

Typification and Relationships of *Cheilanthes incisa* (Pteridaceae)

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ABSTRACT.—*Cheilanthes incisa*, a small and rare endemic fern of Rio de Janeiro State (Brazil), was described in 1859. *Hypolepis serrata*, published ten years later, is usually considered a taxonomic synonym. Both names have typification problems, addressed here by designation of a neotype for *C. incisa* and selection of a lectotype of *H. serrata* from among Glaziou materials cited by Fée. Epidermal characteristics and spores of *C. incisa* are described for the first time and their diagnostic value assessed. Taxonomic relationships between *C. incisa* and putatively related cheilanthoid ferns are also discussed.

During preparation of the pteridophyte Catalog of the Southern Cone of South America we detected taxonomic and typification problems involving *Cheilanthes incisa* Kunze ex Mett. and *Hypolepis serrata* Fée. According to Mynssen & Windisch (2002), *Cheilanthes incisa* is a small fern endemic to Rio de Janeiro State, Brazil. *Hypolepis serrata*, described by Fée (1869) in the *Cryptogames vasculaire du Brésil v. 1*, is very similar morphologically and was considered a synonym of *C. incisa* by Baker (1872). Both names have typification problems. The protologue of *C. incisa* mentions one specimen (without collector and now lost) from Serra da Estrella, Rio de Janeiro. The original description of *H. serrata* cited two syntypes (*Glaziou 929* and *2336*) and requires selection of a lectotype to stabilize application of the name.

According to Mettenius (1859), *Cheilanthes incisa* is closely related to *C. californica* (Hook.) Mett. and *C. schimperi* Kunze because all three species have dentate segments. Most recent treatments (Lellinger, 1968; Smith, 1975; Mickel and Smith, 2004) have assigned *C. californica* to *Aspidotis* (Nutt ex Hook.) Copel., a small genus confined of the western USA and Mexico. *Aspidotis* can be recognized by dentate-mucronate segments and striate lamina. *Cheilanthes schimperi* has a paleotropical distribution (Africa and Madagascar) and it was included in *Aspidotis* by Pichi-Sermolli (1950) because of its similar morphology.

In this paper we review the typification of *Cheilanthes incisa* and *Hypolepis serrata* and discuss the similarities and differences between *C. incisa* and related species based on the morphology of the sporophyte and spores.

MATERIALS AND METHODS

To clarify the typification of *Cheilathes incisa* and *Hypolepis serrata* we examined materials from B, HBG, K, LE, R, RB, and P. The following specimens from K, MO, UC, RB, and SI were used for studies of spore and sporophyte morphology.

Aspidotis californica (Hook.) Nutt. ex Copel.

SPECIMENS STUDIED.—UNITED STATES. **California:** Butte County, in mosses in rock crevices, embankment of Macabes Creek, ca. 1300 ft., 19 Feb 1980, *M. S. Taylor 2393* (MO); Tehama County, Paynes Creek Recreation Area located ca. 1.5 mi northeast of the Bend Bridge over the Sacramento River, ca. 6.5 miles north-northeast of Red Bluff, occasional in crevices in basalt outcrops in *Quercus wislizenii-Pinus sabiniana* woodland, 9 May 1991, *V. H. Oswald & L. Ahart 4564* (MO); Butte County, along trail to Feather Falls, ca. 5 mi N of the town of Feather Falls, yellow pine forest, granite rocks, 600 m, 28 May 1983, *L. Ahart, E. Ahart & M. Baer 4023* (MO); Devils Kitchen, Upper Bidell Park, 900 ft., dry crevices of rocks cliffs, basaltic cliffs, 14 Jan 1983, *M. S. Taylor 5213* (MO); Santa Catalina Island, Avalon, cañon, 1897, *B. Trask 5* (MO).

