

## CYSTOPTERIDACEAE

冷蕨科 leng jue ke

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Plants small to medium-sized, summer-green; rhizomes slender, creeping or ascending; costae articulate to rachis (in *Gymnocarpium*) or not so; lamina pinnate to 3(or 4)-pinnate-pinnatifid; veins free; sori orbicular or elongate, abaxial on veins, indusiate or exindusiate; indusia ovate-lanceolate, ovate, or orbicular, attached proximally to receptacle.  $x = 40, 42$ .

Four genera and more than 30 species: worldwide, mainly in the temperate and cold temperate zones and tropical mountains; four genera (one endemic) and 20 species (ten endemic) in China.

Wang Zhong-ren. 1999. *Acystopteris*, *Cystoathyrium*, *Cystopteris*, and *Gymnocarpium*. In: Chu Wei-ming, ed., *Fl. Reipubl. Popularis Sin.* 3(2): 38–74.

- 1a. Sori exindusiate ..... 1. *Gymnocarpium*
- 1b. Sori indusiate.
  - 2a. Multicellular articulate hairs present on stipe and lamina; indusia small, often hidden under sporangia ..... 3. *Acystopteris*
  - 2b. Multicellular articulate hairs absent from stipe and lamina; indusia visible.
    - 3a. Lamina deltoid to lanceolate, base slightly narrowed or broadest part of lamina; spore wall echinate ..... 4. *Cystopteris*
    - 3b. Lamina oblong-lanceolate, base gradually narrowed, spore wall with conical spines ..... 2. *Cystoathyrium*

### 1. GYMNOCARPIUM Newman, *Phytologist* 4: 371. 1851.

羽节蕨属 yu jie jue shu

Wang Zhongren (王中仁); Kathleen M. Pryer

*Carpogymnia* (H. P. Fuchs ex Janchen) Á. Löve & D. Löve; *Currania* Copeland; *Thelypteris* sect. *Carpogymnia* H. P. Fuchs ex Janchen.

Plants terrestrial, summer-green, small to medium-sized. Rhizomes long creeping, blackish brown, glabrate, clothed with brown, thin, broadly lanceolate or ovate-lanceolate scales at apices and stipe bases. Fronds distant; stipe thin, much longer than lamina, dark brown at base, upper part stramineous, U-shaped grooved adaxially; lamina simple-pinnatifid to 3-pinnate-pinnatifid, deltoid-ovate to pentagonal-oval, base articulate to stipe apex, apex acuminate; pinnae stalked or sessile, articulate to rachis, basal pair not shortened. Veins free, pinnate in ultimate segments, lateral veins simple or occasionally forked, terminating at margin. Lamina herbaceous or thinly herbaceous, stipe apex, rachis, costae, and lamina  $\pm$  with hyaline or pale yellow glands on surfaces, or glands absent. Sori oblong or orbicular, exindusiate, abaxial on veins, uniseriate along each side of costule or midrib. Spores bean-shaped, perispore surface rugate, folds lobed, foveolate or sometimes reticulate.  $x = 40$ .

Two sections, ten species, and several hybrids: temperate zone of the N Hemisphere (Asia, Europe, and North America) and subtropical mountains of Asia, occurring in forests; five species (two endemic) in China.

- 1a. Lamina pinnatifid; sori oblong ..... 1. *G. oyamense*
- 1b. Lamina 2- or 3-pinnate; sori smaller, orbicular.
  - 2a. Rachis glandular abaxially.
    - 3a. Stipe sparsely glandular, rachis base and costa base of basal 1–3 pairs of pinnae glandular; veins often forked ..... 2. *G. jessoense*
    - 3b. Stipe apex, rachis, and costae densely glandular abaxially, other parts also glandular; veins usually simple ..... 3. *G. altaycum*
  - 2b. Rachis glabrate, eglandulose.
    - 4a. Lamina ovate-pentagonal or ternate, lowest pinnae nearly as large as rest of lamina, 2-pinnate-pinnatifid; basicopic basal pinnules of lowest pinnae nearly as large as third pinnae; ultimate pinnules oblong,  $\pm$  pinnatifid, or shallowly lobed ..... 4. *G. dryopteris*
    - 4b. Lamina deltoid-ovate, lowest pinnae smaller than rest of lamina, 3-pinnate-pinnatifid; basicopic basal pinnules of lowest pinnae nearly as large as fourth pinnae; ultimate pinnules narrowly oblong, usually entire ..... 5. *G. remotepinnatum*

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**1. *Gymnocarpium oyamense* (Baker) Ching, Contrib. Biol. Lab. Sci. Soc. China, Bot. Ser. 9: 40. 1933.**

东亚羽节蕨 *dong ya yu jie jue*

*Polypodium oyamense* Baker, J. Bot. 15: 366. 1877; *Aspidium krameri* (Franchet & Savatier) Christ; *Carpogymnia oyamensis* (Baker) Á. Löve & D. Löve; *Currantia gracilipes* Copeland; *C. oyamensis* (Baker) Copeland; *C. oyamensis* var. *gracilipes* (Copeland) Tagawa; *Dryopteris gracilipes* (Copeland) C. Christensen; *D. gymnogrammoides* (Baker) C. Christensen; *D. oyamensis* (Baker) C. Christensen; *Gymnocarpium gracilipes* (Copeland) Ching; *G. oyamense* var. *gracilipes* (Copeland) W. C. Shieh; *Nephrodium gymnogrammoides* (Baker) Diels; *N. krameri* (Franchet & Savatier) Diels; *Phegopteris krameri* (Franchet & Savatier) Makino; *P. oyamensis* (Baker) Alderwerelt; *Polypodium gymnogrammoides* Baker; *P. krameri* Franchet & Savatier; *P. krameri* var. *incisum* Franchet & Savatier.

Rhizomes long creeping, 1.5–2(–3) mm in diam., clothed with red-brown, broadly lanceolate scales, glabrate when old. Fronds distant; fertile fronds (13–)25–45(–50) cm; stipe stramineous, shiny, (7–)12–25(–31) cm, 1.5–2 mm in diam., terete abaxially and grooved adaxially, scaly at base, upward glabrate, articulate to lamina at apex; lamina ovate-triangular, (7–)10–18(–22) × (4–)6–13(–20) cm, herbaceous, glabrate, base cordate, pinnatifid 4–5 mm to rachis, apex acuminate; pinnae 6–9(–13) pairs, opposite, spreading, approximate, broadly lanceolate, falcate, base decurrent to narrow rachis wing, shallowly lobed to pinnatifid, apex acute or acuminate; basal pair of pinnae descending, often broadly lanceolate, (2–)4–7(–10) × 1–1.8(–3) cm; second pair slightly longer than basal pinnae or subequal, spreading, shallowly lobed; pinna lobes obtuse-rounded, entire or crenate; veins pinnate, lateral veins (2–)4 or 5(–8) pairs, simple, slightly visible; rachis inserted obliquely and articulate to stipe; upper part of stipe, lower part of rachis, and bases of costae in lower pinnae sparsely pubescent with short glands, or glabrate. Sori oblong, medial on veins, biserrate along both sides of costules, exindusiate. Spore wall surface rugate, foveolate.  $2n = 80, 160$ .

Damp areas in forests, on moss-covered rocks; 300–2900 m. Anhui, Chongqing, Gansu, Guizhou, Henan, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [NE India, Japan, Nepal, New Guinea, Philippines].

