

Schistidium ignatovae (Grimmiaceae), a new species from Sichuan, China

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Schistidium ignatovae C. Feng, X.L. Bai, J. Kou & W. Li (Grimmiaceae) is described and illustrated as a new species from Sichuan Province, China. It closely resembles *S. trichodon*, but differs by the green to yellow-green plants; slightly flexuose, broadly and long-decurrent, denticulate leaf hair-point; narrower perichaetial leaves that have frequently narrowly recurved margins to 1/2–2/3 way up the leaf; shorter peristome teeth; and larger spores. The relationships of this new species with other species of *Schistidium* are discussed.

Schistidium (Grimmiaceae) is a taxonomically difficult moss genus (McIntosh 2007, Ignatova *et al.* 2009). For a long time, species of *Schistidium* were broadly interpreted, especially by Bremer (1980, 1981) who lumped a number of species described from all continents within *S. apocarpum*. That classification has however not been widely accepted (Cao & Vitt 1986, Smith 2004, McIntosh 2007).

The difficult taxonomic problems associated with *Schistidium* were coupled with nomenclatural ones, especially when Ochyra (1989) showed that the type species of this generic name, *S. pulvinatum*, was identical with *Grimmia anodon*. This made *Schistidium* congeneric with *Grimmia s. stricto* but the generic name was saved after acceptance of proposal to conserve the application of *Schistidium* in *Bryologia europaea* with the conserved type *S. maritimum* (Ochyra & Isoviita 1989). Since then the genus gained unanimous acceptance, and many species have since

been transferred from *Grimmia* to *Schistidium* (Ochyra 1998a, Ochyra & Muñoz 2000, Blom & Darigo 2009, Ignatova *et al.* 2009, Ochyra & Bednarek-Ochyra 2011a).

The species concept in *Schistidium* was vigorously tested and re-evaluated by Blom (1996, 1998), who put forward a revolutionary classification of the genus based on a narrower species concept, and that system has gained worldwide acceptance (Ochyra *et al.* 2003a, Smith 2004, McIntosh 2007, Ignatova *et al.* 2009). It has also been supported by recent molecular phylogenetic data (Goryunov *et al.* 2007, Ignatova *et al.* 2009). In the last decade, new species of *Schistidium* were continuously described from the Antarctic, South America, Europe, Asia and North America (Ochyra 1987, 1998b, 2003a, 2004, Blom & Lüth 2002, Blom *et al.* 2006, 2011, Ignatova *et al.* 2009, Ochyra & Afonina 2010, Ochyra & Bednarek-Ochyra 2011b).

In China, *Schistidium* was generally considered a subgenus or section within *Grimmia*: Chen (1963) recognized 3–4 species in China; Gao (1977) recognized four species in northeastern China; and Cao and Gao (1985) recognized two species in Tibet (Xizang). Cao and Vitt (1986) were the first to publish a taxonomical revision of *Schistidium* in China. They supported *Schistidium* as an independent genus and recognized six species in the country. Further investigations continued in many regions of China, including Shandong (Cao 1997, recognized one species), Inner Mongolia (Bai 1997, three species), the Hengduan Mountains (Cao 2000a, three species), the Helan Mountains (Bai 2010, two species), and the entire country (Cao 2000b, 2003, Cao *et al.* 2003, with seven, four and seven species, respectively). However, in all those treatments a broad concept of *S. apocarpum* was applied. Like elsewhere, in China the most controversial problem is the status of *S. strictum*. *Schistidium sinensiapocarpum* was considered to be conspecific with *S. strictum* by Cao and Vitt (1986), whereas Blom *et al.* (2006) considered the former to be a very distinct species with a wide European and Asian distribution. Recently, Blom *et al.* (2011) described two new species from China.

While attending the 2012 National Symposium of the Bryological Society of China, we were able to travel to the Dagu Glacier Nature Reserve and the adjacent regions in Sichuan Province. We collected ca. 100 specimens, some belonging to the genus *Schistidium*. Some of these specimens had a jet-black colour, muticous leaves, and long, dome-shaped peristomes, features that were highly characteristic of *S. trichodon* var. *trichodon*. Other specimens possessed also dome-shaped peristomes, but the teeth were shorter and the plants were green to yellow-green, with leaves having distinct, long hair-points. Subsequent detailed observations revealed further differences between these unique specimens and *S. trichodon*, which prompted us to describe a new species.

