

Re-evaluation of the taxonomic status of *Frullania caulisequa* and *Frullania obcordata* (Frullaniaceae, Marchantiophyta)

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Abstract: Winter, G. & Schäfer-Verwimp, A. (2020): Re-evaluation of the taxonomic status of *Frullania caulisequa* and *Frullania obcordata* (Frullaniaceae, Marchantiophyta). *Frahmia* 19:1-21.

Jungermannia obcordata LEHM. & LINDENB. was published 1834 by LEHMANN and transferred to *Frullania* in Synopsis Hepaticarum 1845. YUZAWA (1988) transferred 4 species as synonyms sub *Frullania caulisequa* (NEES) MONT., among them *Frullania obcordata* (LEHM. & LINDENB.) LEHM. & LINDENB. probably without having seen the type of *Frullania caulisequa*. The examinations of the types of *Frullania obcordata* (hb GLM) and *Frullania caulisequa* (hb STR) clearly proved both to be different. All specimens named since 1988 probably belong to *Frullania obcordata*, not to *Frullania caulisequa* and have to be re-checked. New synonyms of both species are provided and all synonyms known to us are listed. The lobuli of *Frullania caulisequa* indicate that it is close to *Frullania curvilobula* SCHÄF.-VERW., D.F.PERALTA & S.M.SIQUEIRA. For *F. caulisequa* and allied species (“*Diastaloba* IV”) the new subgenus *Caulisequa* is proposed.

Key words: *Diastaloba*, liverworts, taxonomy, new synonyms, new subgenus

1. History of *Frullania caulisequa* (NEES) MONT. 1839

Jungermannia caulisequa NEES was published 1833 in NEES (1833) as “auricula cylindrica vel interdum subclavata, incurva, obtusa, a caule remotiuscula, denudata, in foliis caulinis diametro folii transversali dimidid subaequalis vel paullo longior, in ramulorum foliis latitudinem folii saepe aequans vel parum brevior, basi obsolete unidentata, cava.” and depicted in Martius (1828-1834), *Icones plantarum cryptogamicarum* [...] Brasiliam (p. 33-34, pI. 17, figs. 1-14) and noted “auriculis cylindricis incurvis divergentibus denudatis in ramulis majoribus” - “Auriculae duae separatae, magis auctae”.

MONTAGNE (1839:51) transferred *Jungermannia caulisequa* to *Frullania*. GOTTSCHKE, LINDENBERG & NEES (1845:448), mentioned as a differentiating feature “Auriculis denudatis elongatis teretibus subfalcatis haec species a reliquis facili negotio distinguitur”. There is a drawing of GOTTSCHKE mentioned „81. *Frullania caulisequa* N. ab E. [...] Gottsche Icon. *Frullan.* inedit.”. Unfortunately most of the original drawings and the liverwort herbarium of GOTTSCHKE housed at the Botanical Museum Berlin were destroyed in a bombing night in 1943 (FRAHM [2002]). Only some survived. His illustrations of the mosses are now at the library of the Herbarium Hamburgense (HBG) and very few illustrations of Madagascan *Frullania*-species and some other counties which were on loan to FRANS VERDOORN are now in Geneva (G).



Figure 1 - *Jungermannia caulisequa* from MARTIUS 1828-1834, tab XVII, fig. 1

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HEPATICAЕ. II. JUNGERMANNIA.

Crescit in Minarum districtu adamantino, cauli Jungermanniae diffusae Swartzii secundum longitudinem arcte adhaerens. 2.

Tab. XVII. Fig. I. 1. Plantula magnitudine naturali. 2. Pars plantae a dorso, magn. aucta. 3. Particula caulis, cum foliis, auriculis et amphigastriis, a latere ventrali visa, auctior. 4. Folium seorsim in particula caulis, cum auricula pariter auctum. 5. 6. Auriculae duae separatae, magis auctae. 7. Caulis pars cum stipula. 8. Ramulus fructifer, auctus. 9. Calyx de hoc ramulo resectus, cum foliis perichaetialibus a parte dorsali, magis auctus. 10. Idem magis auctus, cum foliis perichaetialibus a parte ventrali. 11. 12. Folia duo perichaetialia. 13. Sporocarpium apertum in setae apice, valde auctum et 14. Elater magis magisque auctus.

Figure 2 - *Jungermannia caulisequa* from MARTIUS 1828-1834: 34

Fortunately, VICTOR FELIX SCHIFFNER (1862-1944) had access to GOTTSCHES drawings and made copies of these. Among them there is a black and white copy of GOTTSCHES drawing of *Frullania caulisequa* (Figure 3). [Private collection of R.S. GRADSTEIN, now in Geneva (G)].

Thus historical images can make an important contribution to the descriptions of the species.

STEPHANI (1911:638) listed *Frullania compsotera* SPRUCE as synonym of *Frullania caulisequa* with “Lobulus longissimus, anguste clavatus, quintuplo longior quam latus, leviter curvatus, a caule valde remotus, oblique patens”. He must have seen the copy of SCHIFFNER as in his *Icones Hepaticarum* Nr. 3260 (fig. Figure 4) there is a small insertion of SCHIFFNER's copy. STEPHANI Nr. 3260 depicts “*Frullania caulisequa* (Nees), syn: *Frull compsotera* SPRUCE, Campana, leg. SPRUCE”. This led to great confusion in later times.

CLARK (1955: 201) provided the following detailed description of *Frullania caulisequa*: “Ventral lobes of stem leaves all saccate and wholly so, about stem-width from stem, leaning at about 45°, slightly curved, extending slightly below ventral margin of dorsal lobe, 420-500 μ long and 36-56 μ wide, 5-14 times as long as wide, transverse marginal walls on outer side near mouth slightly projecting, mouth truncate.”

The image (Figure 5) was drawn by R. MOORE from a specimen collected in Brazil, Rio de Janeiro by Auguste F.M. GLAZIOU (1828-1906), who collected in Brasil (1861-1895) (GLAZIOU 7209, undated).

