
Himalayopteris, a New Fern Genus from India and the Adjacent Himalayas (Polypodiaceae, Polypodioideae)

Wen Shao and Shu-Gang Lu

Institute of Ecology and Geobotany, Yunnan University, Kunming, Yunnan 650091, People's Republic of China. shaowen19792005@163.com

ABSTRACT. A new fern genus, *Himalayopteris* W. Shao & S. G. Lu (Polypodiaceae, Polypodioideae), is described and established based on the new combination *H. erythrocarpa* (Mett. ex Kuhn) W. Shao & S. G. Lu, for its only known species distributed in northern India, Sikkim, and the adjacent Himalayas. Evidence for its generic separation lies in its venation pattern, scale characteristics, leaf epidermis, sporangia, spore ornamentation, and chromosome number. Assessment of its IUCN conservation status with georeferenced localities places the new genus in the Vulnerable category.

Key words: Bhutan, China, *Himalayopteris*, India, IUCN Red List, Nepal, Polypodiaceae.

Polypodium erythrocarpum Mett. ex Kuhn (Polypodiaceae) was originally published in 1869 and was later treated as *Goniophlebium erythrocarpum* (Mett. ex Kuhn) Bedd. by Beddome in 1876. When analyzing the type specimen from Kew, we found that the venation of this species corresponds to the description of Beddome (1876, 1883) in having a goniophlebioid pattern and dichotomous or trichotomous included veinlets, as illustrated in Figure 1B. Goniophlebioid venation occurs only in subfamily Polypodioideae, while drynarioid venation presents in other subfamilies of Polypodiaceae. However, Ching transferred *G. erythrocarpum* from *Goniophlebium* C. Presl to the genus *Phymatodes* C. Presl (Ching, 1933), and then to *Phymatopsis* J. Sm. (Ching, 1964), in what is now the subfamily Selliguae in the Polypodiaceae, because of its nonclathrate rhizome scales and the nonarticulation of the rachis, which differs from that seen in *Goniophlebium*. From examination of additional specimens in PE and HITBC, we confirm that the characteristics of the scales and rachis are as described by Ching in 1933, as shown in Figure 1D. Nonclathrate rhizome scales and nonarticulation of the rachis are distinguishing characteristics of this species.

Due to problems concerning the application of *Phymatodes* and *Phymatopsis*, Pichi Sermolli (1973) transferred *Phymatopsis erythrocarpa* to *Phymatopteris erythrocarpa* (Mett. ex Kuhn) Pic. Serm., but

Japanese botanists treated *Phymatopteris* Pic. Serm. as a synonym of *Crypsinus* C. Presl (Nakaïke, 1987). Rödl-Linder (1990) accepted this synonymy, with other species of *Phymatopteris* and *Crypsinus* assigned to *Selliguea* Bory in her monograph on *Goniophlebium*. Lu (2000) supported the prior treatment of Pichi Sermolli (1973), while Hovenkamp (1998) further treated *Phymatopteris* and *Crypsinus* as synonyms of *Selliguea*. Fraser-Jenkins (2008) separated this and certain other species from *Selliguea* as the genus *Pichisermollia* Fraser-Jenk. (non *Pichisermollia* H. C. Monteiro), now *Pichisermollodes* Fraser-Jenk. (Fraser-Jenkins, 2009). However, until now no one has separately recognized the individual species *P. erythrocarpa* generically.

During examination of the spores, leaf epidermis, and sporangia of this species under light microscope (LM) and scanning electron microscope (SEM), we found that the spores have slightly verrucate ornamentation (Fig. 1E) and that many trichomes are present on both sides of the leaf epidermis (Fig. 1C). We also found that this species has a setose sporangium, which rarely occurs in species of the Polypodiaceae.

The chromosome number of *Phymatopteris erythrocarpa* was reported from India by Malhotra in Mehra (1961: 162) as $x = 37$ (cited by Löve et al., 1977: 57, as $2n = 74$). This basic number is prevalent in subfamily Polypodioideae, but rare in *Phymatopteris*. No suitable material was available to cytologically investigate for this study, and the chromosome count needs further confirmation.

