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# A new species of Lejeuneaceae (Marchantiophyta) from New Caledonia: *Ceratolejeunea bardatii* sp. nov.

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**Abstract** – The liverwort *Ceratolejeunea bardatii* sp. nov. (Lejeuneaceae) is described and illustrated from submontane, mesophilous valley forest of New Caledonia. The new species stands out by 1) leaf lobes with a 2-cells wide vitta of dark brown ocelli and some additional adjacent ocelli; 2) upper leaf margins with *Allorgella*-type denticulations; 3) utricles absent; and 4) perianths short obovoid and with 4 flat or twisted horns. The new species constitutes the first record of the genus *Ceratolejeunea* for New Caledonia.

**Hepaticae / Lejeuneaceae / New Caledonia / Pacific region / taxonomy**

**Résumé** – *Ceratolejeunea bardatii*, une nouvelle espèce d'hépatique (Lejeuneaceae) récoltée en forêt mésophile vallicole de basse montagne en Nouvelle-Calédonie est décrite et illustrée. Elle se distingue par 1) une vitta sur les lobes foliaires, formée d'une double rangée d'ocelles brun foncé, avec quelques ocelles supplémentaires ; 2) les marges antérieures des feuilles présentant une denticulation du type *Allorgella* ; 3) l'absence d'utricules ; et 4) des périanthes courtement obovoides et munis de 4 cornes aplaties ou torsadées. Cette nouvelle espèce constitue une première citation en Nouvelle-Calédonie pour le genre *Ceratolejeunea*.

**Hepaticae / Lejeuneaceae / Nouvelle-Calédonie / région Pacifique / taxonomie**

## INTRODUCTION

*Ceratolejeunea* is a pantropical genus of about 40 species. The centre of diversity is in tropical America with 26 species (Dauphin, 2003; Ilkiu-Borges & Alvarenga, 2008; Reiner-Drehwald, 2011; Silva Brito & Ilkiu-Borges, 2012; Campos *et al.*, 2014). Africa harbors ten or 11 species (Vanden Berghen, 1951; Fischer & Vanderpoorten, 2010; Pócs, 2011) with *C. saroltae* Pócs being a doubtful member of *Ceratolejeunea*, and tropical Asia about six (Mizutani, 1981; Zhu *et al.,* 2005). The majority of the species are rather widespread and four species exhibit

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intercontinental ranges: *C. cornuta* (Lindenb.) Steph. and *C. coarina* (Gottsche) Schiffn. occur in America and Africa (Pócs, 2011; Gradstein, 2013), *C. grandiloba* J.B.Jack *et* Steph. in South America and Asia (Gradstein, 2013a) and *C. belangeriana* (Gottsche) Steph. in Africa and Asia (Pócs, 2011). The latter species also occurs in Australia, where it is the only representative of the genus (McCarthy, 2006). *Ceratolejeunea* is not yet known from New Caledonia, but it is known from Papua New Guinea where three species occur (*C. belangeriana*, *C. moniliata* Herz., *C. ledermannii* Steph.; see Grolle & Piippo, 1984) and from Fiji with two species (*C. belangeriana* and the distinctive *C. vitiensis* Steph.; see Söderström *et al*., 2011).

During a field survey in New Caledonia in 2008, the first author collected what appeared to be a species of *Ceratolejeunea*. The genus is new to this French overseas territory. As the species does not fit any of the known species of *Ceratolejeunea* it is described here as new to science.

