The emendation of the fern genus Christiopteris, including the transference of two taxa to the microsorioid Polypodiaceae

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With 1 figure in the text

Abstract

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In the present paper the genus *Christiopteris* is emended. The species *C. tricuspis* and *C. sagitta* are retained in the genus. *C. varians* proved to consist of two different species, both originally published as formas. To one of these the rank of species is given, the other one remains as the typical form to *C. varians*. Furthermore, both species are transferred to the genus *Microsorium* (Polypodiaceae).

1. Introduction

The genus *Christiopteris* was founded by COPELAND (1905) to accommodate *Polypodium sagittum* Christ. Subsequent authors all accepted the genus though its systematic position within the Polypodiaceae has been ambiguous from its creation onwards. In its modern construction it should consist of three species, i.e. *C. sagitta* (syn.: *C. copelandii*; Philippines), *C. tricuspis* (syn.: *C. eberhardtii*; mainland Asia), and *C. varians* (New Caledonia); also reported from the Loyalty Is. by BROWNLIE 1969).

Our studies on Polypodiaceae revealed *Christiopteris* to be heterogeneous, the species from Asia being much different from that from New Caledonia. Besides, the latter taxon revealed to consist of two different elements which have been given specific rank in *Microsorium* s.l.

This study is executed as part of the Polypodiaceae Project. For details see HENNIPMAN (1984). We are thankful to co-workers for help in various ways,

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2. Taxonomic history

In the original description of *Christiopteris* ("*Christopteris*") COPELAND (1905) listed *C. sagitta* (*Polypodium sagittum* Christ.) Copel. only. CHRIST (1906) described *Christiopteris* ("*Christopteris*") *copelandii* (= *C. sagitta*), and thought the genus to represent "un petit genre 'erratique' dérivé de *Polypodium* sect. *Pleopeltis*,...". He later (1908) added *Christiopteris* ("*Christopteris*") *tricuspis* (*Acrostichum tricuspe* Hooker) Christ, *C. eberhardtii* Christ (= *C. tricuspis*), and *C. cantoniensis* (*Gymnogramme cantoniense* Baker = *Leptochilus cantoniensis* (Baker) Ching) Christ. CHRIST questioned whether the latter species could not be better placed in the genus *Cheiropleuria* with which he thought *Christiopteris* possibly even better united.

Detailed anatomical work on the acrostichoid ferns by SCHUMANN (1915) and BOWER (1917) stimulated COPELAND (1917) to study *Leptochilus varians* (*Acrostichum varians* Mett.) Fournier which he subsequently included in *Christiopteris*. The name of the genus was at the same time corrected (*Christiopteris* replaced "*Christopteris*"). The genus as thus construed was regarded by COPELAND to be related to a number of different ferns, e.g. the polypods with stellate hairs, the drynarioid ferns, apart from the genera *Dipteris* (Dipteridaceae) and *Cheiropleuria* (Cheiropleuriaceae). BOWER (1928) related *Christiopteris* to *Dipteris*, *Cheiropleuria*, and *Platycerium* because of a shared occurrence of the diplodesmic venation in the fertile parts of these ferns.

COPELAND later (1928) expressed strong doubts as to the inclusion of *Christiopteris cantoniensis* in *Christiopteris* mentioning the resemblances of this fern to *Campium dilatatum* Copel. CHING (1930) who emended BAKER's imperfect description of *Christiopteris cantoniensis*, agreed with COPELAND and referred the species to *Campium cantoniense* (Baker) Ching. CHRISTENSEN (1929) included *Campium dilatatum* in *Myuropteris cordata* (= *Drymoglossum cordatum* Christ) Christensen, the type of CHRISTENSEN's new monotypic genus *Myuropteris* which he regarded drymoglossoid. CHING (1933), followed CHRISTENSEN in recognizing the polyphyletic nature of *Campium* though refuting *Myuropteris*. He transferred *Campium cantoniense* to *Leptochilus* and thought this species possibly conspecific with both *Campium dilatatum* and *Leptochilus* (syn.: *Myuropteris*) *cordatus* (Christ) Ching. The genus *Leptochilus* sensu CHING (1933) was regarded by CHING to be related to the polypodioid genus *Colysis*.