**2. *Gymnocarpium jessoense* (Koidzumi) Koidzumi, Acta Phytotax. Geobot. 5: 40. 1936.**

羽节蕨 *yu jie jue*

*Dryopteris jessoensis* Koidzumi, Bot. Mag. (Tokyo) 38: 104. 1924; *Aspidium dryopteris* (Linnaeus) Baumgarten var. *longulum* Christ; *Carpogymnia jessoensis* (Koidzumi) Á. Löve & D. Löve; *Dryopteris linnaeana* C. Christensen var. *jessoensis* (Koidzumi) C. Christensen; *Gymnocarpium longulum* (Christ) Kitagawa; *G. robertianum* (Hoffmann) Newman subsp. *longulum* (Christ) Toyokuni; *G. robertianum* var. *longulum* (Christ) H. Itô ex Nakai; *Lastrea jessoensis* (Koidzumi) Akasawa; *L. robertiana* (Hoffmann) Newman var. *longula* (Christ) Ohwi.

Rhizomes long creeping, apex clothed with brownish

ovate-lanceolate scales; fronds distant, sometimes approximate. Fertile fronds (16–)20–50(–76) cm; stipe stramineous, (8–)15–32(–51) cm, up to 3.5 mm in diam., base sparsely scaly, upper part glabrate; lamina pinnate-pinnatifid or 2-pinnate-pinnatifid, deltoid-ovate, (7–)15–20(–27) × (7–)14–22(–30) cm, herbaceous or papery, base rounded, apex acuminate; pinnae (3–)5–8 pairs, opposite, oblique, basal 1–4 pairs stalked, articulate to rachis; basal pinnae largest, narrowly triangular, (4–)8–15(–18) × 3–7(–11) cm at base, base subtruncate, with stalk (0.8–)1–2.5(–3.5) cm, slightly oblique, pinnate-pinnatifid or pinnate-pinnatifid, apex acuminate; pinnules 5–8 pairs, deltoid-lanceolate, base subtruncate, apex acuminate, opposite or subopposite; basal one to several pairs articulate to costa, usually sessile, sometimes basal pair shortly stalked, 1–3(–12) mm; basal basiscopic pinnules longest, 1–5(–7) × (0.7–)1–2.3 cm, descending; pinnule segments 5–10 pairs, oblong to narrowly ovate, base free or adnate to narrow wing, margin crenate, apex rounded-obtuse; second basal pair of pinnae (2–)4–5(–7.5) cm apart from basal pair, narrowly triangular, much smaller than lowest pinnae, 4–8(–12) cm; third and upper pairs of pinnae broadly lanceolate, gradually smaller; veins pinnate in segment, veins usually forked, sometimes simple, very oblique, visible; stipe apex, rachis, and costae with hyaline or pale yellow short glands. Sori small, orbicular or oblong, abaxial on veins, submarginal, exindusiate. Spore wall surface rugate, foveolate.  $2n = 80, 160$ .

Wet areas in forests, mountain slopes; 400–4000 m. Gansu, Guizhou, Hebei, Heilongjiang, Henan, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, Xinjiang, SE Xizang, NW Yunnan [Afghanistan, Bhutan, N India, Japan, Korea, Nepal, N Pakistan, E Russia; NW North America].

Treated as a pro parte synonym of *Gymnocarpium jessoense*, *G. disjunctum* (Ruprecht) Ching (Acta Phytotax. Sin. 10: 304. 1965; *Polypodium dryopteris* Linnaeus var. *disjunctum* Ruprecht, Distr. Crypt. Vasc. Ross. 52. 1845; *Carpogymnia disjuncta* (Ruprecht) Á. Löve & D. Löve; *Dryopteris* (Linnaeus) Newman subsp. *disjunctum* (Ruprecht) Sarvela; *G. dryopteris* var. *disjunctum* (Ruprecht) Ching) is restricted to W North America (see Pryer & Haufler, Syst. Bot. 18: 150–172. 1993).

**3. *Gymnocarpium altaycum* Chang Y. Yang, Fl. Xinjiang. 1: 304. 1992.**

密腺羽节蕨 *mi xian yu jie jue*

Rhizomes long creeping, apex clothed with brownish ovate-lanceolate scales. Fronds distant; fertile fronds 18–40 cm; stipe stramineous, 11–25 cm, 0.5–1 mm in diam., base sparsely scaly, upper part glabrate; lamina 2-pinnate to 3-pinnatifid, deltoid-ovate, 7–13 × 4–8 cm, herbaceous or papery, base rounded, apex acuminate; pinnae 5–8 pairs, opposite, oblique, basal 3 or 4 pairs stalked, articulate to rachis, basal pair largest, narrowly triangular, 4.5–8.5 × 3–4.5 cm at base, base subtruncate, with stalk 6–13 cm, slightly oblique, pinnate, apex acuminate; pinnules 4–6 pairs, opposite or subopposite, deltoid-lanceolate or narrowly oblong, base broadly cuneate, basal 1 or 2 pairs articulate to costae, subsessile, apex acuminate; basal basiscopic pinnules longest, descending, 1.5–2.7 cm × 6–8 mm, pinnate or pinnatifid; pinnule segments 5–7 pairs, oblong to narrowly ovate, separate or adnate at base, crenate, apex rounded-obtuse; second basal pair of pinnae 1.7–3.3 cm apart

from basal pinnae, narrowly triangular, much smaller than basal pinnae, 2–5.5 cm; third and upper pairs of pinnae broadly lanceolate, gradually smaller; veins pinnate in segment, simple, sometimes forked, oblique, visible; stipe (at least upper part), lower part of rachis, costae, and midribs pubescent with short glands. Sori small, orbicular or oblong, abaxial on veins, submarginal, exindusiate.

• Shaded places in forests, mountain slopes; 1500–2500 m. Qinghai, Xinjiang.

One of us (Pryer) notes that *Gymnocarpium robertianum* (Hoffmann) Newman (Phytologist 4: append. xxiv. 1851; *Polypodium robertianum* Hoffmann, Deutschl. Fl. 2: add. et emend. 10. 1795), which was treated as conspecific with *G. altaycum* in FRPS (3(2): 70–71. 1999), is glandular on both sides of the upper stipe, firm and stiff in texture, and moderately glandular on the adaxial as well as the abaxial surface, including on the laminae.

**4. *Gymnocarpium dryopteris*** (Linnaeus) Newman, Phytologist 4: append. xxiv. 1851.

欧洲羽节蕨 ou zhou yu jie jue

*Polypodium dryopteris* Linnaeus, Sp. Pl. 2: 1093. 1753; *Aspidium dryopteris* (Linnaeus) Baumgarten; *Carpogymnia dryopteris* (Linnaeus) Á. Löve & D. Löve; *Dryopteris linnaeana* C. Christensen; *Lastrea dryopteris* (Linnaeus) Bory.

Rhizomes slender, creeping, black, shiny, apex clothed with brown ovate-lanceolate scales. Fronds distant; fertile lamina (15–)20–30(–50) cm; stipe stramineous, 10–22(–35) cm, slender, with sparse scales at base; lamina nearly tripartite, usually 2-pinnate-pinnatifid, pentagonal-ovate or broadly ovate-triangular, 7–15(–20) cm long and wide, thinly herbaceous or submembranous, base broadly cuneate, apex acuminate; basal pair of pinnae nearly as large as other portion of lamina, narrowly triangular, (3.5–)5–9(–12) × 2.5–4(–7) cm, pinnate-pinnatifid, base subtruncate, with stalk (0.8–)1–1.5(–2.5) cm, portion of rachis between basal pinnae and central lamina ca. 3 cm; pinnules 5 or 6 pairs, oblong-lanceolate, 1.5–2(–4) × 0.5–2 cm, base rounded-cuneate, sessile, apex acute or acuminate, opposite or subopposite, spreading; largest pinnules with 6–10 pairs of segments, segments approximate, oblong to narrowly ovate, ca. 4 mm, lobed to narrow costular wing, entire to shallowly lobed at margin, rounded-obtuse at apex; second basal pair of pinnae 1.5–4 cm apart from basal pair, sometimes shortly stalked, upper pinnae sessile; veins pinnate in segment, simple, oblique, visible abaxially; rachis and costae slender, eglandular.

