype); Subprov. of Benguet, Mt. Santo Tomas, leg. Williams, 10-1904, No. 1722, c.fr. (H).

Distribution: N.W. Himalaya; Szechwan; Luzon.

Ecology: On trees and on rocks. Alt.: 1500—3100 m.

Notes. 1. The present species is easily to be distinguished from the previous one by the slightly glossy aspect, the mostly somewhat arborescent branching, the more appressed and longer acuminate leaves, the more elongate leaf cells (especially in the upper part of the leaf), the distinct leaf border and the strongly serrate leaf margin.

2. *D. declinata* has often been confused with *D. wallichii* (Mitt.) Broth. (see there, note 2).

D. wallichii (Mitt.) Broth. f. *robusta* Broth. nom. nud. is not to be distinguished from the type specimen of *D. declinata.* Reimers (l. c. 1937) states that *D. wallichii* f. *robusta* belongs to *D. mussooriensis* Reim. and because the latter is identical with *D. declinata* (Mitt.) Zant., this bears out my statement.

3. Reimers says in his original description of *D. mussooriensis* Reim. (l. c. 1937): "Diese Art steht der *Duthiella wallichii* nahe, unterscheidet sich von ihr aber durch die plötzlicher und schärfer zugespitzten Blätter, gestrecktes Zellnetz, kräftiger Randzähnelung und deutlichen Saum. Sie scheint habituell kräftiger zu sein als *D. wallichii*".

These differences are exactly those characters in which *D. declinata* differs from *D. wallichii* (with the exception of the more robust habit).

The type specimens of *D. mussooriensis* and *D. declinata* proved indeed to be wholly identical.

4. *D. declinata* hitherto used to belong to the genus *Trachypodopsis*, probably on account of its rather long-acuminate leaves and its somewhat elongate leaf cells. Because the sporophyte was said to be unknown (which was however based on an error, for the fruiting specimens of *D. declinata* were confused with *D. wallichii*) the exact position of the species, within the genus *Duthiella*, was not recognized.

But even when not in fruit this species can hardly be confused with one of the *Trachypodopsis* species on account of the absence of leaf auricles.

5. Jaeger, Ber. S. Gall. Naturw. Ges. 1875/76(1877)273, mentions the name *Pilotrichum declinatum* Doz. et Molk. nom. nud. as a synonym for *Papillaria declinata* (Mitt.) Jaeg., which name is said to be found in Bryol. Jav. 2(1864)100. This must however be an error for in Bryol. Jav. there does not occur any *Pilotrichum declinatum*.

4. Duthiella robusta Nog. — Plate IX, Fig. 4. Plate X, Map 2.

Noguchi, Trans. Nat. Hist. Soc. Formosa 24(1934)470; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)63.

Type specimen: Formosa, Prov. of Sintiku, Mt. Rito, leg. Hirotu, 8-1925; holotype in herb. Noguchi, No. 609 (not seen).

Dioicous; *fairly robust*, green or yellowish-green plants in *dull* or *somewhat glossy* mats. Secondary stems procumbent, up to 7 cm long, densely irregularly branched, densely, either somewhat complanately foliate or not; branches up to 3 cm long. Leaves spreading to horizontally spreading when dry, horizontally spreading when moist, up to *4 mm* long, *not* longitudinally *plicate* or *crisped* near apex, from a broad, *not auriculate* base gradually or somewhat abruptly, rather long-acuminate; leaf margin rather *faintly* to *moderately serrate*. Leaf rib single, ending below apex. Leaf cells *elongate-hexagonal*, on both sides *unipapillate* over lumen, more elongate and smooth towards base, border cells *not differentiated*; alar cells few, quadrate to rectangular, smooth; cell walls *incrassate, pitted*.

Seta about *3 cm* long. Capsule not known.

FORMOSA: Prov. of Taihoku, Doba, leg. Noguchi, 23-8-1932 (herb. Noguchi, No. 6215).

Distribution: Formosa only.

Ecology: On rocks.

Notes. 1. The present species is remotely allied to *D. speciosissima* Card. and *D. formosana* on account of its fairly robust habit, but differs mainly by its incrassate, pitted cell walls, faint to moderate toothing and by the absence of leaf auricles.

From *D. declinata* (Mitt.) Zant. it differs mainly by its more robust habit, incrassate cell walls, faint or moderate toothing and by the absence of a leaf border and from *D. wallichii* (Mitt.) Broth. mainly by its more robust habit, incrassate cell walls and its more elongate leaf cells.

2. I have not seen the actual type but a specimen which, according to Noguchi, is identical with the type.

5. Duthiella formosana Nog. — Plate IX, Fig. 5. Plate XII, Map 1.

Noguchi, Trans. Nat. Hist. Soc. Formosa 24(1934)469; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)62.

Type specimen: Formosa, Prov. of Takao, Mt. Daibu, leg. Kodaira, 1-1928; holotype in herb. Noguchi, No. 1758 (not seen).

Dioicous; *fairly robust*, green, yellowish-green or brownish-green plants in *dull-shining*, lax mats. Secondary stems procumbent, up to 7 cm long, irregularly pinnately branched, densely foliate. Leaves *appressed* to erect spreading when dry, erect spreading to horizontally spreading when moist, up to *4 mm* long, more or less longitudinally plicate, crisped near apex, from a broadly, mostly *faintly auriculate* base gradually or somewhat abruptly, rather long-acuminate; leaf margin *strongly serrate*. Leaf rib single, ending below apex. Leaf cells *elongate-hexagonal* to more or less *elongate*, on both sides *unipapillate* over lumen, more elongate and smooth towards base; border cells more elongate, forming a *distinct border*, mostly smooth; alar cells lax, *rather numerous*, quadrate, smooth; cell walls often *more or less sinuose*, rather *thin*. Leaf cells often greatly *varying in width* and being of the same length.

Sporophyte as in the diagnosis of the genus. Seta about *2.5 cm* long.

FORMOSA: Prov. of Tainan, Mt. Kodama, leg. Noguchi, 18-8-1932 (herb. Noguchi, No. 5847).

Distribution: Formosa only.

Ecology: On moist soil or decayed logs.

