

## ASPLENIACEAE

铁角蕨科 tie jiao jue ke

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Plants small to medium-sized, predominantly epilithic or terrestrial, but also many epiphytic. Rhizome creeping, decumbent, or erect, radial or dorsiventral (*Hymenasplenium*), sometimes massive and bearing detritus-collecting fronds, scaly; scales narrowly triangular, clathrate with anticlinal walls thickened and periclinal walls translucent, often costate and with a central zone of cells with thicker anticlinal walls, in some taxa becoming completely opaque, rarely whole scale black and opaque, margins entire, dentate, or with short or long outgrowths (fimbriate scales), often with a terminal glandular cell, both surfaces glabrous. Fronds remote (in China mainly in *Hymenasplenium*) or clustered, spirally arranged or in two abaxial rows (*Hymenasplenium*), herbaceous or leathery to subfleshy, with scales similar to those on rhizome or gradually reduced in size (mini-scales) and filiform to hastate-stellate, usually with small, 3- or 4-celled uniseriate hairs terminating in a gland, rarely glandular or completely glabrous, occasionally gemmiferous with buds often on, but not restricted to, rachis or at pinna apex; stipe usually distinct, not articulate, rarely forming a trochopod (*Asplenium adiantum-nigrum*) or persistent (*Hymenasplenium*), distinctly scaly at base, green to grayish brown, in some species castaneous to black and then often shiny, rounded to grooved (sulcate) adaxially, with two vascular bundles at its base, upward near rachis combined into one X-shaped bundle. Lamina outline variable, from simple to 4-pinnate, apical pinnae usually reduced and confluent into a pinnatifid apex, rarely conform with lateral pinnae (e.g., *A. formosae*), usually branching anadromously; rachis structure variable, adaxially often sulcate, with or without central supravascular ridge, with or without lateral wings derived from decurrent frond margins, rarely with an abaxial wing (*A. tripteropus*); pinnae and other divisions often more strongly developed in direction of apex, ultimate pinnules or segments often rhombic, trapeziform, or cuneiform with asymmetrical base, rarely dimidiate, margin rarely entire, more often repand or sinuate to crenate or serrate, each tooth usually with a single vein. Veins mostly free, anadromously branching, veinlets usually not reaching margin, with or without terminal hydathode, rarely anastomosing near margin or with a marginal connecting vein (*A. subg. Thamnopteris* C. Presl); some species with a dissected lamina have one single vein per ultimate segment. Sori single, rarely “double” on two different veins (*A. subg. Phyllitis* (Hill) Jermy & Viane), or J-shaped (e.g., *A. fontanum*), linear to subelliptic, attached along one side of a veinlet, usually indusiate (indusium reduced in *A. subg. Ceterach* (Willdenow) Vida ex Bir, Fraser-Jenkins & Lovis); indusia thinly membranous to thick and firm, usually flat but occasionally rolling back at maturity, free margin entire to erose, sinuate, fimbriate, glandular, or rarely with mini-scales, attached laterally along a veinlet, opening toward costa, costule, or vein from which soriferous vein originated, in some species with a dissected lamina seemingly opening toward margin (*A. prolongatum*). Sporangia with a vertical annulus of ca. 20 thickened cells, stalk uniseriate, not glandular. Spores usually 64 per sporangium, bilateral, elliptic to reniform, monoletic; exospore smooth, perispores elaborate and very variable, consisting of three layers, outer with ridges (lophate), spines (echinate), or with large pori (reticulate) and no ridges or spines, or a combination. Plants sexual or agamosporous and then often with only 32 spores per sporangium,  $x = (35)36$  in *Asplenium*, but (36, 38)39 in *Hymenasplenium*.

Two genera and ca. 700 species: subcosmopolitan, but mainly in montane and (sub)tropical regions; two genera and 108 species and species complexes (*Hymenasplenium*) (25 endemic) in China.

Wu Shiew-hung. 1999. Aspleniaceae. In: Wu Shiew-hung, ed., *Fl. Reipubl. Popularis Sin.* 4(2): 1–153.

- 1a. Rhizome erect or shortly creeping, if long creeping then usually more than 0.6 cm in diam. and densely scaly throughout; fronds remote or clustered, lamina simple to 4-pinnate; costa usually with all basal basisopic veins present ..... 1. *Asplenium*  
1b. Rhizome long creeping, usually less than 0.6 cm in diam. and with very few scales except near apex; fronds remote, lamina rarely simple, usually 1-pinnate; costa usually with several (rarely one) basal basisopic veins absent ..... 2. *Hymenasplenium*

### 1. ASPLENIUM Linnaeus, Sp. Pl. 2: 1078. 1753.

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*Acropteris* Link; *Amesium* Newman; *Asplenidictyum* J. Smith; *Asplenium* sect. *Ceterachopsis* J. Smith; *A. subg. Thamnopteris* C. Presl; *Camptosorus* Link; *Ceterach* Willdenow, nom. cons.; *Ceterachopsis* (J. Smith) Ching; *Darea* Jussieu; *Neottopteris* J. Smith; *Phyllitis* Hill; *Schaffneria* Fée ex T. Moore; *Scolopendrium* Adanson; *Sinephropteris* Mickel; *Tarachia* C. Presl; *Thamnopteris* (C. Presl) C. Presl (1851), not Brongniart (1849) [fossil].

Plants epilithic, epiphytic, or terrestrial. Rhizome rarely dorsiventral, creeping, decumbent, or erect, with clathrate scales. Fronds herbaceous to leathery, sometimes subfleshy, remote or (more often) clustered; stipe dull, green to castaneous or black and

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then often shiny, base terete or semiterete, often becoming sulcate adaxially, rounded to carinate abaxially; lamina simple to 4-pinnate; rachis sulcate adaxially often with raised central supravascular ridge; margin of pinnae or pinnules often decurrent and forming adaxial wings along rachis or costa; acroscopic side of pinnae, pinnules, and ultimate segments often more developed and these then asymmetrical, pseudodimidiolate to dimidiolate; margin entire to coarsely serrate, each tooth usually with one veinlet, obtuse, mucronate to acute. Veins free, rarely anastomosing, anadromously branching, rarely with a single vein per pinnule or segment, not reaching margin. Sori linear to subelliptic, rarely double, indusiate; indusia thinly membranous to papery, free margin entire to erose, sinuate or fimbriate, rarely with uniseriate glandular hairs; stalks of sporangia long uniseriate, annuli with 20–28 thickened cells. Spores bilateral, elliptic to reniform, monolete, exospore smooth, perispores elaborate and very variable; in sexual plants 64 spores per sporangium. Plants sexual or agamosporous,  $x = 35, 36$ .

