

NOTES ON SOME MALAYSIAN SPECIES OF ANTHOCEROS L.  
(HEPATICAE)—I

W. MEIJER\*

SUMMARY

1. The present paper is mainly based on studies on the spot of some members of the genus *Anthoceros*. Detailed descriptions and figures taken for the greatest part from living plants are given and notes on ecology and synonymy added. All species are treated as members of the genus *Anthoceros*, in which *Aspiromitus* Steph. and *Phaeoceros* Prosk. are included.

2. Several of the species treated in this paper are very common in the cultivated area of West Java and their distribution is probably much wider than known at present and their number of synonyms larger. About forty badly described species of Stephani, based on material from tropical Asia, need a revision by a monographer.

3. *Anthoceros tjibadensis* W. Meijer appears in this paper as a new name for *Anthoceros polyandrus* Steph.

INTRODUCTION—Soon after my arrival in the tropics I started collecting and studying species of *Anthoceros* in the vicinity of Bogor, and on the slopes of Mount Pangerango near TUGU and Tjibodas, in West Java. A short trip to Bandung, West Java, and an expedition to Mount Beratus, East Borneo, supplied some additional information. It appeared that at least nine species of *Anthoceros* occur in West Java, four of which were also noticed in Borneo, a region decidedly poorer as regards this group, owing to the peculiar preference of *Anthoceros* for volcanic regions. In addition to the living plants, types from several herbaria were studied and the whole of the collections at Bogor and Leyden were taken into consideration. It may be expected that a further monographic study of this group will be given by Dr. J. Proskauer, who has in the meantime extended his interesting studies of European forms to tropical ones.

This genus is certainly a very fruitful subject for those bryologists who like to reduce to some extent the many new specific names published by Stephani in his "Species Hepaticarum" for *Anthoceros* and *Aspiromitus* from tropical Asia. That in this group at least Stephani did not recognize his own taxa will become evident from the fact that he gave four different

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\* Botanist, Herbarium Bogoriense, Kebun Raya Indonesia.

names to a common species of *Anthoceros* from Malaysia, as shown by specimens preserved in the herbaria of Leyden and Bogor.

The genus *Anthoceros* is treated here in a conservative sense, as comprising the species described by Stephani and more recent authors under *Anthoceros* L. and *Aspiromitus* Steph.; a part of *Anthoceros* s.l. has been redescribed by Proskauer (in Bull. Torrey bot. Cl. 78: 331-349. 1951) under *Phaeoceros* Prosk. Proskauer (in Ann. of Bot. II 12: 237-265. 1948) proved that Stephani's genus *Aspiromitus* is nomenclatorially based on a species which is very closely related to the type species of *Anthoceros* L. and he pointed out that, therefore, the name *Aspiromitus* should be dropped. His division of the old genus *Anthoceros* (not including *Dendroceros* Steph., *Megaceros* Campb., and *Notothylas* Sull.) into two genera, viz., *Anthoceros* sensu stricto, comprising species with mucilage-cavities in the thallus and with dark spores (type species, *A. punctatus* L.), and *Phaeoceros* Prosk., comprising species without mucilage-cavities and with yellow spores (type species, *A. laevis* L.) seems more natural at first sight. However, experience gained from Malaysian forms, convinced me that it is not necessary to accept two separate genera for these groups. The species which according to Proskauer belong to these taxa certainly represent two natural groups, each containing closely related species, but a study of the whole family reveals that these taxa are more closely related to each other than to any of the other groups of Anthocerotaceae, i.e. the genera *Megaceros*, *Dendroceros*, and *Notothylas*. It may perhaps be more suitable to treat *Phaeoceros* Prosk. as a subgenus of *Anthoceros* and to postpone the introduction of many new specific recombinations until the whole family has been revised.

ACKNOWLEDGEMENTS.—Thanks are due for the lending of valuable type specimens and other material to the Directors of the following Institutes: Rijksherbarium (Leyden), Naturhistoriska Museum (Stockholm), Institute de Botanique de la Faculté des Sciences (Strassbourg), Conservatoire Botanique (Genève), and Farlow Herbarium (Cambridge, Mass., U.S.A.). I want to express my appreciation for the valuable help given by Dr. H. Persson (Naturhistoriska Riksmuseum, Stockholm), who supplied a literature citation and copies of Stephani's Icones; to Dr. J. Proskauer (University of California, Berkeley) for criticism and help with literature; and to Dr. R. van der Wijk (Botanical Institute of the University of Groningen) for sending a living specimen of *Anthoceros laevis* L. The habit drawings of the figures are from the able hands of the Indonesian draughtsmen of Herbarium Bogoriense, Sukirno and Moh. Anwar.