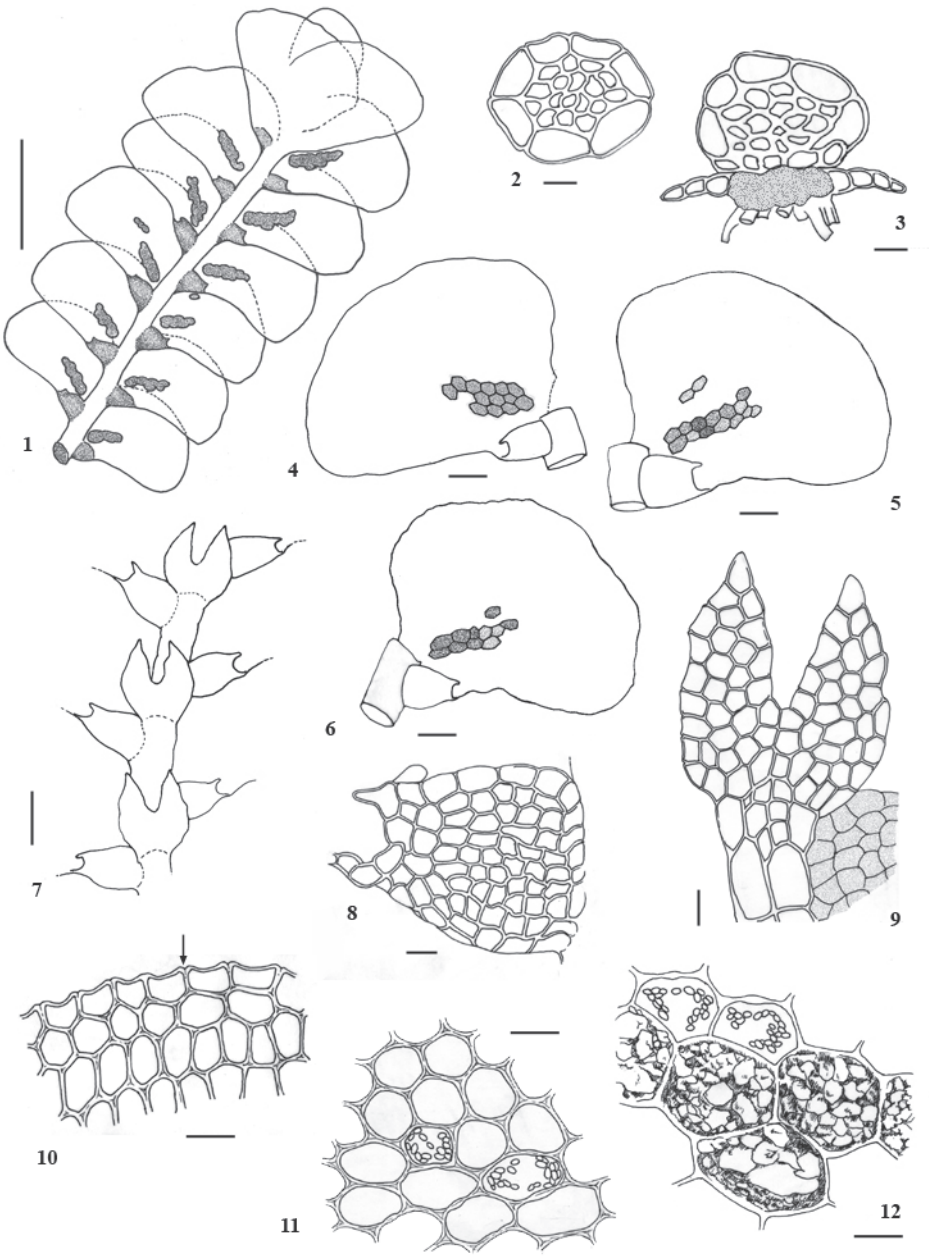
## TAXONOMIC DESCRIPTION

***Ceratolejeunea bardatii*** Thouvenot, Gradst. *et* R.L.Zhu, **sp. nov.** **Figs 1-20**

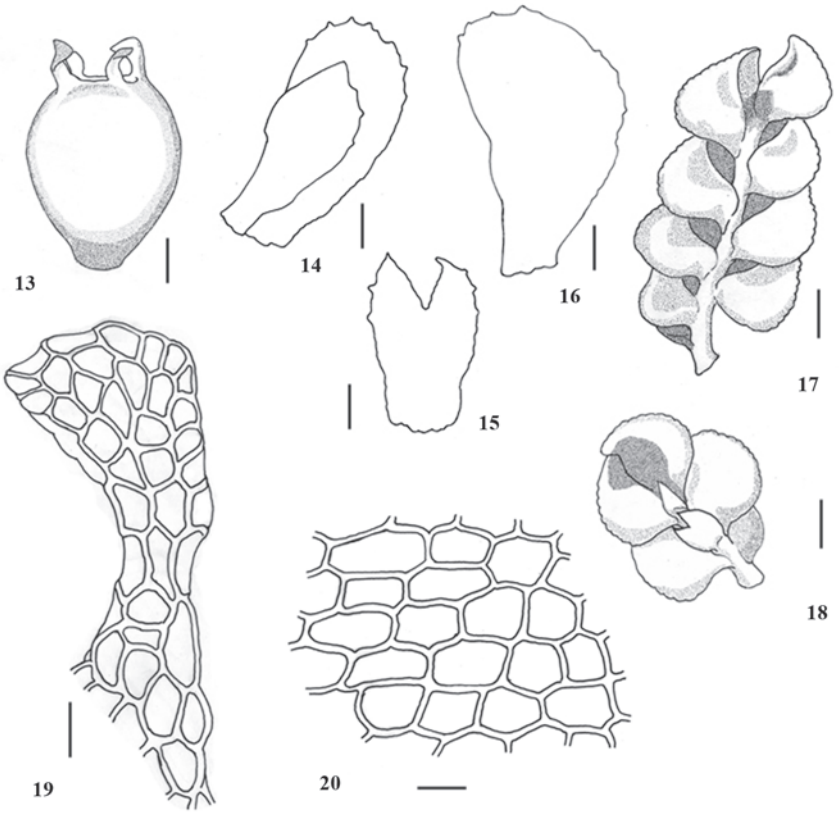
Autoicous; leaf lobes asymmetrically ovate-falcate, with a 2-cells wide vitta of dark brown ocelli and some additional adjacent ocelli; upper leaf margins with *Allorgella*-type denticulations; utricles absent; perianths small, short obovoid, with 4 medium sized, flat or twisted horns. Among the morphologically similar species of *Ceratolejeunea*, *C. minor* differs by ocelli not forming a vitta and inconspicuous perianth horns, *C. moniliata* and *C. vitiensis* by the one-lined vitta and long slender perianth horns, the latter being 5-horned, *C. beninensis* by yellowish ocelli, entire leaf margins and short rounded perianth horns.

**Type**: New Caledonia, Province Sud, Moindou, "Parc Provincial des Grandes Fougères", Houé river valley, near Campement Rivalin, 430 m a.s.l., UTM 58K (0577685, 7610349), submontane mesophyllous valley forest, on bark of a palm tree, shaded, 24 September 2008, *L. Thouvenot NC1294* (**holotype**, PC 0736706; isotypes, hb. Thouvenot, HSNU).

**Plants** 0.8-1.2 mm wide when dry, to 1.5 mm wide when moist, glistening olive green to brownish in herbarium, growing in dense mats, fragile. **Branching** *Lejeunea* type, distantly and irregularly pinnate, branches relatively short, spreading at 45-90° from the stem. **Stems** very fragile, elliptic, dorsiventrally flattened, 