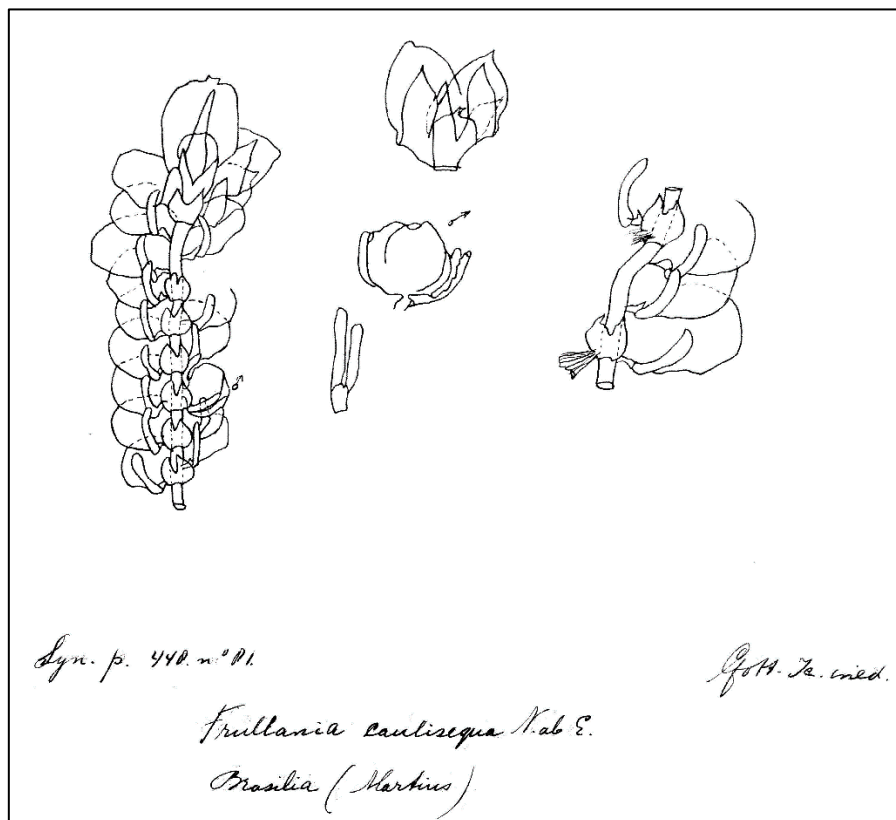


Figure 3 - *Frullania caulisequa*, copy of „Gott. Jc. Ined.“ by SCHIFFNER

CLARK reports that only of 4 of 20 packets he examined contained *Frullania caulisequa*, all other *Frullania hypoleuca*. “Our material examined agrees with the description by STEPHANI (Sp. Hep. 4: 638. 1911). *F. caulisequa* differs from *F. hypoleuca* in that the former has a stylus 1/6-1/10 as long as the ventral leaf lobe and a ventral leaf lobe 420-500 μ long, while the latter has a stylus about 1/3 as long as the ventral leaf lobe and a ventral leaf lobe 200-300 μ long.”