Notes. 1. This species is closely allied to *D. speciosissima* Card., but differs on account of the following characters:

a. leaves mostly appressed, often somewhat more abruptly acuminate,
b. leaf margin slightly stronger serrate,
c. cells towards the leaf margin forming a more distinct border, especially in the upper part of the leaf,
d. a larger number of alar cells,
e. a shorter seta.

The basal membrane of the endostome is, as shown in the figure given by Noguchi (l. c. 1934), papillose as in contrast with *D. speciosissima* Card.

The aerolation of the leaves bears close resemblance to that of *D. declinata* (Mitt.) Zant., but the general habit of the plants and the shape of the leaves are quite different.

2. I have not seen the actual type specimen, but a specimen without sporophyte which, according to Noguchi, is identical with the type.

6. Duthiella speciosissima Broth. ex Card. — Plate XI, Fig. 2. Plate XII, Map 1.

Duthiella speciosissima Broth. ex Card.: Cardot, Bull. Soc. Bot. Genève 2, 5(1913)317; Brotherus, Nat. Pfl. ed. 2, 11(1925)123; Reimers, Bot. Jahrb. 64(1931)544; Reimers, Hedwigia 76(1937)289; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)63; Horikawa, Bull. Soc. Plant. Ecol. 2, 4(1953)144 (geographical distribution); Sakurai, Musc. Jap. (1954) 101; Chen, Fedd. Rep. 58(1955)29.

Matsumuraea japonica Okam., Bot. Mag. Tokyo 28(1914)106; Okamura,

J. Coll. Sc. Imp. Univ. Tokyo 36(1915)43; Brotherus, Nat. Pfl. ed. 2, 11(1925)123.

Pleuropus sakuraii Broth. nom. nud.: Cardot, Bull. Soc. Bot. Genève 2, 5(1913)317.

Type specimens: *Duthiella speciosissima* Card.: Japan, Honshiu, Prov. of Kai, Mt. Sasako, leg. Sakurai, 2-10-1910, ex herb. Brotherus, No. 472; holotype in PC. — *Matsumuraea japonica* Okam.: Japan, Honshiu, Prov. of Iga, Takikawa-mura, Naga-gun, leg. Sasaoka, 5-10-1913; lectotype in H.

Dioicous; *fairly robust,* green or yellowish-green plants in somewhat *glossy* mats. Secondary stems procumbent, up to 15 cm long, irregularly branched, densely foliate. Leaves erect spreading to spreading when dry, horizontally spreading when moist, up to *4 mm* long, more or less longitudinally plicate, crisped near apex, from a broadly ovate, *faintly auriculate* base more or less gradually, rather long-acuminate; leaf margin moderately to rather *strongly serrate.* Leaf rib single, ending below apex. Leaf cells *hexagonal to elongate,* up to 6 times as long as wide, mostly on both sides *unipapillate* over lumen, more elongate and smooth towards base; border cells mostly somewhat more elongate, smooth; alar cells present, *mostly few,* quadrate, smooth; cell walls rather thin.

Sporophyte as in the diagnosis of the genus. Seta about *5 cm* long. Basal membrane of the endostome almost *smooth.*

JAPAN: Honshiu: Prov. of Kai, Mt. Sasako, leg. Sakurai, 2-10-1910, ex herb. Brotherus, No. 472 (PC, holotype); Prov. of Sagami, O-Yama, leg. Sakurai, 28-8-1910 (PC); Prov. of Sagami, Mt. Tanzawa, leg. Sakuri, 28-8-1910. c. fr. (H); Prov. of Sagami, O-Yama, leg. Sakurai, 12-4-1940 (herb. Sakurai); Prov. of Musashi, Mt. Takao, leg. ?, 4-4-1911 (PC); Prov. of Iga, Takikawa-mura, Naga-gun, leg. Sasaoka, 5-10-1913 (H, Matsumuraea japonica, lectotype); Prov. of Tajima, Kinosaki, leg. Cono, 30-8-1906, c. seta (H); Prov. ?, Aichi, Kitashidara, Miwa, leg. Takaki, 9-1949, ser. 4, No. 176 (GRO, L); Prov. ?, Koino Kii, leg. Okamura, 31-7-1903 (H, Matsumuraea japonica).

Distribution: Japan (Honshiu, Kiushiu, Shikoku); China (Sikang, fid. Chen, l. c. 1955).

Ecology: On the ground. From low altitudes up to 1200 m.

Notes. 1. This species is easily to be distinguished from most other *Duthiella* species on account of its robust habit. It bears most resemblance to *D. formosana* Nog. (see there, note 1).

It bears also close resemblance to *Trachypodopsis serrulata* (P. Beauv.) Fleisch. var. *serrulata* when not in fruit (see there, note 4).

2. For the type specimen of *Matsumuraea japonica* Okam. (lectotype) Okamura mentioned as date of collecting 12-11-1913, this should however be 5-10-1913 as is indicated on the herbarium capsule.

7. Duthiella flaccida (Card.) Broth.

For literature and type specimens see below.

Dioicous; *medium sized,* green or yellowish-green plants in *dull* or rarely somewhat glossy mats. Secondary stems irregularly pinnately branched. Secondary stems and branches procumbent or somewhat ascending, mostly more or less complanately foliate. Leaves mostly spreading when dry, horizontally spreading when moist, plane or faintly longitudinally

plicate and crisped near apex, from an ovate, *not auriculate* base more or less gradually acuminate; leaf margin *faintly,* but distinctly to moderately toothed or serrate; stem leaves sometimes somewhat shorter acuminate than the branch leaves. Leaf rib single, ending below apex. Leaf cells hexagonal or *elongate-hexagonal to linear,* 1.5—10 times as long as wide, 8—40 μ long, having the same length often *greatly varying in width,* on both sides *seriately papillate* over lumen (2—6 papillae), occasionally smooth or nearly so, towards base more elongate; border cells *not differentiated*; alar cells few, quadrate, smooth; cell walls rather thin or slightly incrassate, often more or less *sinuose.*

Sporophyte as in the diagnosis of the genus. Seta about *3 cm* long. Basal membrane of the endostome *strongly papillose.*

The present species is rather variable with 3 varieties which may be distinguished by the following key:

1. Papillae on the leaf cells indistinct or wanting; median leaf cells opaque, 12—25 μ long; stems and branches rigid . . . . . **7b. var. rigida** (Broth.) Zant.
1. Papillae on the leaf cells distinct; median leaf cells somewhat opaque or pellucid, 8—40 μ long; stems and branches mostly flaccid.
   2. Median leaf cells 8—25 μ long, mostly slightly opaque; cell walls more or less sinuose **7a. var. flaccida**
   2. Median leaf cells 20—40 μ long, pellucid; cell walls not sinuose **7c. var. media** (Nog.) Zant.