110-125 µm wide, 80-85 µm high, in cross section with 7 cortical cells and about 9-17 conspicuously smaller and thicker medullar ones, the cortical cells transversally elongate, 30-50 µm wide, 15-25 µm high, the medullary cells 7-17 µm in diameter. **Leaves** imbricate, spreading at right angles or nearly so, flat to slightly convex (more strongly convex when dry); leaf lobes falcate-ovate, 450-800 µm long, 400-550 µm wide, asymmetrical with a semicircular dorsal margin and an almost straight ventral margin, apex rounded to obtuse or subacute, upper margin usually weakly crenulate by *Allorgella*-type denticulations (outer wall protruding between the cells) and with a few remote, short teeth, margins otherwise ± entire, dorsal base widely rounded, extending across and beyond the stem, ventral margin forming an almost straight line with the keel, sometimes making a sharp curve at the sinus before joining the keel; lobe cells evenly thick-walled, middle lamella conspicuous,




Figs 1-12. *Ceratolejeunea bardatii* Thouvenot, Gradst. *et* R.L.Zhu. **1.** Part of shoot in ventral view (underleaves not shown). **2-3.** Cross sections of stem. **4-6.** Leaves in ventral view. 7. Part of stem in ventral view. **8.** Lobule. **9.** Underleaf and part of stem and lobule. **10.** Dorsal lobe margin with *Allorgella*-type denticulation (arrow). **11.** Median cells (the lower ones from near ocelli). **12.** Ocelli. (Scale bars: 1: 0.5 mm; 2, 3 & 8-12: 20 μm; 4-7: 0.1 mm; all drawn from the type specimen).