More than 700 species: subcosmopolitan; 90 species (17 endemic) in China.

Six uncertain taxa, not included in the following key, are listed at the end of the account.

- 1a. Fronds simple or 2- or 3-forked.
- 2a. Fronds 2- or 3-forked into linear segments.
- 3a. Average exospore length less than 37  $\mu\text{m}$ ; plants sexual diploids:  $n = 36^{\text{II}}$  or  $2n = 72$  ..... 1. *A. caucasicum*
- 3b. Average exospore length more than 37  $\mu\text{m}$ ; plants sexual tetraploid:  $n = 72^{\text{II}}$  or  $2n = 144$  ..... 2. *A. septentrionale*
- 2b. Fronds simple, not forked.
- 4a. Veins free, rarely connected near margin, never united into a marginal vein.
- 5a. Sori double (paired) ..... 8. *A. komarovii*
- 5b. Sori simple.
- 6a. Lamina reniform, ca.  $1 \times 1$  cm.
- 7a. Average exospore length 35–40  $\mu\text{m}$ ; plants diploid:  $2n = 72$  ..... 67. *A. dolomiticum*
- 7b. Average exospore length 41–49  $\mu\text{m}$ ; plants tetraploid:  $2n = 144$  ..... 68. *A. ruta-muraria*
- 6b. Lamina not reniform, larger than ca.  $1 \times 1$  cm.
- 8a. Stipe shiny black; lamina less than 10 cm, apex obtuse, margin black ..... 3. *A. speluncae*
- 8b. Stipe not shiny black; lamina more than 10 cm, apex acute to acuminate, margin not black.
- 9a. Most sori more than 12 mm, at an angle less than  $40^\circ$  to midrib (rachis); lamina margin repand to entire.
- 10a. Fronds lanceolate, 6–10  $\times$  longer than wide, apex acute-acuminate; midrib raised, semiterete adaxially; sori at angle of  $30^\circ$ – $40^\circ$  to rachis ..... 6. *A. holosorum*
- 10b. Fronds narrowly lanceolate, 10–25  $\times$  longer than wide, apex acuminate-caudate; midrib sulcate adaxially; sori at angle of  $15^\circ$ – $30^\circ$  to rachis ..... 7. *A. ensiforme*
- 9b. Most sori less than 12 mm, at an angle of  $40^\circ$ – $80^\circ$  to midrib (rachis); lamina margin crenate to sinuate, often notched.
- 11a. Frond stalked; stipe 8–16 cm ..... 29. *A. formosae*
- 11b. Frond sessile; stipe 0.5–6 cm.
- 12a. Frond linear to narrowly lanceolate, up to 2 cm wide or more than 13  $\times$  longer than wide ..... 4. *A. scortechinii*
- 12b. Frond lanceolate, 2–2.5 cm wide or less than 13  $\times$  longer than wide ..... 5. *A. griffithianum*
- 4b. Veins anastomosing, connected near margin, or united into a marginal vein.
- 13a. Lamina orbicular or ovate, base cordate.
- 14a. Rhizome short and erect; fronds clustered; lamina orbicular; most sori double ..... 9. *A. delavayi*
- 14b. Rhizome long and creeping; fronds remote; lamina ovate; most sori simple ..... see *Hymenasplenium cardiophyllum* (p. 309)
- 13b. Lamina lanceolate to oblanceolate, base cuneate, rarely cordate.
- 15a. Mature fronds less than 20 cm, herbaceous to subleathery, apex usually flagelliform, proliferous and rooting; veins anastomosing, forming 1 or 2 rows of areoles but not ending in a marginal vein ..... 16. *A. ruprechtii*
- 15b. Mature fronds more than 20 cm, subleathery to leathery, apex not proliferous; veins ending in a marginal connecting vein (*A.* subg. *Thamnopteris*).
- 16a. Frond distinctly spatulate, widest above middle; midrib stramineous to pale brown.
- 17a. Stipe distinct; midrib semiterete abaxially; lamina reduced at base; plants hexaploid ..... 10. *A. humbertii*
- 17b. Stipe very short or absent; midrib keeled abaxially; lamina very gradually reduced into a long broadly winged basal part; plants tetraploid ..... 11. *A. antrophyoides*
- 16b. Frond lanceolate, widest near middle; midrib pale or grayish brown to brownish black.
- 18a. Stipe basal scales subulate to very narrowly triangular-ovate, more than 10  $\times$  longer than wide.
- 19a. Midrib abaxially flat; sori covering up to 1/2 of their subtending vein; perispore winged ..... 12. *A. nidus*
- 19b. Midrib abaxially prominent, obtusely carinate; sori covering more than 1/2 of their subtending vein; perispore echinate ..... 13. *A. oblanceolatum*
- 18b. Stipe basal scales triangular-ovate, less than 10  $\times$  longer than wide.