Sori small, exindusiate, orbicular, abaxial on veins. Spore wall surface rugate, foveolate.  $2n = 160$ .

Damp areas in coniferous forests; 300–2900 m. Heilongjiang, Jilin, Liaoning, Nei Mongol, Shaanxi, Shanxi, Xinjiang [Japan, Korea; Europe, North America].

American *Gymnocarpium dryopteris* is an allotetraploid species that arose following hybridization and polyploidization between *G. disjunctum* (Ruprecht) Ching and *G. appalachianum* Pryer & Haufler.

Sarvela noted that a specimen of *Gymnocarpium dryopteris* from Japan was indusiate; the indusia were reniform, ca. 0.5 mm in diam., hyaline, glabrate, erose at margin. It may be an example of atavism.

**5. *Gymnocarpium remotepinnatum*** (Hayata) Ching, Icon. Fil. Sin. 4: t. 172. 1937 [“*remote-pinnatum*”].

细裂羽节蕨 xi lie yu jie jue

*Dryopteris remotepinnata* Hayata, Suppl. Icon. Pl. Formosan. 6: 108. 1917, based on *D. remota* Hayata, J. Coll. Sci. Imp. Univ. Tokyo 30(1): 421. 1911, not (A. Braun) Hayek (1908); *Gymnocarpium remotum* Ching; *Thelypteris remotepinnata* (Hayata) Alston.

Rhizomes slender, creeping, with sparse brownish ovate-lanceolate scales. Fronds distant; fertile fronds 20–30 cm; stipe stramineous, (10–)12–20 cm, slender, fragile, sparsely scaly at base; lamina 3-pinnate or 3-pinnate-pinnatifid, triangular, 10–14 × 6–9 cm, thinly herbaceous, base subtruncate, apex acuminate; pinnae 5 or 6 pairs, opposite, basal 2 pairs shortly stalked, upper pinnae sessile, basal pinnae largest, narrowly triangular, 6–8 × 5–6 cm, base subtruncate, stalk 1–2.2 cm, articulate to rachis, 2-pinnate, apex acuminate, spreading; pinnules 5 or 6 pairs, opposite, oblong-lanceolate, 1.5–2 × ca. 1 cm, base broadly rounded, sessile, apex acuminate, spreading; pinnule segments or secondary pinnules narrowly oblong, separate or lobed to costular wings, entire but lobed on basiscopic side, apex rounded-obtuse; second basal pair of pinnae 2–3 cm apart from basal pinnae, smaller, ascending, oblong, falcate, base rounded and equilateral, sessile; upper pinnae gradually smaller than second basal pinnae; veins pinnate in segment, simple, very oblique, visible abaxially; lamina glabrate, abaxial surface of rachis and costae eglandular. Sori small, brown, orbicular, exindusiate, abaxial on veins.  $2n = 80^*$ .

• Coniferous forests, on rocks at forest margins; 2500–3400 m. Taiwan, NW Yunnan.

## 2. *CYSTOATHYRIUM* Ching, Acta Phytotax. Sin. 11: 22. 1966.

光叶蕨属 guang ye jue shu

Wang Zhongren (王中仁); Masahiro Kato

Plants evergreen, medium-sized. Rhizomes short, ascending, bearing remaining stipe bases and dense thick roots, clothed with dark brown ovate-lanceolate scales at apex. Fronds approximate; fertile fronds: rachis grooved adaxially, glabrate; lamina pinnate-pinnatifid; pinnae pinnatifid, up to 30 pairs, subopposite, spreading, sessile, ca. 1 cm apart (lower pinnae more widely apart). Veinlets 3–5 pairs, simple but basal veins frequently forked, oblique, reaching margins of lobes. Sori orbicular, single per pinna lobe, abaxial on basal acroscopic veins, close to costae; indusia pale green, broadly ovate or orbicular, thinly membranous, fugacious, basiscopic to receptacle, inferior (i.e., hidden by sporangia), partly covering sori when young, hidden by sporangia at maturity, persistent; annulus consisting of 12 or 13 thick-walled cells. Spores dark brown, bean-shaped, perispore with dense conical spines.

- One species: China.

*Cystoathyrium* is similar to *Athyrium* and *Cystopteris*. It differs from *Athyrium* by the rhizome shortly ascending, glabrate, the stipe base not beak-shaped, the spore surface with conical spines, and the indusia basicopic and inferior. It also differs from *Cystopteris* by the stipe short compared to the lamina, the lamina bipinnatifid, gradually narrowed toward the base, almost papery and evergreen, and the pinnae numerous, lanceolate and falcate.

**1. *Cystoathyrium chinense*** Ching, Acta Phytotax. Sin. 11: 23. 1966.

光叶蕨 *guang ye jue*

Fertile fronds 40–45 cm; stipe brown at base, upward stramineous, up to 7–8 cm, base ca. 2 mm in diam., slightly swollen, with 1 or 2 lanceolate scales, upper part glabrate, grooved adaxially; rachis grooved adaxially, glabrate; lamina pale green, narrowly lanceolate, up to 35 × 6–8 cm at middle, subpapery, glabrate, gradually narrowed toward both ends, with scattered orange glands on abaxial surface; longest middle pinnae 3–4 × ca. 1 cm at base, narrowly falcate-lanceolate, base inequilateral (acroscopic side broader, truncate, basicopic side narrowly cuneate or obtuse-rounded), pinnatifid, lobed to

4/5 or close to costae, apex acuminate and falcate; lower pinnae gradually shorter than upper pinnae, basal pair shortest, ca. 1 cm, triangular; pinna lobes up to ca. 10 pairs, oblique, oblong, obtuse at apex, separated by narrow incisions, acroscopic basal lobe slightly longer than basicopic one, basal 2 lobes largest, 5–8 × ca. 3 mm, upper lobes gradually shorter, basal basicopic lobe almost broadly ovate, slightly shorter, entire at margin, or basal 1 or 2 pairs slightly crenate; costae grooved adaxially; small processes of unknown nature 1 to few, on abaxial surface of lateral veins in most middle pinna apices.

- Damp areas in forests; 2400–2500 m. W Sichuan.

*Cystoathyrium chinense* has not been collected recently; it is possible that it is now extinct.

**3. ACYSTOPTERIS Nakai, Bot. Mag. (Tokyo) 47: 180. 1933.**

亮毛蕨属 *liang mao jue shu*

Wang Zhongren (王中仁); Masahiro Kato

Plants terrestrial, medium-sized. Rhizome creeping, forked, sparsely scaly; scales shiny, lanceolate or ovate-lanceolate, margin with sparse glandular-hairlike teeth, apex long acuminate. Fronds approximate; stipe chestnut-brown or stramineous, nearly as long as lamina, with scales, hyaline multicellular hairs, and scalelike hairs, grooved adaxially; lamina 2-pinnate to 3-pinnate-pinnatifid, broadly ovate to ovate-lanceolate, thinly herbaceous, not narrowed to base, apex subacute or acuminate; pinnae mostly subopposite, spreading or ascending, pinnatisect to 2-pinnate, broadly lanceolate to lanceolate, slightly falcate at apex, equilateral, truncate or rounded-cuneate at base, sessile or very shortly stalked, apex acuminate; basal pair of pinnae not shortened; pinnules sessile, alternate, only basal pair of pinnules subopposite, slightly shorter than upper pinnules, ovate-lanceolate or lanceolate, equilateral, base subtruncate or rounded-cuneate, basicopic base slightly wider than acroscopic base, apex obtuse or acuminate; pinnule lobes oblong, sessile or adnate to costae or costules, lobed or parted, obtuse. Veins visible but not clearly so, free, pinnate, simple or forked, reaching marginal teeth of lobes. Lamina surface, all costae, and veins with hyaline long multicellular hairs and narrow scalelike hairs. Sori small, orbicular, abaxial on veins, sorophore protuberant; sporangia with slender stalks, annulus cells 12–14; indusia small, laterally equilateral, pale green, broadly ovate, membranous, glandular hairy, sparsely ciliate at margin, attached proximally to sorophore, hidden by sporangia at maturity; spores yellow, bean-shaped or narrowly spheroidal, perispore with dense inflated, bulbous processes.  $x = 42$ .