Aspidotis densa (Brack.) Lellinger

SPECIMENS STUDIED.—UNITED STATES. **California:** 10 Apr 1934, *L. L. Brown 1* (MO); Tulare County, Sequoia National Park, between Franklin Pass and Kern River, 8400 ft., crevices among granite boulders, trail, 23 Jul 1942, *R. S. Ferris & L. Lorraine 10792* (MO); Del Norte County, Mill Creek, 27 Jun-1 Jul 1922, *L. R. Abrams 8423* (MO); Mts. about the head waters of Sacramento River, rocky places, 3 Sep 1882, *C. G. Pringle 2778* (MO).

Aspidotis meifolia (D. C. Eaton) Pic. Serm.

SPECIMENS STUDIED.—MEXICO. **San Luis Potosí:** near Los Canos, 15–21 Oct 1902, *E. Palmer 264* (MO); **Nuevo León:** Sierra Madre above Monterrey, 3000 ft., shaded banks, 8 Jun 1888, *C. G. Pringle 1987* (MO), 27 Aug 1903, *C. G. Pringle 11778* (MO, SI); **Coahuila:** Mun. Muzquiz, Rancho Agua Dulce, wooded canyon on the east slope of the Sierra de San Manuel, 28 Jun 1936, *F. Lyle Wynd & C. H. Mueller 350* (MO). Tamaulipas, oak forest on Jaumave road about 13 miles southwest of Ciudad Victoria, rough limestone mountainsides near summits of Sierra Madre, ca. 100 m, abundant, 13 May 1949, *R. McVaugh 10516* (MO).

Cheilanthes incisa Kunze ex Mett.

SPECIMENS STUDIED.—BRAZIL. **Rio de Janeiro:** Mangaratiba, Reserva Ecológica Rio das Pedras, trilha Toca da Aranha, 350 m, local sombrio e úmido na mata densa de encosta, rupícola, ciófila, 4 Nov 1997, *J. M. A. Braga et al. 4427* (RB); Rio de Janeiro, Jan 1881, *A. Glaziou 12289* (K); Sierra dos Orgãos, Dec 1891, *Ule 17929* (UC); “Brasilia”, *Riedel 1822* (K).

Cheilanthes schimperi Kunze

SPECIMENS STUDIED.—MALAWI. Southern, Mt. Mulanje foot - Likabula Valley, 900 m, little fern, up to 30 cm tall, rhizome surrounded by a dense mass of roots, localized on shady road bank, nearby are *Actiniopteris dimorpha*, *Adiantum phillipense*, *Pellaea* spp., 20 Feb 1989, J. D. & E. G. Chapman 9498 (MO); North Region, Rumphi District, Livingstonia escarpment, 1000 m, growing on shady bank, 25 Jan 1986, I. F. La Croix 3594 (MO). DEMOCRATIC REPUBLIC OF CONGO (ZAIRE). Katanga (Shaba Meridional) Rivière Mabondo Route Mupala Kindalo entre Ifunda & Malashi, 1290 m, termitière en forêt galerie, 4 Apr 1987, A. Bodenghien & F. Malaisse 2324 (MO); Katanga (Shaba Meridional) Kintu 27°28'E 11°49'S 1250 m Termitière 1Feb 1985 A. Bodenghien & F. Malaisse 46 (MO). ZAMBIA. Southern Prov., Mazabuka Distr., Kafue Gorge below Kafue Dam, 15°48'S, 28°25'E, 950 m, humid, shaded slope in woodland, 30 Dec 1971, J. Kornás 6741 (MO).

Morphological studies.—Several fronds were bleached with NaOH (5%) and sodium hypochlorite solution (5%), stained and mounted in glycerin jelly. The observations and illustrations were made using the light microscope Wild M20 and stereomicroscope Willd M5 both with camera lucida drawing.

Spores.—Spores obtained from dry herbarium specimens in the list were studied by light microscopy (LM) and scanning electron microscopy (SEM). For LM the spores were treated with 3% hot sodium carbonate for 2 min and acetolysed according to Erdtman (1960). For SEM the material was treated with 3% hot sodium carbonate for 2 min, washed with distilled water, dehydrated, suspended in 96% ethanol, and then transferred to acetate plates. After drying these were coated with gold. All of the observations were performed with a BH2 light microscope and a JEOL JSMT-100 scanning electron microscope at the Facultad de Ciencias Naturales y Museo de La Plata.