- 20a. Stipe basal scales > 15 mm; lamina with many small scales at base; midrib semiterete abaxially ..... 14. *A. antiquum*
- 20b. Stipe basal scales < 15 mm; lamina subglabrous at base; midrib obtusely keeled abaxially ..... 15. *A. phyllitidis*
- 1b. Fronds pinnatipartite or more divided.
- 21a. Lamina pinnatipartite-pinnatisect.
- 22a. Lamina densely covered with scales abaxially; veins anastomosing; indusia reduced to a rim of a few cells ..... 22. *A. ceterach*
- 22b. Lamina (sub)glabrous abaxially; veins free; indusia distinct, not reduced to a rim.
- 23a. Several pairs of basal pinnae widely separated from more apical ones.
- 24a. Rachis green, without scales ..... 17. *A. castaneoviride*
- 24b. Rachis dark brown, with dark filiform scales ..... 39. *A. adnatum*
- 23b. Basal pinnae not widely separated from more apical ones (*A. subg. Ceterachopsis*).
- 25a. Segments acute, adaxially often with submarginal gemmae at acroscopic side of pinnae ..... 21. *A. qiujiangense*
- 25b. Segments obtuse, without submarginal gemmae at acroscopic side of pinnae.
- 26a. Middle segments up to 10 mm wide; mean exospore length < 35  $\mu\text{m}$  ..... 18. *A. dalhousiae*
- 26b. Middle segments more than 10 mm wide; mean exospore length > 35  $\mu\text{m}$ .
- 27a. Plants up to 20 cm; mean exospore length < 50  $\mu\text{m}$ ; plants tetraploid ..... 19. *A. paucivenosum*
- 27b. Plants more than 20 cm; mean exospore length > 50  $\mu\text{m}$ ; plants octoploid ..... 20. *A. magnificum*
- 21b. Lamina 1–4-pinnate.
- 28a. Rhizome long creeping; lamina 1-pinnate.
- 29a. Rhizome less than 0.6 cm in diam., with few scales; venation with several basal basisopic veins absent ..... see *Hymenasplenium* (p. 308)
- 29b. Rhizome more than 0.6 cm in diam., densely scaly; all basal basisopic veins present ..... 37. *A. lepturus*
- 28b. Rhizome erect or shortly creeping; lamina 1–4-pinnate.
- 30a. Ultimate pinnules or segments linear, with a single vein; sorus reaching frond margin.
- 31a. Stipe and rachis shiny dark brown to black on both sides.
- 32a. Lamina widest at base ..... 84. *A. pulcherrimum*
- 32b. Lamina not widest at base ..... 85. *A. cornutissimum*
- 31b. Stipe and rachis not shiny dark brown to black on both sides.
- 33a. Plants with minute gemmae on costae or costules ..... 66. *A. tenuifolium*
- 33b. Plants not gemmiferous.
- 34a. Lamina bipinnate.
- 35a. Rachis apex flagelliform gemmiferous, often rooting and functioning as a runner; pinnae ascending ..... 86. *A. prolongatum*
- 35b. Rachis apex not flagelliform; pinnae spreading, attached at right angle to rachis ..... 87. *A. sampsonii*
- 34b. Lamina 3-pinnatifid to 3-pinnate.
- 36a. Pinnae less than 10 cm ..... 89. *A. ritoense*
- 36b. Pinnae more than 10 cm ..... 90. *A. trigonopterum*
- 30b. Ultimate pinnules or segments not linear, with several veins; sorus rarely reaching frond margin.
- 37a. Lamina 1-pinnate.
- 38a. Stipe and rachis shiny, castaneous to dark brown or black.
- 39a. Rachis adaxially without brown membranous wings or fingerlike papillae.
- 40a. Lamina less than 2 cm wide; rachis semiterete; pinnae 1–2  $\times$  longer than wide ..... 30. *A. kiangsuense*
- 40b. Lamina more than 2 cm wide; rachis with deep furrow adaxially; pinnae 2 or more  $\times$  longer than wide ..... 31. *A. normale*
- 39b. Rachis adaxially with distinct wings or rows of fingerlike papillae.
- 41a. Rachis with brown to yellowish brown wings.
- 42a. Rachis with 2 adaxial and 1 abaxial wings, often proliferous near apex ..... 24. *A. tripteropus*
- 42b. Rachis with 2 adaxial wings, abaxial wing absent, never proliferous.
- 43a. Plants diploid with average exospore length < 31  $\mu\text{m}$  and average guard cell length < 39  $\mu\text{m}$  ..... 25. *A. trichomanes*
- 43b. Plants tetraploid with average exospore length > 32  $\mu\text{m}$  and average guard cell length > 40  $\mu\text{m}$  ..... 26. *A. quadrivalens*
- 41b. Rachis adaxially with 2 rows of fingerlike papillae.
- 44a. Rachis gemmiferous at its base; pinnae (slightly) reduced below apex ..... 27. *A. microtum*
- 44b. Rachis not gemmiferous; pinnae not reduced near apex.
- 45a. Rachis papillae closely set and often coalescent at their base; basal pinnae orbicular-ovate ..... 28. *A. humistratum*
- 45b. Rachis papillae separated and rarely coalescent at their base; basal pinnae hastate-deltoid ..... 29. *A. glanduliserrulatum*

- 38b. Stipe and rachis dull, not shiny, green, stramineous, or gray-brown.
- 46a. Costa raised and semiterete on adaxial surface of pinna.
- 47a. Frond apex a single pinna, conform with lateral ones ..... 32. *A. formosae*
- 47b. Frond apex a pinnatisect or pinnatifid terminal segment different from lateral pinnae.
- 48a. Frond apex of 1 or 2 basal segments attached to single terminal pinna; indusia not rolling back at maturity; costa with first basiscopic vein lacking and more distal veins simple ..... 33. *A. matsumurae*
- 48b. Frond apex pinnatifid and consisting of several confluent segments; indusia rolling back at maturity; costa with all veins present and forking.
- 49a. Pinnae obtuse, usually less than 5 cm ..... 88. *A. tenerum*
- 49b. Pinnae acuminate to caudate, usually larger ..... 34. *A. wrightii*
- 46b. Costa flat or depressed (grooved) on adaxial surface of pinna.
- 50a. Frond apex similar to one lateral pinna.
- 51a. Plants less than 10 cm tall.
- 52a. Average exospore length 35–40  $\mu\text{m}$ ; plants diploid:  $2n = 72$  ..... 67. *A. dolomiticum*
- 52b. Average exospore length 41–49  $\mu\text{m}$ ; plants tetraploid:  $2n = 144$  ..... 68. *A. ruta-muraria*
- 51b. Plants more than 10 cm tall.
- 53a. Stipe and rachis pale yellow-green to gray; veins irregularly anastomosing near margin ..... 35. *A. finlaysonianum*
- 53b. Stipe and rachis brown to dark brown; veins free ..... 36. *A. polyodon*
- 50b. Frond apex pinnatifid and not similar to a lateral pinna.
- 54a. Lamina more than 10 cm wide.
- 55a. Frond herbaceous; rhizome creeping; rachis often gemmiferous near apex; spores pale, perispore echinate ..... 38. *A. trapezoideum*
- 55b. Frond papery; rhizome erect; rachis not gemmiferous; spores dark brown-black, perispore lophate ..... 47. *A. saxicola*
- 54b. Lamina less than 10 cm wide.
- 56a. Rachis dark brown to black, with many dark brown to blackish scales with long filiform apex.
- 57a. Frond shorter than 30 cm, less than 3 cm wide; pinnae oblong, obtuse ..... 40. *A. asterolepis*
- 57b. Fronds longer than 30 cm, more than 3 cm wide; pinnae narrowly ovate, acute ..... 41. *A. crinicaule*
- 56b. Rachis gray-stramineous to green, with few narrowly triangular, reddish brown scales without filiform apex.
- 58a. Lamina less than 1.5 cm wide; stipe and rachis green, never gemmiferous ..... 23. *A. viride*
- 58b. Lamina more than 1.5 cm wide; stipe dull grayish brown, rachis green in apical part and occasionally gemmiferous.
- 59a. Gemmae on adaxial surface near pinna apex; scales costate with dark brown central zone and pale hyaline margin; perispore cristate-alate (with narrow crests on thin wings) ..... 44. *A. gueinzianum*
- 59b. Gemmae on rachis or close to rachis on pinna stalk; scales not costate; perispore costate (with rounded crest on broad ridges).
- 60a. Plants tetraploid:  $2n = 144$ ; average exospore length less than 36  $\mu\text{m}$  ..... 42. *A. indicum*
- 60b. Plants octoploid:  $2n = 288$ ; average exospore length more than 36  $\mu\text{m}$  ..... 43. *A. yoshinagae*
- 37b. Lamina pinnate-pinnatifid to 4-pinnate.
- 61a. Stipe entirely shiny dark brown to black ..... 83. *A. coenobiale*
- 61b. Stipe not entirely shiny dark brown to black.
- 62a. Stipe dark gray to dark brown.
- 63a. Fronds pinnate-pinnatifid to almost 2-pinnate.
- 64a. Gemmae present.
- 65a. Bud on adaxial surface of pinnae ..... 44. *A. gueinzianum*
- 65b. Bud on adaxial surface of rachis below apex ..... 50. *A. cuneatiforme*
- 64b. Gemmae absent.
- 66a. Rachis densely scaly.
- 67a. Fronds widest near base; stipe more than 5 cm; scales with filiform apical tail ..... 45. *A. aethiopicum*
- 67b. Fronds widest near middle; stipe less than 5 cm; scales without filiform apical tail ..... 51. *A. rockii*
- 66b. Rachis not densely scaly.
- 68a. Plants less than 20 cm tall, usually less than 10 pinnae pairs ..... 48. *A. oldhamii*
- 68b. Plants more than 20 cm tall, usually more than 10 pinnae pairs.
- 69a. Fronds herbaceous; pinna stalk less than 4 mm ..... 46. *A. pseudopraemorsum*
- 69b. Fronds leathery; pinna stalk more than 4 mm ..... 47. *A. saxicola*
- 63b. Fronds more divided, up to 4-pinnatifid.