Three species: tropical to temperate areas of SE and E Asia and New Zealand; three species (one endemic) in China.

- 1a. Plants usually less than 60 cm; stipe, rachis, and costae chestnut-black or purple-brown; orange unicellular glands absent on lamina and at indusium margin ..... 1. *A. japonica*  
 1b. Plants usually to 80 cm or longer; stipe and rachis stramineous or brownish red, costae stramineous; orange unicellular glands present on abaxial surface of lamina and at indusium margin.  
 2a. Stipe and rachis stramineous; multicellular hairs dense ..... 2. *A. tenuisecta*  
 2b. Stipe and rachis brownish or dull brown; multicellular hairs sparse ..... 3. *A. taiwaniana*

**1. *Acystopteris japonica*** (Lueresen) Nakai, Bot. Mag. (Tokyo) 47: 180. 1933.

亮毛蕨 *liang mao jue*

*Cystopteris japonica* Lueresen in Engler, Bot. Jahrb. Syst. 4: 363. 1883.

Plants summer-green. Rhizome creeping, 2–4 mm in diam., with sparse yellowish brown, broadly lanceolate, thinly membranous scales. Fronds approximate; fertile frond (12–) 40–60(–90) cm; stipe chestnut-black or purple-brown, (6–)

15–25(–40) cm, (1–)2–3(–4) mm in diam., grooved adaxially, with sparse scales at base, upward glabrate, shiny; lamina 2- or 3-pinnate, broadly ovate to deltoid-ovate, (6–)20–35(–50) × (3.5–)15–18(–40) cm, not narrowed to base, herbaceous, base subcordate, apex shortly acuminate or acuminate; pinnae 10–15 pairs, opposite or subopposite, 3–4 cm apart, spreading or ascending, sessile or very shortly stalked, basal pair not shorter, oblong or broadly lanceolate; upper pinnae lanceolate, (1.8–)8–15(–25) × (1–)3–6(–11) cm, base subtruncate, apex acuminate; pinnules 10–24 pairs, sessile, alternate, subequilateral, basicopic pinnules slightly longer than acroscopic pin-

nules; basal pair slightly shorter, subopposite or anadromous, oblong, (0.5–)2.5–4(–6) × (3–)6–10(–20) mm, base truncate or broadly cuneate, apex obtuse; costae chestnut-brown or stramineous in distal half; pinnule segments 5–14 pairs, spreading or slightly ascending, oblong, crenate, apex obtuse; veins pinnate in segment, simple, reaching marginal teeth. Hyaline multicellular long hairs and scalelike hairs sparse on both sides of veins, costae, rachis, and stipe. Sori orbicular, abaxial on basal acroscopic veins; indusia pale green, broadly ovate, small, membranous, glandular, sparsely ciliate at margin, proximal to sorophore, hidden by sporangia at maturity, persistent. Spores yellow, bean-shaped or long spheroidal, perispore with dense inflated, bulbous processes.  $2n = 84^*$ ,  $168^*$ .

Forests in valleys; 400–2800 m. Chongqing, Fujian, Guangxi, Guizhou, Hubei, Hunan, Jiangxi, Yunnan, Zhejiang [Japan].

**2. *Acystopteris tenuisecta*** (Blume) Tagawa, *Acta Phytotax. Geobot.* 7(2): 73. 1938.

禾秆亮毛蕨 he gan liang mao jue

*Aspidium tenuisectum* Blume, *Enum. Pl. Javae* 2: 170. 1828; *Alsophila tenuisecta* Blume ex T. Moore; *Asplenium tenuisectum* (Blume) Hooker; *Athyrium tenuisectum* (Blume) T. Moore; *Cornopteris tenuisecta* (Blume) Tardieu; *Cystopteris formosana* Hayata; *C. setosa* Beddome; *C. tenuisecta* (Blume) Mettenius; *Davallia setosa* (Beddome) Baker (1874), not J. Smith (1808); *Lastrea setosa* Beddome (1868), not C. Presl (1851), nor T. Moore (1858).

Rhizome creeping, 2–5 mm in diam., with sparse brownish, lanceolate, thinly membranous scales. Fronds approximate; fertile frond (22–)65–80(–150) cm; stipe pale stramineous, (7–)30–40(–90) cm, (1.5–)3–4(–5) mm in diam. at base, grooved adaxially, clothed with brownish lanceolate scales and sparse multicellular hairs at base; lamina 3-pinnate, ovate to ovate-lanceolate, (14–)35–50(–70) × (7–)20–25(–60) cm, herbaceous, base subcordate, apex acuminate; pinnae 15–20 pairs, subopposite, subsessile or shortly stalked, broadly lanceolate to lanceolate, acuminate, slightly falcate, equilateral, base subtruncate; basal 1 or 2 pairs broadly lanceolate, (3.5–)15–20(–33) × (2–)4–8(–20) cm, base subtruncate or rounded-cuneate, apex long acuminate; pinnules 10–25 pairs, basal pair slightly shorter, acroscopic pinnule slightly shorter than basiscopic, broadly lanceolate, (1–)2.5–5(–10) × (0.4–)1–2(–3) cm, base truncate, sessile, apex obtuse or acuminate; pinnule segments oblong, 4–10 × 2–3 mm, sessile or ± adnate, lobed, obtuse; veins pinnate in segment, simple or forked. Orange or yellow small glands borne on abaxial surface and at indusium margin, hyaline multicellular long hairs present on veins, costules, costae, rachis, and stipe. Sori orbicular, abaxial on basal acroscopic veins; indusia small, pale green, broadly ovate, membranous, proximal to sorophore, hidden by sori at maturity, persistent. Spores normal.  $2n = 82^*$ .

gin, hyaline multicellular long hairs present on veins, costules, costae, rachis, and stipe, and subulate scales adaxially. Sori orbicular, abaxial on basal acroscopic veins; indusia small, pale green, broadly ovate, membranous, proximal to sorophore, hidden by sori at maturity, persistent. Spores yellow, bean-shaped or narrowly spheroidal, perispore with dense inflated, bulbous processes.  $2n = 82$ ,  $84$ ,  $168$ .

Forests in valleys and damp streamsides; 700–2600 m. Guangxi, Sichuan, Taiwan, Xizang, Yunnan [Bhutan, NE India, Indonesia, S Japan, Malaysia, Myanmar, Nepal, Philippines, Singapore, Thailand, Vietnam; Pacific islands (New Zealand)].

**3. *Acystopteris taiwaniana*** (Tagawa) Á. Löve & D. Löve, *Taxon* 26: 326. 1977.

台湾亮毛蕨 tai wan liang mao jue

*Cystopteris japonica* Luerssen var. *taiwaniana* Tagawa, *Acta Phytotax. Geobot.* 4: 57. 1935; *Acystopteris japonica* (Luerssen) Nakai var. *taiwaniana* (Tagawa) W. C. Shieh.