Schistidium ignatovae C. Feng, X.L. Bai, J. Kou & W. Li, *sp. nova* (Figs. 1–3)

TYPE: China. Sichuan Province, Dagu Glacier Nature

Reserve, on rock in *Rhododendron* forest, 3800 m a.s.l., 24 Aug. 2012 *Xue-Liang Bai* 201208056 (holotype HMC; isotype KRAM). — PARATYPE: China. Sichuan Province, Dagu Glacier Nature Reserve, on rock, 3300 m a.s.l., 24 Aug. 2012 *Jin Kou* 201208093 (HMC).

ETYMOLOGY: In honor of Elena A. Ignatova, a Russian bryologist.

Plants medium-sized, relatively robust, forming fairly loose to dense tufts, green to yellow-green in upper part, reddish-brown to brownish below. Stems erect to secund, 2–6 cm long, usually relatively long branched, in transverse section irregularly rounded on fertile branches and rounded on sterile branches, consisting of 2–4(–5)-stratose epidermis of small, thick-walled and orange cells, separated from large, thin-walled, hyaline medullary cells arranged in 3–4 layers; central strand narrow, composed of 10–15 small cells, present in fertile branches and absent from sterile branches. Leaves imbricate, erect-appressed, strongly concave, occasionally falcate-secund, ovate-lanceolate, sharply keeled, acuminate, 2.1–3.8 × 0.4–0.7 mm; hair-points sparsely, sharply toothed, 0.2–1.2 mm long, fairly flexuose on upper leaves, broken on lower leaves, longly and broadly decurrent on one or occasionally on both sides of leaf; costa percurrent to shortly excurrent, hemispherical in transverse section, distantly papillose-denticulate in upper 1/5–1/4 of the leaf length, bi- to tristratose in upper and middle part, 3- to 4-stratose in lower part. Margins irregularly denticulate below apex or smooth, narrowly recurved for most of leaf length except apex, bistratose in 1–2 rows on both sides of leaf or rarely tristratose in 1 row, unistratose in lower part. Leaf lamina smooth or rarely with one papillae on ventral side in extreme apex, unistratose; laminal cells moderately to strongly thick-walled, in upper and central part rounded, transversely rectangular or shortly oblong, straight to slightly sinuose, 7–8 μm wide, in lower parts oblong, strongly sinuose, 5–15 × 7–8 μm; basal cells rectangular, strongly thick-walled, chlorophyllose or subhyaline in a small juxtacostal group, 13–30 × 7–9 μm; basal marginal cells small, strongly thick-walled, chlorophyllose or subhyaline, short, oblate, isodiametrical, and shortly oblong, slightly sinuose. KOH reaction orange. Gonioautoicous. Perichaetial leaves erect to erecto-