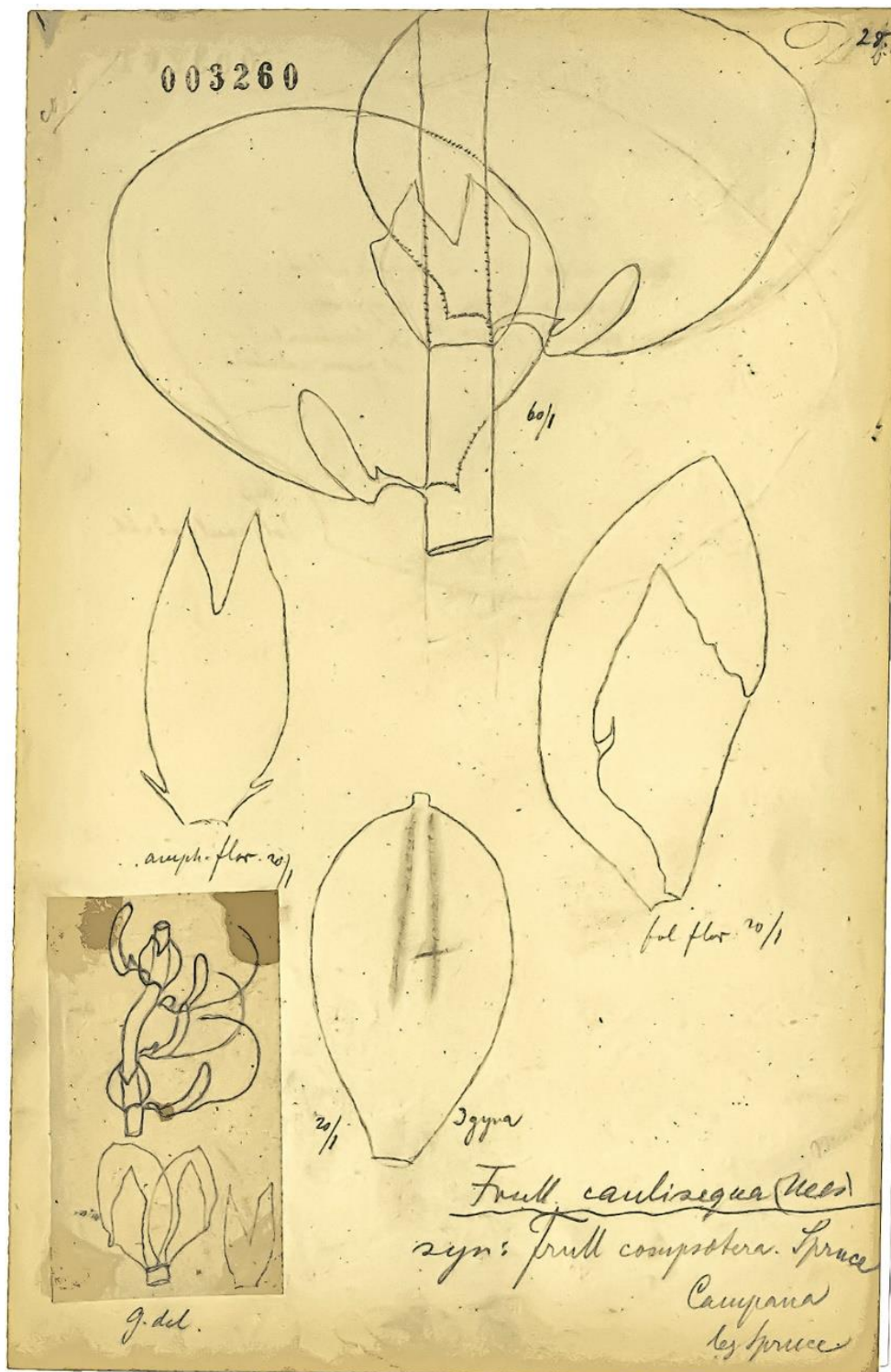


Figure 4 - STEPHANI 1985, Icones Hepaticarum Nr. 3260 from hb G

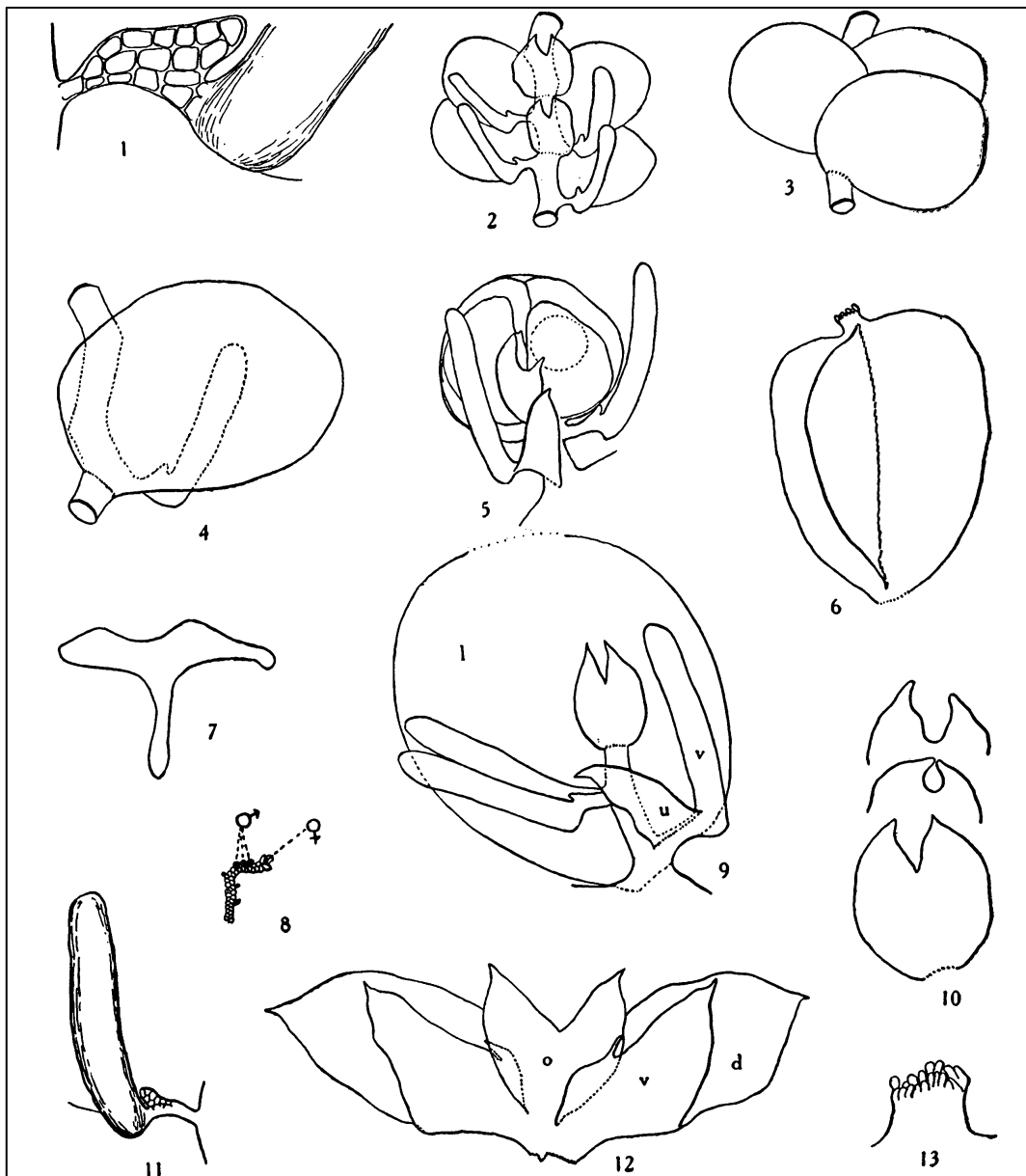


Figure 5 - *Frullania caulisequa* from CLARK (1955:202, fig. 1-13)

YUZAWA (1988:442 – 449) transferred several species as synonyms to *Frullania caulisequa*: *Frullania galapagona* AONGSTR., *Frullania obcordata*, *Frullania pabstiana* STEPH., *Frullania miradorensis* STEPH. and depicted a drawing of the type of *Frullania obcordata* from a specimen in G as *Frullania caulisequa*. (see Figure 6).

YUZAWA did not check the type of *Frullania caulisequa* and unfortunately he was misled by the drawing of STEPHANI. "GOTTSCHKE illustrated this species in his *Icones* (unpublished). His illustration (Figure 6) shows *F. caulisequa* is a highly variable taxon. I have examined many specimens of *F. caulisequa* from Latin America, [.]. I consider not only the type specimen of *F.*

obcordata but the specimen illustrated by GOTTSCHKE to be merely a form of *F. caulisequa*.” (YUZAWA [1988: 444-445]).

It obviously led to the confusion about the species resulting in a situation that all specimens named *Frullania caulisequa* after 1988 should be re-checked, as *Frullania caulisequa* seems to be very rare species.

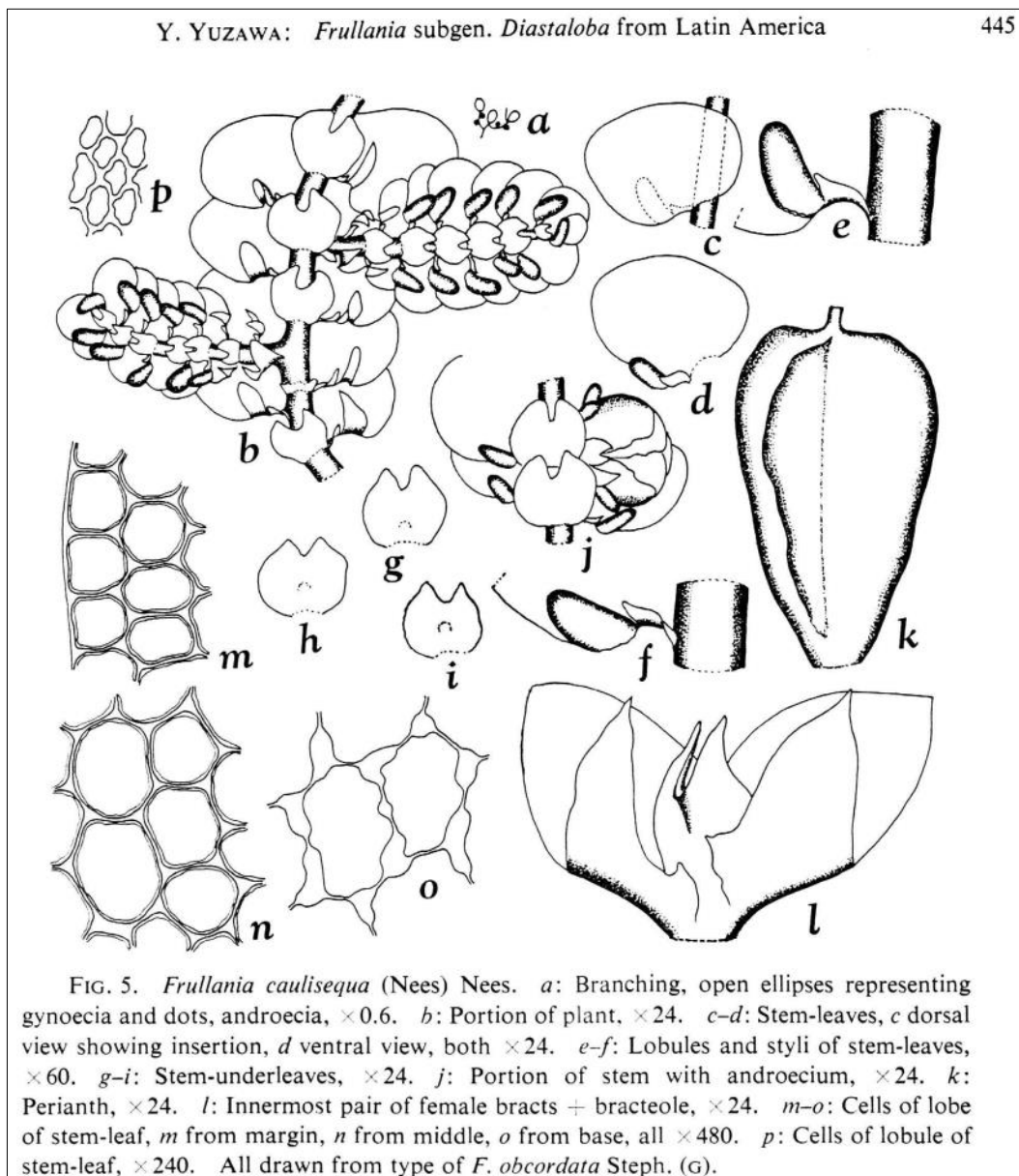


Figure 6 – Drawing of the type of *F. obcordata* STEPH. in G. (YUZAWA 1988:445, fig. 5, as “*Frullania caulisequa*”)