Rhizome creeping, 2–4 mm in diam., with sparse yellowish brown, broadly lanceolate, thinly membranous scales. Fronds approximate; fertile frond 35–80 cm; stipe chestnut-brown, dull brown, or sometimes stramineous, 15–40 cm, 1–4 mm in diam., grooved adaxially, with sparse scales at base, upward glabrate, shiny or dull; rachis except upper part chestnut-brown; lamina 2- or 3-pinnate, broadly ovate to deltoid-ovate, 18–45 × 12–25 cm, herbaceous or thickly herbaceous, not narrowed to base, base subcordate or truncate, apex shortly acuminate or acuminate; pinnae 10–15 pairs, opposite or subopposite, 3–8 cm apart, spreading or ascending, subsessile or very shortly stalked, basal pair not shorter, oblong or broadly lanceolate; upper pinnae lanceolate, 8–18 × 3–6 cm, base subtruncate, apex acuminate; pinnules 10–15 pairs, sessile, alternate, subequilateral, basiscopic pinnules slightly longer than acroscopic pinnules, basal pair slightly shorter, subopposite, oblong, 0.5–2.5 × 1.5–6 mm, base truncate or broadly cuneate, apex obtuse; costae stramineous or brown; pinnule segments 7–12 pairs, spreading or slightly ascending, oblong, crenate, apex obtuse; veins pinnate in segment, simple, reaching marginal teeth. Orange or yellow small glands borne on abaxial surface and at indusium margin, hyaline multicellular long hairs present on veins, costules, costae, rachis, and stipe. Sori orbicular, abaxial on basal acroscopic veins; indusia small, pale green, broadly ovate, membranous, proximal to sorophore, hidden by sori at maturity, persistent. Spores normal.  $2n = 82^*$ .

• Forests in humid valleys; 1600–2600 m. Taiwan.

#### 4. *CYSTOPTERIS* Bernhardt in Schrader, *Neues J. Bot.* 1(2): 26. 1805, nom. cons.

冷蕨属 leng jue shu

Wang Zhongren (王中仁); Christopher Haufler

*Cyste* Dulac; *Cystea* J. Smith; *Filix* Adanson (1763), not Séguier (1754), nor Ludwig (1757); *Rhizomatopteris* A. P. Khokhrjakov.

Plants small, summer-green. Rhizomes long or shortly creeping, blackish brown, glabrate or densely red-brown pubescent, sparsely scaly; scales brown or brownish, thin, ovate to broadly lanceolate. Fronds distant, approximate, or caespitose, thin; stipe dark brown at base, upper part stramineous or chestnut-colored; lamina 2- or 3-pinnate, rarely 4-pinnate or more divided, ovate-lanceolate,

ovate-triangular, or subpentagonal; pinnae with anadromous pinnules, shortly stalked, unequally sided or subequilateral at base; minutely toothed at segment margin; veins free, forked or pinnate, terminating in teeth or emarginations. Lamina thinly herbaceous or herbaceous, green when dried, stipe, rachis, costae, and costules with few small scales at base, and multicellular hairs or unicellular glandular hairs, lamina usually glabrate. Sori orbicular, abaxial on veins, sorophore slightly protuberant, annulus of sporangium consisting of 14–16 cells; indusia ovate, lanceolate, orbicular, or shallowly cup-shaped, attached at proximal side of sorophore, membranous, persistent, covering sporangia when young, hidden at maturity. Spores bilateral, dark brown, bean-shaped, perispore usually with spines, rarely with folds.  $x = 42$ .

More than 20 species and many hybrids: mainly in the temperate and frigid-temperate zones and in tropical mountains; 11 species (six endemic) in China.

The following taxon is excluded from the present treatment, pending further research: *Cystopteris maborasensis* Masamune (Trans. Nat. Hist. Soc. Formosa 28: 141. 1938), described from Taiwan.

- 1a. Rhizomes shortly creeping or ascending; fronds approximate or caespitose; lamina lanceolate to broadly lanceolate; veins terminating in teeth, rarely in emarginations.
  - 2a. Veins terminating in teeth.
    - 3a. Perispore echinate; on calcareous soil ..... 1. *C. fragilis*
    - 3b. Perispore rugose or verrucose, not echinate; on acidic soil ..... 2. *C. dickieana*
  - 2b. Veins terminating in emarginations.
    - 4a. Plants usually less than 10 cm tall; stipe slender, slightly longer than lamina or nearly as long as lamina, chestnut-colored ..... 3. *C. kansuana*
    - 4b. Plants up to 29 cm tall; stipe thick (ca. 1 mm), shorter than lamina, dark purple at base ..... 4. *C. guizhouensis*
- 1b. Rhizomes long creeping with fronds distant; lamina broadly ovate, ovate-triangular, or subpentagonal; veins terminating in emarginations.
  - 5a. Lamina subpentagonal with basal basispic pinnules of basal pinnae prominently elongated.
    - 6a. Ultimate segments not revolute at margin; spore surface shortly spinose or verrucose ..... 5. *C. montana*
    - 6b. Ultimate segments revolute at margin; spore surface rugately folded ..... 6. *C. modesta*
  - 5b. Lamina broadly ovate or ovate-triangular with basal basispic pinnules of basal pinnae not elongated.
    - 7a. Indusia glandular; plants slender ..... 7. *C. sudetica*
    - 7b. Indusia not glandular, plants moderately stout.
      - 8a. Lamina with short glandular hairs ..... 8. *C. tibetica*
      - 8b. Lamina lacking short glandular hairs.
        - 9a. Fronds up to 50 cm or longer; lamina to 4-pinnatisect; perispore densely echinate ..... 9. *C. deqinensis*
        - 9b. Fronds less than 50 cm; lamina 2- or 3-pinnate; perispore sparsely echinate.
          - 10a. Ultimate segments 3–5 mm wide; indusia attached to ca. 1/2 of circumference of receptacle ..... 10. *C. moupinensis*
          - 10b. Ultimate pinnules or segments 5–7 mm wide; indusia attached to ca. 2/3 of circumference of receptacle ..... 11. *C. pellucida*

**1. *Cystopteris fragilis* (Linnaeus) Bernhardt** in Schrader, Neues J. Bot. 1(2): 26. 1805.

冷蕨 leng jue

*Polypodium fragile* Linnaeus, Sp. Pl. 2: 1091. 1753; *Aspidium fragile* (Linnaeus) Swartz; *Athyrium fragile* (Linnaeus) Sprengel; *Cyclopteris fragilis* (Linnaeus) Gray; *Cyste fragilis* (Linnaeus) Dulac; *Cystea fragilis* (Linnaeus) J. Smith; *Cystopteris filix-fragilis* Gilibert.

Rhizomes shortly or long creeping, scaly at apex and stipe bases; scales brownish, broadly lanceolate. Fronds approximate or caespitose; fertile fronds (3.5–)20–35(–49) cm; stipe brown at base, upper part stramineous or chestnut-colored, usually shorter than lamina, nearly 1/3–2/3 as long as lamina, occasionally slender and slightly longer than lamina when plant in crevices, 5–14(–20) cm, (0.2–)1–1.5 mm in diam., with sparse, shiny scales; lamina usually 2-pinnate to 2-pinnate-pinnatifid, occasionally pinnate or 3-pinnate, lanceolate to broadly lanceolate, 17–28 × (0.8–)4–5(–8) cm, shortly acuminate at apex; pinnae 12–15 pairs, ascending, basal 1 or 2 pairs slightly

shortened, or nearly not shortened, ovate to ovate-lanceolate, (0.4–)2–4(–7) × (0.2–)1–2.5 cm, obtuse or shortly acuminate, toothed at apex, subopposite, sessile, widely separated from each other, usually 1–2 × as long as wide, 1.5–4.5 cm apart, base parallel to rachis on acroscopic side, ± cuneate on basispic side; pinnules 5–7 pairs, ovate or oblong, acroscopic side truncate, basispic side cuneate at base, sessile or shortly stalked, entire or toothed at margin, or pinnatifid, rounded or obtuse and toothed at apex; middle pinnae similar to lower pinnae, but slightly longer, separated from each other by 1.2–2.5 cm, subopposite or alternate, sessile; upper pinnae pinnatifid, toothed only on apices and acroscopic margin; veins pinnate, costules slightly tortuous, terminating in entire teeth. Lamina herbaceous when dried, green or yellow-green. Rachis and costae, especially their bases, ± with sparse unicellular to long multicellular hairs, even with few scale hairs. Sori small, orbicular, medial on veins, 2–4 pairs per pinnule, 1 or 2 sori at acroscopic side in upper pinnules; indusia pale green or brownish, ovate to lanceolate, membranous. Spores dark brown, perispore surface with regular, denser spines.  $2n = 84^*$ , 168, 252, 336.