COPELAND (1947) when discussing the differences between *Christiopteris sagitta, C. tricuspis*, and *C. varians*, thought the latter species "more suggestive of the *Microsorium-Phymatodes* group of genera. The genus as a whole seems more likely to belong in the *Crypsinus* group".

The report of the occurrence of paracytic stomata in *Christiopteris* by VAN COTTHEM (1968) — a stomatal type also found by him in *Dipteris* — revived the interest in the relationship of *Christiopteris*. Earlier, WILSON (1959) demonstrated several characteristics of the sporangia of *Dipteris* (and *Cheiropleuria*). Unfortunately WILSON did not study the sporangia of *Christiopteris*. The supposed occurrence of the paracytic stomata of *Christiopteris* in the Polypodiaceae s.str. induced PICHI SERMOLLI (1977) to give the genus an isolated position within the Polypodiaceae. In the meantime SEN & HENNIPMAN (1981) failed to confirm VAN COTTHEM's observations. Furthermore, we found that the shape of the sporangia is similar to that found in most other Polypodiaceae being much different from that found in Dipteridaceae and Cheiropleuriaceae. The systematic position of *Christiopteris* within the Polypodiaceae will be discussed in another paper.

3. Taxonomy

I. Christiopteris Copel.

Christiopteris Copel. in Perkins, Fragm. Fl. Philipp. (1905) 188; Philipp. J. Sci. C, Bot. 12 (1917) 311, p.p.; Bower, The Ferns 3 (1928) 213, p.p.; Copel., Gen. Fil. (1947) 178, p.p.; Holttum, Ferns of Malaya (1954) 210, p.p.; Copel., Fern Fl. Philipp. 3 (1960) 456, p.p.; Brownlie, Pteridophyta in Aubrév., Fl. Nouv.-Caléd. 3 (1969) 289, p.p. — Type: *Christiopteris sagitta* (Christ) Copel.

The genus is here defined by the characters as given by COPELAND in the original publication.

Key to the species

1a. Sterile fronds sagittate . . . . . 1. *Christiopteris sagitta*
b. Sterile fronds deeply palmately lobed, lobes 3–5 . . 2. *Christiopteris tricuspis*

1. Christiopteris sagitta (Christ) Copel. in Perkins, Fragm. Fl. Philipp. (1905) 188; Philipp. J. Sci. 1, Suppl. 2 (1906) 157, pl. 13; Fern Fl. Philipp. 3 (1960) 457. — *Polypodium sagittum* Christ, Bull. Herb. Boissier 6 (1898) 199. — Type: *Loher s.n.* (P).

Christiopteris copelandii Christ, Bull. Herb. Boissier, Ser. 2, 6 (1906) 990; Bower, The Ferns 3 (1928) 218; Copel. Fern Fl. Philipp. 3 (1960) 457. — Syntypes: small specimens from the collections made by COPELAND and WHITFORD.

Description: The present species is excellently described and illustrated by CHRIST (op. cit. 1898) and COPELAND (op. cit. 1905, 1906).

Distribution: Philippines; Luzon and Mindanao.

2. Christiopteris tricuspis (Hooker) Christ, J. Bot. 21 (1908) 273; Copel., Philipp. J. Sci. C, Bot. 12 (1917) 332; Bower, The Ferns 3 (1928) 214, fig. 722—726, pl. *s.n.* (frontispiece); Tard. & C. Chr. in Lecomte, Fl. Indo-Chine 7, 2 (1941) 450, fig. 52: 2; Holttum, Ferns of Malaya (1954) 211. — *Acrostichum tricuspe* Hooker, Sp. Fil. 5 (1864) 272, pl. 304. — *Gymnopteris tricuspis* Beddome, Ferns Brit. India (1866) pl. 53, c. descr.; Suppl. (1876) 27; Handb. Ferns Brit. India (1883) 434, fig. 263. — *Cheiropleuria tricuspe* J. Smith., Hist. Fil. (1875) 139. — *Leptochilus tricuspis* C. Chr., Index Filic. (1906) 388; Schumann, Flora 108 (1915) 250. — Type: *Atkinson s.n.* (K, n.v.).

