



## Notes on Early Land Plants Today. 70. Nomenclatural notes in hornworts (Anthocerotophyta)

JUAN CARLOS VILLARREAL<sup>1</sup>, D. CHRISTINE CARGILL<sup>2</sup>, LARS SÖDERSTRÖM<sup>3</sup>, ANDERS HAGBORG<sup>4</sup>,  
MATT VON KONRAT<sup>4</sup>

<sup>1</sup>Department of Biology, Ludwig-Maximilians-Universität, Menzinger Str. 67, D-80638, München, Germany; [jcarlos.villarreal@gmail.com](mailto:jcarlos.villarreal@gmail.com)

<sup>2</sup>Centre for Australian National Biodiversity Research, Australian National Herbarium, GPO Box 1600, Canberra, ACT 2601, Australia; [chris.cargill@environment.gov.au](mailto:chris.cargill@environment.gov.au)

<sup>3</sup>Department of Biology, Norwegian University of Science and Technology, N-7491 Trondheim, Norway; [lars.soderstrom@ntnu.no](mailto:lars.soderstrom@ntnu.no)

<sup>4</sup>Department of Science and Education, The Field Museum, 1400 South Lake Shore Drive, Chicago, IL 60605–2496, USA; [hagborg@pobox.com](mailto:hagborg@pobox.com), [mvonkonrat@fieldmuseum.org](mailto:mvonkonrat@fieldmuseum.org)

Prior to the publication of the world checklist of hornworts and liverworts (Söderström *et al.*, in press) some taxa still need to be validated, transferred or synonymized. We are here dealing with the remaining nomenclatural issues among the Anthocerotophyta. Several taxa have not been typified properly and we are here suggesting several new lectotypes to stabilize the nomenclature.

The format of the note follows Söderström *et al.* (2012).

### Anthocerotaceae

*Anthoceros cristatus* Steph., *Sp. Hepat.* [Stephani] 5: 996, 1916 (Stephani 1916). Type:—ASCENSION. *Herb. Beschereille, pores from holotype Stephani herb. no. 24501* (G-00045042! [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=141014&lang=en>]), lectotype **here designated** [or possibly holotype, *cf.* McNeill 2014]) Fig. 1A.

*Anthoceros expansus* (Steph.) J.C.Villarreal et Cargill, **comb. nov.** Basionym:—*Aspiromitus expansus* Steph., *Sp. Hepat.* [Stephani] 5: 961, 1916 (Stephani 1916). Type:—CAMEROON. South-West: Buea, 24 September 1891, *Preuss 989, Stephani herb. no. 20510* (G-00045055! [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=141040&lang=en>]), lectotype **here designated** [or possibly holotype].

*Anthoceros myriandroecius* Steph., *Wiss. Ergebn. Deut. Zentr.-Afr. Exped. (1907-08), Bot.* 2: 134 (Stephani 1911 [1910]). Type:—RWANDA. Kiwu lake, *Exped. Fr. Mildbraed 808* (G-00128028! [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=133358&lang=en>]), lectotype **here designated** [or possibly holotype]. Note:—The specimen was used by Stephani for his illustrated *icones inedit* and it was annotated by Hasegawa in 1993 as “type” but it seems that he did not publish it.

= *Anthoceros volkensii* Steph., *Sp. Hepat.* [Stephani] 5: 997, 1916 (Stephani 1916), **syn. nov.** Type:—TANZANIA. Kilimanjaro, 17.12.1893, *Volkens 1504* (G-00045053! [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=141027&lang=en>]), lectotype **here designated** [or possibly holotype]. Note:—The specimen is annotated by Hasegawa in 1993 as “type” (but it appears that he did not publish it) and conspecific with *Anthoceros myriandroecius*.

*Anthoceros punctatus* L., *Sp. Pl.* 1: 1139 (Linnaeus 1753). Type:—Herb. Dillen., Oxford, *Anthoceros minor*, in den oberen Ecken des Blättchens. *Hist. musc.* (1741) Tab. 68, Fig. 1. (lectotype designated by Proskauer 1958)

= *Aspiromitus dismieri* Steph., *Sp. Hepat.* [Stephani] 5: 961, 1916 (Stephani 1916), **syn. nov.** Type:—MADAGASCAR. s. loc. spec., *Spores from holotype, Rotereau s.n., Stephanie herb. no.00045054* [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=141039&lang=en>]), lectotype **here designated** [or possibly holotype]) Fig. 1B. Note:—The type specimen also includes an un-named *Phaeoceros* species which Hasegawa annotated in 1995.