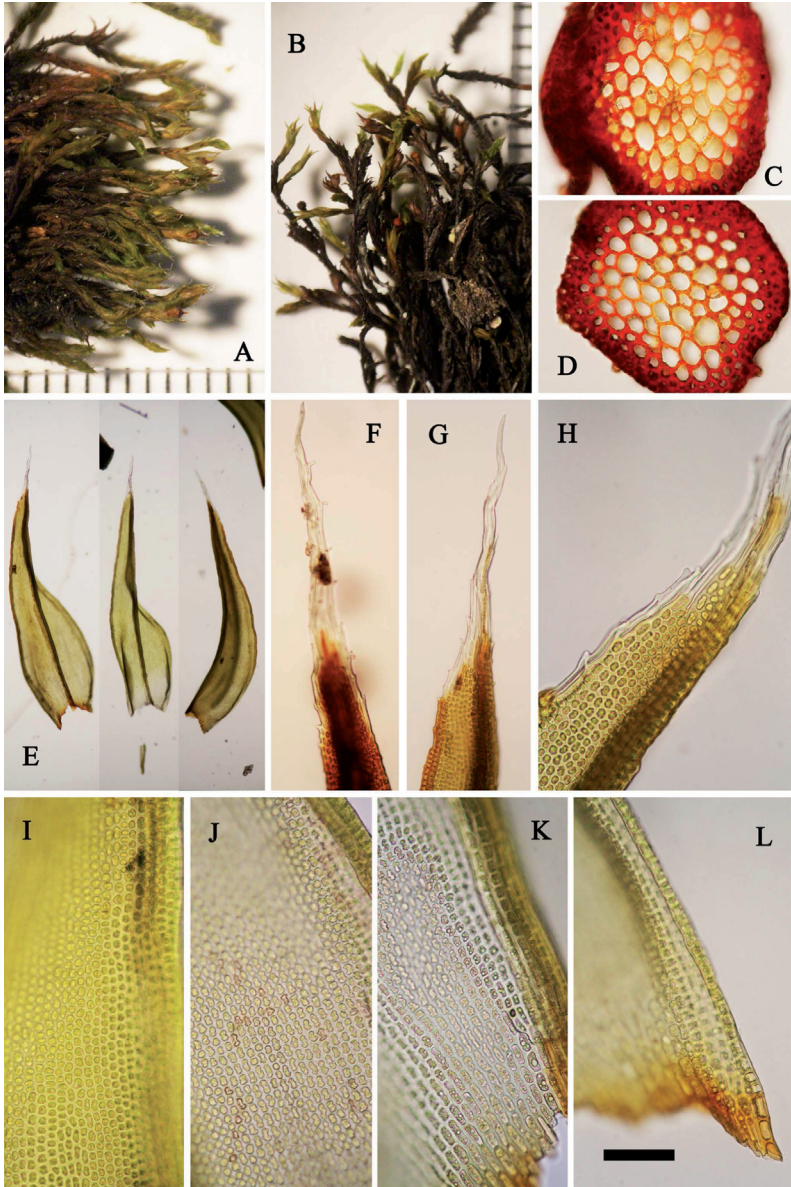


Fig. 1. — **A, C–L:** *Schistidium ignatovae* (from the holotype), **B:** *Schistidium trichodon* (from Xue-Liang Bai 201208042, HIMC). — **A and B:** Plant when dry (ruler scale in mm). — **C:** Cross-section of fertile branches. — **D:** Cross-section of sterile branches. — **E:** Leaves. — **F and G:** Hair-points. — **H:** Apical part of leaf. — **I:** Upper part of leaf. — **J:** Lower part of leaf. — **K:** Basal juxtacostal laminal cells. — **L:** Basal marginal laminal cells. Use transverse scale bar as $50\ \mu\text{m}$ for **C, D** and **H–L**; $0.5\ \text{mm}$ for **E**; $0.1\ \text{mm}$ for **F** and **G**.

patent, usually symmetrical, $2.9\text{--}4.1 \times 0.6\text{--}0.9\ \text{mm}$; hair-points coarsely spinulose-denticulate, $0.3\text{--}0.5\ \text{mm}$; margins nearly smooth, narrowly recurved in lower $1/2\text{--}2/3$ lamina length. Calyptra larger, mitriform, narrowly split at base in 4 lobes, nearly covering operculum. Sporophytes abundant, immersed; seta short, $0.32\text{--}0.44\ \text{mm}$; urn yellowish-brown, shortly obloid, $1.3\text{--}1.4 \times 0.6\text{--}0.7\ \text{mm}$, length/width ratio $1.8\text{--}2.3$; exothecial cells short, irregular in shape and varying in size, predominantly short, isodiametrical and

transversely elongate, $18\text{--}46 \times 18\text{--}36\ \mu\text{m}$, with thin or slightly thickened walls; stomata present; peristome teeth $400\text{--}450\ \mu\text{m}$, incurved when dry, gradually long-tapering, with very few narrow median slits below and perforated distally, very densely, spiculously papillose throughout, arranged in rows. Columella persistent in urn. Rostrum narrow, straight. Spores subspherical, smooth to granulate, $13\text{--}16\ \mu\text{m}$ in diameter.