Under alpine shrubs, in rock crevices on shaded slopes, base of rocks, damp areas at streamsides; (200–)1500–4500(–4800) m. Anhui, Gansu, Hebei, Heilongjiang, Henan, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shandong, Shanxi, W Sichuan, Taiwan, Xinjiang, Xizang, Yunnan [Afghanistan, India, Japan, Kashmir, Korea, Mongolia, Nepal, Pakistan, Russia; Africa, SW Asia (Iran, Turkey), Europe, North and South America].

According to Knapp (Ferns Fern Allies Taiwan, 445. 2011), Windham described several cytotypes for Taiwan (diploid, tetraploid, and hexaploid) in 2007; thus, further study of the taxon is pending. Many infraspecific taxa have been described from Europe.

**2. *Cystopteris dickieana*** R. Sim, Gard. Farmers' J. 2: 308. 1848.

皱孢冷蕨 zhou bao leng jue

*Cystopteris baenitzii* Dörfler; *C. fragilis* (Linnaeus) Bernhardt var. *baenitzii* (Dörfler) Ascherson & P. Graebner; *C. fragilis* subsp. *dickieana* (R. Sim) Hylander; *C. fragilis* var. *dickieana* (R. Sim) Lindberg; *C. sikkimensis* Ching ex Bir.

Very similar to *Cystopteris fragilis*, hardly distinguished from it morphologically except in spore ornamentation, i.e., perispore rugose or verrucose not echinate. It is reported that they can make sterile hybrids and form a species complex with other species.  $2n = 168, 252$ .

Sympatric in the distribution area of *Cystopteris fragilis*, valleys, rock crevices on mountain slopes, on rocks in forests, damp areas in grasslands; 1400–5400(–5600) m. Gansu, Hebei, Qinghai, Shaanxi, Sichuan, ?Taiwan, Xinjiang (common), Xizang (common), Yunnan [Afghanistan, India, Nepal, Pakistan; Africa, Europe, North America].

The taxonomic status of Chinese *Cystopteris dickieana* is uncertain. Scottish and American *C. dickieana* are considered conspecific with *C. fragilis*, based on the variable echinate and rugose spore ornamentation in *C. fragilis*.

**3. *Cystopteris kansuana*** C. Christensen, J. Wash. Acad. Sci. 17: 499. 1927.

西宁冷蕨 xi ning leng jue

*Cystopteris* ×*kansuana* Blasdell.

Rhizomes slender, shortly creeping, sparsely scaly. Fronds approximate; fertile fronds 10–19 cm; stipe chestnut-colored, 6–11 cm, less than 1 mm in diam., base with few brown lanceolate scales, upper part glabrate; lamina bipinnatifid, pale green or dark brown when dried, lanceolate, 4–10 × 1.3–3 cm, thinly herbaceous, base obtuse, apex long acuminate; pinnae 5–8 pairs, basal pinnae 1–2.4 cm apart from, and slightly shorter than, second basal pinnae, subopposite; upper pinnae alternate, ascending, subsessile or shortly stalked (stalk 1–2 mm); lower pinnae ovate to narrowly ovate, 9–20 × 4–8 mm, acroscopic base broadly cuneate, basispic base narrowly cuneate, lobed to narrow costal wings, apex acuminate; pinna segments ca. 3 pairs, ascending; basal acroscopic segment largest, narrowly ovate, 4–8 × 2–3 mm, crenate or dentate-pinnatifid, apex acute or obtuse-rounded; upper segments oblong or linear-oblong, acuminate, with 2 or 3 small teeth, entire at margin. Veins in basal acroscopic lateral segment pinnate, upper or basispic lateral veins simple or occasionally forked, terminating in laminar emarginations. Sori yellow-brown, orbicu-

lar, medial on veins; indusia pale yellow-brown, ovate, entire at margin, persistent. Spore with echinate perispore.

• Shaded rock crevices; 3000–4500 m. Gansu, Qinghai, Sichuan, Xizang, Yunnan.

**4. *Cystopteris guizhouensis*** X. Y. Wang & P. S. Wang, Acta Bot. Yunnan. 19: 141. 1997.

贵州冷蕨 gui zhou leng jue

Rhizomes shortly creeping, scaly at apex along with stipe bases; scales brown, ovate-lanceolate. Fronds approximate or caespitose, up to 29 cm; stipe base dark purple, upper part stramineous, 7–9 cm, nearly 1/2 as long as lamina; lamina bipinnatifid, lanceolate, 18–21 × 4–5 cm at middle, thinly herbaceous when dried, dark green, glabrate on surfaces, base slightly narrowed, apex long acuminate; pinnae 12–15 pairs, spreading, basal 1 or 2 pairs slightly shorter than upper pinnae, subopposite, sessile, oblong or ovate-oblong, 2.5–2.8 × 1–1.2 cm, subequilateral, cuneate at base, obtuse at apex; pinna segments 8–10 pairs, often oblong, crenate, apex rounded or truncate; veins free, terminating in emarginations. Sori small, orbicular, usually in one row on either side of costa; indusia broadly ovate, membranous, persistent. Perispore echinate, spines 6–7 μm.

• Rock crevices in forests; ca. 2800 m. Guizhou.

**5. *Cystopteris montana*** (Lamarck) Bernhardt ex Desvaux in Schrader, Neues J. Bot. 1(2): 26. 1805.

高山冷蕨 gao shan leng jue

*Polypodium montanum* Lamarck, Fl. Franç. 1: 23. 1779; *Aspidium montanum* (Lamarck) Swartz; *Athyrium montanum* (Lamarck) Rohl ex Sprengel; *Cyathea montana* (Lamarck) J. Smith; *Cystopteris montana* (Lamarck) Dulac; *Cystopteris allioni* Newman; *Filicula montana* (Lamarck) Farwell; *Filix montana* (Lamarck) Underwood; *Rhizomatopteris montana* (Lamarck) A. P. Khokhrjakov.

Rhizomes long creeping, blackish brown, glabrate, with sparse brownish, ovate, membranous scales, more densely scaly at apex. Fronds distant; fertile fronds 20–49 cm; stipe blackish brown at lower part, upper part stramineous or pale chestnut-colored, (6–)14–31 cm, 1–3 × as long as lamina, with sparse brownish, ovate scales at base, upper part subglabrate with few scales; lamina 3- or 4-pinnate, rarely 4-pinnate-pinnatifid, subpentagonal, (5–)8–15(–20) cm long and wide, thinly herbaceous, apex acuminate; pinnae 4–7(–10) pairs, basal pinnae subopposite (upper pinnae alternate), spreading, shortly stalked (stalk 3–10 mm), ca. 2.5 cm apart from second basal pinnae, largest, deltoid-ovate or triangular, (2.5–)6–11(–13) × (2–)4–7 cm, base subtruncate, strongly inequilateral, 2-pinnate with pinnatifid secondary pinnules, apex acuminate; pinnules (3–)6–8(–10) pairs, anadromous; acroscopic pinnules triangular, (0.4–)1–2 × (6–)8–9(–12) mm, base subtruncate, equilateral, basispic pinnules prominently larger than acroscopic pinnules, nearly 2 × as long, apex acuminate; basal basispic pinnules of lowest pinnae largest, oblong-triangular, 2–3 × as long as acroscopic pinnules, 3–5 × 1.5–2.5 cm, inserted at costa at nearly right angles, sessile or with stalk 1–2 mm, base truncate,

apex acuminate; secondary pinnules ca. 6 pairs, alternate, spreading, ovate to oblong, subacute, sessile, often decurrent to costules; acroscopic basal secondary pinnules shorter, deltoid-ovate, 4–9 × 3–6 mm, basispicopic pinnules up to 8–16 × 6–9 mm; secondary pinnule segments 4 or 5 pairs, subopposite, ascending, base cuneate, lobed to narrow wing of midrib, apex obtuse-rounded; ultimate segments oblique, lobed or slightly incised, rounded-obtuse. Veins pinnate, costules slightly tortuous, simple or forked, terminating in emarginations. Rachis, costae, and costules with unicellular hairs, multicellular hyaline hairs, or short glandular hairs. Sori small, brown, orbicular, abaxial on veins, 3–7 sori per ultimate segment; indusia pale green or yellow-brown, orbicular, thinly membranous. Perispore with short spinose or verrucose processes.  $2n = 168$ .