*Anthoceros subtilis* Steph., *Sp. Hepat.* [Stephani] 5: 1003, 1916 (Stephani 1916). Type:—INDIA. Karnataka: Mangalore, R. Pfeleiderer 12923, *Stephani herb. no. 12823* (G-00060882 [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=115887&lang=en>] lectotype designated by Asthana & Srivastava 1991: 54).  
 = *Anthoceros chevalieri* Steph., *Spec. Hepat.* [Stephani] 6: 425, 1923 (Stephani 1923), **syn. nov.** Type:—CENTRAL AFRICAN REPUBLIC. Ubangi, 1902, *Chevalier 43* (G-00128024! [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=133363&lang=en>], lectotype **here designated** [or possibly holotype]).

*Folioceros argillaceus* (Steph.) J.C.Villarreal et Cargill, comb. nov. Basionym:—*Aspiromitus argillaceus* Steph., *Sp. Hepat.* [Stephani] 5: 970, 1916 (Stephani 1916). Type:—INDONESIA. Java: Bogor (“Buitenzorg”), February 1894, *Schiffner s.n.*, *Stephani herb. no. 20494* (G-00061272, lectotype **here designated**; G-00061271 [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=130334&lang=en>], G-0061270, JE-04000311, isolectotypes). ≡ *Anthoceros argillaceus* (Steph.) Verd., *Ann. Bryol.* 5: 143, 1932 (Verdoorn 1932).

*Folioceros dilatatus* (Steph.) J.C.Villarreal et Cargill, comb. nov. Basionym:—*Anthoceros dilatatus* Steph., *Bot. Jahrb. Syst.* 8: 95, 1886 (Stephani 1886). Type:—EQUATORIAL GUINEA. Bioko (Fernando Pó): s. loc., May 1885, *Mönkemeyer 15*, *Stephani herb. no. 20500* (G-00128025! [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=133424&lang=en>]), lectotype **here designated** [or possibly holotype]). Note:—The selected lectotype was annotated by J. Hasegawa in 1993 as belonging to *Anthoceros* subg. *Folioceros*.

*Folioceros fuciformis* (Mont.) D.C.Bharadwaj, *Geophytology* 5: 227, 1975 (Bharadwaj 1975). Basionym:—*Anthoceros fuciformis* Mont., *Ann. Sci. Nat. Bot. (ser. 2)* 20: 296, 1844 [1843] (Montagne 1844). Type:—RÉUNION. “Bourbon”, 1837, *Gaudichaud s.n.* (PC-0032647, lectotype selected by Piippo 1993: 36; G-00115646, isolectotype).

= *Aspiromitus hildebrandtii* Steph., *Sp. Hepat.* [Stephani] 5: 961, 1916 (Stephani 1916), **syn. nov.** Type:—MADAGASCAR. Tananarivo, *Hildebrandt s.n.* (G-00045056! [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=141041&lang=en>]), lectotype **here designated**; G-00120707 [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=163184&lang=en>], PC-0101754, [<http://science.mnhn.fr/institution/mnhn/collection/pc/item/pc0101754>], isolectotypes)