RESULTS

Typification.—The syntypes of *Hypolepis serrata* were located at B, HBG, K, and P. At K, among the specimens identified and cited by Baker in the *Flora Brasiliensis*, we found one specimen (*Glaziou 2336*) with two labels: one containing the name *H. serrata* and another with *C. incisa*. For Baker, the latter epithet was the correct name for this material. There is an isosytype, *Glaziou 929*, in HBG but we could not study it; we only located a photograph in BM. Based on this information, we chose the authentic specimen, *Glaziou 2336*, that we had seen and studied at K and P, as the lectotype of *Hypolepis serrata*.

No authentic type material of *Cheilanthes incisa* or any other old annotated specimen by Mettenius or Kunze were found in the European herbaria. According to the TL-2 (Stafleu and Cowan, 1981) the types of species described by Mettenius and Kunze housed at LZ were destroyed during the Second World War. Thus, for *Cheilanthes incisa* we selected a neotype, which is from the same area and district as the original Glaziou. The taxonomic summary is as follows.



JARDIM BOTÂNICO DO RIO DE JANEIRO

Herb. N.º 42471
 Fam. Pteridaceae
Cheilanthes incisa Kunze ex Mett.
 Proced. Est. do Rio. Teresopolis. Grutaão 800 m.
 Obs. Nas pedras
 Col. Brade 16288
 Data 13. VI. 1940

FIG. 1. At top. Lectotype of *Hypolepis serrata* Fée, Glaziou 2336 (K). At bottom. Neotype of *Cheilanthes incisa* Kunze ex Mett., A. C. Brade 16288 (duplicate at SI).



FIG. 2. Lamina and epidermal characteristics. A–B. *Aspidotis californica* (Hook.) Nutt. ex Copel. C. *Aspidotis densa* (Brack.) Lellinger. D–E. *Aspidotis meifolia* (D. C. Eaton) Pic. Serm. F–G. *Cheilanthes incisa* Kunze ex Mett. H–I. *Cheilanthes schimperi* Kunze.

Cheilanthes incisa Kunze ex Mett., Cheil. 44 no. 65, tab. 3, fig. 28–31. 1859. Neotype (here designated): BRAZIL. RIO DE JANEIRO: Mun. Teresópolis, Grotão, 800 m, nas pedras, 13 Jun 1940, A. C. Brade 16288 (RB, duplicate at SI).

Hypolepis serrata Fée, Cr. vasc. Br. 1. 53, tab. 13, fig. 3. 1869. Lectotype (here designated): BRAZIL. RIO DE JANEIRO: A. Glaziou 2336 (K; duplicates at B, P). (Fig. 1).

Morphological characteristics and taxonomic affinities.—*Aspidotis* (sensu Smith, 1975) is distinguished from most other cheilanthoid ferns by having striate lamina surfaces. This striation is formed by epidermal cells that are elongate and parallel with thickened walls. These aspects can be observed in

TABLE 1. Comparative spore characteristics of the studied taxa.

	<i>Cheilanthes incisa</i>	<i>Aspidotis californica</i>	<i>Aspidotis densa</i>	<i>Aspidotis meifolia</i>	<i>Cheilanthes schimperii</i>
Characteristics					
Shape	subglobose, tetrahedral-globose	subglobose	globose	globose	globose
Color	light yellow	dark brown	brown, light brown	light brown	light brown
Equatorial diam.	34–35 μm	51–60 μm	43–45 μm	32–46 μm	40–48 μm
Polar diam.	27–34 μm	45–48 μm	40–50 μm	34–39 μm	36–58 μm
Perispore thickness	1–2 μm	2–3.5 μm	1–3 μm	2–3 μm	3–4.5 μm
Perispore Structure					
Surface	rugulate, rugulate-cristate	rugulate-cristate	rugulate-cristate	reticulate, reticulate-cristate	cristate-reticulate
Cristae	0.5 μm , isolated	1.5 μm	2 μm	1–1.5 μm	2–4 μm
Outer stratum	continuous	continuous	continuous	discontinuous	continuous
Middle stratum	interwoven threads	interwoven threads	interwoven threads	interwoven threads	interwoven trabeculae
Inner stratum	thin, continuous	thin, continuous	thin, continuous	thin, continuous	thin, continuous