- 70a. Fronds 3-pinnate or 4-pinnatifid.
- 71a. Plants less than 50 cm.
- 72a. Ultimate soriferous segment cuneiform, with several veins and sori ..... 56. *A. wilfordii*
- 72b. Ultimate soriferous segment linear with 1 vein and 1 sorus ..... 89. *A. ritoense*
- 71b. Plants more than 50 cm.
- 73a. Fronds herbaceous; indusia elliptic, ca. 4 mm; indusium margin with glandular hairs ..... 55. *A. bullatum*
- 73b. Fronds papery to subleathery; indusia linear, most than 4 mm; indusium margin without glandular hairs.
- 74a. Pinnules broadly ovate, less than 2 × longer than wide ..... 57. *A. sublaserpitiifolium*
- 74b. Pinnules triangular-ovate, more than 2 × longer than wide ..... 58. *A. pseudolaserpitiifolium*
- 70b. Fronds 2-pinnate to 3-pinnatifid.
- 75a. Gemmae present on rachis.
- 76a. Pinnae with more than 3 pairs of free pinnules ..... 49. *A. affine*
- 76b. Pinnae with less than 3 pairs of free pinnules ..... 50. *A. cuneatifforme*
- 75b. Gemmae absent.
- 77a. Stipe less than 5 cm; rachis densely scaly ..... 51. *A. rockii*
- 77b. Stipe more than 5 cm; rachis not densely scaly.
- 78a. Largest pinnae with less than 3 pairs of free pinnules, most decurrent on costa.
- 79a. Sori more than 5 mm ..... 47. *A. saxicola*
- 79b. Sori less than 5 mm ..... 52. *A. austrochinense*
- 78b. Largest pinnae with more than 3 pairs of free pinnules.
- 80a. Plants less than 50 cm tall ..... 53. *A. hainanense*
- 80b. Plants more than 50 cm tall.
- 81a. More than 5 free pinnules per pinna; veins close together and almost parallel; free margin of indusium glabrous ..... 54. *A. subspathulinum*
- 81b. Less than 5 free pinnules per pinna; venation different; free margin of indusium with glandular hairs ..... 55. *A. bullatum*
- 62b. Stipe green, abaxially at base and higher up often castaneous to black.
- 82a. Fronds lanceolate, reduced at base.
- 83a. Pinnae with minute gemma or plantlet at apex.
- 84a. Average exospore length less than 29 μm; plants diploid: 2n = 72 ..... 59. *A. lushanense*
- 84b. Average exospore length more than 29 μm; plants tetraploid: 2n = 144 ..... 60. *A. exiguum*
- 83b. Pinnae not gemmiferous at apex.
- 85a. Fronds thinly herbaceous; stipe and rachis with thin, green lateral wings ..... 61. *A. incisum*
- 85b. Fronds firmly herbaceous; stipe and rachis without thin, green wings.
- 86a. Marginal teeth usually slender, obtuse to subacute ..... 62. *A. nesii*
- 86b. Marginal teeth short, subacute to mucronate ..... 63. *A. fontanum*
- 82b. Fronds ovate-triangular, not reduced or not much reduced at base.
- 87a. Small gemmae present on pinnae stalk, costa, costule, or rachis tip.
- 88a. Pinnae usually with more than 3 pairs of free pinnules; gemmae on costa or costule ..... 66. *A. tenuifolium*
- 88b. Pinnae with less than 3 pairs of free pinnules; gemmae on pinnae stalk or on flagelliform apex.
- 89a. Lamina triangular, without extended gemmiferous rachis ..... 64. *A. capillipes*
- 89b. Lamina oblong-linear with flagelliform gemmiferous apex ..... 65. *A. fugax*
- 87b. Gemmae absent.
- 90a. Fronds deltoid to broadly triangular.
- 91a. Margin of indusium not fimbriate ..... 69. *A. interjectum*
- 91b. Margin of indusium fimbriate (with long uniseriate hairs).
- 92a. Average exospore length 35–40 μm; plants diploid: 2n = 72 ..... 67. *A. dolomiticum*
- 92b. Average exospore length 41–49 μm; plants tetraploid: 2n = 144 ..... 68. *A. ruta-muraria*
- 90b. Fronds triangular to ovate; indusial margin not fimbriate.
- 93a. Stipe green or only brown at very base; rachis entirely green.
- 94a. Fronds thinly herbaceous; average exospore length less than 32 μm; plants diploid: 2n = 72 ..... 81. *A. sarelii*
- 94b. Fronds firmly herbaceous to subleathery; average exospore length more than 32 μm; plants tetraploid: 2n = 144 ..... 82. *A. pekinense*
- 93b. Stipe and often base of rachis brown on abaxial side.
- 95a. Fronds 3-pinnate at base; pinnae with more than one free acroscopic pinnule.
- 96a. Plants diploid; average exospore length less than 32 μm ..... 70. *A. tenuicaule*