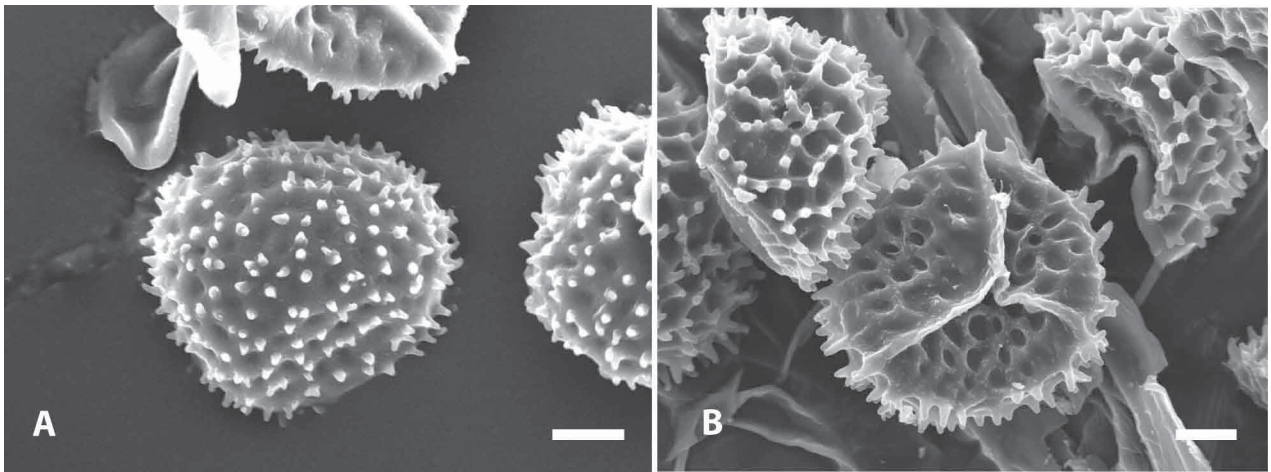


FIGURE 1. Spores of *Anthoceros cristatus*. (A) Spores from holotype Stephani herb. no. 24501 (G-00045042) and *Aspiromitus dismieri* (B). Scale bar is 10 µm. Spores from holotype, Rotereau s.n., Stephanie herb. no. 00045054

## Dendrocerotaceae

*Dendroceros breutelii* Nees, *Syn. Hepat.* 4: 581, 1846 (Gottsche *et al.* 1846). Type:—ST. KITTS. *Breutel s.n.* (G-00115617!). Note:—We do not lectotypify this name as we do not know if any material exists in STR.

= *Dendroceros macrosporus* Steph., *Spec. Hepat.* [Stephani] 5:1014, 1917 (Stephani 1917), **syn. nov.** Type:—BRAZIL. São Paulo: Rio Grande, ad São Paulo Railway, 7 June 1901, *Schiffner 700*, *Stephani herb. no. 24035* (G-00067711! lectotype **here designated** [or possibly holotype]).

= *Dendroceros angustifrons* Steph., *Spec. Hepat.* [Stephani] 5:1016, 1917 (Stephani 1917), **syn. nov.** Type:—