Figs 13-20. *Ceratolejeunea bardatii* Thouvenot, Gradst. *et* R.L.Zhu. **13.** Perianth. **14.** Bract in ventral view. **15.** Bracteole. **16.** Bract in dorsal view. **17-18.** Androecia in ventral view. **19.** Perianth horn. **20.** Perianth body cells. (Scale bars: 13-18: 0.1 mm; 19-20: 20 µm; all drawn from the type specimen).

trigones absent or very small, intermediate thickenings scarce, cuticule smooth, marginal cells isodiametrical, 15-17 µm, median cells isodiametrical, 20-30 µm, basal cells elongate, 50-55 µm long, 17-25 µm wide; oil bodies (in dry material) small, ellipsoid, homogeneous, to 30 per cell; ocelli present, usually deep brown (sometimes a few grayish ones present), forming a 2-cells wide and 3-7-cells long, suprabasal vitta; some further scattered or juxtaposed ocelli present in the leaf lamina as well. **Leaf lobules** strongly inflated, short-ovate, 150-180 µm long, 100-120 µm wide, 1/4-1/5 the lobe length, on branches sometimes reduced, keel arched, free margin curved outwards, entire, plane or incurved, apex truncate, with one curved tooth, the tooth oriented toward the lobe apex and formed by an elongate, ca. 30-37 µm long cell, hyaline papilla at the proximal base of the tooth, elongate, often lying along the free margin, apical margin two cells long between tooth and keel; utricles not seen. **Underleaves** distant, oval, slightly longer than wide, 125-175 µm long, 110-135 µm wide, 2× wider than the stem, bilobed to 1/2, lobes lanceolate, acute with a conical apical cell, sinus usually narrow U-shaped, margins entire or sinuate, with weak *Allorgella* denticulations, rarely with an obtuse lateral tooth, underleaf base with a small primary rhizoid disc and four superior central cells (cross-section), insertion line slightly curved.

**Autoicous. Androecia** on short lateral branches, 0.3-1.0 mm long, 0.30-0.45 mm wide, with 2-6 pairs of bracts, the bracts hypostatic and with a crenulate keel, bracteoles 1(-2) limited to the base of the spike, shortly to deeply bilobed, sometimes undivided, ca. 130 µm long, 85-110 µm wide. **Gynoecia** on very short lateral branches with one sterile, pycnolejeuneoid innovation, female bracts erect to spreading; bract lobes asymmetrically obovate, 500-650 µm long, 250-350 µm wide, margins remotely toothed, lamina with 1-4 ocelli in a group or scattered in the lobe centre, bract lobules obovate-lanceolate, acute, 375-400 µm long, 140-160 µm wide, without ocelli, margins more or less remotely toothed, the teeth composed of one protruding cell; female bracteoles free down to the base, 270-300 µm long, 170-225 µm wide, similar to underleaves but larger and relatively less deeply divided, without ocelli, margins toothed like the bracts. **Perianths** short-obovoid, 400-600 µm long, 300-450 µm wide, strongly inflated, rounded in section, with a short, 2-cells long beak and 4 low and rounded, crenulate keels, each keel extending into a narrow, upright horn, the horns 100-150 µm long, to 50 µm wide, strap-shaped to spathulate, flat or twisted, areolation of horns irregular, cells smaller than those of the perianth body; perianth body cells short rectangular to quadrate, 17-32 µm long, 12-22 µm wide, otherwise similar to leaf cells, ocelli absent. **Sporophyte**: capsule (dehisced) rounded, ca. 260 µm in diameter, elaters pale-colored, 250-350 µm long, straight, attached to valve margins, 18 per capsule (4 or 5 per valve), spiral rudimentary; spores not seen.

**Etymology**: it is a pleasure to dedicate the new species to our friend and colleague Jacques Bardat, who warmly encouraged the first author to work on the New Caledonian bryophyte flora.

**Distribution**: *Ceratolejeunea bardatii* is only known from the type locality, in the middle of the Central Range of Grande Terre, New Caledonia, and may be considered a New Caledonian endemic species.