Christiopteris eberhardtii Christ, J. Bot. (Morot) 21 (1908) 272; Copel., Philipp. J. Sci. C, Bot. 12 (1917) 332; Bower, The Ferns 3 (1928) 218; Copel., Gen. Fil. (1947) 179; Holttum, Ferns of Malaya (1954) 211. — Type: *Eberhardt 84* (P, 2 sh.).

Description: See BOWER (op. cit.) and HOLTTUM (op. cit.).

Distribution: Mainland Asia (northeastern India to Indo-China).

Excluded

3. Christiopteris cantoniensis (Baker) Christ, J. Bot. 21 (1908) 272. — *Gymnogramme cantoniense* Baker in Hooker, Icon. Pl. 3, 7 (1887) pl. 1685, c. descr. — *Polypodium cantoniense* C. Chr., Index Filic. (1906) 515. — *Campium cantoniense* Ching, Sinensia 1 (1930) 53. — *Leptochilus cantoniensis* Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 343. — Type: *C. Ford s.n.* (Kwantung, North River), (K, n.v.).

= **Leptochilus cantoniensis** (Baker) Ching

II. Microsorium Link in Hort. Berol. 2 (1833) 110.

Full synonymy of this genus is not given as its generic delimitation is presently under investigation. Pending the results of this investigation the genus is here defined in the sense of COPELAND (1947) i.e. including those species usually accommodated in *Phymatodes* Presl (= *Phymatosorus* Pichi Serm.).

Key to the species of Microsorium formerly referred to Christiopteris varians

1.a. Scales of the rhizome appressed, round to slightly elongate; index of lobes of sterile fronds 8—20, apex ± acute . . . . . 1. *Microsorium varians*

b. Scales of the rhizome spreading, triangular, apex acute to acuminate; index of lobes of sterile fronds 3–6, apex obtuse . . . 2. *Microsorium latilobatum*

1. Microsorium varians (Mett.) Hennipman & Hetterscheid, **comb. nov.** — Fig. 1a.

Acrostichum varians, Mett., Ann. Sci. Nat. Bot., Sér. 4, 15 (1861) 56; Baker in Hooker & Baker, Syn. Fil., ed. 2 (1874) 524. — *Acrostichum varians* Mett. f. *varians* (art. 24 ICBN, "*normalis*"), Ann. Sci. Nat. Bot., Sér. 4, 15 (1861) 57. — *Leptochilus varians* Fourn., Bull. Soc. Bot. France 15 (1868) 394; Ann. Sci. Nat. Bot. 18 (1873) 273; Bonap. in Sarasin & Roux, Nova-Caled. Bot. (1914) 38; Compton, J. Linn. Soc. Bot. 45 (1922) 442. — *Gymnopteris varians* Diels in Schlechter, Bot. Jahrb. Syst. 39 (1906) 7. — *Christiopteris varians* Copel., Philipp. J. Sci. C, Bot. 12 (1917) 333; Guillaumin, Mém. Mus. Natl. Hist. Nat. Sér. B, Bot. 8 (3) (1962) 202; Brownlie, Pteridophyta in Aubrév., Fl. Nouv.-Caléd. 3 (1969) 289. — Type: *Vieillard 1526*, Poila (B, iso in P, p.p.). See note 1.

Acrostichum varians Mett. f. *contracta*, Mett., Ann. Sci. Nat. Bot. Sér. 4, 15, (1861) 57. — Type: *Vieillard 1525*, Balade (B, iso in P, p.p.). See note 2.