- 96b. Plants polyploid; average exospore length more than 32  $\mu\text{m}$ .  
 97a. Lamina triangular; stipe base swollen ..... 79. *A. adiantum-nigrum*  
 97b. Lamina narrowly triangular to ovate; stipe base not swollen.  
 98a. Pinna stalk wiry; perispore with many wide pori (reticulate) and almost  
 no ridges ..... 76. *A. kansuense*  
 98b. Pinna stalk not wiry; perispore with ridges and few minute pori (cristate) ... 80. *A. anogrammoides*  
 95b. Fronds 2-pinnate at base; pinnae with 1 free acroscopic pinnule.  
 99a. Plants diploid; average exospore length less than 32  $\mu\text{m}$ .  
 100a. Pinna stalk wiry; marginal teeth broad, mucronate; average exospore  
 length 29–32  $\mu\text{m}$ ; perispore reticulate or cristate ..... 70. *A. tenuicaule*  
 100b. Pinna stalk not wiry; marginal teeth slender, acute; average exospore  
 length 24–27  $\mu\text{m}$ ; perispore alate ..... 71. *A. semivarians*  
 99b. Plants polyploid; average exospore length more than 32  $\mu\text{m}$ .  
 101a. Lamina triangular, widest at base; largest pinnae broadly ovate-deltoid.  
 102a. Plants hexaploid; average exospore length 38–42  $\mu\text{m}$  ..... 72. *A. aitchisonii*  
 102b. Plants tetraploid; average exospore length 33–36  $\mu\text{m}$  ..... 73. *A. neovarians*  
 101b. Lamina ovate, widest just above base; largest pinnae ovate to narrowly triangular.  
 103a. Lamina thin, membranous; largest pinnae triangular to narrowly triangular ..... 74. *A. mae*  
 103b. Lamina more firm, herbaceous; largest pinnae ovate to triangular.  
 104a. Lamina acuminate to shortly caudate; scales with inner part of cell walls  
 warty ..... 75. *A. kukkonenii*  
 104b. Lamina not shortly caudate; scales with inner part of cell walls smooth.  
 105a. Lamina firmly herbaceous to subleathery; basal pinnae deltoid to  
 flabellate ..... 78. *A. altajense*  
 105b. Lamina herbaceous; basal pinnae oval-triangular.  
 106a. Pinna stalk wiry; perispore with many wide pori (reticulate) and almost  
 no ridges ..... 76. *A. kansuense*  
 106b. Pinna stalk not wiry; perispore with ridges and few minute pori (cristate) ..... 77. *A. varians*

**1. *Asplenium caucasicum*** (Fraser-Jenkins & Lovis) Viane, Pteridol. New Millennium, 89. 2003.

高加索铁角蕨 gao jia suo tie jiao jue

*Asplenium septentrionale* (Linnaeus) Hoffmann subsp. *caucasicum* Fraser-Jenkins & Lovis, Notes Roy. Bot. Gard. Edinburgh 38: 281. 1980.

Plants 8–15 cm tall. Rhizome shortly creeping to ascending, apex scaly; scales dark brown, narrowly triangular to subulate, entire to denticulate, at base fimbriate. Fronds caespitose; stipe shiny castaneous only at base, abruptly green toward rachis, 6–10 cm, 2–3  $\times$  as long as lamina, with unicellular glands or subglabrous, apex 2- or 3-forked; segments linear, 2–3  $\times$  0.1–0.15 cm, base gradually decurrent onto stipe, minutely forked again at apex. Fronds without distinct rachis, green, other veins slender and subparallel to central axis, 1 veinlet per ultimate segment. Fronds herbaceous-leathery, grass-green. Sori 1–5 per segment, linear, 1–2 cm, on acroscopic veins and close to costa, at maturity covering entire surface; indusia brown, linear, membranous, free margin often with unicellular glands, entire-sinuate, opening toward main vein (costa), persistent but reflexed and covered by sporangia at maturity. Spores with lophate perispore, average exospore length 32–36  $\mu\text{m}$ . Plants sexual diploid:  $2n = 72$ .

In crevices of non-calcareous (often granitic) rocks in open or partial shade; below 4100 m. ?Taiwan, Xinjiang, Xizang [Afghanistan, N India, Pakistan, Russia; SW Asia (Abkhazia/Georgia, Azerbaijan, Iran, Turkey), E Europe].

*Asplenium caucasicum* is the diploid ancestor of the more com-

mon autotetraploid *A. septentrionale* (see below). This taxon is best known from the Caucasus region, but microcharacters have shown its presence in Xinjiang. A recent chromosome count from Xizang confirms its presence in China. A doubling of its genome has led to the origin of autotetraploid *A. septentrionale*. In places where both taxa grow together, their triploid sterile hybrid, *A.  $\times$ direns* Viane & Reichstein, can be expected.

*Asplenium sasakii* (Hayata) Makino & Nemoto was distinguished from *A. septentrionale* by its narrower fronds (a.o., Tagawa, Acta Phytotax. Geobot. 10: 204–205. 1941); it may be an earlier name for *A. caucasicum* if Taiwanese plants turn out to be diploid. However, at present, no chromosome counts or flow-cytometric data are available for Taiwanese plants.

**2. *Asplenium septentrionale*** (Linnaeus) Hoffmann, Deutschl. Fl. 2: 12. 1796.

叉叶铁角蕨 cha ye tie jiao jue

*Acrostichum septentrionale* Linnaeus, Sp. Pl. 2: 1068. 1753; *Acropteris septentrionalis* (Linnaeus) Link; *Amesium sasakii* Hayata; *A. septentrionale* (Linnaeus) Newman; *Asplenium sasakii* (Hayata) Makino & Nemoto; *A. septentrionale* var. *sasakii* (Hayata) C. Christensen.