The lack of articulation in the rachis excludes this species from *Goniophlebium* (including *Schellolepis* J. Sm.), and the nonclathrate scales distinguish it from *Polypodiodes* Ching (including *Polypodiastrum* Ching). The goniophlebioid venation pattern and the basic chromosome number exclude this species from *Phymatopteris* and prevent the inclusion of this species in *Selliguea*. Because *Phymatopteris erythrocarpa* does not fit comfortably in any existing genus of the Polypodiaceae, we think it best to recognize this distinctive taxon at the genus level.

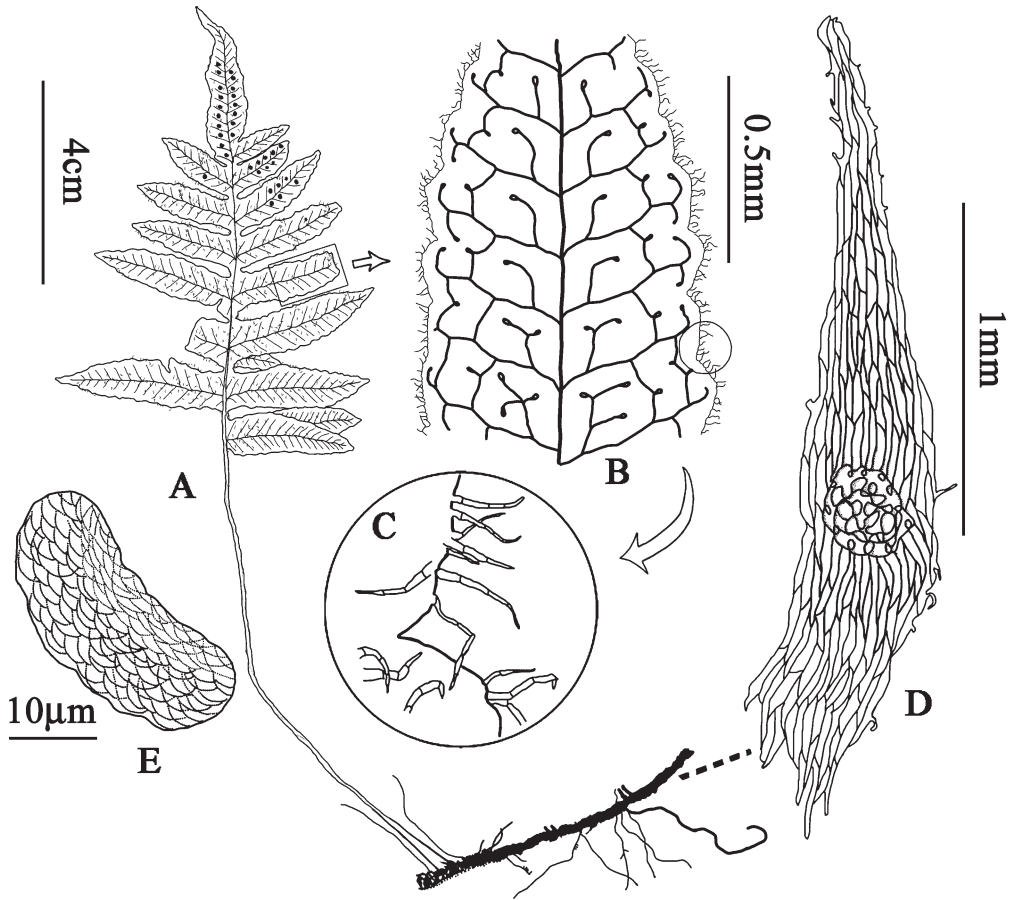


Figure 1. *Himalayopteris erythrocarpa* (Mett. ex Kuhn) W. Shao & S. G. Lu. —A. Frond. —B. Venation pattern. —C. Trichomes on lamina. —D. Scale. —E. Spore. Drawn from *Qinghai-Xizang Exped. 3998* (PE).

Himalayopteris W. Shao & S. G. Lu, gen. nov.

TYPE: *Polypodium erythrocarpum* Mett. ex Kuhn [= *Himalayopteris erythrocarpa* (Mett. ex Kuhn) W. Shao & S. G. Lu]. Figure 1.

Genus novum quoad paleas non clathratas, rhachim ad laminae basim non articulatum etiam soros rotundos *Phymatopteridi* Pic. Serm. affine, sed ab ea numero chromosomatum $x = 37$, venatione goniophlebioidea atque areolis praesentibus distinguitur.