2. Lectotype of *Frullania caulisequa* (NEES) MONT. 1839

Among the specimens of NEES in the herbarium at Straßbourg (STR) there are 5 specimens under NEES Nr. 81 *Frullania caulisequa*. GOTTSCHÉ had checked all specimens and made pencil notes on the capsules (handwriting confirmed by R.S. GRADSTEIN).

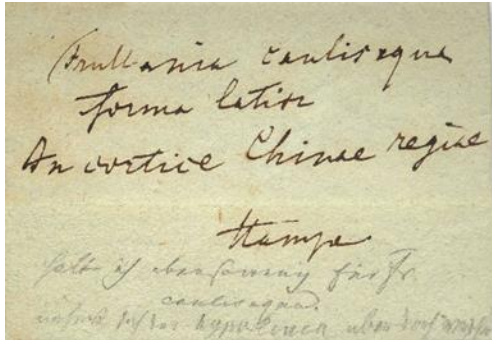


Figure 7 – NEES Nr. 81a: "*Frullania caulisequa*, forma latior An cortice Chinae regiae, Hampe" Annot. GOTTSCHÉ: "I don't think its *Fr. caulisequa*, approaches rather more *hypoleuca*" [translated]

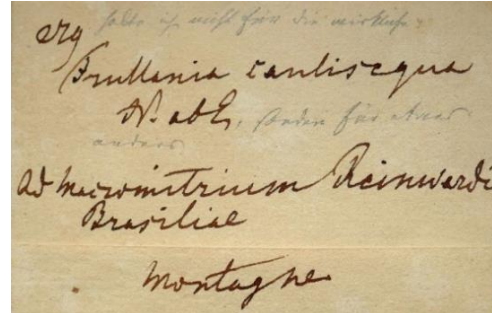


Figure 8 – NEES Nr. 81b "*Frullania caulisequa* N. ab E., Ad *Macromitrium Reinwardi*, Brasiliae, Montagne" Annot. GOTTSCHÉ: "I don't think it's a real [*Frullania caulisequa*] but something else" [translated]

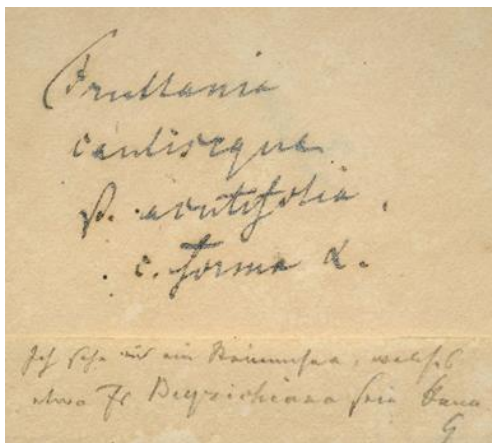


Figure 9 – NEES Nr. 81c: "*Frullania caulisequa*, fo. *acutifolia*, c. forma α ". Annot. GOTTSCHÉ: "I only see a little stem, which could also be *Fr. Beyrichiana*" [translated]

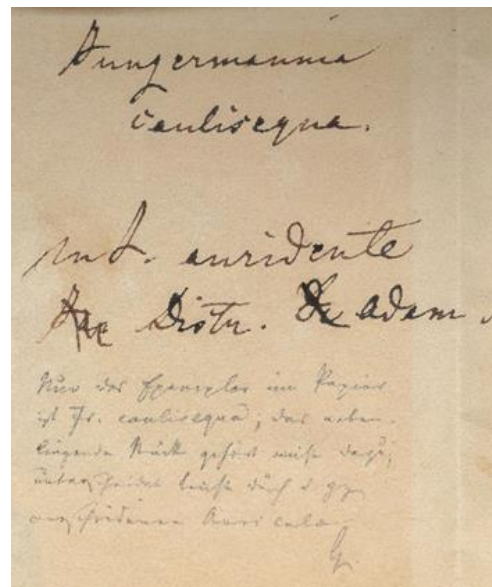


Figure 10 – *Jungermannia caulisequa*, "Int. auridente, Dist. adam. [Adamantum]" Annot. GOTTSCHÉ: "Only the specimen in the small capsule is *Fr. caulisequa*; the adjacent stem is not one of them; distinguished by the very different auricula" [translated]

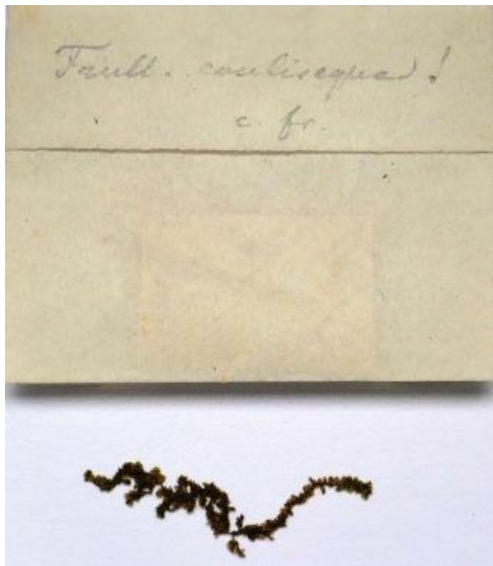


Figure 11 – NEES Nr. 81d: Inside there is a larger stem [= *Frullania obcordata*, det G. Winter 2020] and a small insert capsule with a small stem



Figure 12 – NEES Nr. 81e: in the small insert capsule there is a very short stem of *Frullania caulisequa*



Figure 13 –
Lectotype of
Frullania
caulisequa (NEES
Nr. 81e in STR)
Photo: E. RUDOLF,
Senckenberg
Research Institute

Jungermannia caulisequa NEES IN MARTIUS. Flora brasiliensis seu enumeratio plantarum. Vol. 1 (1):373.

≡ *Frullania caulisequa* (NEES) MONT. *Annales des Sciences Naturelles; Botanique, sér. 2*, 12: 51. 1839.

Type citation: In *Jungermannia diffusa* Sw. Districtus Adamantum, cujus cauli secundum longitudinem arcte adhaeret. (V. c. cal. pauca exempla.)

Specimen label: Int auridente, Dist. adam. [Adamantum] „Frull. caulisequa ! c.fr.“

Lectotype: designated here, NEES Nr. 81e STR (stem in small insert) see Figure 13, Figure 13 and Figure 14.