HABITAT AND DISTRIBUTION: On rocks in *Rhododendron* forest, $3300\text{--}3800\ \text{m a.s.l.}$; known

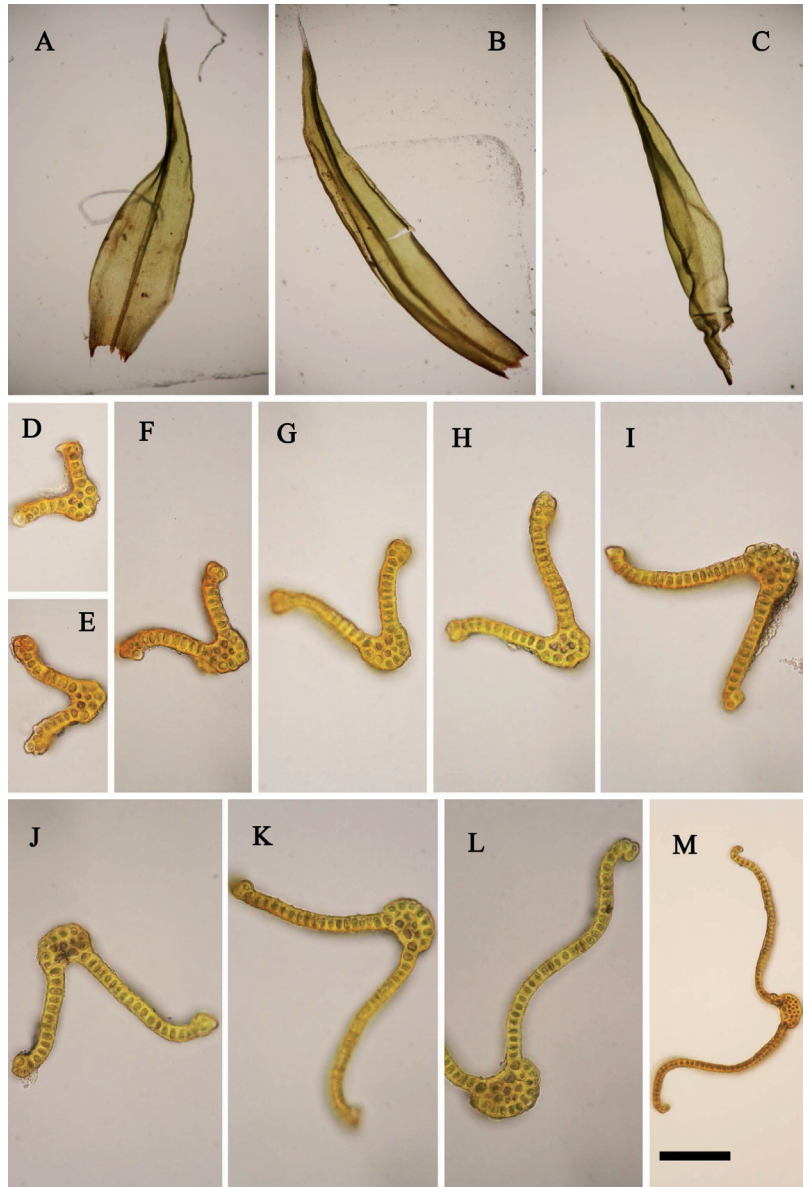


Fig. 2. *Schistidium ignatovae* (from the holotype). — **A–C:** Perichaetial leaves. — **D–M:** Cross-section of leaves, sequentially from apex to base. Use scale bar as 0.5 mm for **A–C**; 50 μ m for **D–L**; 0.1 mm for **M**.

only from the Dagu Glacier Nature Reserve, Sichuan Province, China.

Schistidium ignatovae is a distinct species although it closely resembles *S. trichodon*. The differences between the two species are summarized in Table 1.

The jet-black colour of *S. trichodon* is an important and stable character of this species (Cao & Vitt 1986, Blom 1996, Smith 2004, McIntosh 2007). The green to yellow-green colour that is typical of *S. ignatovae* does not

appear in *S. trichodon* var. *trichodon* and is occasional only in *S. trichodon* var. *nutans*, but *S. ignatovae* is a more robust plant.