Rhizome long-creeping, 3–5 mm diam., bearing fronds 1–3 cm apart; the rhizome scales linear-lanceolate, castaneous in their central portion, brown and somewhat ciliolate marginally, acuminate at apex. Fronds simple, stipe 5–15 cm, stramineous, very slender; lamina pinnatifid, rachis with narrow wings or wingless in lower parts; lobes usually 1–5 × 0.8–1.5 cm, apex acute, with conspicuous main veins and distinct lateral veins, costal areoles in 1 or 2 series, the lowest lateral lobe somewhat decurrent; venation type goniophlebioid; margins with distinct

small incisions or notches; texture subcoriaceous, with thick multicellular trichomes on both the abaxial and adaxial surfaces; apical part of lamina fertile, sori in a single series in the lower areoles.

Table 1 gives a comparison of the characteristics of the related genera of *Goniophlebium*, *Phymatopteris*, *Polypodiastrum*, *Polypodiodes*, and *Selliguea* with the new genus *Himalayopteris*.

Himalayopteris erythrocarpa (Mett. ex Kuhn) W.

Shao & S. G. Lu, comb. nov. Basionym: *Polypodium erythrocarpum* Mett. ex Kuhn, *Linnaea* 36: 135. 1869. *Goniophlebium erythrocarpum* (Mett. ex Kuhn) Bedd., *Suppl. Ferns Brit. Ind.* 21, pl. 382. 1876. *Phymatodes erythrocarpa* (Mett. ex Kuhn) Ching, *Contr. Inst. Bot. Natl. Acad. Peiping* 2(3): 80. 1933. *Phymatopsis erythrocarpa* (Mett. ex Kuhn) Ching, *Acta Phytotax. Sin.* 9(2): 191. 1964. *Phymatopteris erythrocarpa* (Mett. ex Kuhn) Pic.

Table 1. Comparison of related genera with the new fern genus *Himalayopteris*.

	<i>Himalayopteris</i>	<i>Goniophlebium</i>	<i>Phymatopteris</i>	<i>Polypodiastrium</i>	<i>Polypodiodes</i>	<i>Selliguea</i> (syn. <i>Crypsinus</i>)
Chromosome number	$x = 37$	$x = 36, 37$	$x = 36$	$x = 37$	$x = 36, 37$	$x = 36, 37$
Scales	nonclathrate	clathrate	nonclathrate	clathrate	clathrate	nonclathrate
Leaf venation pattern	goniophleboid type	goniophleboid type	drynarioid type	goniophleboid type	goniophleboid type	drynarioid type
Areole of frond lobe	one lined areole	one or two lined areoles	no areole	one or two lined areoles	one lined areole	no areole
Rachis articulation	absent	present	absent	absent	absent	absent
Sort	round, superficial	round, superficial or slightly immersed	round, superficial or slightly immersed	round, slightly immersed	round, superficial	linear or round, superficial

Serm., *Webbia* 28(2): 462. 1973. *Pichisermollia erythrocarpa* (Mett. ex Kuhn) Fraser-Jenk., *Taxon. Revis. Indian Subcontinental Pteridophytes* 51. 2008. TYPE: India. N India, Sikkim, Lachen, 3500 m, 10 Dec. 1862, *J. D. Hooker s.n.* (holotype, K). Figure 1.

Distribution and habitat. The genus *Himalayopteris* is found in the western and eastern Himalayas in China (Tibet, Sichuan), India (northern India, Sikkim, Uttarakhand, Himachal Pradesh), Nepal, and Bhutan. The distributional ranges of *Goniophlebium*, *Phymatopteris*, and *Selliguea* extend into tropical southern Asia, the Malay Peninsula, and Indonesia, while *Polypodiastrium* can extend into Australia. *Polypodiodes* is sympatric with the new genus *Himalayopteris*, with the former occurring in Japan, Thailand, as well as southern and eastern China, while the latter is endemic to the western and eastern Himalayas. *Himalayopteris erythrocarpa* is epiphytic on tree trunks and has also been found growing superficially on mossy banks and among bushes.

IUCN Red List category. *Himalayopteris erythrocarpa* is known from seven allopatric populations endemic to the western and eastern Himalayas. Because the distributional areas for its known collection habitat have declined gradually, this species should be considered Vulnerable (VU) according to IUCN Red List criteria (IUCN, 2001).