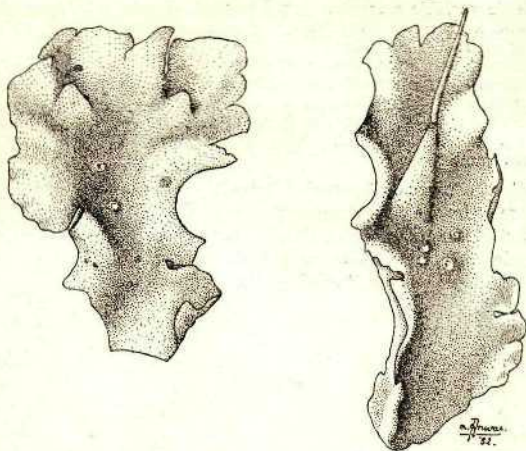


FIG. 1. *Anthoceros laevis* L. s.l.: habit, enlarged. — After Meijer 259.

1. ANTHOCEROS LAEVIS Linnaeus s.l.—Figs. 1, 2, 8a

*Anthocerot laevis* L., Sp. Pl. 1139. 1753; Zollinger. Syst. Verz. 18. 1854; ?Schiffner, Consp. Hep. Arch. ind. 351. 1858.

Monoecious and dioecious. Thalli growing in dense patches, up to 2.5 cm long, sparingly or repeatedly branched; margins flat or upright, rather irregularly dissected; cross-sections show the thalli as solid and 8—10 cells thick in the central parts, gradually tapering into the acute wings, the dorsal and ventral epidermal cells smaller than the interior ones, with larger chloroplasts; ventral parts of thallus in specimens from Java occasionally infected with a fungus. Involucres 8—10 mm long. Sporangia single on each thallus branch, occasionally 2 within an involucre, in front of antheridia; wall composed of 4—5 layers of cells. Spores yellow-brown or green-yellow, on the convex outer face minutely papillose, on the inner face nearly smooth, 30—40 $\mu$  in diameter. Elaters yellow-brown, long and composed of 4 cells, or shorter and with 1 or 2 cells, with thin walls, many of which branched, some with ring-like structures. Antheridial cavities with 2—4 antheridia. Antheridia with obovate body and short stalk; dimensions of body variable, length 100—200 $\mu$ , normally about 140 $\mu$ ; wall composed of irregularly arranged cells, in longitudinal rows of 6—12.

Plants variable according to the habitat, especially in dimensions of thalli and antheridia; hygrophilous forms are much bigger than those growing on rather dry places.

**ECOLOGY.**—In West Java common from the hilly lowland up to 2100 m, on moist soil along streams, wet roadsides, ditches, on inundated rice-fields, and near waterfalls.

**DISTRIBUTION.**—This species is apparently very widely distributed in the Malaysian region, from where it has been described under many different names.

After Zollinger (*I.e.*) recorded it for this region, it was not mentioned any more under the correct name. Stephani based about eleven new species on collections of this taxon. I refrain from giving the synonyms, because the whole complex of *A. laevis* and *A. carolianus*, distributed over all continents, is now being studied by Dr. Proskauer.

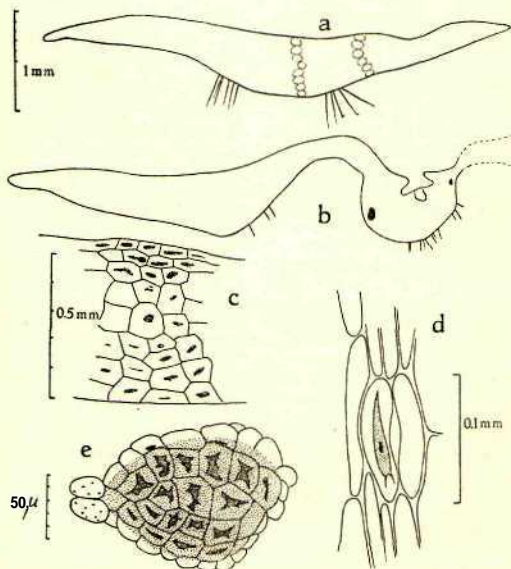


FIG. 2. *Anthoceros laevis* L. s.l.: a, transverse section through thallus; b, same with tuber-like swollen portion; c, detail of transverse section; d, stoma; e, antheridium.  
— After Meyer 259.