7a. Duthiella flaccida (Card.) Broth. var. **flaccida.** — Plate XI, Fig. 3a and 3b. Plate XII, Map 2.

Duthiella flaccida (Card.) Broth., Nat. Pfl. 1, 3(1908)1010; ibid. ed. 2, 11(1925)123; Bruehl, Rec. Bot. Surv. India, 13, 1(1931)68; Sakurai, Bot. Mag. Tokyo 46(1932)739; Reimers, Hedwigia 76(1937)289; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)60; Noguchi and Hattori, J. Hattori Bot. Lab. 19(1958)122.

Trachypus flaccidus Card., Beih. Bot. Centralbl. 19, 2(1905)117.

Trachypodopsis flaccida (Card.) Fleisch., Hedwigia 45(1906)67.

Duthiella japonica Broth. ex Card.: Cardot, Bull. Soc. Bot. Genève 2, 3(1911)283; Brotherus, Oev. Finsk. Vet. Soc. Foerh. 62(1920)34; Brotherus, Nat. Pfl. ed. 2, 11(1925)123; Sakurai, Bot. Mag. Tokyo 46(1932)740; Reimers, Hedwigia 76(1937)289; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)60; Sakurai, Musc. Jap. (1954)101.

Duthiella pellucens Thér. syn. nov.: Thériot, Bull. Géogr. Bot. 21(1911) 271; Brotherus, Nat. Pfl. ed. 2, 11(1925)123; Noguchi, J. Sc. Hiroshima Univ. B, 2, 3(1936)15; Reimers, Hedwigia 76(1937)289; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)61; Noguchi and Hattori, J. Hattori Bot. Lab. 19(1958)122.

Duthiella perpapillata Broth. syn. nov.: Brotherus, Symb. Sin. 4(1929) 78; Reimers, Hedwigia 76(1937)289.

Duthiella lacustris Reim. et Sak., Bot. Jahrb. 64(1931)543; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)60; Sakurai, Musc. Jap. (1954)101 (fid. Noguchi).

Duthiella emodi C. Muell. ex Reim. syn. nov.: Paris, Ind. Bryol. Suppl. (1900)133 (as nom. nud.); Reimers, Hedwigia 76(1937)288.

Duthiella brassii Bartr. syn. nov.: Bartram, Britt. 9, 1(1957)45.

Bryhnia olivacea Sak., Bot. Mag. Tokyo 46(1932)508; Sakurai, Musc. Jap. (1954)101 (fid. Sakurai).

Glossadelphus alaris (non Broth. et Yas.) Sak., Bot. Mag. Tokyo 52 (1938)135; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2 (1947)60. (fid. Noguchi).

Duthiella flaccida (Card.) Broth. var. *gigantea* Nog. syn. nov.: Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)61.

Duthiella japonica Card. var. *pallida* Sak., Bot. Mag. Tokyo 51(1937) 796; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)60; Sakurai, Musc. Jap. (1954)101.

Duthiella tortifolia Dix. nom. nud.: Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)60.

Type specimens: *Duthiella flaccida* (Card.) Broth.: Formosa, Prov. of Taihoku, Kushaku, leg. Faurie, 6-6-1903, No. 139; holotype in PC. — *Duthiella japonica* Card.: Japan, Shikoku, Prov. of Tosa, leg. Cono, 10-1905; holotype in PC. — *Duthiella pellucens* Thér.: China, Kwei-Chow, Pin-fa, leg. Cavalerie, 5-4-1904; holotype in PC. — *Duthiella perpapillata* Broth.: China, Yuennan, between Moengdse and Manhao, leg. Handel-Mazzetti, 7-3-1915, No. 6011; holotype in H. — *Duthiella lacustris* Reim. et Sak.: Japan, Honshiu, Prov. of Sagami, Hakone Mountains, Ashinoko-lake, leg. Sakurai, 3-1-1911, No. 327; type probably lost. — *Duthiella emodi* Reim.: N.W. Himalaya, Mussoorie, leg. Gollan, 26-11-1903; holotype in FI. — *Duthiella brassii* Bartr.: New Guinea, Mt. Dayman, leg. Brass, 6-7-1953, No. 23317a; holotype in herb. Bartram. — *Duthiella flaccida* (Card.) Broth. var. *gigantea* Nog.: Japan, Shikoku, Prov. of Tosa, Kochi, leg. Kamimura, 21-7-1935, No. 2117; holotype in herb. Noguchi. — *Duthiella japonica* Card. var. *pallida* Sak.: Japan, Kiushiu, Prov. of Higo, Nakaharu, leg. Mayebara, 13-12-1936; holotype in herb. Sakurai.

Plants *flaccid,* mostly complanately foliate, occasionally however not or hardly so. Leaves mostly rather faintly longitudinally *plicate, crisped* near apex when dry. Median leaf cells hexagonal to elongate-hexagonal, up to *7* times as long as wide, *8—25* μ long, often *greatly varying in width* having the same length, mostly somewhat *opaque*; papillae on the leaf cells *distinct*; cell walls *sinuose,* rather thin to slightly incrassate.