Etymology. The new genus name is taken from the distribution of its sole known species, *Himalayopteris erythrocarpa*, for which all localities exist along the Himalayas.

Paratypes. BHUTAN. W Bhutan (Thimphu valley), 2500 m, *C. R. Fraser-Jenkins s.n.* (BM). CHINA. (Tibet, Motuo), 2700 m, 3 Aug. 1974, *Qinghai-Xizang Exped. 3998* (PE). **Sichuan:** Daocheng, 3400 m, *Qinghai-Xizang Exped. 6012* (HITBC). INDIA. N India (Himachal Pradesh, Simla), 2200 m, *Fraser-Jenkins s.n.* (BM); N India (Uttarakhand), 2700–2900 m, *Fraser-Jenkins s.n.* (BM); N India (Sikkim, Yakla valley), 2400–3300 m, *J. D. Hooker & T. Thomson s.n.* (K). NEPAL. E Nepal (Kathmandu), 3300 m, *Fraser-Jenkins s.n.* (BM).

Acknowledgments. We thank X. C. Zhang (PE) and W. M. Chu (PYU) for providing access to the specimens and valuable references cited in this paper, and X. Cheng (KUN) for his kindness in presenting us with photographs of the Kew type of *Himalayopteris erythrocarpa* as a gift. The authors are grateful to Victoria C. Hollowell (MO), Christopher Fraser-Jenkins (BM), and two anonymous reviewers for critical comments on the manuscript. The first author also thanks Cindy Q. Tang of Golden Gate National Parks Conservancy for her helpful sugges-

tions and P. Hovenkamp (L) for his comments on the treatment of *Phymatopteris* in the *Flora of China*. The first author expresses gratitude to Rosemary Davies (K) for adding this author's name to the IPNI author database, and to B. S. Kholia, Botanical Survey of India, Gangtok, Sikkim, for providing a photo of the live plant. This paper is supported by the National Natural Science Foundation of China (grant no. 30770164).

Literature Cited

- Beddome, R. H. 1876. Supplement to the Ferns of Southern India and British India. Ganz Bros., Madras. [Reprinted 1996 by International Book Distributors, Dehra Dun.]
- Beddome, R. H. 1883. Handbook to the Ferns of British India, Ceylon, and the Malay Peninsula. Thacker, Spink & Co., Calcutta. [Reprinted 1976 by Today and Tomorrow's Printers and Publishers, New Delhi.]
- Ching, R. C. 1933. The studies of Chinese ferns 11. Contrib. Inst. Bot. Natl. Acad. Peiping 2(3): 31–100.
- Ching, R. C. 1964. On the genera *Phymatopsis* J. Sm. and *Crypsinus* Presl. Acta Phytotax. Sin. 9(2): 179–197.
- Fraser-Jenkins, C. R. 2008. Taxonomic Revision of Three Hundred Indian Subcontinental Pteridophytes with a Revised Census-List. Bishen Singh Mahendra Pal Singh, Dehra Dun.
- Fraser-Jenkins, C. R. 2009 [2010]. A brief comparison of modern Pteridophyte classifications (families and genera in India). Indian Fern J. 26: 107–131.
- Hovenkamp, P. 1998. An account of the Malay–Pacific species of *Selliguea* (Polypodiaceae). Blumea 43: 1–108.
- IUCN. 2001. IUCN Red List Categories and Criteria, Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.
- Löve, A., D. Löve & R. E. G. Pichi Sermolli. 1977. *Polypodium erythrocarpum*. P. 57 in Cytotaxonomical Atlas of the Pteridophyta. J. Cramer, Vaduz, Liechtenstein.
- Lu, S. G. 2000. *Phymatopteris*. P. 190 in Flora Reipublicae Popularis Sinicae, Vol. 6(2). Science Press, Beijing.
- Mehra, P. N. 1961. Chromosome numbers in Himalayan ferns. Res. Bull. Punjab Univ., New Ser., Sci. 12: 139–164.
- Nakaike, T. 1987. An enumeration of the ferns of Nepal III. *Crypsinus* Presl. Bull. Natl. Sci. Mus., Tokyo, B 13(3): 89–105.
- Pichi Sermolli, R. E. G. 1973. Fragmenta Pteridologiae 4. *Webbia* 28(2): 445–477.
- Rödl-Linder, G. 1990. A monograph of the fern genus *Goniophlebium*. Blumea 34(2): 277–423.