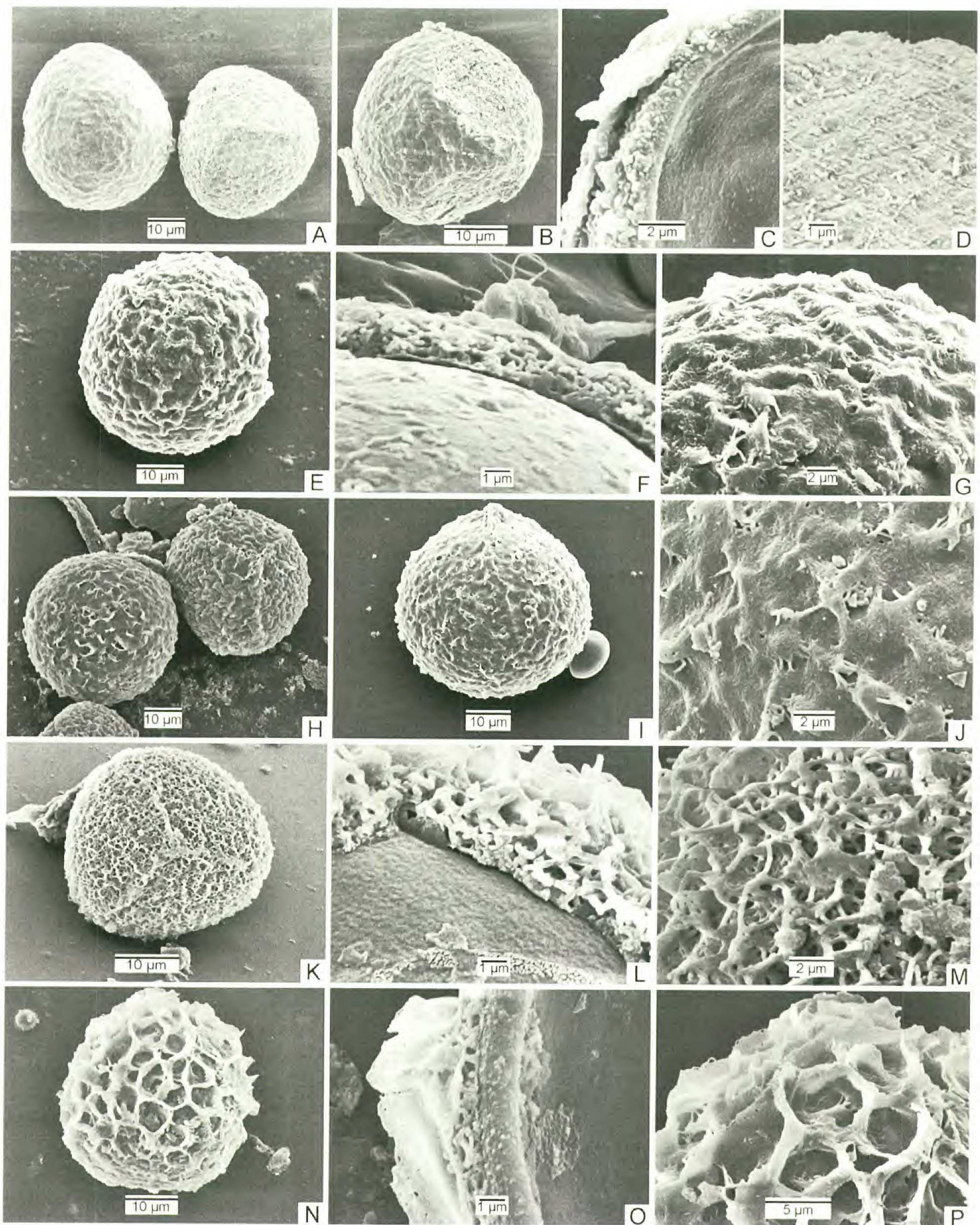


FIG. 3. Spores. A–D. *Cheilanthes incisa* Kunze ex Mett. A. Distal view. B. Equatorial view. C. Fracture of the sporodermis. D. Detail of the surface, Braga et al.4427 (RB). E–G. *Aspidotis californica* (Hook.) Nutt. ex Copel. E. Distal view. F. Fracture of the sporodermis. G. Detail of the surface, Oswald & Ahart 4564 (MO). H–J. *Aspidotis densa* (Brack.) Lellinger. H. Distal and proximal view. I. Equatorial view. J. Detail of the surface, Ferris & Lorraine 10792 (MO). K–M. *Aspidotis meifolia* (D. C. Eaton) Pic. Serm. K. Distal view. L. Fracture of the sporodermis. M. Detail of the surface, Wynd & Mueller 350 (MO). N–O. *Cheilanthes schimperi* Kunze. N. Distal view. O. Fracture of the sporodermis. P. Detail of the surface, Bodenghieu & Mubala 2324 (MO).

A. californica (Hook.) Nutt. ex Copel., *A. densa* (Brack.) Lellinger, and *A. meifolia* (D. C. Eaton) Pic. Serm.(Fig. 2).

Although superficially similar to *Aspidotis* in the shape of the dentate-mucronate ultimate segments, *Cheilanthes incisa* and *C. schimperi* differ in having smooth (non-striate) laminae with sinuous, thin-walled epidermal cells and by the sori with lobate-laciniate pseudoindusia having erose or dentate margins (Fig. 2). Tryon and Tryon (1982) stated that the apparent morphological similarity of *C. schimperi* to the rest of their “*C. californica* Group” was due to morphological convergence, not to true relatedness, and they excluded *C. schimperi* from the group.

Other characteristics that distinguish *Cheilanthes incisa* from *Aspidotis* and *C. schimperi* are its erect rhizome and chartaceous or subcoriaceous lamina with hidden venation. *Cheilanthes incisa* occurs isolated in southeastern Brazil and no other species from Central and South America is morphologically similar to it.