JAPAN: Kiushiu: Prov. of Buzen, Shirakawa-m, leg. Ada, 4-10-1921, herb. Sasaoka No. 2138 (BM, D. tortifolia); Prov. of Higo, Nakaharu, leg. Mayebara, 13-12-1936 (herb. Sakurai No. 9408, D. japonica var. pallida, isotype); Prov. of Hyuga, Minaminaka, Kitago, leg. Noguchi and Hattori, 8-1946, ser. 1, No. 26 (GRO, L); Prov. of Higo, Kumamoto, Koonose, leg. Mayebara, 4-1948, ser. 3, No. 120 (GRO, L). — Shikoku: Prov. of Tosa, Kochi, leg. Kamimura, 21-7-1935 (herb. Noguchi, D. flaccida, var. gigantea, isotype); Prov. of Tosa, leg. Cono, 10-1905 (PC, D. japonica, holotype); Prov. of Tosa, ex coll. Cono, leg. ?, 11-10-1904 (H, D. wallichii). — Honshiu: Prov. of Ise, Dayingu, leg. Tsuchiya (= Tutija), 22-5-1927 (H, D. japonica).

FORMOSA: Prov. of Taihoku, Kushaku, leg. Faurie, 6-6-1903, No. 139 (PC, holotype).

PHILIPPINE ISLANDS: Luzon: Prov. of Laguna, Mt. Mahiling, leg. Deguilla and Apolinario, 6-5-1949, No. 3 and No. 5 (GRO); ibid. 6-6-1949, No. 12 (GRO). — Palawan: Mt. Mantalingajan, leg. Edano, 8-5-1947, No. 582, 583 and No. 584 (GRO); ibid. 5-5-1947, No. 623 (GRO).

AUSTRALIAN NEW GUINEA: Boianai, leg. Cruttwell, 31-10-1950, No. M 50 (GRO); Mt. Dayman, leg. Brass, 6-7-1953, No. 23317a (herb. Bartram, D. brassii, holotype).

CHINA: Kwei-Chow: Pin-fa, leg. Cavalerie, 5-4-1904 (PC, D. pellucens, holotype); Pin-fa, leg. Cavalerie, 25-1-1905, No. 1796, c.fr. (PC). — Yuennan, between Moengdse

and Manhao, leg. Handel-Mazzetti, 7-3-1915, No. 6011 (H, D. perpapillata, holotype).
INDIA: Mussoorie: Dehra Dun, Raspanna Valley below Mussoorie, leg. Duthie, 4-1-1892, No. 424 (FI); Arnigadh, leg. Gollan, 13-12-1895 (FI); leg. Duthie, 10-1879, c.fr. (FI); below old Botanic Garden, leg. Gollan, 26-11-1903 (FI, D. emodi, holotype). — Bhutan: Challoons, herb. late East India Comp. No. 498, herb. Griffith No. 53, leg. Bahadru (K, Hypnum wallichii). — Kumaon: Pheroka, herb. Strachey et Winterbottom (K, Hypnum wallichii).

Distribution: Japan; Philippine Islands; New Guinea; China (Yuennan, Szechwan, Kwei-Chow); India (Mussoorie, Bhutan, Kumaon).

Ecology: On the ground and on rocks. Alt.: up to 1800 m.

Notes. 1. A rather variable variety. The plant from Formosa (type specimen) and Yuennan (type of *D. perpapillata*) for instance deviate from most other plants (mostly identified as *D. japonica* or *D. emodi*) in having short, not complanately foliate stems and branches and strongly crisped leaves. Microscopically there is no difference and because there also occur intermediate forms (*e. g.* herb. Strachey et Winterbottom No. 78, K) it is not practical to separate these plants.

Noguchi (l. c. 1947) regards *D. japonica* Broth. as to be identical with *D. flaccida* (Card.) Broth. Sakurai however maintains it to be a separate species (l. c. 1954).

2. According to Brotherus (l. c. 1929) *D. perpapillata* Broth. is to be compared with *D. rigida* Broth., it bears however much greater similarity to *D. flaccida* (Card.) Broth. var. *flaccida,* for the leaves are strongly crisped when dry and the laef cells are distinctly papillate.

3. Although I have not seen the type specimen of *D. lacustris* Reim. et Sak. (probably lost) in my opinion it is almost certain that this species is conspecific with *D. flaccida* var. *flaccida* for the following reasons:

a. the characters mentioned in the original diagnosis all fall between the limits of *D. flaccida* var. *flaccida.*
b. the same holds good for the figure given with the diagnosis,
c. the authors based their new species on account of the shape of the leaves, which is in *D. flaccida* var. *flaccida* very variable and Reimers himself doubts whether the differences with *D. flaccida* are stable ones (l. c. 1931).

Noguchi also regards the plant to be conspecific with *D. flaccida* (Card.) Broth. (l. c. 1947). Sakurai however maintains it to be a separate species (l. c. 1954).

4. The type specimen of *D. brassii* Bartr. differs from that of *D. flaccida* var. *flaccida* in having more pellucid leaf cells with non-sinuose walls and in having its leaf cells all of the same width and it inclines therefore towards var. *media* (Nog.) Zant., which variety however is clearly distinguished on account of its having much more elongate leaf cells. Another specimen from New Guinea (Boianai, leg. Cruttwell, 31-10-1950, No. M 50 (GRO)) is intermediate between var. *flaccida* and the specimen identified as *D. brassii* Bartr.

5. I compared an isotype of *D. flaccida* (Card.) Broth. var. *gigantea* Nog. with the type specimen of *D. flaccida* from Formosa, but could not find great differences. Var. *gigantea* appeared to be only slightly more robust and to have somewhat less pellucid leaf cells, but is not at all to

be distinguished from most other specimens which belong to *D. flaccida.* The type specimen of *D. flaccida* (Card.) Broth. namely is not characteristic for this species. All other specimens I saw of this species were somewhat more robust than the type specimen. Brotherus called the plants from China consequently *D. wallichii* (Mitt.) Broth. f. *robusta* Broth. nom. nud. (l. c. 1929; he has confused *D. flaccida* with *D. wallichii,* see note 8) and Noguchi those from Japan *D. flaccida* var. *gigantea Nog.* (l. c. 1947).

6. *D. japonica* Card. var. *pallida* Sak. differs from *D. flaccida* var. *flaccida* only in its pale colour. In all probability it is only a skiophile form as Sakurai himself says (l. c. 1937), which opinion is fortified by the fact that the plant grew in a rocky hole. Also Noguchi (l. c. 1947) mentions var. *pallida* Sak. as a synonym for *D. flaccida* (Card.) Broth.