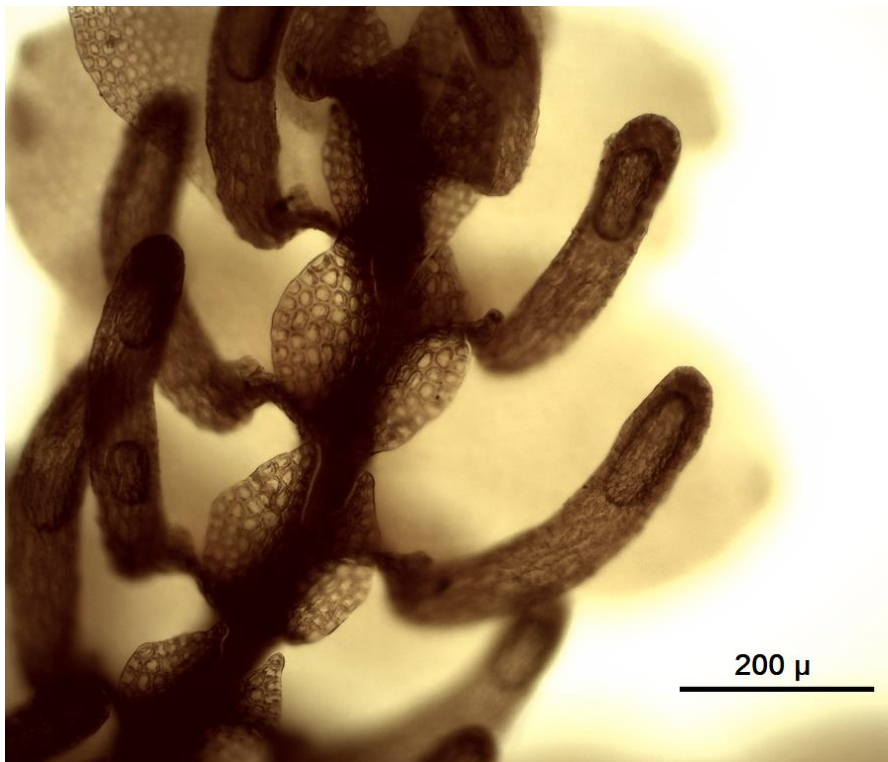


Figure 14 - Lobuli of lectotype of *Frullania caulisequa* (hb NEES Nr. 81e in hb STR)

3. Types of *Frullania obcordata* (LEHM. & LINDENB.) LEHM. & LINDENB. 1845

The basionym *Jungermannia obcordata* LEHM. & LINDENB. was published 1834 by LEHMANN, Pugillus 6: 51-52: “Habitat in Guiana. (Herb. Hookeri.)” He compared *Jungermannia obcordata* with two other *Jungermannia* species: „Obs. Affinis *J. intermediae* N. ab Es. et *brunneae* Spr. A priori, cui simillima, differt foliis squarrosis, brevioribus, rotundis, amphigastriis convexi, auriculis plerisque erectis. A *J. brunnea* statura minus gracili, foliis squarrosis, omnibus obtusis haud nitidis, amphigastriis minoribus minus denticulatis, praesertim vero calyce non obtuse trigono sed cordiformi acute triangulari satia superque diversa.”

The lectotype is located in G [G00265244 - n° SIB 269297/8] which was published as “type” by YUZAWA (1988:445, fig. 5) (see Figure 6) and annotated on the herbar capsule by HATTORI May 1986 as “isotype”.

1845 *Jungermannia obcordata* was transferred to *Frullania* in Synopsis Hepaticarum. There is mentioned a "Gottsche Icon. Frull. Inedit." From this specimen there is no copy available among SCHIFFNER's drawings, but from the second specimen mentioned in literature.

LINDENBERG & GOTTSCHKE (1851:638) published a second specimen which Kegel had collected in Surinam "In Nieuw Ryweg apud Paramaribo. Collet. Kegelli sine numero". This specimen was drawn bei GOTTSCHKE of which SCHIFFNER made a copy.

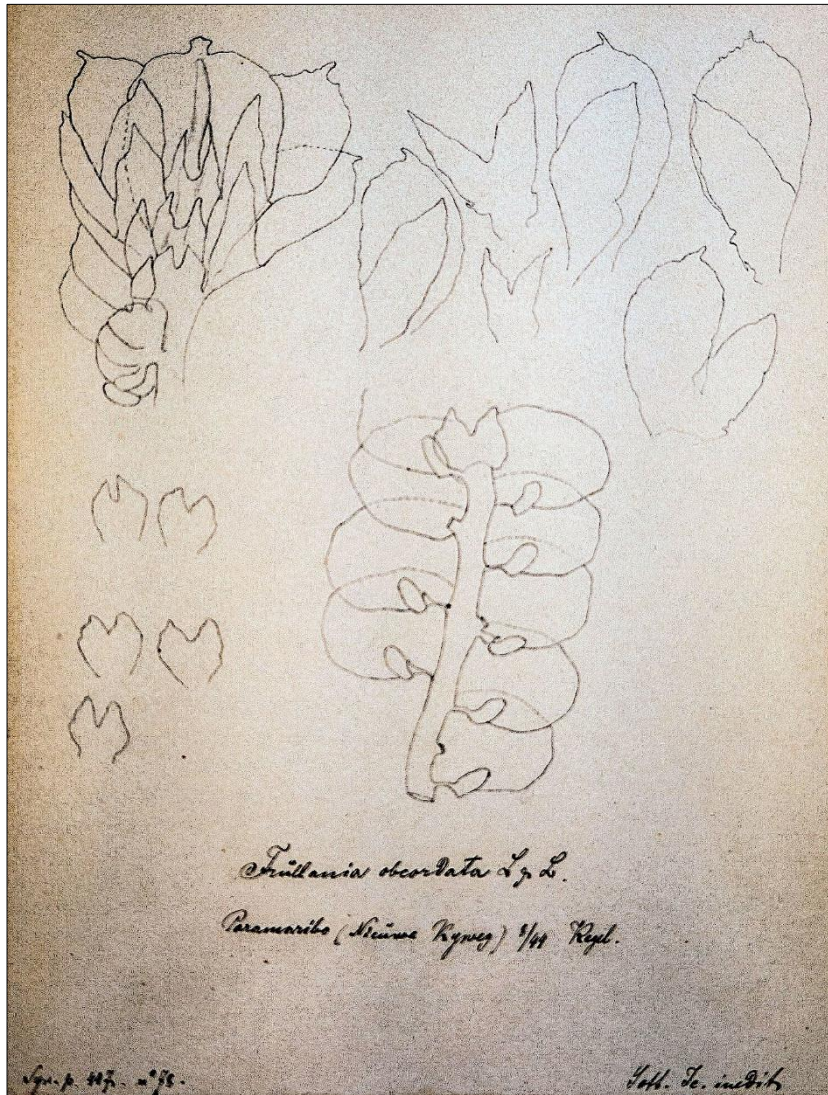


Figure 15 –
Frullania
obcordata, copy
of „Gott. Ic.
Inedit.“ by
SCHIFFNER



Figure 16 – hb GLM 06016: “*Frullania obcordata* L. Ldg., Guiana, Ex Hb. Hookerium. Lehmann Nr. 1853”. [“1853 is probably not the collection number, it’s the year when the Lehmann collection was acquired from the conductor of the PRINCE ALUMWERK AT MUSKAU, DR. SCHUCHARDT.” - translated, pers. com. VOLKER OTTE]

One type of *Frullania obcordata* in LEHMANN'S herbarium is housed in Herbarium Senckenberg G6rlitz (hb GLM).