Alpine areas in mountains, wet areas in forests; 1700–4500 m. Gansu, Hebei, Henan, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, ?Taiwan, Xinjiang, Xizang, Yunnan [N India, Japan, Kashmir, Korea, Nepal, E Pakistan, Russia; E Europe, North America].

**6. *Cystopteris modesta*** Ching, Bull. Fan Mem. Inst. Biol., Bot. 10: 5. 1940.

卷叶冷蕨 juan ye leng jue

Rhizomes long creeping, blackish brown, glabrate, with sparse brownish, broadly ovate, membranous scales, more densely scaly at apex. Fronds distant; fertile fronds 10–30 cm; stipe brown or chestnut-colored, upward stramineous, 6–17 cm, base with sparse brownish, ovate scales, upper part with only few scales; lamina 3-pinnate with secondary pinnules pinnatifid-partite, ovate, 5–13 × 4–7 cm, base broadly cuneate, apex acuminate; pinnae 4 or 5 pairs, alternate, ascending, stalk 3–5 mm; basal pinnae largest, narrowly deltoid-ovate, ca. 7 × 2.5 cm, base broadly cuneate, apex acuminate; pinnules 5–9 pairs, alternate, much ascending, ca. 8 mm apart, oblong-ovate, base subtruncate, equilateral, shortly stalked, apex acuminate; basal basispicopic pinnules of lowest pinnae longest, up to 3.2 cm; secondary pinnules 4 or 5 pairs, oblong, 3–6 mm, gradually narrowed to apex, base sessile, not decurrent, apex obtuse; pinnule segments small, 2 or 3 pairs, approximate, broadly ovate, decurrent to narrow costular wing, subentire, revolute at margin, apex rounded-obtuse; second basal pinnae ca. 3 cm apart from basal pinnae. Veins pinnate in segment, free; rachis, costae, and midribs glabrate. Sori orbicular, abaxial on veins; indusia brown, persistent. Perispore foveolate or reticulate with rugate folds.

• Rock crevices at streamsides; ca. 3600 m. NW Yunnan (watershed between Nuijiang and Qiujiang).

*Cystopteris modesta* is very similar to *C. montana* but distinct from it in the revolute segments and foveolate or finely reticulate perispore.

**7. *Cystopteris sudetica*** A. Braun & Milde, Jahresber. Schles. Ges. Vaterl. Cult. 92. 1855.

欧洲冷蕨 ou zhou leng jue

*Cystopteris leucosoria* Schur; *Rhizomatopteris sudetica* (A. Braun & Milde) A. P. Khokhrjakov.

Rhizomes long creeping, 1–2 mm in diam., rhizome and stipe bases clothed with brown short hairs and few pale brown,

membranous, ovate-lanceolate scales, apex more densely scaly. Fronds distant; fertile fronds (15–)20–30 cm; stipe stramineous, shiny, 10–16(–20) cm, thin; lamina 3-pinnate, broadly ovate or ovate-triangular, 9–15(–20) × 8–12(–15) cm, thinly herbaceous or herbaceous when dry, acuminate; pinnae 8–12 pairs, ascending, basal pinnae not shortened, oblong or ovate-lanceolate, (3–)4.5–7(–8) × 1.8–3 cm at middle, slightly narrowed, inequilateral at base, stalked (stalk 2–3 mm), subopposite, (1–)1.5–2.5(–3) cm apart from second basal pinnae, 2-pinnate, apex acuminate; pinnules 8–12 pairs, anadromous, alternate, acroscopic pinnule slightly shorter than basispicopic one or subequal, second basispicopic pinnule largest, ovate or ovate-triangular, 1–2 cm × 5–8 mm, unequally sided, acroscopic base parallel to costa, basispicopic base cuneate, subsessile or with 1–2 mm stalk, toothed, apex obtuse or acute; secondary pinnules or pinnule segments 4 or 5 pairs, broadly ovate to oblong, basal acroscopic one largest, 5–6 × 3–4 mm, broadly cuneate, free or adnate to costule by narrow wing at base, margin lobed, rounded-obtuse or subtruncate, serrate at apex; upper pinnules gradually smaller, oblong-obovate, crenate at apex, basispicopic side entire, acroscopic side with 1 or 2 lobes; upper pinnae lanceolate, pinnatifid, segments serrate at apex, toward base entire at margin; veins visible on both surfaces, simple or 1- or 2-forked, terminating in emarginations. Rachis and costae with sparse or dense short glandular hairs and few long multicellular hairs. Sori small, orbicular, 1 or 2 per ultimate segment, often abaxial on suprabasal veins; indusia pale brown or yellow-brown, suborbicular or shallowly cupular, with sparse tiny glandular hairs. Perispore echinate.  $2n = 84, 168$ .

Coniferous and mixed forests; 900–3300 m. Hebei, Heilongjiang, Jilin, Liaoning, Nei Mongol, Shanxi, Xizang, Yunnan [Japan, Korea, E and W Russia; Europe].

**8. *Cystopteris tibetica*** Z. R. Wang, Acta Phytotax. Sin. 32: 85. 1994.

藏冷蕨 zang leng jue

Rhizomes long creeping, 1.5–2 mm in diam., rhizome and stipe base clothed with brown hairs and few membranous scales. Fronds distant; fertile fronds 15–20 cm; stipe brownish at base, upward stramineous, 6–14 cm, 1–1.5 mm in diam., base clothed with brown hairs and few broadly ovate or ovate-lanceolate scales; lamina 3-pinnate, deltoid-ovate, 6–11 × 3–5 cm, acuminate; pinnae 8–10 pairs, alternate, basal pinnae subopposite, 1.2–3 cm apart from second basal pinnae, ascending, largest, oblong or ovate-lanceolate, 3–5 × 1.2–1.5 cm, base slightly narrowed and inequilateral, with stalk 1.5–3 mm, apex acuminate; upper pinnae lanceolate; pinnules 6–8 pairs, anadromous, alternate, acroscopic one usually slightly shorter than basispicopic one, second basal basispicopic pinnules largest, deltoid-ovate, 6–8 × 4–5 mm, inequilateral at base, acroscopic base parallel to costae, basispicopic base broadly cuneate, very shortly stalked, toothed, apex obtuse; secondary pinnules or pinnule segments ca. 3 pairs, basal acroscopic largest, ovate, oblong, or obovate, 2–3 × 1.5–2 cm, base cuneate and adnate to costular wing or partly separate, serrate, apex obtuse; upper segments rhomboid or shortly linear, only acroscopic side and apices toothed; veins visible on surfaces, pinnate, terminating in emarginations. Fronds thinly herbaceous when dried, green,

clothed with short glandular hairs on both surfaces. Sori small, orbicular, 1 or 2 sori per ultimate segment, abaxial on supra-basal veins; indusia pale brown, orbicular or shallowly cupular, frequently with few glands, covering sporangia when young, hidden at maturity.