The species as described above from living specimens from Java is distinctly monoecious, in contrast with the English specimens, described by Proskauer (*in Ann. of Bot.* II 12: 239-256. 1948). Some authors however record dioecious plants from European localities. The whole question needs re-examination because many descriptions are not original. Plants with sporogonia, sent to me through the kindness of Dr. R. van der Wijk, Groningen, Netherlands, seemed to be dioecious, as I could not discover any antheridia on them.

I am unable to indicate any other really important morphological differences between the latter European form and the Malaysian one. Perhaps the culture experiments and cytological investigations shortly to be published by Dr. Proskauer, will clear up some points not evident with a gross morphological treatment only.

SPECIMENS EXAMINED.—SUMATRA. West Coast. Mt. Merapi, *van fiofisum Waates -2133a* (BO). — JAVA. West Java. Bogor, 200 m, Hort. Bog., along Tjiliwung, *Meijer 26S, 327, 372* (BO); Tugu, 1100 m, *Meijer 230a, 63H* (BO); *ibid.*, Djalan Mandalawangi, above tea-estate "Gunung Mas," 1200—1500 m, *Meijer 259—262, 261., 266* (BO); Tjibodas, 1450—2100 m, *Meijer 123, 12., 125A, 127, 102h, 1020* (BO); Bandung, Tjumbuleuit, 700 m, *Meijer 3181* (BO); Mt. Tangkubanprahu, 1500 m, *Meijer 3521* (BO). East Java. Mt. Semeru, *Zollinger 2S10* (L, S; mixed with *A. falsinervius* Lindenb.); Mt. Ardjuno, vicinity of Pudjon, 1200 m, *Verdoorn 35, HB 1,23* (BO), waterfall Tjabanrondo above Batu, 1700 m, *Verdoorn SS, HB SS6* (BO); Tengger Mts., Tosari, waterfalls near "Nymphenbad," 1650 m, *Verdoorn 31, HB 10SG* (BO); *ibid.*, S. slope, Mt. Pandansari near Tosari, 1600 m, *Verdoorn S3, HB 1012* (BO); Tosari to Ranu Pani 1900—2800 m, *Verdoorn 25, HB 1025, 102S, 17116* (BO); Toari to Kletak-pas, 1700 m, *van Steevis 11913* (BO); Ijang plateau, Tamanhidup, 1900 m, *van Steenis 10801* (BO); *ibid.*, Lake Tandjung, 1900 m, *van Steenin 11005* (BO). — BORNEO. East Borneo. East Kutei, Mt. Beratus (Peak of Balikpapan), along Tulus R., 100 m, *Meijer 1315, 1361* (BO), Berikanbulu terrace, along brooklet, 800 m, *Meijer 2316* (BO). — PHILIPPINES. Luzon. Benguet Prov., Sablang, *Fenir B.S. 12812* (L; named *A. silvaticum* Steph. by Stephani); crater of Mt. Mariveles, *Shaw 1916* (L; distributed as *A. monandrus* Steph.). Negros. Dumaguete, Cuernos Mts., *Elmer 10285* (L, BO; distributed as *A. philippinensis* Steph.). — CELEBES. South-western Peninsula. Lompobatang (Peak of Bonthain), 2500 m, mountain forest, *Monod de Froidville s.it.* (L).

## 2. *Anthoceros tjibodensis* W. Meijer, *nom. nov.*—Figs. 3, 4, 8b

*Anthoceros polyandrum* Steph., Sp. Hep. 5: 985. 1916, *non* Goebel, Organografie, Ed. 2, 2: 901. 1915.