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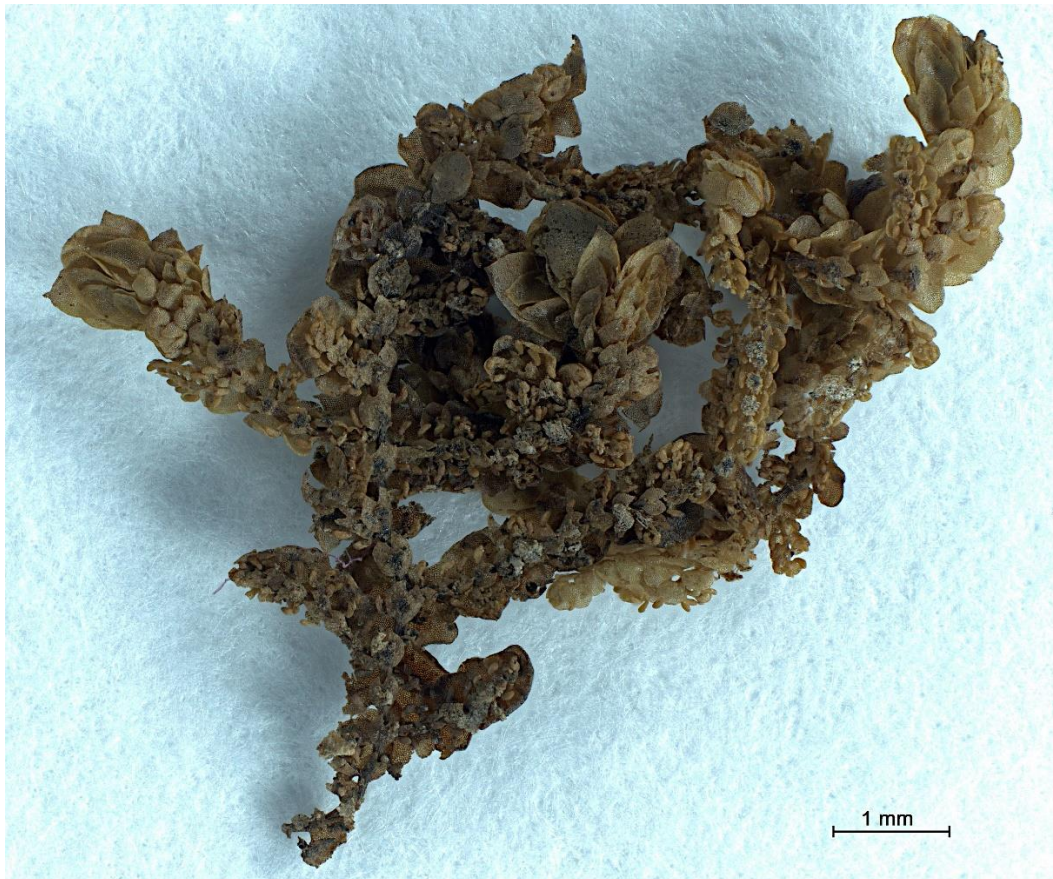


Figure 17 - Isolectotype of *Frullania obcordata* [hb GLM 06016] Photo: ELENA RUDOLF, Senckenberg Research Institute

Jungermannia obcordata LEHM. & LINDENB. IN LEHM. *Novarum et Minus Cognitarum Stirpium Pugillus* 6: 51. 1834.

≡ *Frullania obcordata* (LEHM. & LINDENB.) LEHM. & LINDENB. Synopsis Hepaticarum 447. 1845.
Type citation: Habitat in Guiana (Herb. Hookeri.)

Specimen label: „Frullania obcordata L. Ldg. Guiana, Ex Hb. Hookerium. Lehmann Nr. 1853“

Isolectotype: designated here No. 06016 in GLM (see Figure 17).

In the NEES herbarium at Straßbourg there are also two types of *Frullania obcordata* housed. Both specimens are from Guiana, but on the capsule there is a note that they belong to *Frullania intermedia*. Both specimens could be determined as typical *Frullania obcordata* (det G. Winter 2020).

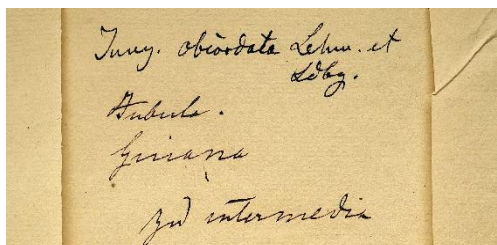


Figure 18 - *Jung. obcordata* LEHM. ET LDBG.,
Jubula, Guiana, „zu intermedia“

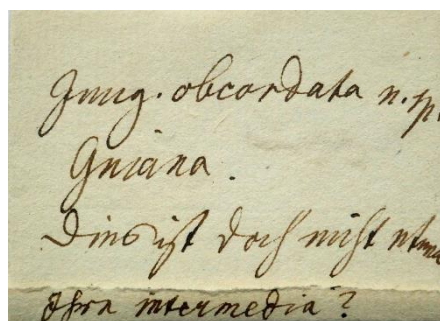


Figure 19 - *Jung. obcordata* n.sp., Guiana
“Dies ist doch nicht etwa [...] intermedia?”

Two other types (B28349 and B28350) are in the herbarium of the Naturhistoriska Riksmuseet, Stockholm (hb S) checked by VERDOORN 1929 [Internet search of Herbarium Catalogue (S)].

The given synonyms of *Frullania caulisequa* are accordingly transferred to *Frullania obcordata*.

Frullania obcordata (LEHM. ET LINDENB.) LEHM. ET LINDENB. IN GOTT. ET AL., Syn. Hep.: 447.1845.