Cheilanthes schimperi differs from *C. incisa* and *Aspidotis* species by its nodose rhizomes, membranaceous lamina with very thin mesophyll, and easily visible venation.

The spores of *Aspidotis* and *Cheilanthes* studied here are similar to the other cheilanthoid ferns such as *Argyrochosma* and *Pellaea*. The perispore with three layers is the main feature of the group (Morbelli and Michelena, 1989; Morbelli and Ponce, 1997; Morbelli *et al.*, 2001). The spore characteristics are summarized in Table 1 and SEMs of the spores are shown in Fig. 3. The studied material had some well-formed spores, but collapsed spores and spores intermediate between trilete and monolete were frequent.

DISCUSSION

Despite similarities between the dentate-mucronate lamina of *Cheilanthes incisa*, *C. schimperi* and *Aspidotis*, the former species lack the striate leaf tissue (formed by elongate epidermal cells with their thickened walls) and well-defined, scarious indusia characteristic of the latter genus. Our studies showed that the spores of *C. incisa* are slightly different from those of *Aspidotis* and *C. schimperi* as well. Although the palynological characteristics of the studied species are those of *Cheilanthes*, this genus is highly polymorphic (and polyphyletic; Smith *et al.*, 2006), and we are uncertain whether the observed spore features are indicative of a close relationship. Based on the morphological evidence here presented we retain *Cheilanthes incisa* and *C. schimperi* in *Cheilanthes*. However, the final decision regarding the correct generic placement of this species requires further study.

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