7. In his original description of *D. pellucens* Thér. (l. c. 1911) Thériot says that this species differs from *D. flaccida* (Card.) Broth. on account of its having more pellucid leaves, a slightly more robust habit, non-complanate, rigid, stronger serrate leaves etc., but when comparing the type specimens of the two species I could hardly find any differences.

8. In his description of *D. japonica* Card. (l. c. 1920), from the type specimen of Cardot, Brotherus compares this plant with *D. wallichii* (Mitt.) Broth. and according to this description it deviates principally in its somewhat less robust appearance. He does not however mention the two very conspicuous differences between the two species *viz.* that *D. japonica* has elongate, pluripapillate leaf cells and *D. wallichii* more or less isodiametric, unipapillate leaf cells.

Furthermore Brotherus states in the description mentioned above: "cellulis ellipticis, papillis paucis supra lumen instructis". This is right, but because he did not mention the above cited differences, it is clear in my opinion that by *D. wallichii* Brotherus meant a species very closely allied to *D. flaccida* with elongate, pluripapillate leaf cells, which is contradictory to the facts.

The same conclusion may be drawn from the following fact: in his original description of *D. rigida* Broth. (= *D. flaccida* (Card.) Broth. var. *rigida* (Broth.) Zant.; l. c. 1922 and 1929) Brotherus compares this species too with *D. wallichii,* but again he does not mention the above differences.

Not only Brotherus made this mistake but also Thériot, which may be concluded from the following fact: in his original description of *D. pellucens* Thér. (= *D. flaccida* (Card.) Broth. var. *flaccida;* l. c. 1911) Thériot states that this species differs from *D. wallichii* only on account of its having pellucid leaves. He too does not mention the two very conspicuous differences between *D. flaccida* and *D. wallichii.*

It is very unlikely that both Brotherus and Thériot should have overlooked these differences and in my opinion it is clear that these authors have confused *D. wallichii* (Mitt.) Broth. with another *Duthiella* species, which has elongate, pluripapillate leaf cells. *D. flaccida* (Card.) Broth. is the only species to be considered.

Which makes it even more likely that there must have been some confusion is the fact that the only specimen of *D. wallichii* I got from herb. Brotherus is actually *D. flaccida.*

In herb. Griffith and in herb. Strachey et Winterbottom (both in K) there are also plants under the name of *Hypnum wallichii* Schwaegr. which are in reality *D. flaccida* (*cf. D. wallichii*, note 3).

This confusion has also been noticed by Reimers when he writes: "Merkwürdigerweise ist die Typusart der Gattung *Duthiella, D. emodi* C. Muell. msc. offenbar niemals publiziert und fälschlicherweise mit *Hypnum wallichii* Hook. identifiziert worden, von dem sie aber ganz verschieden ist" (l. c. 1937).

Because *D. emodi* Reim. is conspecific with *D. flaccida* (Card.) Broth. this bears out my opinion.

The figure shown by Brotherus (l. c. 1908 and 1925) of *D. wallichii* however has got isodiametric, unipapillate leaf cells. Obviously Brotherus's conception of this species has not always been the same.

7b. Duthiella flaccida (Card.) Broth. var. **rigida** (Broth.) Zant. comb. nov. — Plate XI, Fig. 3c and 3d. Plate XII, Map 3.

Duthiella rigida Broth., Sitzungsber. Akad. Wiss. Wien 1, 131(1922) 218; Brotherus, Symb. Sin. 4(1929)78; Reimers, Hedwigia 76(1937)289.

Duthiella rivicola Sak., Bot. Mag. Tokyo 50(1936)264; Noguchi, J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)60.

Type specimens: *Duthiella rigida* Broth.: China, Yuennan, Hsinlung, leg. Handel-Mazzetti, 10-3-1914, No. 518; holotype in H. — *Duthiella rivicola* Sak.: Japan, Kiushiu, Prov. of Higo, Minamata, Ishizaka brooklet, leg. Kaneda, 26-5-1935; holotype in herb. Sakurai No. 5002.

Plants *rigid*, not or faintly complanately foliate. Leaves *plane*, not longitudinally plicate, not crisped near apex. Median leaf cells elongate-hexagonal, up to *7* times as long as wide, *all of about the same width, 12—25* μ long, *opaque;* papillae on the leaf cells *absent or indistinct;* cell walls *not sinuose*, rather thin to slightly incrassate.

I have only seen the two above mentioned type specimens; neither of them were in fruit.

Distribution: Yuennan; Kiushiu.

Ecology: On sandstone rocks at 2000 m altitude (Yuennan) or in running water at low altitude (Kiushiu).

Notes. 1. The present variety is closely allied to var. *flaccida*, but differs mainly in the following characters:

a. stems and branches rigid,
b. papillae on the leaf cells absent or indistinct,
c. leaf cells more opaque,
d. all leaf cells of about the same width,
e. cell walls not sinuose.

In how far these differences are stable ones or have been caused by an aberrant habitat will have to be investigated with the help of further material.

2. *D. rivicola* Sak. differs from the plant from Yuennan in having longer stems with mostly appressed to erect spreading leaves. These differences may have been caused by the aberrant habitat in running water.

Noguchi regards *D. rivicola* Sak. to be conspecific with *D. flaccida* (l. c. 1947). Sakurai (l. c. 1954) however maintains it to be a separate species.

7c. Duthiella flaccida (Card.) Broth. var. **media** (Nog.) Zant. comb. nov. — Plate XI, Fig. 3e. Plate XII, Map 3.

Duthiella media Nog., J. Hattori Bot. Lab. (= J. Hattori Shokub. Kenk.) 2(1947)61.

Type specimen: Formosa, Prov. of Taihoku, Agyoku, leg. Suzuki, 11-2-1928, No. 469; holotype in herb. Noguchi.

Plants *flaccid,* more or less complanately foliate. Leaves mostly rather faintly longitudinally *plicate, crisped* near apex when dry. Median leaf cells elongate-hexagonal to linear, up to *10* times as long as wide, *all of about the same width, 20—40* μ long, *pellucid*; papillae on the leaf cells *distinct;* cell walls *not sinuose,* rather thin.