Synonyms:

= *Frullania amoena* STEPH., Sp. Hepat. 4: 635, 1911, **syn. nov.**

sub *Frullania caulisequa* (NEES) MONT. - GRADSTEIN, MENESES & ARBE (2003:15-16) and GRADSTEIN & COSTA (2003:86)

sub *Frullania gymnotis* NEES & MONT. - YUZAWA & KOIKE (1989:350-351, fig. 6)

= *Frullania caroliniana* SULL., *Amer. J. Sci. Arts, ser. 2*, 1: 74, 1846.

sub *Frullania brunnea* (SPRENG.) DRÈGE - SCHIFFNER (1895:134, as *F. brunnea* SPRENG.)

sub *Frullania obcordata* (LEHM. ET LINDENB.) LEHM. ET LINDENB. IN GOTT. ET AL. - FREY & CLARK (1947:760), WAREHAM (1968:304) and SCHUSTER (1992:111)

sub *Frullania caulisequa* (NEES) MONT. - GRADSTEIN & COSTA (2003:86)

= *Frullania compsotera* SPRUCE, *Trans. Proc. Bot. Soc. Edinburgh* 15: 57-58, 1884.

sub *Frullania caulisequa* (NEES) MONT. - STEPHANI (1911:638) and CLARK (1955:201)

- sub *Frullania obcordata* (LEHM. ET LINDENB.) LEHM. ET LINDENB. IN GOTTE. ET AL. – SCHUSTER (1992:111)
- = *Frullania galapagona* AONGSTR., *Kongl. Vet. Akad. Forh. Stockholm* 30(5): 116, 1873.
 sub *Frullania caulisequa* (NEES) MONT. - YUZAKAWA (1988:442-444, fig. 4)
 sub *Frullania obcordata* (LEHM. ET LINDENB.) LEHM. ET LINDENB. IN GOTTE. ET AL. – GRADSTEIN & WEBER (1982:148)
- = *Frullania gymnotis* NEES & MONT., *Ann. Sci. Nat., Bot., sér. 2*, 19(4): 257, 1843, **syn. nov.**
 sub *Frullania caulisequa* (NEES) MONT. - GRADSTEIN (1997:10) and GRADSTEIN & COSTA (2003:86)
 sub *Frullania obcordata* var. *arma* LINDENB. & GOTTSCHKE – GRADSTEIN & HEKING (1989:209)
- = *Frullania leptophylla* DE NOT., *Mem. Reale Accad. Sci. Torino, ser. 2*, 16: 234-235, 1857, **syn. nov.**
 sub *Frullania caulisequa* (NEES) MONT. - YUZAWA & KOIKE (1989:348, fig. 4)
- = *Frullania martiana* GOTTSCHKE, *Syn. Hepat.*, (fasc. 3): 448, 1845
 sub *Frullania caulisequa* (NEES) MONT. - GRADSTEIN & COSTA (2003:86)
 sub *Frullania obcordata* (LEHM. ET LINDENB.) LEHM. ET LINDENB. IN GOTTE. ET AL. – FRYE & CLARK (1947:760) and SCHUSTER (1992:111)
- = *Frullania myosota* (HOOK. F. & TAYLOR) MITT., *Antarctic voyage, II. Fl. Novae-Zelandiae* 2: 163, 1855, **syn. nov.**
 sub *Frullania compsotera* SPRUCE – SPRUCE (1884:57)
 sub *Frullania ptychantha* MONT. - MITTEN (1855:163)
- = *Frullania miradorensis* STEPH. NON LINDENB. ET GOTTSCHKE, *Sp. Hepat.* 4: 632, 1911 [as “miradoremsis”], **syn. nov.**
 sub *Frullania caulisequa* (NEES) MONT. - YUZAWA (1988:448, fig. 7)
- = *Frullania pabstiana* STEPH., *Sp. Hepat.* 4: 629, 1911, **syn. nov.**
 sub *Frullania caulisequa* (NEES) MONT. - YUZAWA (1988:447, fig. 6)
- = *Frullania parasitica* HAMPE EX LEHMANN, *Nov. Stirp. Pug.* 7: 11-12, 1838, **syn. nov.**
 sub *Frullania caulisequa* (NEES) MONT. - GRADSTEIN & COSTA (2003:86)

Some years ago, a new *Frullania* species from Brazil was established: *Frullania curvilobula* SCHÄF.-VERW., D.F. PERALTA & S.M. SIQUEIRA (SCHÄFER-VERWIMP ET AL. 2012). Although the lobuli and the hemiphylls are nearly the same in size, both specimens can mainly be separated by stem leaf-apex, being rounded to obtuse in *Frullania caulisequa* and usually strongly apiculate in *Frullania curvilobula*, and the larger, rounded underleaves in *F. curvilobula* (4-5 x stem width) usually covering the lobules, whereas underleaves in *F. caulisequa* are smaller (2,5-3,5 x stem width), clearly longer than wide and the lobules are usually well visible in ventral view.

4. Adjustments to the subgeneric structure of *Frullania*

HENTSCHER ET AL. (2009:147,152) published a refined phylogeny and subgeneric classification based on molecular research of genus *Frullania* RADDI. Subgenus *Diastaloba* was divided into four clades. They remark “In some cases, e.g., *F.* subg. *Diastaloba*, modifications of the morphological subgeneric concepts seem necessary to arrive at a natural subdivision. [...] Classification of the remaining “*Diastaloba*”-lineages is hampered by insufficient knowledge of their morphology, especially characters of the sporophyte and oil bodies. A formal assignment to one of these clades to *F.* subg. *Diastaloba* s. str. should await sequencing of the lectotype *F. subtilissima* (NEES &

MONT.) LINDENB. that was not available for this study. For the time being, we assign the clades to informal units “*F.* subg. *Diastaloba* I to IV”.”

HENTSCHEL ET AL. (2015:130) remark “*Diastaloba* IV” corresponds to a group of distinctive plants that have strong microphyllous branches and long, narrow lobules oblique to the stem, e.g., *F. hypoleuca* Nees in Gottsche *et al.* (1843:471) and *F. obcordata* (Lehmann 1834:51) LEHM. ET LINDENB. IN GOTTSCHKE ET AL. (1845:447) (= *F. caulisequa* (NEES) MONTAGNE (1839: 51)]. As with the previous group, none of the taxa included by HENTSCHEL ET AL. (2009) in this group is a type of any subgeneric taxon, and we have no existing name that we think may be applicable to it.”

HENTSCHEL ET AL. (2009) clearly established clade *Diastaloba* IV as an outgroup to all other species of *Diastaloba* (clade *Diastaloba* I – III). As we consider *Frullania obcordata* and *Frullania caulisequa* as two clearly distinct species, and the latter was the first one published in this group we propose a new subgenus for *F.* subg. *Diastaloba* IV.

***Frullania* subg. *Caulisequa* G. WINTER & SCHÄF.-VERW., subg. nov.**

Type: *Frullania caulisequa* (NEES) MONT., *Annales des Sciences Naturelles; Botanique, sér. 2*, 12: 51. 1839. (≡ *Jungermannia caulisequa* NEES IN MARTIUS. *Flora brasiliensis seu enumeratio plantarum*. Vol. 1 (1):373.)

Diagnosis: This subgenus is morphologically well-separated from all other subgenera of *Frullania* species by (1) lobules, which are clearly distant from the stem and the distance is almost as wide as the width of the lobule (*Diastaloba*-type), (2) leaf-lobes and underleaves of many branches being remarkably to extremely smaller than those of the stem (microphyllous branches), (3) robust, medium-sized to large plants and (4) three-keeled perianths with smooth surface.

The subgenus contains *Frullania brunea* (SPRENG.) DRÈGE, *Frullania caulisequa* (NEES) MONT., *Frullania curvilobula* SCHÄF.-VERW., D.F.PERALTA & S.M.SIQUEIRA, *Frullania grossifolia* STEPH., *Frullania hypoleuca* NEES, *Frullania lindenberghii* LEHM., *Frullania obcordata* (LEHM. & LINDENB.) LEHM. & LINDENB., *Frullania ponapensis* S. HATT. & N. KOIKE IN N. KOIKE, and *Frullania tricarinata* SANDE LAC.