Plants 8–15 cm tall. Rhizome shortly creeping to ascending, apex scaly; scales dark brown, narrowly triangular to subulate, entire to denticulate, at base fimbriate. Fronds caespitose; stipe shiny castaneous only at base, abruptly green toward rachis, 6–10 cm, 2–3  $\times$  as long as lamina, with unicellular glands or subglabrous, apex 2- or 3-forked; segments linear, 2–3  $\times$  0.1–0.15(–0.25) cm, base gradually decurrent onto stipe, minutely forked again at apex. Fronds without distinct rachis,

green, other veins slender and subparallel to central axis, 1 veinlet per ultimate segment. Fronds herbaceous-leathery, grass-green. Sori 1–5 per segment, linear, 1–2 cm, on acroscopic veins and close to costa, at maturity covering entire surface; indusia brown, linear, membranous, free margin often with unicellular glands, entire-sinuate, opening toward main vein (costa), persistent but reflexed and covered by sporangia at maturity. Spores with lophate perispore, average exospore length 39–44  $\mu\text{m}$ . Plants sexual tetraploid:  $2n = 144$ .

In crevices of non-calcareous (often granitic) rocks in open or partially shaded situations; 1100–4100 m. Shaanxi, Shanxi, Taiwan, Xinjiang, Xizang [Afghanistan, India, Kashmir, Kazakhstan, Kyrgyzstan, W Mongolia, Nepal, Pakistan, Russia, Tajikistan; NW Africa, SW Asia, Europe, North America].

*Asplenium septentrionale* is the autotetraploid that originated by chromosome doubling in its diploid ancestor *A. caucasicum*. In the absence of a chromosome count, it can best be distinguished by its larger mean exospore length (more than 37  $\mu\text{m}$ ) and its broader lamina.

*Asplenium septentrionale* often hybridizes with other *Asplenium* species in Europe wherever they co-occur; one of these, *A. ×heufleri* Reichardt (*A. septentrionale*  $\times$  *A. quadrivalens*), was recently found in Xinjiang.

### 3. *Asplenium speluncae* Christ, Bull. Acad. Int. Géogr. Bot. 13: 113. 1904.

黑边铁角蕨 hei bian tie jiao jue

Plants 4–8 cm tall. Rhizome erect, short, apex scaly; scales blackish brown, iridescent, narrowly triangular to subulate, entire. Fronds simple, tufted; stipe purplish black, shiny, 5–12(–20) mm, terete, with scales when young, subglabrous when old; lamina elliptic to narrowly triangular, 3–6(–8.5)  $\times$  1.2–1.7(–2) cm, base broadly cuneate to truncate, margin entire to undulate and with narrow black edge, apex obtuse. Rachis or midrib distinct abaxially, black and shiny; veins obscure, oblique, 2(or 3)-forked. Fronds leathery, adaxially olive-green when dry, brown abaxially. Sori linear, 3–6 mm, medial between midrib and margin; indusia grayish brown, linear-elliptic, thinly papery, entire and with narrow purple edge, opening toward midrib, persistent. Spores with cristate-alate perispore.

• In limestone crevices, forests; 1100–1400 m. Guangdong, Guangxi, Guizhou, Hunan, Jiangxi.

*Asplenium speluncae* is a particular and distinct species. Hybrids with *A. normale* were probably described from Hunan as *A. ×xianqianense* C. M. Zhang (Keys Vasc. Pl. Wuling Mts. 568. 1995, pro sp.) but are also known from Guangxi.

### 4. *Asplenium scortechinii* Beddome, J. Bot. 25: 322. 1887.

狭叶铁角蕨 xia ye tie jiao jue

*Asplenium annamense* Christ; *A. pinfaense* Christ.

Plants 20–45(–60) cm tall. Rhizome shortly creeping to erect, apex densely scaly; scales medium to dark brown, ovate-triangular, subentire to denticulate. Fronds simple,  $\pm$  clustered, sessile or with stramineous stipe 1–5(–)7 cm; lamina linear to narrowly lanceolate, 15–40(–50)  $\times$  1.1–2(–3) cm, usually more than 13  $\times$  longer than wide, gradually attenuate at

both ends, base narrowly cuneate and decurrent on stipe, margin entire to repand or sinuate, with minute notches, apex long acuminate. Midrib (rachis) distinct, often slightly raised (semi-terete) abaxially or adaxially; veins distinct, usually forked in their upper part. Fronds leathery, brownish green to olivaceous when dry, with sparse minute brown triangular-stellate scales. Sori linear, 4–7 mm, starting close to midrib at an angle of (40°–)50°–70°(–80°); indusium gray to yellowish brown, linear, relatively thick, entire, opening toward midrib, persistent. Spores with alate perispore.

On tree trunks or shaded wet rocks in forests; 1300–1600 m. Guangdong, Guangxi, Guizhou, Hainan, Yunnan [India, Malaysia, Myanmar, Thailand, Vietnam].

Typical *Asplenium scortechinii* plants have narrow fronds, but intermediates with *A. griffithianum* exist. Plants from the Malay Peninsula were found to be tetraploid ( $n = ca. 72$ ) by Manton (in Holttum, Revis. Fl. Malaya 2: 625. 1954), but our recent FCM results show that, at least in China, this taxon is an aggregate of hexaploid (Hainan) and dodecaploid (Yunnan) species. In particular, the relationships with dodecaploid *A. griffithianum* needs further investigation.

### 5. *Asplenium griffithianum* Hooker, Icon. Pl. 10: t. 928. 1854.

厚叶铁角蕨 hou ye tie jiao jue

*Asplenium baibarensense* Tawewaki & Tagawa; *A. holophyllum* Baker; *A. iridiphyllum* Hayata; *A. nakanoanum* Makino; *A. scolopendrifrons* Hayata; *Diplazium iridiphyllum* (Hayata) Hayata.

Plants 15–25(–30) cm tall. Rhizome erect, short, apex densely scaly; scales blackish brown, narrowly triangular or ovate, margins denticulate. Fronds caespitose, simple; stipe stramineous, very short or absent, 0.4–2.5 cm; lamina lanceolate, 15–25  $\times$  (1.5–)1.9–2.5(–3.9) cm, usually ca. 10  $\times$  longer than wide, base gradually decurrent and forming narrow wing on stipe, margin entire or sinuate in basal part, upward irregularly sinuate-crenate, and often notched, apex acuminate or acute. Midrib stramineous, not distinctly raised abaxially, adaxially raised; veins obscure, 1-forked. Fronds fleshy, grayish green when dry, with minute brown triangular to stellate scales, subglabrous when old. Sori brown, linear, 5–9(–11) mm, starting close to midrib at an angle of (30°–)45°–50°(–65°), and up to 2/3 width of lamina; indusia gray to yellowish brown, linear, entire, opening toward midrib, persistent. Spores with many perforations in outer subechinate-lophate perispore.