Dioecious. Thalli oblong, about 1 cm long and 0.5 cm broad, partly branched; dorsal surface densely covered with small laciniae; cross-sections show young parts of thalli solid, older parts with scattered rather narrow elongated (mucilage?)-cavities, middle region about 10 layers of cells thick and the wings about 5 layers; rhizoids numerous, rather large,



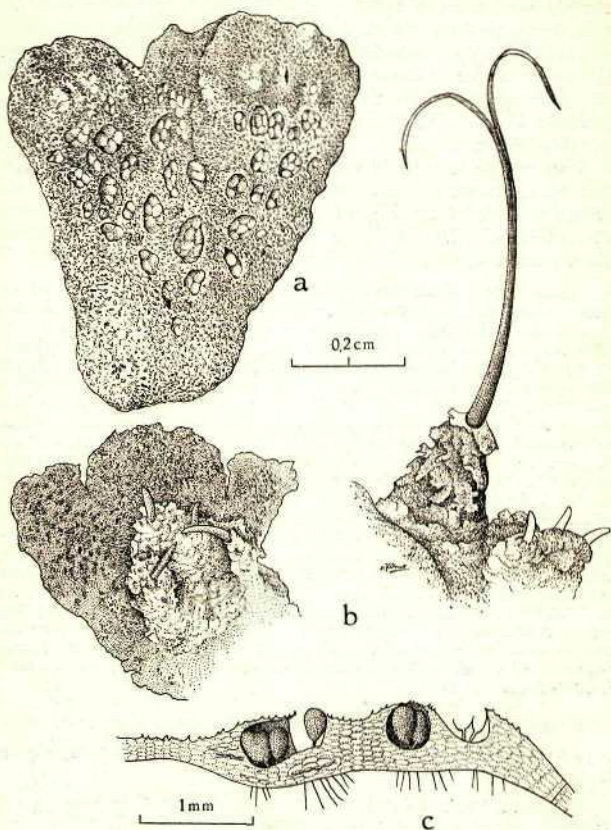


FIG. 3. *Anthoceros tjibodensia* W. Meijer: a, habit of male plant; b, habit of female plants; c, transverse section through male plant. — After Meijer 105G.

with brown punctations. Involucres with long, irregularly shaped, run-cinate laciniae. Sporogonia several on each thallus; wall about 8 cells thick. Spores yellow, smooth, 20—30  $\mu$ . in diameter. Elaters dark-brown, long and narrow and composed of 3—1 cells, or shorter and of 1—2 cells. Male plants with numerous antheridial cavities, visible with the naked eye as

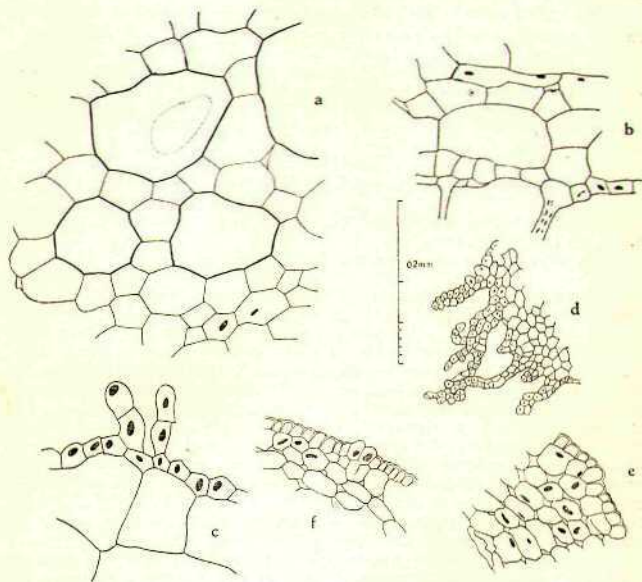


FIG. 4. *Anthoceros tjibodetixis* W, Meijer: n and 6, part of section through old thallus, showing mucilage cavities; ?, dorsal epidermis; d, outer part of section through involucre; e, transverse section through wall of sporogonium; f, epidermis of sporogonium, showing cross-section through stomatum. — After Meyer 1056.

orange spots; each cavity with 2—8 antheridia. Antheridia of the same type as those of *A. laevis*, large; body about 340  $\mu$  in length; wall with longitudinal rows of about 20 irregular cells.