FORMOSA: Prov. of Taihoku, Agyoku, leg. Suzuki, 11-2-1928 (herb. Noguchi No. 7267, isotype).

Distribution: Formosa only.

Ecology: No data.

Note. The present variety is closely allied to var. *flaccida,* but differs in the following characters:

a. leaf cells larger and more elongate, mostly more pellucid,
b. cell walls not sinuose,
c. all leaf cells of about the same width.

6. **Pseudotrachypus** P. Vard. et Thér.

Potier de la Varde and Thériot, Mem. Soc. Nat. Fel. Poey Cubana 14, 4(1940)357.

Medium sized, yellowish-green, slightly glossy plants. Stems *creeping,* up to 8 cm long, with tufts of blackish rhizoids, densely and *regularly* pinnately branched, rather densely foliate. Central strand absent. Branches short, up to 1 cm long, densely foliate. *Leaves dimorphous.* Stem leaves appressed to spreading when dry, erect spreading to horizontally spreading when moist, up to 2.5 mm long, longitudinally plicate, from a *deltoid* or *broadly ovate, auriculate* base long- and somewhat abruptly acuminate. Branch leaves erect spreading to spreading when dry, spreading to horizontally spreading when moist, up to 2 mm long, strongly longitudinally plicate, from an ovate, auriculate base *subulately* acuminate, with a short point. Leaf margin plane or slightly undulate, crenulate. Leaf rib single, *rather faint,* ending in or somewhat below midleaf. Leaf cells *linear,* up to *12* times as long as wide, mostly with a more or less distinct *papilla* over the lumen; marginal rows not differentiated; alar cells present, quadrate to rectangular, smooth; cell walls not incrassate, towards base somewhat thicker.

Gametoecia and sporophyte not known.

Type species of the genus is the only known species *Pseudotrachypus pinnatus* P. Vard. et Thér.

Relationships.

The classification of this genus is difficult because the sporophyte is not known.

It bears however resemblance to the genus *Trachypodopsis,* but differs

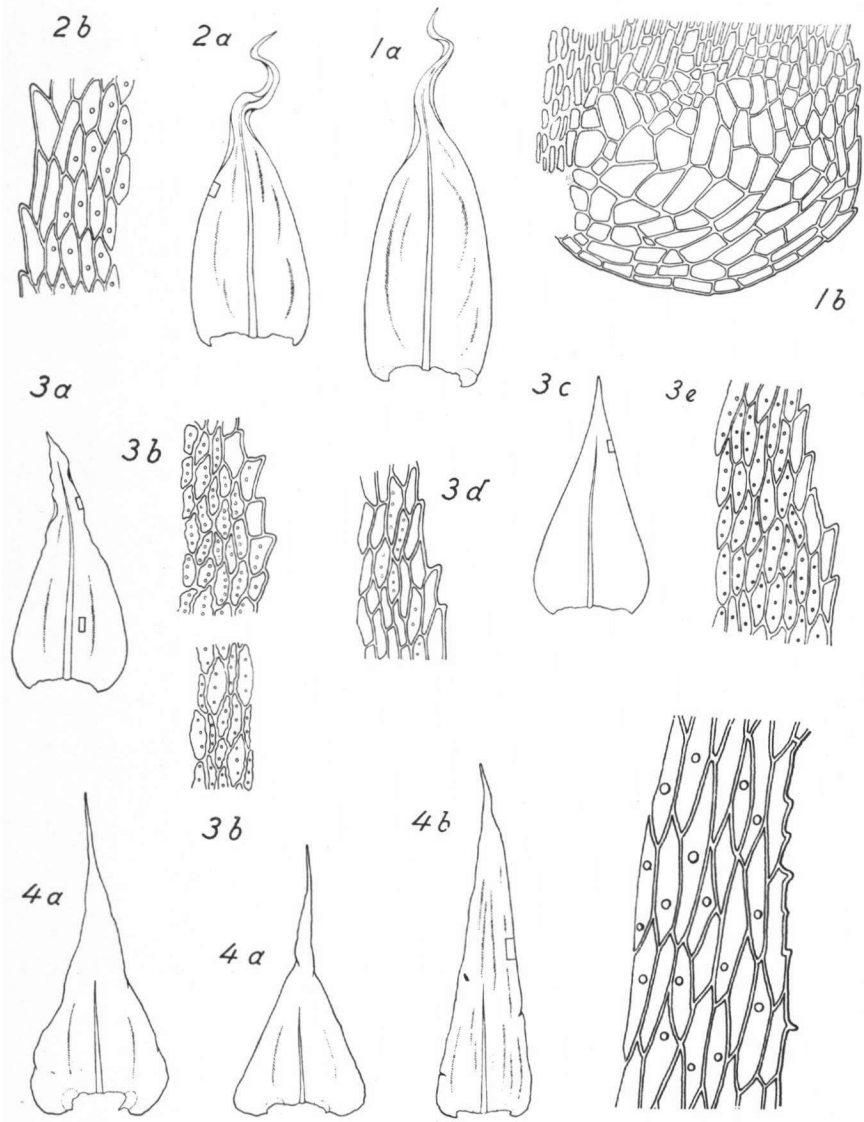


Plate XI. — Fig. 1: *Trachypodopsis laxoalaris* Broth., 1a leaf (15/1), 1b auricle (125/1); Fig. 2: *Duthiella speciosissima* Card., 2a leaf (10/1), 2b leaf cells (150/1); Fig. 3a, b: *Duthiella flaccida* (Card.) Broth. var. *flaccida*, 3a leaf (12/1), 3b leaf cells (150/1); Fig. 3c, d: var. *rigida* (Broth.) Zant., 3c leaf (12/1), 3d leaf cells (150/1); Fig. 3e: var. *media* (Nog.) Zant., leaf cells (150/1); Fig. 4: *Pseudotrachypus pinnatus* P. Vard. et Thér., 4a stem leaves (12/1), 4b branch leaf (12/1), 4c leaf cells (300/1). (Original).