On tree trunks or wet rocks in forests; 100–1600 m. Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hunan, Sichuan, Taiwan, Xizang, Yunnan [Bhutan, India, Japan, Myanmar, Nepal, Vietnam].

Plants from Sikkim, India, were reported to be diploid hybrids by Bir (Curr. Sci. 29: 445–447. 1960) and by Mehra (Res. Bull. Panjab Univ. Sci., n.s., 12: 139–164. 1961), but our recent FCM results show that at least the Guizhou plants are polyploids (12–14 $\times$ ).

In its present circumscription this species includes different taxa that need further study. *Asplenium ×xinyiense* Ching & S. H. Wu (Bull. Bot. Res., Harbin 9(2): 82. 1989, pro sp.), a plant with abortive spores described from SW Guangdong, is a hybrid between either *A. griffithianum* or *A. loxogrammoides* and *A. wrightii*. These species grow intermixed on cliffs near the type locality of *A. ×xinyiense*.

**6. *Asplenium holosorum*** Christ, Bull. Herb. Boissier 7: 10. 1899.

江南铁角蕨 jiang nan tie jiao jue

*Asplenium loxogrammoides* Christ.

Plants 20–40 cm tall. Rhizome erect, short, apex scaly; scales dark brown, narrowly triangular, entire. Fronds simple, clustered; stipe grayish stramineous, 2–4 cm, with scales; lamina lanceolate, 15–30(–36) × 2.5–3.5(–4) cm, base decurrent on stipe, margin pale, ± entire to repand or sinuate, apex acuminate to subcaudate. Midrib (rachis) distinctly raised and semiterete on both surfaces in basal half of lamina, with dark brown to black filiform paleasters (rudimentary scales), brownish; veins obscure, 1-forked. Fronds herbaceous, dark green to brown when dry, subglabrous or with small stellate scales. Sori linear, 1.4–2.1(–2.5) cm, often starting close to midrib or more medial, at an angle of (20°–)30°–40°, on acroscopic veinlets; indusia yellowish brown to deep brown, linear, thickly membranous, margin composed of thin-walled hyaline cells, entire to repand, opening toward midrib, persistent. Spores with alate perispore.

On rocks by streamsides in forests; 500–1000 m. Guangdong, Guangxi, Guizhou, Hainan, Hubei, Hunan, Jiangxi, Sichuan, Taiwan, Yunnan [Vietnam].

*Asplenium holosorum* is similar to *A. ensiforme* but generally grows at lower elevations. Its fronds are more herbaceous and their midrib (rachis) is flat near the apex but raised adaxially in the lower half of the frond and not sulcate. Both species have a similar epidermis structure with cryptoplocytic to basiplocytic (also called anomocytic, staurocytic, or cyclocytic) stomata. In both taxa, the outer free margin of the indusium consists of translucent cells with very thin walls, but this marginal rim is narrow (ca. 2 cell layers) in *A. holosorum*, but more elaborate and dentate-fimbriate in *A. ensiforme*.

No chromosome counts seem to be available, but our recent FCM results suggest this taxon is probably hexaploid.

**7. *Asplenium ensiforme*** Wallich ex Hooker & Greville, Icon. Filic. 1: t. 71. 1828.

剑叶铁角蕨 jian ye tie jiao jue

*Asplenium ensiforme* f. *bicuspe* (Hayata) Ching ex S. H. Wu; *A. ensiforme* var. *bicuspe* (Hayata) Tagawa; *A. ensiforme* var. *parvum* Tardieu & Ching; *A. ensiforme* f. *stenophyllum* (Beddome) Ching ex S. H. Wu; *A. ensiforme* var. *stenophyllum* (Beddome) Ching; *A. gracilipes* Ching & Y. X. Lin; *A. melanolapis* Baker (1890), not Franchet & Savatier (1879), nor Colenso (1888); *A. tonkinense* C. Christensen; *A. stenophyllum* Beddome; *Diplazium bicuspe* Hayata.

Plants 30–45(–65) cm tall. Rhizome erect, short, apex scaly; scales dark brown to black, narrowly triangular, ca. 6 × 1 mm, entire. Fronds simple and clustered; stipe stramineous, 5–8(–15) cm, base with scales, becoming subglabrous above; lamina narrowly lanceolate, 20–40(–50) × 1.5–2.5(–4) cm, base decurrent on stipe, margin entire to repand, apex acuminate to caudate. Midrib stramineous, abaxially semiterete and raised, adaxially sulcate; veins obscure, 1-forked. Fronds leathery, yellowish green or brownish when dry, subglabrous. Sori lin-

ear, 1.3–2(–3) cm, starting close to midrib at an angle of 15°–25°(–30°), on acroscopic veinlets; indusia yellowish brown or brownish green and becoming dark brown when dry, linear, papery, margin composed of thin-walled hyaline cells, fimbriate to entire, opening toward midrib, persistent. Spores without perforations in outer cristate-alate perispore. Plants sexual tetraploid:  $2n = 144$ .

On rocks and tree trunks in forests; 800–2800 m. Guangdong, Guangxi, Guizhou, Hunan, Jiangsu, Jiangxi, Sichuan, Taiwan, Xizang, Yunnan [Bhutan, India, Japan, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam].

Plants of *Asplenium ensiforme* with extremely narrow fronds, occurring at higher elevations, have sometimes been recognized as a separate species, variety, or form. A specimen from Taiwan with forked frond apices was described as "*A. bicuspe*" (nom. nud., cited in the protologue of *Diplazium bicuspe*), and we have seen such aberrant forked forms also from Yunnan. Forked fronds occur in all species of peridophytes, often randomly in particular plants, and do not merit taxonomic status.

Plants from India were reported to be tetraploid ( $n = 72$ ) by Mehra and Bir (Curr. Sci. 26: 151–152. 1957) and by Bir (Curr. Sci. 29: 445–447. 1960; Curr. Sci. 31: 248–250. 1962; Caryologia 18: 107–115. 1965). This species is similar to *Asplenium holosorum*; for differences, see below that species.