- BRAZIL. São Paulo: “in sylvaticis ad Rio Mambu in districtis urbis Concecao de Itanhaen”, 30 June 1901, *Schiffner 726, Stephani herb. no. 24025* (G-00060906! [http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=115857&lang=en], lectotype **here designated** [or possibly holotype]).
- = *Dendroceros schiffneri* Steph., *Spec. Hepat. [Stephani]* 5: 1017, 1917 (Stephani 1917), **syn. nov.** Type:—BRAZIL. São Paulo: “ad flumen Rio Branco prope Santos”, 13 September 1901, *Schiffner 2147, Stephani herb. no. 24037* (G-00067709! [http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=127941&lang=en], lectotype **here designated** [or possibly holotype]).
- = *Dendroceros ecuadoriensis* Steph., *Spec. Hepat. [Stephani]* 6: 429, 1923 (Stephani 1923), **syn. nov.** Type:—ECUADOR. Gualaquiza, “Llionis salesianum”, 1908, *Allioni 6511* (G-00060904, lectotype **here designated**), *Allioni 6510* (G-00060903, lectosynotype). Note:—The lectotype was annotated as “lectotypus nov.” by Hasegawa in 1995 but we are unable to find any publication of it.
- Dendroceros crispus*** (Sw.) Nees, *Syn. Hepat.* 4: 581, 1846 (Gottsche *et al.* 1846). Basionym:—*Anthoceros crispus* Sw., *Prodr. [O.P.Swartz]*: 146, 1788 (Swartz 1788). Type:—JAMAICA. *Swartz s.n.* (S-B20564 [http://andor.nrm.se/fmi/xsl/kryptos/kbo/publDetailitems.xml?-lay=webbkollekter&-token.nav=items&-db=kbo\_mossregister&-recid=20141&-find=-find&-token.post=all&-token.languagecode=en-GB], lectotype selected by Proskauer 1960).
- = *Dendroceros foliatus* Spruce, *Trans. & Proc. Bot. Soc. Edinburgh* 15: 574, 1885 (Spruce 1885). Type:—ECUADOR. Canelos, Cuesta de Mapoto, *Spruce s.n.* (E-00002013! [http://elmer.rbge.org.uk/bgbase/vherb/bgbasevherb.php?current\_names\_family=&current\_names\_genus=Dendroceros&current\_names\_species=foliatus&coll\_name=&coll\_num=&specimens\_barcode=&full\_name=&specimens\_region=&cfg=bgbase%2Fvherb%2Fbgbasevherb.cfg], lectotype **here designated**; NY, isolectotype).
- Dendroceros javanicus*** (Nees) Nees, *Syn. Hepat.* 4: 582, 1846 (Gottsche *et al.* 1846). Basionym:—*Anthoceros javanicus* Nees, *Enum. Pl. Crypt. Javae*: 1, 1830 (Nees 1830). Type:—INDONESIA. Java: *hb. Nees* (G-00115610, E-00002014, isotypes). Note:—Proskauer named the E specimen as isotype in 1964 (possibly also the specimen in G).
- = *Dendroceros fenestratus* Ångstr., *Öfvers. Kongl. Vetensk.-Akad. Förh.* 33(4): 53, 1876 (Ångström 1876), **syn. nov.** Type:—TAHITI. 1852, *N. J. Andersson s.n.* (S-B22419, B22420, isotypes).
- Nothoceros vincentianus*** (Lehm.) J.C.Villarreal, *Bryologist* 113 (1): 111, 2010 (Villarreal *et al.* 2010). Basionym:—*Anthoceros vincentianus* Lehm., *Nov. Stirp. Pug.* 6: 16, 1834 (Lehmann 1834). Type:—ST. VINCENT. *Rev. Guilding s.n.* (S-B20587!), lectotype selected by Proskauer 1957: 134; W!, NY!, isolectotypes).
- = *Megaceros columbianus* Steph., *Spec. Hepat. [Stephani]* 5: 950, 1916 (Stephani 1916) **syn. nov.** Type:—COLOMBIA. *Karsten XXXV, herb. Schiffner, Stephani herb. no. 24042* (G-00112634! [http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=142898&lang=en], lectotype **here designated** [or possibly holotype]).
- = *Megaceros jamaicensis* Steph., *Spec. Hepat. [Stephani]* 6: 424, 1923 (Stephani 1923) **syn. nov.** Type:—JAMAICA. *Börgeesen s.n.* (G-00112670! [http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=142899&lang=en], lectotype **here designated** [or possibly holotype]).

## Notothyldaceae

- Paraphymatoceros pearsonii*** (Howe) J.C.Villarreal et Cargill, **comb. nov.** Basionym:—*Anthoceros pearsonii* Howe, *Bull. Torrey Bot. Club* 25 (1): 8, 1898 (Howe 1898). Type:—USA. California: Marin Co., Mill Valley, 7 May 1892, *M.A.Howe 16* (NY-253464! lectotype selected by Hässel 1989; G-00115627, isolectotype). ≡ *Phaeoceros pearsonii* (Howe) Prosk., *Bull. Torrey Bot. Club.* 78 (4): 347, 1951 (Proskauer 1951).
- Paraphymatoceros proskaueri*** (Stotler, Crand.-Stotl. et W.T.Doyle) J.C.Villarreal et Cargill, **comb. nov.** Basionym:—*Phaeoceros proskaueri* Stotler, Crand.-Stotl. et W.T.Doyle, *Fieldiana, Bot. (n. ser.)* 47: 232 (Crandall-Stotler *et al.* 2008). Type:—USA. California: Monterey Co., Barloy Canyon Road, Native Plant Reserve, 14 April 2005, *Doyle 11350* (UC, holotype; ABSH, BA, BM, FH, G, MANCH, NY, W, isotypes)