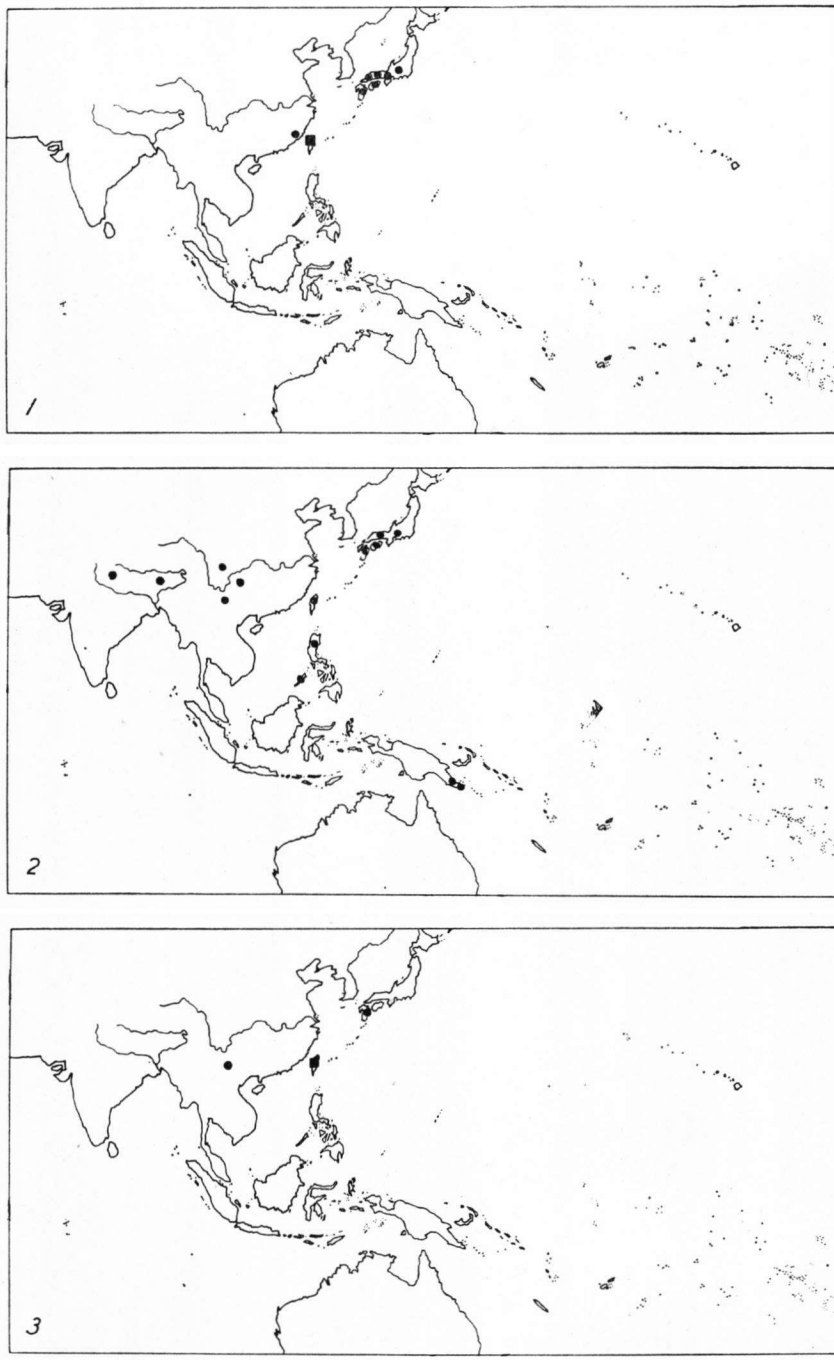


Plate XII. — Map 1: Area of *Duthiella speciosissima* Card. (●) and of *Duthiella formosana* Nog. (■); Map 2: Area of *Duthiella flaccida* (Card.) Broth. var. *flaccida*; Map 3: Area of *Duthiella flaccida* (Card.) Broth. var. *rigida* (Broth.) Zant. (●) and var. *media* (Nog.) Zant. (■).

from it by its creeping habit, its regular, pinnate branching, its strongly dimorphous leaves and its faint leaf rib.

Potier de la Varde and Thériot (l. c.) compare *Pseudotrachypus* with the genus *Trachypus* from which it differs however on account of its creeping habit, its regular, pinnate branching, the presence of auricles at the leaf base and because the papillae are situated over the cell lumen.

Unless the sporophyte indicates differently, the place of the genus *Pseudotrachypus* within the family of the *Trachypodaceae* is the most likely one.

1. **Pseudotrachypus pinnatus** P. Vard. et Thér. — Plate XI, Fig. 4.

For literature see above.

Type specimen: Cuba, Pinar del Rio, Rangel, leg. Acuna, No. 254; type in herb. Potier de la Varde.

Diagnosis as in the description of the genus.

Distribution: Cuba (found only once).

Ecology: No data extant.

SUMMARY

1. Trachypus.

1. *T. bicolor* Reinw. et Hornsch. is divided into 4 varieties:

a. var. *bicolor,*
b. var. *hispidus* (C. Muell.) Card.,
c. var. *viridulus* (Mitt.) Zant. comb. nov.,
d. var. *scindifolius* (Sak.) Nog.

2. *T. humilis* Lindb. is divided into 2 varieties:

a. var. *humilis,*
b. var. *tenerrimus* (Herz.) Zant. comb. nov.

3. *T. baviensis* Besch. has been transferred to the genus *Chrysocladium.*

4. *T. pendulus* Dix. has been transferred to the genus *Papillaria* as *P. semitorta* (C. Muell.) Jaeg.

5. The following species and varieties have been transferred to *T. bicolor* Reinw. et Hornsch. var. *bicolor:*

T. nietneri (C. Muell.) Par. syn. nov.
T. bicolor Reinw. et Hornsch. var. *sinensis* (C. Muell.) Broth.
T. appressus Fleisch. syn. nov.
T. cuspidatus Fleisch. syn. nov.
T. bicolor Reinw. et Hornsch. var. *pilifer* Fleisch. syn. nov.
T. bicolor Reinw. et Hornsch. var. *tenellus* Fleisch. syn. nov.
T. bicolor Reinw. et Hornsch. var. *simplicicaulis* Dix. syn. nov.
T. bicolor Reinw. et Hornsch. var. *floribundarioides* Nog. syn. nov.