• Alpine slopes, damp areas in coniferous forests, streamsides, on rocks and tree trunks; 2400–3600 m. Xizang, Yunnan.

*Cystopteris tibetica* is similar to *C. moupinensis*, but the lamina has short glandular hairs on both surfaces and the indusia also has short glandular hairs.

**9. *Cystopteris deqinensis*** Z. R. Wang, Acta Phytotax. Sin. 32: 84. 1994.

德钦冷蕨 de qin leng jue

Rhizomes long creeping. Fronds distant; fertile fronds 45–60 cm; stipe dark brownish at base, upward stramineous, 20–25 cm, 1.5–3 mm in diam., base clothed with brown hairs and few broadly ovate or lanceolate scales; lamina 3-pinnate, narrowly ovate or ovate-oblong, 25–35 × 15–20 cm, thinly herbaceous when dried, apex acuminate; pinnae up to 10–13 pairs or more, alternate, basal and second basal pinnae largest, subopposite, 5–7 cm apart from second basal pinnae, ascending, ovate-lanceolate, 12–17 × 4–6 cm, base slightly narrowed and inequilateral, with stalk 0.5–1.5 cm, apex acuminate; pinnules 10–15 pairs, anadromous, alternate, usually basispic one slightly longer than acroscopic one, basispic second and third basal pinnules largest, ovate to broadly lanceolate, 2.5–4.3 × 1.5–2.2 cm, base inequilateral, acroscopic base parallel to costae, basispic base broadly cuneate, with stalk 1.5–2 mm, apex acuminate; secondary pinnules 5–7 pairs, basal acroscopic pinnule largest, broadly ovate, 8–14 × 5–8 mm, base narrowly cuneate, pinnatifid, toothed at margin, apex rounded-obtuse; veins visible on both surfaces, forked, terminating in emarginations. Sori orbicular, 1–6 sori per ultimate segment, abaxial on veins; indusia pale green to brownish, orbicular or shallowly cupular, without glands, covering sporangia when young, hidden at maturity. Spores bean-shaped, perispore very densely echinate.

• On rocks in valleys, mountain slopes in *Quercus* forests, streamsides; 2400–3000 m. NW Yunnan.

**10. *Cystopteris moupinensis*** Franchet, Nouv. Arch. Mus. Hist. Nat., sér. 2, 10: 111. 1887.

宝兴冷蕨 bao xing leng jue

*Cystopteris mairei* Brause; *C. sphaerocarpa* Hayata; *C. sudetica* A. Braun & Milde var. *moupinensis* (Franchet) C. Christensen; *C. tangutica* Grubov.

Rhizomes long creeping, 1–2 mm in diam., rhizomes and stipe bases clothed with brown hairs and few pale brown, broadly ovate, membranous scales. Fronds distant; fertile fronds (20–)30–40(–50) cm; stipe stramineous or chestnut-brown, shiny, 10–22(–25) cm, 1–2 mm in diam.; lamina pinnate-pinnatifid to 3-pinnate, ovate or deltoid-ovate, 9–17(–25) × 5–8(–15) cm, thinly herbaceous when dried, apex acuminate; pinnae 8–12(–15) pairs, ascending, basal pinnae oblong or ovate-lanceolate, 5–10 × 2–3.5 cm, as long as and wider

than second basal pinnae, toothed, base slightly narrowed and inequilateral, with stalk 3–4 mm (2–3 mm in second basal pinnae), apex acuminate, subopposite, 3–3.5(–5) cm apart from second basal pinnae; pinnules 8–12 pairs, anadromous, alternate, usually acroscopic pinnule slightly shorter than basispic one, second basal basispic pinnule largest, deltoid-ovate or narrowly triangular, 1–2.2(–3) cm × 8–13 mm, toothed, inequilateral, acroscopic base parallel to costae, basispic base broadly cuneate, with stalk 1–2 mm, apex obtuse; secondary pinnules or pinnule segments 3 or 4 pairs; basal acroscopic one largest, broadly ovate, 4–9 × 3–5 mm, base cuneate and adnate to costular wing, cut or toothed at margin, apex rounded-obtuse and toothed; upper secondary pinnules rhomboid or shortly linear, apex and acroscopic side toothed. Veins visible on surfaces, 1 to several times forked, terminating in emarginations. Sori small, orbicular, abaxial on supra-basal veins, 1 or 2 sori per ultimate segment; indusia pale green or yellow-brown, orbicular or shallowly cupular, membranous, without tiny glandular hairs, covering sporangia when young, hidden at maturity. Perispore echinate.

Damp areas and on wet rocks in mixed forests; 1000–4100 m. Gansu, NW Guizhou, Hebei, Henan, Qinghai, Shaanxi, Sichuan, Taiwan, SE Xizang, Yunnan [N India].

*Cystopteris moupinensis* is very similar to *C. sudetica* but differs in the indusia without tiny glandular hairs and the plants moderately stout. The two are segregated phytogeographically: *C. sudetica* occurs in N and NE China, and occasionally in high mountains of Yunnan and Xizang, while *C. moupinensis* occurs in mountains of W China, north to Qin Ling and west to E Xizang.

**11. *Cystopteris pellucida*** (Franchet) Ching in C. Christensen, Index Filic., Suppl. 3: 67. 1934.

膜叶冷蕨 mo ye leng jue

*Aspidium pellucidum* Franchet, Nouv. Arch. Mus. Hist. Nat., sér. 2, 10: 119. 1887; *Cystopteris alata* Ching; *Dryopteris pellucida* (Franchet) C. Christensen; *Nephrodium pellucidum* (Franchet) Diels.

Rhizomes long creeping, ca. 2 mm in diam., rhizome and stipe bases densely clothed with red-brown short hairs, and few pale brown, broadly ovate, membranous scales. Fronds distant; fertile fronds (20–)50–60 cm; stipe pale stramineous or brownish red, shiny, (10–)20–32 cm, 1–2 mm in diam., with few pale brown, broadly ovate, membranous scales mixed with short hairs at base; lamina 3-pinnate, ovate to narrowly ovate-oblong, (10–)20–33 × (5–)10–15(–25) cm, thinly herbaceous or submembranous when dried, apex long acuminate; pinnae (10–)12–15(–17) pairs, ascending, subopposite, basal pinnae longest, deltoid-lanceolate, (5–)8–14 × 2.5–4.5 cm, base inequilateral, with stalk 3–5(–8) mm, apex caudate-acuminate, (3–)5(–7) cm apart from second basal pinnae; pinnules 8–12 pairs, anadromous, alternate, usually acroscopic one slightly smaller than basispic one, second basal basispic pinnules largest, narrowly ovate or narrowly triangular, 1.5–2.5(–4) × 1–1.5 cm, base very inequilateral, acroscopic base narrowly cuneate, parallel to costae, basispic base broadly cuneate, very shortly stalked or sessile, apex acute

or subobtuse and toothed; secondary pinnules or pinnule segments 3–5 pairs, basal acroscopic one largest, oblong or ovate, rounded-obtuse or subtruncate at apex, toothed at apex and margin; veins visible on surfaces, more obvious abaxially, simple or 1- or 2-forked, terminating in emarginations. Sori brown, orbicular, abaxial suprabasally, 1 or 2 sori per ultimate segment; indusia pale brown, orbicular or half cup-shaped, membranous, without tiny glandular hairs, covering sporangia

when young, hidden at maturity. Perispore echinate.  $2n = ca. 84^*$ .

• Forests on mountain slopes, damp areas at streamsides; 1500–3700 m. S Gansu, Henan, Shaanxi, W Sichuan, Xizang, Yunnan.

*Cystopteris pellucida* is very similar to and sympatric with *C. moupinensis* but differs in the plants slightly larger, ultimate segments wider, and lamina thinner. The indusia are larger and attached up to 2/3 of the circumference of the receptacle.