**Ecology**: *Ceratolejeunea bardatii* occurred on bark of a palm tree 15 cm in diameter, in submontane mesophilous forest in the schistose foothills on the leeward side of the Central Range, at 430 m a.s.l. It was growing associated with *Drepanolejeunea vesiculosa* (Mitt.) Steph. and *Cheilolejeunea ceylanica* (Gottsche) R.M.Schust. *et* Kachroo.

## DISCUSSION

The most distinctive features of *Ceratolejeunea bardatii* are: 1) asymmetrically ovate-falcate leaf lobes with a distinct, usually 2-cells wide and 3 to 7-cells long vitta of dark brown ocelli and some additional adjacent ocelli; 2) *Allorgella*-type denticulations on upper margins of leaf lobes; 3) utricles absent; and 4) small, short-obovoid perianths with 4 flat or twisted horns.

Among the Asian species of *Ceratolejeunea*, the new species is morphologically similar to *C. minor* Mizut. by the presence of *Allorgella*-type denticulations on leaf margins and the absence of utricles, and *C. moniliata* Herzog and *C. vitiensis* Steph. by having vitta-like lined up ocelli. However, *C. minor* clearly differs by having leaves without a vitta and perianths without distinct horns (Zhu *et al*., 2005), whereas *C. moniliata* and *C. vitiensis* differ by their narrower, 1-cell wide vitta of gray-colored (not dark-brown) ocelli, and a pyriform perianth

with five long horns. Habitually, *C. bardatii* closely resembles *C. beninensis* Jones *et* Vanden Berghen from West Africa, which also has asymmetrically ovate-falcate leaves and ocelli in a double line. However, the ocelli in *C. beninensis* are yellowish, not dark brown, the lobule tooth is curved downward, the perianth horns are short-rounded, the underleaves are 3× wider than the stem and the lobe margins are entire (Vanden Berghen, 1951; Wigginton, 2004). A double line of ocelli is otherwise only seen in the neotropical *C. rubiginosa* Steph. but the ocelli in the latter species are also grayish, the plants are reddish-brown, the lobe margins are more strongly toothed and without *Allorgella*-type denticulations, the lobules are larger, and the perianth horns are inflated, not flat or twisted (Dauphin, 2003). Furthermore, *C. belangeriana* is the most common *Ceratolejeunea* in the region but it is readily distinguished by its wide reniform underleaves, leaf lobes without ocellus and slender perianths with relatively longer, attenuate, erect horns.

The discovery of *Ceratolejeunea bardatii* adds a further genus and species to flora of New Caledonia and a further member to the Lejeuneaceae, which is the largest liverwort family in New Caledonia with about 142 species in 27 genera (updated from Thouvenot *et al*., 2011). Interestingly, the vicinity of the locality where the new species was collected has been intensively prospected by bryophyte collectors for a long time (see e.g. Brotherus 1906; Paris, 1910; Tixier 1979; Hürlimann, 1991; Iwatsuki & Kitagawa, 1985; Müller & Tan, 2013; Thouvenot & Bardat, 2013). As the habitat of *C. bardatii* is far from exceptional in New Caledonia, this species may be expected to occur more widely on the island.

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## REFERENCES

BROTHERUS V.F., 1906 — Contribution à la flore bryologique de la Nouvelle-Calédonie. *Öfversigt af Finska vetenskaps-societetens förhandlingar* 48, 15: 1-42.

CAMPOS L.V., GRADSTEIN R., URIBE-M. J. & STEEGE H.H., 2014 — Additions to the Catalogue of Hepaticae of Colombia II. *Cryptogamie, Bryologie* 35: 77-92.

DAUPHIN G., 2003 — *Ceratolejeunea* (Lejeuneaceae: Lejeuneoideae). *Flora neotropica monograph* 90: 1-86.

FISCHER E. & VANDERPOORTEN A., 2010 — New records of the liverwort flora of Gabon, with a description of *Ceratolejeunea kuerschneri*, sp. nov. (Lejeuneaceae, Jungermanniopsida). *Nova Hedwigia, Beiheft* 138: 85-97.

GRADSTEIN S.R., 2013 — Afro-American hepatics revisited. *Polish botanical journal* 58: 149-177.

GRADSTEIN S.R., 2013a — Notes on Early Land Plants Today 26. Miscellaneous new synonyms in liverworts. *Phytotaxa* 81: 3-7.