6. The following species and varieties have been transferred to *T. bicolor* Reinw. et Hornsch. var. *hispidus* (C. Muell.) Card.:

T. bicolor Reinw. et Hornsch. var. *rigidus* (Broth. et Par.) Card.
T. paulensis (Broth.) Broth. syn. nov.
T. molliculus Broth. et Par. syn. nov.
T. rhacomitrioides Broth. syn. nov.
T. bicolor Reinw. et Hornsch. var. *brevifolius* Broth. syn. nov.

7. The following species, varieties and forms have been transferred to *T. bicolor* Reinw. et Hornsch. var. *viridulus* (Mitt.) Zant.:

T. molleri (C. Muell.) Broth. syn. nov.
T. laetus (Ren. et Card.) Broth. syn. nov.
T. subbicolor Card. syn. nov.
T. cuspidatus Fleisch. var. *brevifolia* Fleisch. syn. nov.
T. bicolor Reinw. et Hornsch. var. *hispidus* (C. Muell.) Card. f. *flagelliformis* Fleisch. syn. nov.
T. subbicolor Card. f. *robusta* Broth. syn. nov.

8. The following species, varieties and forms have been transferred to *T. humilis* Lindb. var. *humilis:*

T. massarti Ren. et Card. syn. nov.
T. novae-caledoniae Thér. syn. nov.
T. dimorphus Dix. et P. Vard. syn. nov.
T. massarti Ren. et Card. var. *brachyphyllus* Fleisch. syn. nov.
T. humilis Lindb. var. *brevifolius* Card. syn. nov.
T. humilis Lindb. var. *major* Broth. syn. nov.
T. humilis Lindb. f. *secundus* Nog. syn. nov.

9. The following species and varieties have been transferred to *T. humilis* Lindb. var. *tenerrimus* (Herz.)Zant.:

T. mauiensis Broth. syn. nov.
T. tenerrimus Herz. var. *flagelliferus* Herz. syn. nov.
T. humilis Lindb. var. *gracilis* Nog. syn. nov.

2. Trachypodopsis.

1. *T. serrulata* (P. Beauv.)Fleisch. is divided into 3 varieties:

a. var. *serrulata,*
b. var. *crispatula* (Hook.) Zant. comb. nov.,
c. var. *guilbertii* (P. Vard.) Zant. comb. nov.

2. The following species have been transferred to *T. serrulata* (P. Beauv.) Fleisch. var. *serrulata:*

T. nodicaulis (C. Muell.) Fleisch.
T. rutenbergii (C. Muell.) Fleisch.

3. The following species and subspecies have been transferred to *T. serrulata* (P. Beauv.) Fleisch. var. *crispatula* (Hook.) Zant.:

T. himantophylla (Ren. et Card.) Fleisch.
T. crispatula (Hook.) Fleisch. ssp. *macrodon* (Fleisch.) Reim. syn. nov.
T. otiophylla (Card.) Card. syn. nov.
T. densifolia Broth. syn. nov.
T. plicata Dix. syn. nov.
T. angustiretis Dix. syn. nov.
T. subulata Chen syn. nov.
T. crispatula (Hook.) Fleisch. ssp. *longifolia* Reim. syn. nov.

4. *T. ornans* (Reich.) Fleisch. has been transferred to *T. auriculata* (Mitt.) Fleisch.

5. *T. declinata* (Mitt.) Fleisch. has been transferred to the genus *Duthiella* as *D. declinata* (Mitt.) Zant.

6. *T. tereticaulis* Froehl. has been transferred to the genus *Diaphanodon* as *D. blandus* (Harv.) Ren. et Card. var. *blandus.*

3. Diaphanodon.

1. *D. blandus* (Harv.) Ren. et Card. is divided into 3 varieties

a. var. *blandus,*
b. var. *recurvedentatus* Zant. var. nov.
c. var. *ceylonensis* Zant. var. nov.

2. The following species have been transferred to *D. blandus* (Harv.) Ren. et Card. var. *blandus:*
D. thuidioides Ren. et Card. syn. nov.
D. brotheri Ren. et Card.
D. javanicus Ren. et Card. syn. nov.
Trachypodopsis tereticaulis Froehl. syn. nov.

3. *D. ? gracillimus* Card. et Thér. has been transferred to the family of the *Thuidiaceae.*

4. *D. blandus* (Harv.) Ren. et Card. has become the type specimen of the genus instead of *D. thuidioides* Ren. et Card.

5. Duthiella.

1. *D. flaccida* (Card.) Broth. is divided into 3 varieties:
a. var. *flaccida,*
b. var. *rigida* (Broth.) Zant. comb. nov.,
c. var. *media* (Nog.) Zant. comb. nov.

2. *Trachypodopsis declinata* (Mitt.) Fleisch. has been incorporated within the genus *Duthiella* as *D. declinata* (Mitt.) Zant. comb. nov., to which species have been transferred the 2 following species:
D. complanata Broth. syn. nov.
D. mussooriensis Reim. syn. nov.

3. The following species and varieties have been transferred to *D. flaccida* (Card.) Broth. var. *flaccida:*
D. japonica Card.
D. japonica Card. var. *pallida* Sak.
D. pellucens Thér. syn. nov.
D. perpapillata Broth. syn. nov.
D. lacustris Reim. et Sak.
D. emodi Reim. syn. nov.
D. brassii Bartr. syn. nov.
D. flaccida (Card.) Broth. var. *gigantea* Nog. syn. nov.

4. *D. rivicola* Sak. has been transferred to *D. flaccida* (Card.) Broth. var. *rigida* (Broth.) Zant.

5. *D. guilbertii* Thér. et P. Vard. has been transferred to the genus *Trachypodopsis* as *T. serrulata* (P. Beauv.) Fleisch. var. *guilbertii* (Thér. et P. Vard.) Zant.