[*Leptochilus varians* (Mett.) Fourn. var. β ("var. β: *lobis angustioribus*"), Bull. Soc. Bot. France 16 (1869) 394, nom. nud. — *Leptochilus varians* (Mett.) Fourn. var. β ("var. β: *pinnis angustioribus*"), Ann. Sci. Nat. Bot. Sér. 5, 18 (1873) 273, nom. nud.].

[*Leptochilus varians* (Mett.) Fourn. var. "α: *pinnis latioribus*" auct. non Fourn.: Bonaparte, Notes Ptérid. 13 (1921) 252, p.p., nom. nud.].

Usually epiphytic, sometimes epigeous or epilithic. Rhizome stout, long-creeping, terete or somewhat flattened, 0.1—1.0 cm ∅, densely set with scales; scales peltate, rounded or slightly triangular, index 1.0—2.5, 1.0—3.5 x 0.7—2.0 mm, base rounded, margin irregularly denticulate, apex rounded, terminated by a relatively large glandular cell, centrally clathrate with a translucent marginal zone consisting of 2—4 rows of cells. — Fronds widely spaced, articulated to the rhizome, pinnatipartite. Sterile fronds 20—55 cm long; petiole 2—15 cm long; lamina index 0.6—1.3, widest usually somewhat below the middle, 15—40 x 17—40 cm; lobes 4—14, spaced up to 4 cm, straight, index 8—20, widest usually at the middle, 5—25 x 0.4—3.5 cm, margin entire, apex acute; the lamina at the sinuses above the two lowermost lobes 0.5—2 cm wide; terminal segment, index 6—14, 3—30 x 0.7—4 cm. Venation: Veins anastomosing, rhachis and secondary veins prominent, other veins immersed, the largest areoles polygonal, consisting of smaller areoles containing simple or branched, ex- and recurrent free included veinlets; see also Fig. 1a. Fertile fronds 20—40 cm long; petiole 5—17 cm long; lamina, index 0.8—1.5, 15—35 x 12—50 cm; lobes 2—14, spaced up to 6 cm, index 20—100, 8—24 x 0.2—0.7 cm; terminal segment, index 20—40, 10—20 x 0.3—0.8 cm; venation indistinct; sporangia polypodiaceous, intermixed with 2—4-celled receptacular paraphyses which are terminated by a glandular cell. Spores microsorioid, 70—85 x 45—60 x 45—60 µm, exospore thin, perispore inconspicuous.

Habitat: In wet mountain forests, epiphytic on trees and tree trunks (up to 5 m high). Altitude 300—1100 m.

Distribution: New Caledonia: Mé Ammeri, Mé Aoui, Mé Arembo, Col d'Amieu, Plateau de Dogny, Canala, Balade, Poila, Ou Hinna.

Specimens studied: *Balansa 1579* (P); *Baudouin s.n.* (P); *Baumann-Bodenheim & Guillaumin 5441* (P), *8777* (P), *8788* (P), *8892* (P); *Lécard s.n.*, s. loc. (P); *M. & Mme Le Rat 63* (P), *958* (P); *Mackee 5646* (P), *6558* (P); *Mazagot s.n.* (P); *Herbier Pancher 98* (= *Vieillard 98?*) (P), *1526* (= *Vieillard 1526?*, P, p.p.; see note 1); *Schlechter 15612* (B, P); *Vieillard 1525* (P, p.p.; see note 2), *1526* (P, p.p.; see note 1), *1528* (P, not B).

Note 1: The collection *Vieillard 1526* at Paris constitutes a mixture. It comprises two specimens of *Microsorium varians*, one from Poila (erroneously chosen as lectotype by BROWNLIE), the other from Balade, apart from one specimen of *Microsorium latilobatum* from Poila. Three specimens from the herbarium of PANCHER (P) annotated with "*1526*" only, are likely to represent collections made by VIEILLARD. One of these represents *Microsorium varians* and is without a locality record. The other two represent *Microsorium latilobatum*, of which only one has a locality record, viz. Wagap.