GROLLE R. & PIIPPO S., 1984 — Annotated catalogue of Western Melanesian bryophytes. *Acta botanica Fennica* 125:1-86.

HÜRLIMANN H., 1991 — Hepaticae aus dem Gebiete des Südlichen Pazifik. XI. *Bauhinia* 9: 257-264.

ILKIU-BORGES A.L. & ALVARENGA L.D.P., 2008 — On *Ceratolejeunea atlantica*, a new species of Lejeuneaceae (Jungermanniopsida) from Brazil. *Nova Hedwigia* 86: 237-241.

IWATSUKI Z. & KITAGAWA N., 1985 — Bryological expedition to New Caledonia and Fiji, 1982, organized by the Hattori Botanical Laboratory. *Journal of the Hattori botanical laboratory* 58: 83-86.

LEE G.E., GRADSTEIN S.R., SÖDERSTRÖM L. & LATIFF A., 2013 — Catalogue of the Lejeuneaceae of Malaysia. *Malayan nature journal* 65: 81-129.

MC CARTY P.M., 2006 — Checklist of Australian liverworts and hornworts. Australian Biological Ressource Study, Canberra. http://www.anbg.gov.au/abrs/liverwortlist/ liverworts_intro.html. version 6 april 2006

MENZEL M., 1988 — Annotated catalogue of the Hepaticae and Anthocerotae of Borneo. *Journal of the Hattori botanical laboratory* 65: 145-206.
MIZUTANI M., 1981 — Notes on the Lejeuneaceae. 5. Some Asiatic species of the genus *Ceratolejeunea*. *Journal of the Hattori botanical laboratory* 49: 305-318.
MÜLLER F. & TAN B.C., 2013 — New bryophyte records from New Caledonia. *Cryptogamie, Bryologie* 34: 367-371.
PARIS E.G., 1910 — Hépatiques de Nouvelle-Calédonie (3e article). *Revue bryologique* 37: 128-132.
PÓCS T., 2011 — East African Bryophytes XXIX. The *Ceratolejeunea* (Lejeuneaceae) species of the Indian Ocean Islands. *Polish botanical journal* 56: 131-153.
REINER-DREHWALD M.E., 2011 — Studies on Neotropical Lejeuneaceae (Jungermanniopsida). New synonyms and *Ceratolejeunea temnantha* (Spruce) comb. nov. *Cryptogamie, Bryologie* 32: 95-100.
SILVA BRITO E. DA & ILKIU-BORGES A.L., 2012 — A new species of *Ceratolejeunea* Jack & Steph. (Lejeuneaceae, Jungermanniopsida) from a remnant of Amazonian forest in Maranhão, Brazil. *Nova Hedwigia* 95: 423-428.
SÖDERSTRÖM L., HAGBORG A., PÓCS T., SASS-GYARMATI A., BROWN E., VON KONRAT M. & RENNER M., 2011 — Checklist of hornworts and liverworts of Fiji. *Telopea* 13: 405-454.
THOUVENOT L., GRADSTEIN S.R., HAGBORG A., SÖDERSTRÖM L. & BARDAT J., 2011 — Checklist of the liverworts and hornworts of New Caledonia. *Cryptogamie, Bryologie* 32: 287-390.
THOUVENOT L. & BARDAT J., 2013 — Contribution to the bryophyte flora of New Caledonia. I. New taxa and amendments**.** *Cryptogamie, Bryologie* 34: 37-47.
TIXIER P., 1979 — Mosses from Fiji, New Caledonia, Samoa and Society Islands, collected by H.S.MacKee. *Nova Hedwigia* 31: 693-719.
VANDEN BERGHEN C., 1951 — Contribution à l'étude des espèces africaines du genre *Ceratolejeunea*. *Bulletin du jardin botanique de l'État – Bruxelles* 21: 61-81.
WIGGINTON M.J., 2004 — *E. W. Jones's Liverwort and Hornwort Flora of West Africa.* Meise, National Botanical Garden, Belgium.
ZHU R.L., ZHENG M., NAN Z. & SHI X.-Q., 2005 — The genus *Ceratolejeunea* (Lejeuneaceae, Hepaticae) in China. *Cryptogamie, Bryologie* 26: 91-96.