ECOLOGY.—On rocky walls and steep earth-walls. In the mountains, at 700 and 1400—1500 m altitude.

DISTRIBUTION.—At present only known from Java.

Though I have not seen the type of *Anthoceros polyandrus* Steph., Stephani's description seems sufficiently detailed in this rare case, to enable one to recognize the living specimens: "planta dioica rupicola. Frons solida in facie minute aspera. Androecia numerosa, alveolis magnis tetrandris. Antheridia maxima . . ."

The rather narrow thallus cavities are easily overlooked. In former days this species was confused with *A. glandivosus* Lehm. & Lindenb.

SPECIMENS EXAMINED.—JAVA. Without exact locality. Herb. Dozy & Molkenb. (L). West Java. Bogor Res., "ad muros trachyticos juxta flumen Tjiapoës," 2000 ft., *Amann* (= *S. Kvrz*) 207 (L); Tjibodas, near Pantjuranmas, 1500 m, *van der Wijk* 1007 (BO), *Meijer* 1056 (BO), on steep wall near Tjibodas (river), 1400 m, *Meijer* 4063(BO).

### 3. ANTHOCEROS AMBOINENSIS Schiffner—Figs. 5, 8c

*Anthoceros amboinensis* Schiffn., Hep. Gazelle Exp. 45 pi. S. /s. 2-i, 25. 1890; Steph., Sp. Hep. 5: 967. 1916.

*Aspirimitus spinisporus* Steph., Sp. Hep. 5: 971. 1916, *syn. nov.*

Monoecious. Thalli in the form of oblong-suborbicular rosettes, simple or branched, maximal length 1.5 cm; main branches 0.5—1 cm broad; margins crenate with incisions of 0.5—1 mm; dorsal surface flat; chloroplasts with pyrenoids which are distinctly visible within the thin, flat plates of the chloroplast; cross-sections through thallus show translucent mucilage-cavities in 1—2 layers and a rather pronounced midrib, and that it is sharply acuminate toward the margins. Sporogonia 1 or 2 on each main branch. Elaters blackish, long, with narrow lumina and thick walls, sometimes branched, composed of 3—4 cells. Spores dark, 35—40  $\mu$  in diameter; outer face with large, translucent, conically acuminate spines; inner face finely papillose. Plants protandrous. Antheridia of the same type as those of *A. falsinervius*, about 25 in one alveole, formed one after another, but only half of them attaining maturity; stalks 1—2 cells long; cells of body in 3—4 tiers.

ECOLOGY.—A lowland species, growing along streams, on sides of ditches and on steep, shady slopes. From just above sea-level up to 200 m.

DISTRIBUTION.—Known from the Andaman Is., Krakatau Is., Java, Borneo, Amboina, and, according to Stephani (*I.e.*), also from New Guinea.

I have not seen the type specimen of this species. The peculiar conically mamillate spores, in combination with the characters of thallus and elaters also figured by Schiffner (*I.e.*), make it however easy to recognize.

The description given by Stephani (*I.e.*) is misleading as the thallus is according to him solid, that is, without cavities. Though Schiffner (*I.e.*) did not describe them, his figure 24 leaves no doubt about their occurrence.



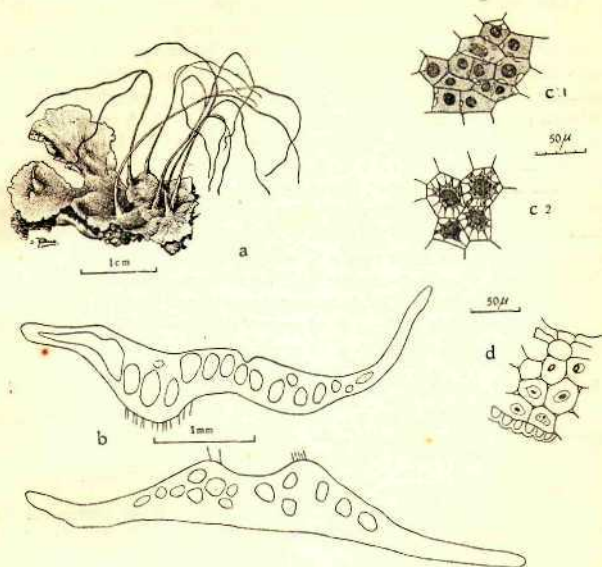


FIG. 5. *Anthoceros amboensis* Schiffn.: a, habit; b, transverse sections through thallus; c 1, young cells with chloroplasts; c 2, older cells with chloroplasts; d, transverse section through wall of sporogonium. — After Meijer 104.