Note 2: The collection *Vieillard 1525* at Paris constitutes a mixture. It comprises three specimens of *Microsorium varians*, all from Balade apart from a specimen representing *Microsorium latilobatum* (annotated: *Vieillard* "No. *1525* = *1526—1528*") from Wagap.

2. Microsorium latilobatum Hennipman & Hetterscheid, **stat. and spec. nov.** — Fig. 1b.

Acrostichum varians Mett. f. *major* Mett., Ann. Sci. Nat. Bot. Sér. 4, 15 (1861) 57. — Type: *Vieillard 1528* ("«Poila» (*1528*)") (B; not P which is *M. varians*).

[*Leptochilus varians* (Mett.) Fourn. var. α ("var. α: *lobis latioribus*"), Bull. Soc. Bot. France 16 (1869) 394, nom. nud. — *Leptochilus varians* (Mett.) Fourn. var. α ("var. α: pinnis latioribus"), Ann. Sci. Nat. Bot. Sér. 5, 18 (1873) 273, nom. nud.].

[*Leptochilus varians* (Mett.) Fourn. var. "α: *pinnis latioribus*" auct, non Fourn.: Bonaparte, Notes Ptérid. 13 (1921) 252 p.p., nom. nud.].

Usually epiphytic, sometimes epigeous or epilithic. Rhizome stout, long-creeping, flattened, 0.5—1.5 cm Ø, densely set with scales; scales peltate, elongate, acute to acuminate, index 1.3—5, 2.0—8.0 x 1.0—2.5 mm, base