Type specimens of the following 5 members of subg. *Caulisequa* were studied.

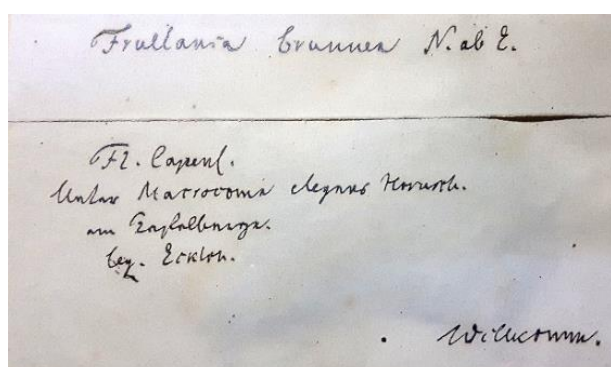


Figure 20 - Isolectotype of *Frullania brunea* (BREM-0002228)

***Frullania brunea* (SPRENG.) DRÈGE**, *Flora* 26 (Beig.): 186. 1843, as “*brunea* Spr.”

Basionym: *Jungermannia brunea* SPRENG. - *Systema Vegetabilium*, editio decima sexta 4(2): 325. 1827. “In cacumine montis tabularis C.B.S.”

VANDEN BERGHEN (1976:24) designated the lectotype: “Le Cap, Montagne de la Table, Ecklon (holotype de *Jungermannia brunea* PR, herb. VÁÑA)”



Figure 21 - Isolectotype of *Frullania brunea* [hb FR-0242568] Photo: Elena Rudolf, Senckenberg Research Institute

At the Übersee-Museum Bremen (BREM) there is a type specimen (BREM-0002228!): “Fl. Capenl. Unter *Macrocoma elegans* Hornsch., am Tafelberge, leg Ecklon”. A duplicate is located at the Herbarium Senckenbergianum, Frankfurt am Main (FR-0242568!)

Jungermannia brunea SPRENG. - Systema Vegetabilium, editio decima sexta 4(2): 325. 1827.

≡ *Frullania brunea* (SPRENG.) DRÈGE, Flora 26 (Beig.): 186. 1843, as “*brunea* Spr.”

Type citation: In cacumine montis tabularis C.B.S.

Specimen label: „*Frullania brunea* N. ab E. Fl. Capenl. Unter *Macrocoma elegans* Hornsch., am Tafelberge, leg Ecklon, [hb] Willkommen“

Isolectotype: designated here, BREM no. 0002228 (see Figure 20)

Isolectotype: designated here, FR no. 0242568 (duplicate of BREM-0002228)

The species from South Africa should not be confused with *Frullania brunnea* AUSTIN 1846 (Hep Bor Amer Exsic No 105e) which was treated by EVANS (1897) as synonym under *Frullania caroliniana* SULL 1846, a synonym of *Frullania obcordata*.

Frullania caulisequa (NEES) MONT., *Annales des Sciences Naturelles; Botanique*, sér. 2, 12: 51. 1839

Basionym: *Jungermannia caulisequa* NEES IN MARTIUS, Flora Brasiliensis seu Enumeratio Plantarum 1: 373. 1833.

Lectotype: Herbarium Nees Nr. 81e in STR !

Frullania curvilobula SCHÄF.-VERW., D.F.PERALTA & S.M.SIQUEIRA, *Phytotaxa* 57: 27. 2012

Paratype: Herbarium SCHÄFER-VERWIMP 9087!

Frullania lindenbergi LEHM., *Novarum et Minus Cognitarum Stirpium Pugillus* 8: 17. 1844

Isolectotype: GLM- 06026!

VAN DEN BERGHEN 1978 designated the lectotype: “Province du Cap: S. loc., Pappé (UPS)”.

Frullania obcordata (LEHM. & LINDENB.) LEHM. & LINDENB., *Synopsis Hepaticarum* 447. 1845

Basionym: *Jungermannia obcordata* LEHM. & LINDENB., *Novarum et Minus Cognitarum Stirpium Pugillus* 6: 51. 1834

YUZAWA 1988 designated the lectotype: “Type: Guiana, sine loco speciali - isotype of *Jungermannia obcordata* LEHM. ET LINDENB. (G.)” [isolectotype hb GLM 06016!]

For other species which may belong to subg. *Caulisequa* compare “*Diastaloba* IV” in SÖDERSTRÖM ET AL. (2016: 272).

In our research, we focused on the lobuli of the members of *Frullania* subg. *Caulisequa*. In addition to the type specimens we included *Frullania hypoleuca* Nees 1843. We checked the description of lobuli from various sources and used images of *Frullania tricarinata* SANDE LAC. (HATTORI [1973:64-65, fig. 28]), and *Frullania ponapensis* HATT. & KOIKE (KOIKE [1994:186-188, fig. 2]). The photos for comparison of the lobuli show only the shape not the size.



Figure 22 – *Frullania caulisequa* from lectotype hb Nees Nr. 81e



Figure 23 – *Frullania curvilobula* from paratype hb SCHÄFER-VERWIMP 9087



Figure 24 – *Frullania lindenbergii* from isoelectotype hb GLM 06026



Figure 25 – *Frullania grossifolia* from hb SCHÄFER-VERWIMP 12422

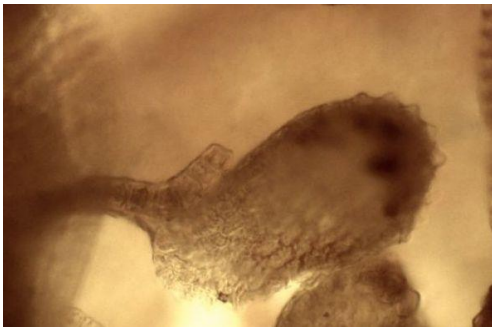


Figure 26 – *Frullania hypoleuca* from hb SCHÄFER-VERWIMP 24905/B



Figure 27 – *Frullania brunea* from isoelectotype hb FR-0242568

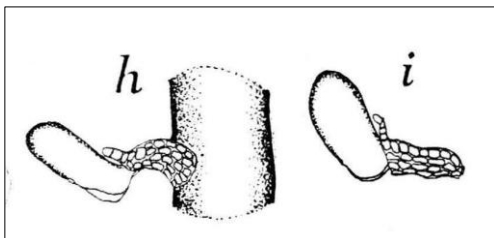


Figure 28- *Frullania ponapensis* from Koike (1994, FIG. 2, H-I)

- 7b** Underleaves laterally without teeth *Frullania ponapensis*
[Micronesia (Ponape)]
- 8a** Underleaf sinus wide, obtuse, Perianth with 2 ventral keels *Frullania obcordata*
[widespread in tropical America and USA]
- 8b** Underleaf sinus very narrow, acute, Perianth with 3 ventral keels
..... *Frullania tricarinata*
[Malaysia (Sabah), Indonesia (Java, Bali)]

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