- Phaeoceros carolinianus*** (Michx.) Prosk., *Bull. Torrey Bot. Club* 78(4): 347, 1951 (Proskauer 1951). Basionym:—*Anthoceros carolinianus* Michx., *Fl. Bor.-Amer. (Michaux)* 2: 280, 1803 (Michaux 1803). Type:—USA. South Carolina: “in humidis Carolinae inferioris” (PC, lectotype selected by Hässel 1987)  
 = *Anthoceros callistictus* Spruce, *Trans. & Proc. Bot. Soc. Edinburgh* 15: 576, 1885 (Spruce 1885). **syn. nov.** Type:—BRAZIL. Fl. Bombonasa, *Spruce s.n.* (NY-00364001!, [http://sweetgum.nybg.org/vh/specimen.php?irn=192134]), lectotype **here designated** [or possibly holotype].  
 = *Anthoceros tenuissimus* Steph., *Hedwigia* 32(3): 145, 1893 (Stephani 1893), **syn. nov.** Type:—ANGOLA. Lubango: Chella Mt., March 1883, *F. Newton s.n.* (G-00045052! [http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=141024&lang=en], lectotype **here designated** [or possibly holotype])
- Phaeoceros tigrinus*** (Gola) J.C.Villarreal, **comb. nov.** Basionym:—*Anthoceros tigrinus* Gola, *Ann. Bot. (Rome)* 13: 72, 1914 (Gola 1914). Type:—ETHIOPIA. Amhara: Debarek, 1 November 1909, *Chiovenda 2981* (FT, holotype).

## Acknowledgement

The Early Land Plants Today project (ELPT) has been generously supported in part by the Global Biological Information Facility (GBIF) Seed Money Award No.2007-41, activities facilitated in part by funding from the Biodiversity Synthesis Center of the Encyclopedia of Life (BioSynC), partial funding from the National Science Foundation (Award No’s 0749762, 1115002), the Warwick Foundation, and the Negaunee Foundation.

## References

- Ångström, J. (1876) Rättelser och tillägg till förteckning 1851-53. *Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar* 33 (4): 50–55.
- Asthana, A.K. & Srivastava, S.C. (1991) Indian hornworts (a taxonomic study). *Bryophytorum Bibliotheca* 42: 1–159.
- Bharadwaj, D.C. (1975) Validation of some new combinations under *Folioceros* Bharadwaj. *Geophytology* 5 (2): 227–228.
- Crandall-Stotler, B.J., Stotler, R.E., Doyle, W.T. & Forrest, L.L. (2008) *Phaeoceros proskaueri* sp. nov., a new species of the *Phaeoceros hallii* (Austin) Prosk. – *Phaeoceros pearsonii* (M. Howe) Prosk. complex and the systematic affinities of *Paraphymatoceros* Hässel. *Fieldiana: Botany (n.ser.)* 47: 213–238.  
<http://dx.doi.org/10.3158/0015-0746-47.1.213>
- Gola, G. (1914) Epatiche dell’Abissinia. *Annali di Botanica. Roma* 13: 59–75.
- Gottsche, C.M., Lindenberg, J.B.G. & Nees von Esenbeck, S.G. (1846) *Synopsis Hepaticarum, fasc. 4*. Meissner, Hamburg, pp. 465–624.  
<http://dx.doi.org/10.5962/bhl.title.15221>
- Hässel, G.G. (1987) *Phaeoceros laevis* (L.) Prosk. and *P. carolinianus* (Michx.) Prosk., their spores. *Journal of the Hattori Botanical Laboratory* 62: 281–288.
- Hässel, G.G. (1989) Las especies de *Phaeoceros* (Anthocerotophyta) de América del Norte, Sud y Central; la ornamentación de sus esporas y taxonomía. *Candollea* 44 (2): 715–739.
- Howe, M.A. (1898) The Anthocerotaceae of North America. *Bulletin of the Torrey Botanical Club* 25 (4): 1–24.
- Lehmann, J.G.C. (1834) *Novarum et minus cognitarum stirpium pugillus sextus*. Meissner, Hamburg, 72 pp.
- Linnaeus, C. (1753) *Species Plantarum, ed. 1*. Laurentii Salvii, Holmiae [Stockholm], 1200 pp.
- McNeill, J. (2014) Holotype specimens and type citations: General issues. *Taxon* 63 (5): 1112–1113.  
<http://dx.doi.org/10.12705/635.7>
- Michaux, A. (1803) *Flora Boreali-Americana, sistens characteres plantarum quas in America septentrionali collegit et detexit, tomus secundus*. Caroli Crapelet, Paris, 340 pp.
- Montagne, J.F.C. (1844) Quatrième centurie de plantes cellulaires exotiques nouvelles. Décade VII. *Annales des Sciences Naturelles; Botanique (sér. 2)* 20: 294–306.
- Nees, C.G. (1830) *Enumeratio plantarum cryptogamicarum Javae et insularum adiacentium*. Grass, Barth & Co., Breslau, 86 pp.
- Piippo, S. (1993) Bryophyte flora of the Huon Peninsula, Papua New Guinea. LIV. Anthocerotophyta. *Acta Botanica Fennica* 148: 27–51.
- Proskauer, J. (1951) Studies on Anthocerotales. III. *Bulletin of the Torrey Botanical Club* 78 (4): 331–349.