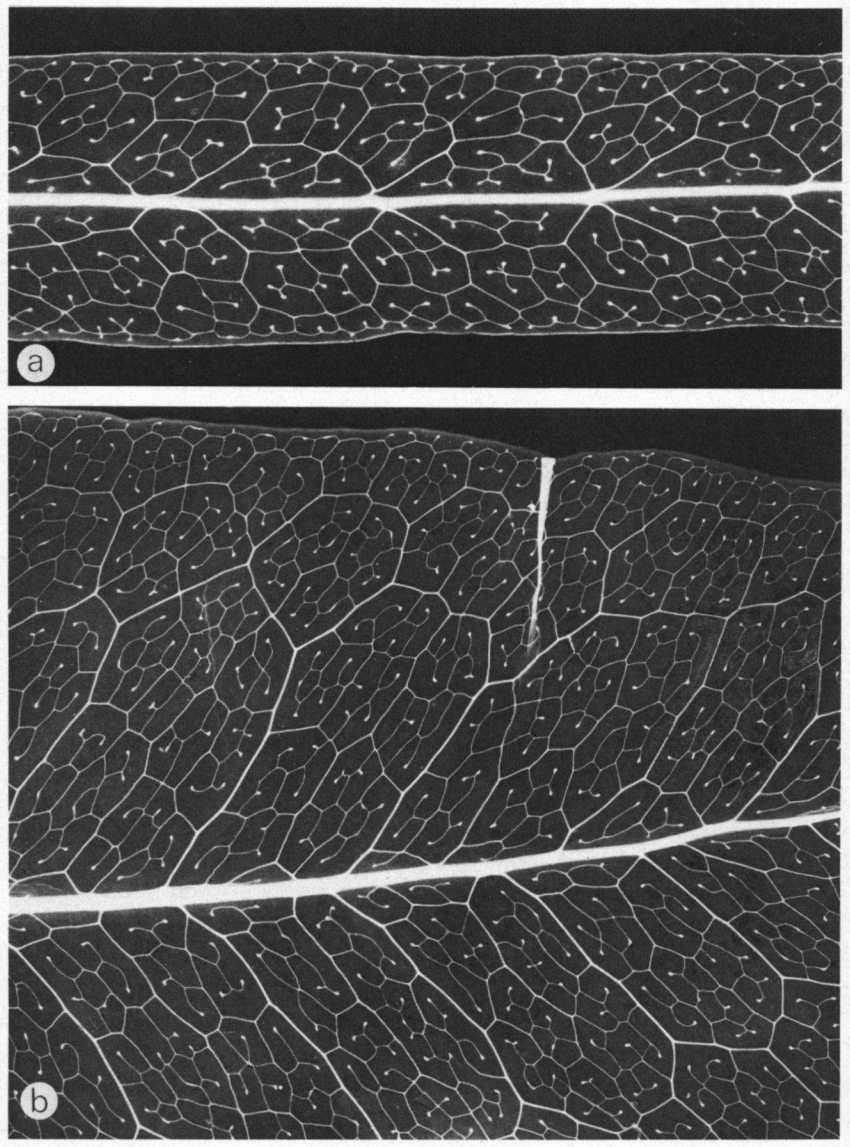

Fig. 1. Projection photography of venation pattern of the central part of sterile lobes. — a, *Microsorium varians* (*Balansa 1579*, P). — b, *M. latilobatum* (*Vieillard 1526*, P, p.p.).

rounded to tridentate, margin irregularly denticulate, provided with glandular cells, marginal teeth translucent or partly clathrate, each terminated by a glandular cell, apex of scale acute, terminated by a relatively large glandular cell, centrally clathrate with a translucent marginal zone consisting of 1—2 rows of

cells. — Fronds widely spaced, articulated to the rhizome, pinnatipartite. Sterile fronds 15—75 cm long; petiole 4—25 cm long; lamina index 1—1.6, widest usually at the middle, 20—50 x 20—40 cm; lobes 2—10, spaced up to 5 cm, straight, index 3—6, widest usually above the middle, 7—23 x 1.8—5.5 cm, margin entire, apex broadly obtuse; the lamina at the sinuses above the two lowermost lobes 0.5—3.0 cm wide; terminal segment, index 3—5, 15—25 x 3—7 cm. Venation: veins anastomosing; rhachis, secondary, and part of the tertiary veins prominent, other veins immersed, the tertiary veins forming large-sized areoles, which are subdivided into variously sized smaller areoles containing simple or branched, ex- and recurrent free included veinlets; see also Fig. 1b. — Fertile fronds 15—50 cm long; petiole 2.5—15 cm long; lamina, index 0.8—1.5, 10—40 x 12—45 cm; lobes 2—8, spaced up to 8 cm, index 20—65, 3—20 x 0.3—0.8 cm; terminal segment, index 15—50, 8—16 x 1.3—1.0 cm; venation indistinct; sporangia polypodiaceous, intermixed with 4—5-celled receptacular paraphyses which are terminated by a glandular cell. Spores microsorioid, 50—60 x 30—40 x 30—40 µm, exospore thin, perispore inconspicuous.

Habitat: In wet mountain forests, usually epiphytic (up to 12 m high), sometimes epigeal or epilithic. Altitude 300—800 m.

Distribution: New Caledonia: Mt. Mi, Mé Aoui, Col de Parari, Col d'Amieu, Plateau de Dogny, Mépéou Forest, Yahoué Forest, Tendia Forest, Pic Noir Forest, Wagap, Nimbayes, Balade, Houailou. — Loyalty Islands: Maré Island.

Specimens studied: *Balansa 799* (P); *Baudouin 4* (P), *Cribs 453* (P), *Franc 656* (P), *686* (P), *1081* (P), *s.n.* (Ros., Fil. Nov. Cal. exsicc. no. 32) (B, P); *Germain s.n.* (P); *Guillaume & Baumann-Bodenheim 10247* (P), *10415* (P); *M. & Mme. Le Rat 74* (P); *Mackee 4777* (P), *7953* (P), *8170* (P), *12043* (P), *12141* (P), *14420* (P); *Montrouzier 250* (P); Herbier Pancher "1526" (= *Vieillard 1526?*, P, 2 sh.; see note 1 to *Microsorium varians*), Anon. *s.n.*, s. loc., s. dat. (P); *Vieillard 1525* (P, p.p.; see note 2 to *Microsorium varians*), *1526* (P, p.p.; see note 1 to *Microsorium varians*), *1528* (B, not P).