SPECIMENS EXAMINED.—ANDAMAN IS. Port Monat, along ravines, Sept. 15, 1894, *Man s.n.*, Herb. Levier (isotype of *Aspiromitus spinispoms* Steph.; spores figured in Stephani's *Iconesj* (FH). — JAVA. West Java. Krakatau Is., Lang Eiland, 30 m, *Doctors van Leeuwe?i* 624 (BO); Bogor, 200 m, *Binnendijk s.n.* (det. Stephani as *Aspiromitus spinisporus* Steph.) (L), Hort. Bog., with *A. falsinervius*, *Meijer 104*, 3528 (BO), along Tjiliwung, *Meijer 364*, 559 (BO), along ditches in the town, *Meyer 2E2*, 364, 1144 (BO); Tjibinong to Tjiteureup, N of Bogor, *Meyer 356* (BO). — BORNEO. East Borneo. West Kutei, district Muaramuntai, at the base of Mt. Beratus (Peak of Balikpapan), along Tulus R., 100m, *Meijer 2842* (BO).

#### 4. ANTHOCEROS ARGILLACEUS (Stephani) Verdoorn

*Aspiromitus argillaceus* Steph., *Sp. Hep.* 5: 970. 1916. — *Anthoceros argillaceus* (Steph.) Verd. in *Ann. Bryol.* 5: 143. 1932.

*Aspiromitus buitnorgiux* Steph., *Sp. Hep.* 5: 971. 1916.

*Anthoceros weistii* Khanna in *Bot. Gaz.* 93: 103. 1932.

I have not seen living specimens of this species and therefore, refrain from giving a detailed description. This species seems to be closely related to *Anthoeros amboinensis*. The most reliable difference is found in the spores which are distinctly hispidly papillose. The type collection made by Schiffner in the Botanic Garden at Bogor, in 1894, was distributed by Verdoorn [Hep. sel. crit. Ser. 4: no. 198. 1932 (L, BO)]. A collection made at Bogor, Nyman s.n., anno 1897 (L) has been named *Anthoeros amboinensis* Schiffn. by Stephani. Another specimen collected by Schiffner (s.n.), also in the Botanic Garden at Bogor, in 1894, indicated as no. 50 (G) and also belonging to *Aspiromitus argillaceus* Steph., is the type of *Aspiromitus buitenzorgii* Steph.! I also studied *Anthoeros weistii* Khanna from Rangoon, distributed by Verdoorn [Hep. sel. crit. Ser. 9: no. 353. 1953 (L, BO)] and agree with Proskauer (*in Bull. Torrey bot. Cl. 78: 345. 1951*) that this species is identical with *Anthoeros argillaceus* (Steph.) Verd.

The species seems to have disappeared from the Botanic Gardens at Bogor: at least I did not succeed in rediscovering it.

#### 5. ANTHOCEROS FALSINERVIUS Lindenberg ex Meissner—Figs. 6, 7, 8d

*Anthoeros falsinervius* Lindenb. ex Meissn. in Bot. Zeit. 6: 463. 1848; Sande Lacoste, Syn. Hep. javan. 100. 1856. — *Aspiromitus falsinervius* (Lindenb.) ex Meissn.) Steph., Sp. Hep. 5: 968. 1916 ("*falsinervis*").

*Anthoceros falsinervius* var. *lyratus* Gottsche in Natuurk. Tydschr. Ned. Indië 4: 575. 1853; Sande Lacoste, Syn. Hep. javan. 100. 1856.

*Aspiromitus gracilis* Goebel in Ann. Jard. bot. Buitenz. 39: 61. 1928, not *Anthoceros gracilis* Reichardt 1866. — *Anthoceros Indonesians* Prosk. in Bull. Torrey bot. Cl. 78: 347. 1951 ("nom. nov.").