- Proskauer, J. (1957) Studies on the morphology of *Anthoceros* V. *Phytomorphology* 7: 113–135.
- Proskauer, J. (1958) Nachtrag zur Familie Anthocerotaceae. In: *Die Lebermoose Europas (Dr. L. Rabenhorst's Kryptogamen-Flora von Deutschland, Österreich und der Schweiz, 3 Aufl., 6 Band), 2 Abth., 9 Lieferung*. Akademische Verlagsgesellschaft: Leipzig, pp. 1303–1319.
- Proskauer, J. (1960) Studies on Anthocerotales VI. *Phytomorphology* 10: 1–19.
- Söderström, L., Hagborg, A., von Konrat M., Bartholomew-Began, S., Bell, D., Briscoe, L., Brown, E., Cargill, D.C., Costa, D.P., Crandall-Stotler, B.J., Cooper, E.D., Dauphin, G., Engel, J.J., Feldberg, K., Glenny, D., Gradstein, S.R., He, X., Ilkiu-Borges, A.L., Heinrichs, J., Hentschel, J., Katagiri, T., Konstantinova, N.A., Larraín, J., Long, D.G., Nebel, M., Pócs, T., Puche, F., Reiner-Drehwald, M.E., Renner, M.A.M., Sass-Gyarmati, A., Schäfer-Verwimp, A., Segarra Moragues, J.G., Stotler, R.E., Sukkharak, P., Thiers, B.M., Uribe, J., Váña, J., Villarreal, J.C., Wigginton, M., Zhang, L. & Zhu, R.-L. World checklist of hornworts and liverworts. *PhytoKeys* (in press).
- Söderström, L., Hagborg, A. & von Konrat, M. (2012) Notes on Early Land Plants Today. *Phytotaxa* 65: 41–42.
- Spruce, R. (1885) Hepaticae Amazonicae et Andinae. II. *Transactions and Proceedings of the Botanical Society of Edinburgh* 15: 309–588.
- Stephani, F. (1886) Hepaticae africanae. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 8 (2): 79–95.
- Stephani, F. (1893) Hepaticarum species novae. Pars II. *Hedwigia* 32 (3): 137–147.
- Stephani, F. (1911) Hepaticae. In: Stephani, F. (Ed.) *Wissenschaftliche Ergebnisse der Deutschen Zentral-Afrika-Expedition, 1907-1908. Band II: Botanik, Lief. 2*. Klinkhart & Biermann: Leipzig, pp. 111–134.  
<http://dx.doi.org/10.5962/bhl.title.7048>
- Stephani, F. (1916) *Species Hepaticarum* 5. George & Cie, Genève & Bale, pp. 833–1008.
- Stephani, F. (1917) *Species Hepaticarum* 5. George & Cie, Genève & Bale, pp. 1009–1044.
- Stephani, F. (1923) *Species Hepaticarum* 6. George & Cie, Genève & Bale, pp. 369–432.
- Swartz, O. (1788) *Nova genera et species plantarum, seu Prodrum descriptionum vegetabilium maximum partem incognitorum quae sub itinere in Indiam occidentalem annis 1783–1787*. Bibliopolio. I.G. Mülleriano, Lipsiae [Leipzig], 152 pp.
- Verdoorn, F. (1932) Hepaticae selectae et criticae, series III et IV (1932). *Annales Bryologici* 5: 125–144.
- Villarreal, J.C., Goffinet, B., Duff, R.J. & Cargill, D.C. (2010) Phylogenetic delineation of *Nothoceros* and *Megaceros* (Dendrocerotaceae). *Bryologist* 113 (1): 106–113.  
<http://dx.doi.org/10.1639/0007-2745-113.1.106>