4. Discussion

In an extensive discussion on *Christiopteris*, COPELAND (1917) gave ample reasons that justified the recognition of *Leptochilus tricuspis* as a second species of *Christiopteris*, also mentioning the results of the anatomical studies on this species by BOWER (1917). The similarities between both *Christiopteris sagitta* and *Christiopteris tricuspis* mentioned included small, simple, or branched paraphyses; diplodesmic venation; peltate rhizome-scales drawn out into a long hair-like apex. To this can be added the resemblance in venation pattern of the sterile fronds of the two species, being a complex pattern of areole-layering.

The inclusion of *Leptochilus varians* as a third species of *Christiopteris* by COPELAND at the same time seemed primarily based on the resemblance of the (rather weak) diplodesmic venation, the "translucent" scale margin, and the acrostichoid condition.

Our results given above confirm the justification of the genus *Christiopteris* as consisting of *Christiopteris sagitta* and *Ch. tricuspis*, at the same time refuting the inclusion of *C. varians*. The relationship of *Christiopteris* in this restricted sense to other genera of Polypodiaceae is under investigation.

The species formerly called *Christiopteris varians* consists of two inferred sister species which both occur exclusively in New Caledonia. They have been accommodated in *Microsorium*. The resemblance of these two species to species of the *Microsorium* alliance is especially born out by the character states of *Microsorium latilobatum*. The paraphyses of the latter species are similar in shape to those occurring in species of e.g. *Lecanopteris, Phymatodes* (viz. *P. scolopendria, P. cromwellii,* and *P. subgeminatum*; BAAYEN & HENNIPMAN, in prep.); the venation pattern shows a resemblance to that of e.g. *Phymatodes nigrescens, P. commutatum, Microsorium bamlerianum, M. sablanianum,* etc. (which all have "normal" paraphyses), cf. HETTERSCHEID & HENNIPMAN 1984; the spores of both *Microsorium varians* and *M. latilobatum* are of the microsorioid type (HENNIPMAN & ROOS 1983), a spore type occurring in the greater part of the species of *Microsorium*, and in part of the species of *Phymatodes* (e.g. *P. nigrescens,* but not in *P. scolopendria* which has the lepisorioid spore type). The relationship of *Microsorium latilobatum* and *M. varians* to one species or a species-group in the *Microsorium* alliance, using the characters mentioned above, remains ambiguous.

We wondered whether atavistic fronds of these acrostichoid ferns might suggest a relationship to a specific element in *Microsorium* s.l. Very informative atavistic fronds of other polypods do give information which is essential for the reconstruction of phylogenetic relationships, e.g. the atavistic fronds of *Paraleptochilus (Leptochilus) decurrens* compared to soral conditions generally found in *Colysis* (HETTERSCHEID & HENNIPMAN 1984). Further, soral instability which is possibly associated with the development of acrostichoidy is found in e.g. *Phymatodes commutatum* and *Microsorium bamlerianum*. However, the atavistic fronds of *M. varians* studied (*Vieillard 1526*, B, P) do not show a condition which recalls one of the soral situations as generally found in *Microsorium* s.l..

As regards the relationship between *Microsorium varians* and *M. latilobatum* it should be noticed that the spores of *M. varians* are significantly larger-sized than those of *M. latilobatum*. The suggestion usually made in cases like this, that these differences are possibly due to polyploidization — which automatically qualifies the differentiating characterstates of *M. varians* as automorphies —, is supported by the characterstates of the paraphyses, venation pattern, etc. when applying the out-group rule in a general way (HENNIPMAN & ROOS 1983). If the suggestion of (auto?)-polyploidy is true, we have a

unique case of two sister-species endemic to a rather small island, showing a large number of differences in characterstates. This should be a promising research object for the study of processes and strategies of speciation in tropical ferns.

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