Monoecious. Thalli oblong, about 2.5—4 cm long, 0.5—1 cm broad; young thalli unbranched, regularly pinnately lobed; older thalli 1—2 times branched and with more irregularly dissected lobes; flat at dorsal side or with bulging mucilage-cavities and small lamellae, which are here and there crowned with papilla-like cells; margins of young parts thin, regularly crenate by cells containing relatively small chloroplasts; chloroplasts with pyrenoid not distinctly contrasted with the plate; on the ventral side of the mucilage-cavities a compact ground-tissue of 5—8 layers of cells, with small distinct intercellular cavities; rhizoids with light-brown punctations on inner side. Plants protandrous. Sporogonia single on thallus branches. Elaters dark-brown, with thick walls and narrow lumina, sometimes branched, most of them composed of 4 cells. Spores 25—35 $\mu$  in diameter, rather coarsely papillose. Antheridial cavities numerous, along the base of the side-lobes or in the median region, protruding above the dorsal surface; mouth on some places surrounded by papilla-like cells. Antheridia 4—20(—25) in each cavity, formed one after another, rather iong-stalked, with the cells of the body-wall in tiers; dimensions somewhat variable according to dimensions of plants.

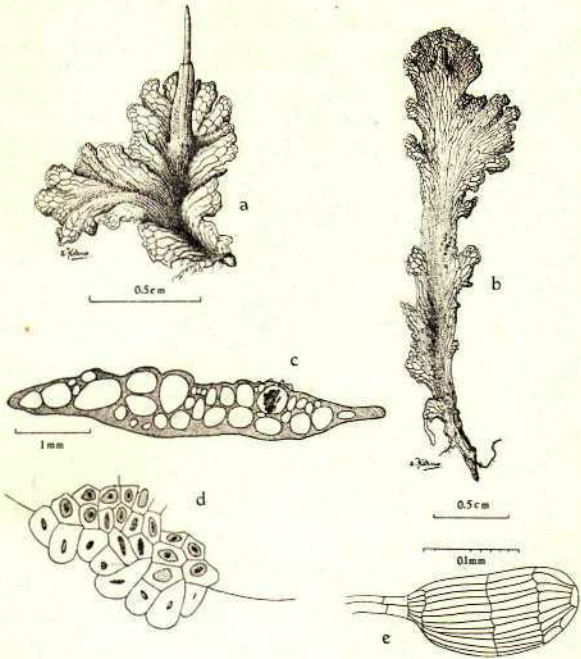


FIG. 6. *AnthoceroH falshiervius* Lindenb., robust form from Tjibodas and Tugu, Gede-Pangrango Mts.: *a* and *b*, habit; *c*, transverse section through thallus; *d*, proliferous cells on thallus-fold; *e*, antheridium. — After Meijer 267 (*a*, *b*), 258 (*c*, *d*), 257 (*e*).

**ECOLOGY.**—In the hilly lowland, on rather wet, shady places, on steep slopes, along rivers; in higher regions frequently in gardens, along forest roads, on sides of walls and ditches, on landslides, along brooklets, and near waterfalls, at 200—1700 m altitude.

**DISTRIBUTION.**—Java, Sumatra, and Borneo. Probably also frequent in Malaysia outside this region.

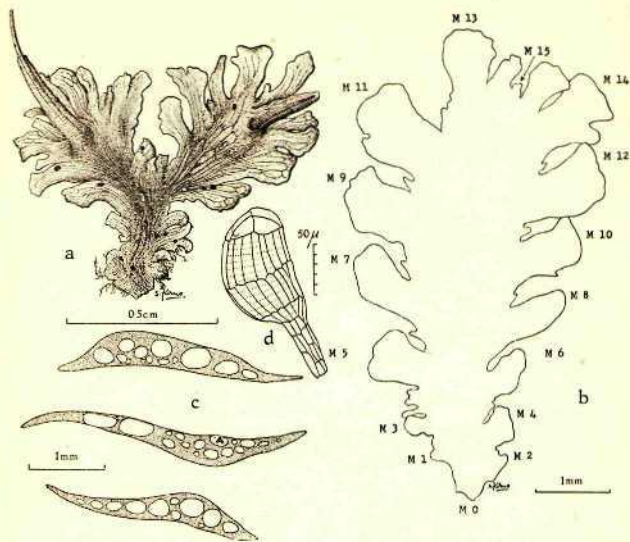


FIG. 7. *Anthoceros falsinervius* Lindenb., lowland form from Bogor: a, habit; b, outline of a regularly built thallus, showing the sequence of lobe formation and rudiments of vegetation points between the lobes; c, transverse section through thallus; d) antheridium. — After Meyer 371 (a), 103 (b-d).