Another remarkable character of *S. ignatovae* is its long, 0.2–1.2 mm, slightly flexuose, longly and broadly decurrent, denticulate hair-points. Hair points are absent or very short, to 0.18 mm in *S. trichodon*. According to Blom (1996), hair-point structure is one of the most important traits in the genus *Schistidium*. Additionally, that author regarded *S. trichodon* as

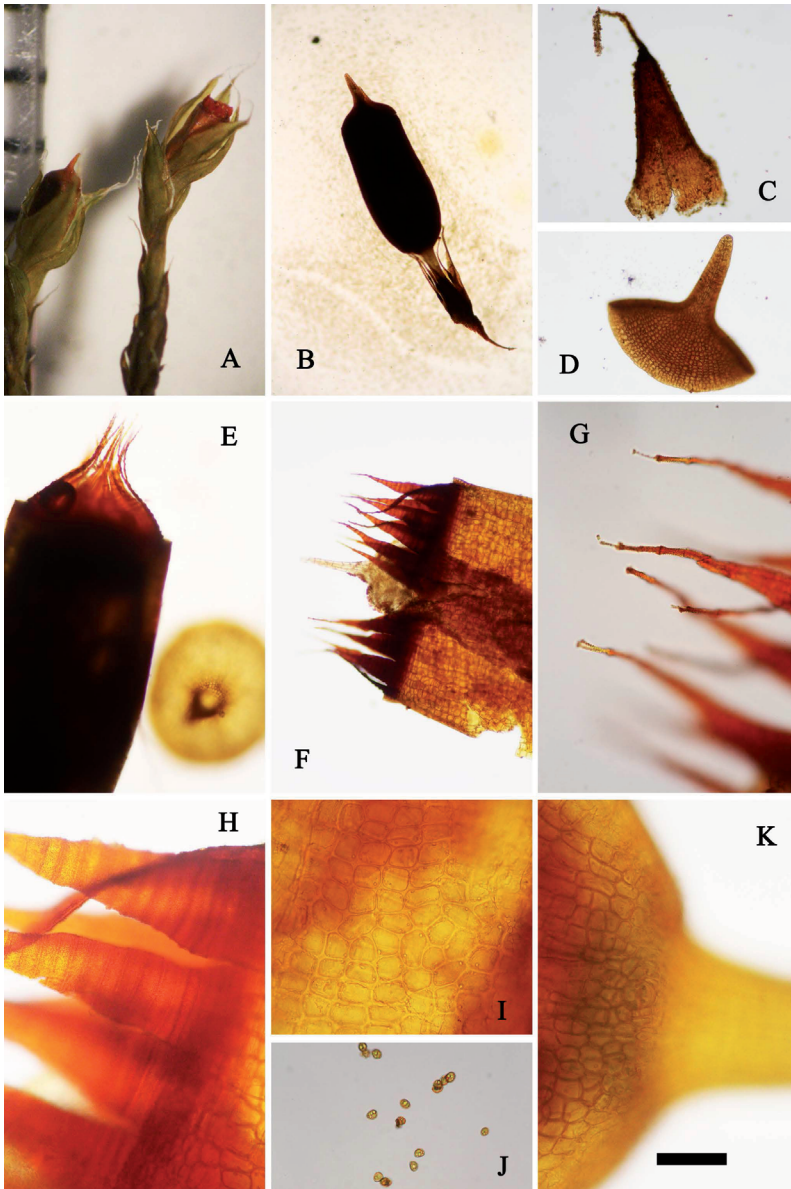


Fig. 3. *Schistidium ignatovae* (from the holotype). — **A**: Sporophyte when dry (ruler scale in mm). — **B**, **E** and **F**: Sporophyte when moist. — **C**: Calyptra. — **D**: Operculum. — **G** and **H**: Peristome teeth. — **I**: Exothecial cells (middle portion). — **J**: Spores. — **K**: Stomata. Use scale bar as 0.5 mm for **B**; 0.2 mm for **C**, **E** and **F**; 100 μm for **D**; 50 μm for **G** and **K**.

rather stenomorphic and much less variable with regard to the leaf margin, lamina thickness and hair-point length throughout its wide range covering Europe, eastern North America and Asia. The absent or short hair-points is a stable feature of *S. trichodon*, as can be demonstrated from known reports of its worldwide distribution area (Deguchi 1978, Bremer 1980, Cao & Vitt 1986, Blom 1996, 1998, Cao 2000b, Cao *et al.* 2003, Smith 2004, McIntosh 2007).