This species is taken here in a wide sense. Locally different forms can be distinguished: a rather small, depauperate lowland form, a juvenile one (*Aspiromitus gracilis* Goebel); a robust form from wet places in the mountains, with thicker, thalli and larger antheridia (var. *lyratus* Gottsche); and a mountain form from drier places with bulging cavities and thallus-folds with papil-like cells. As far as I am able to state no sharp lines of demarcation can be drawn between these minor forms. Culture experiments with these forms became a failure owing to frequent infection with an *Anthoceros*-eating caterpillar, common in all localities.

Dr. Proskauer (in litt.) suggested to me that *Anthoceros fuciformis* Mont, from Réunion may also occur in Indonesia. His description and figures (Proskauer in Bull. Torrey bot. Cl. 80: 65—75. 1953) resemble

*A. falsinervis* to a high degree. Further comparative studies will have to decide whether the two species are identical.

SPECIMENS EXAMINED.—SUMATRA. West Coast. Mt. Marapi, W side, 1500 m, *van Borssum Waalkes 21S2b* (BO). — JAVA. Without exact locality. "Ad saxa in riv.," *Junghuhn s.n. = 1437HB* (BO). West Java. Bogor, Hort. Bog., 200 m, *Meijer 103A, 341* (BO), along Tjiliwung (river), *Meyer 371, 560* (BO); Puntjak, ridge to Mt. Telaga, 1550 m, *van Steenis 11273* (BO); Tugu, tea-estate "Guniing Mas," 1100 m, *Meijer 640—643* (BO), Djalan Mandalawangi above "Gunung Mas," 1200—1500 m,

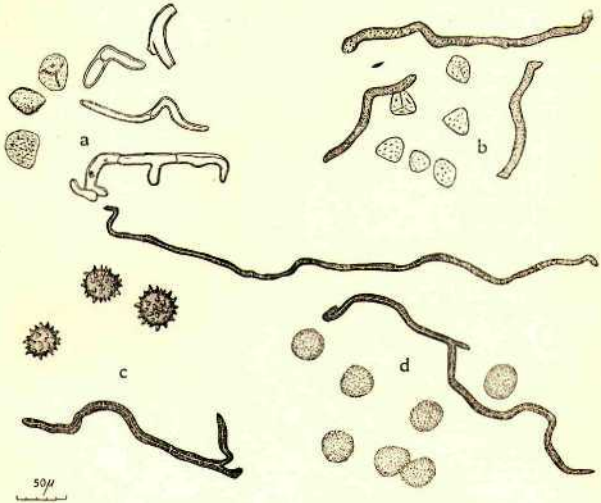


FIG. 8. Elaters and spores: a, *Anthoceros laevia* L. s.l.; ft, *A. tjobodnensis* W. Meyer; c, *A. amboinensis* Schiffn.; d, *A. falsinervis* Lindenb. — After Meijer 259 (a), 105f (b), 104 (c), 103 (d).

*Meyer 257, 25S, 267, 381., 640, 6A3,3404* (BO); Megamendung above Tjiguntur, 1200 m, *Verdoorn 6S, HB SOS5* (BO); Tjibodas, 1400—1700 m, *Meijer 128, 130, IL'SA, JOSS, 1084, 3424, 3181,3531* (BO). East Java. Mt. Someru, "ad saxo in rivulis Handing," *Zollinger 2810*, (type, L; mixed with *A. laevix* L. s.l., as correctly stated by Zollinger, *System. Verz.* 1: 18. 1854, but questioned by Schiffner, *Consp. Hep. Arch. ind.* 351. 1898; both species are often growing together in W. Java). — BORNEO. East Borneo. East Kutei, Muaramuntai district, Mt. Beratus (Peak of Balikpapan), 1100 m, under wet rockside, *Meijer 2224* (BO).