The plant colour and hair-point structure are distinctly different and readily separate the two species, even in the field. *Schistidium ignatovae* also possesses dome-shaped peristomes, but because the teeth are shorter than those of *S. trichodon*, the “dome” seems flat and low. The characteristic “columella attached to the operculum” is also a feature of *S. ignatovae*. The perichaetial leaves of *S. ignatovae* are much narrower and longer than those in *S. trichodon*, and

Table 1. Morphological differences among *Schistidium ignatovae*, *S. trichodon* var. *trichodon* and *S. trichodon* var. *nutans*.

	<i>S. ignatovae</i>	<i>S. trichodon</i> var. <i>trichodon</i>	<i>S. trichodon</i> var. <i>nutans</i>
Habit	relatively robust	slender to robust	slender
Plant colour	green to yellow-green	jet-black or brownish or greyish green	brownish, occasionally dull olivaceous
Central strand	narrow, composed of 10–15 small cells	absent	absent or occasionally with a narrow central strand composed of 2–6 small cells
Leaf size (mm)	2.1–3.8 × 0.4–0.17	1.7–2.6 × 0.5–0.7	1.5–2.2 × (0.35)0.5–0.7
Hair-points	long, flexuose, strongly decurrent 0.2–1.2 mm long	absent or very short, 0–0.18 mm long	absent or very short, 0–0.18 mm long
Margin	regularly bistratose for 1–2 rows on both sides	predominantly unistratose on one side	predominantly unistratose on one side
Perichaetial leaves	often symmetrically linear lanceolate from an elongated rectangular base; hair-points 0.3–0.5 mm; margins frequently narrowly recurved in lower 1/2–2/3 leaf length	often asymmetrical, ovate lanceolate; hair-points 0–0.1 mm; margins narrowly recurved in upper 1/3–3/4 of leaf length	often asymmetrical, ovate lanceolate; hair-points 0–0.1 mm; margins narrowly recurved in upper 1/3–3/4 of leaf length
Urn size (mm)	1.3–1.4 × 0.6–0.71	0.7–1.25 × 0.4–0.65	0.85–1.5 × 0.4–0.7
Length/width of urn	1.8–2.3	1.3–2.1	1.6–2.4
Peristome tooth size (mm)	0.40–0.45	(0.41)0.45–0.7	0.43–0.61
Papillae on peristome teeth	densely long papillose	finely and rather distantly short, papillose	densely short papillose
Spore diam. (µm)	13–15.6	9–12(13)	9–12(13)

the longer, decurrent and denticulate hair-points and frequently narrowly recurved margins in the lower 1/2–2/3 lamina length also distinguish *S. ignatovae* from *S. trichodon*.

Based on the characteristics described above, *S. ignatovae* should be assigned to the *apocarpum* subgroup *sensu* Blom (1996), or sect. *Apocarpiformia* (Ochyra *et al.* 2003b). A combination of gametophyte and sporophyte characteristics serves to distinguish *S. ignatovae* from congeners. When the material lacks sporophytes, it can be separated from *S. flexipile* by the longly decurrent and irregularly denticulate hair-points. The gametophyte characteristics of *S. ignatovae* are much more similar to those of *S. apocarpum*. The two species share similar structural characteristics of hair-points, narrowly recurved throughout, and a regularly bistratose margin distantly denticulate in the upper part. However, the lamina of *S. ignatovae* is unistratose

throughout, only rarely with one papilla on the ventral side of the leaf at the extreme apex, and the basal cell walls are very thick in a small juxtacostal group. In *S. apocarpum*, the lamina is unistratose, quite often with bistratose spots, and the basal cell walls are thin and not in a small juxtacostal group.

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