**8. *Asplenium komarovii*** Akasawa, Bull. Kochi Women's Univ., Ser. Nat. Sci. 10: 26. 1962.

对开蕨 dui kai jue

*Phyllitis japonica* Komarov, Izv. Bot. Sada Akad. Nauk SSSR 30: 192. 1932; *Asplenium scolopendrium* Linnaeus subsp. *japonicum* (Komarov) Rasbach, Reichstein & Viane.

Plants up to ca. 60 cm tall. Rhizome erect or ascending; scales brown, thin, narrowly triangular to triangular, entire. Fronds caespitose; stipe brown, 10–20 cm, with sparse scales; lamina narrowly oblong, 15–45 × 3.5–4.5(–6) cm, leathery, base cordate, margin entire or slightly sinuate, apex acute. Midrib (rachis) distinct, brown basally and becoming green toward apex, raised and rounded on both sides, with small scales at base; lateral veins obscure, anadromous but running straight and almost parallel. Frond green and fleshy when fresh, after drying leathery and brownish green, abaxially subglabrous. Sori linear, usually 7–25 mm, on neighboring veinlets and opposite; indusia brown, linear, entire, opening toward each other (scolopendroid), persistent. Spores with lophate (alate) perispore, average exospore length 31–35 μm. Plants sexual tetraploid:  $2n = 144$ .

Terrestrial; 700–1000(–2600 in Taiwan) m. Jilin (Changbai, Fusong, Ji'an), Taiwan [Japan, Korea, SE Russia; North America].

Due to the peculiar frond shape and double sori facing each other, both *Asplenium komarovii* and *A. scolopendrium* were often placed in the former satellite genus *Phyllitis*. Modern studies confirm that it deserves no recognition. The group consists of two species: a diploid ancestral taxon ( $2n = 72$ ) essentially in Europe and an autotetraploid in North America (including Mexico) and NE Asia (Mitui, J. Jap. Bot. 41: 60–64. 1966; Sci. Rep. Tokyo Kyoiku Daigaku, B, 13: 285–333. 1968).

*Asplenium komarovii* originated by chromosome doubling in diploid *A. scolopendrium*; in local floras it is usually mentioned under this

latter name. In the absence of a chromosome count or flow cytometric data, it can best be distinguished from its ancestor by its larger mean exospore length (more than 31  $\mu\text{m}$ ).

**9. *Asplenium delavayi*** (Franchet) Copeland, Gen. Fil. 165. 1947.

水鳖蕨 shui bie jue

*Scolopendrium delavayi* Franchet, Bull. Soc. Bot. France 32: 29. 1885; *Phyllitis delavayi* (Franchet) C. Christensen; *Schaffneria delavayi* (Franchet) Tardieu; *Sinephropteris delavayi* (Franchet) Mickel.

Plants up to 15 cm tall. Rhizome erect, short; scales black, narrowly triangular, margins sparsely toothed. Fronds simple, clustered; stipe chestnut-black to black, shiny, 3–10 cm, subglabrous, cylindrical but with an adaxial groove; lamina orbicular-reniform, usually 2.5–6 cm in diam., base cordate, margins entire to slightly sinuate, thin. Dark midrib distinct at base and running well into lamina, other veins usually obscure, veinlets mostly free but some connected near margin. Fronds herbaceous or papery, brownish green or brown after drying, minutely hairy. Sori linear, in pairs facing each other, confluent at maturity; indusia brownish, linear, persistent. Spores with lophate (alate) perispore.

On shaded wet rocks in forests; 600–1800 m. S Gansu, S Guizhou, Sichuan, Yunnan [Bhutan, N India, N Myanmar, Nepal].

Based on its peculiar morphology and scolopendrioid sori, *Asplenium delavayi* has been placed in various satellite genera; these have now been abandoned because modern studies show them all nested within *Asplenium*. See Mickel (Brittonia 28: 326–328. 1976) for a discussion on the differences with supposedly related groups.

**10. *Asplenium humberitii*** Tardieu, Asplén. Tonkin, 25. 1932.

扁柄巢蕨 bian bing chao jue

*Asplenium longistipes* (Ching ex S. H. Wu) Viane; *Neottopteris humberitii* (Tardieu) Tagawa; *N. longistipes* Ching ex S. H. Wu.

Plants up to 30 cm tall. Rhizome erect, short, scaly; scales brown, triangular-ovate, margins sparsely ciliate. Fronds caespitose; stipe greenish stramineous, 4–8 cm, soft, without wide wing on lateral side, base with dark brown scales or subglabrous; lamina spatulate, 18–22  $\times$  3.5–5 cm, lower part decurrent on stipe and cuneate, margin entire, apex cuspidate to shortly caudate. Midrib (rachis) almost flat to slightly semiterete, stramineous, abaxially occasionally with small brown scales; veins obscure adaxially, faintly visible abaxially, simple or forked. Fronds leathery, after drying grayish green, subglabrous. Sori linear, 1–1.5(–2.5) cm, on acroscopic veinlets, occupying 1/2–2/3 of subtending vein; indusia grayish yellow, linear, thickly membranous, entire, persistent. Spores with lophate areolate-fenestrate perispore. Plants sexual hexaploid:  $2n = 216$ .

Epilithic on limestone rocks in wet forests; 800–900 m. Guangxi, Hainan, SE Yunnan [Laos, Thailand, Vietnam].

Specimens of *Asplenium humberitii* from Hainan have longer sori than the type, collected in Vietnam. The species is rather similar to *A. grevillei* Wallich ex Hooker & Greville from India and Thailand, which

differs by its smaller scales, distinctly keeled midrib, and areolate-fenestrate perispore (Wei & Dong, Nordic J. Bot. 30: 90–103. 2012). However, the relationship between *A. grevillei*, *A. humberitii*, and *A. antrophyoides* requires further study.

**11. *Asplenium antrophyoides*** Christ, Bull. Acad. Int. Géogr. Bot. 20: 170. 1909.

狭翅巢蕨 xia chi chao jue

*Asplenium antrophyoides* var. *grossidentatum* Bonaparte ex Tardieu; *A. latipes* (Ching ex S. H. Wu) Viane; *A. subspatulatum* Rosenstock; *Neottopteris antrophyoides* (Christ) Ching; *N. antrophyoides* var. *cristata* Ching & S. H. Wu; *N. latipes* Ching ex S. H. Wu.

Plants 30–60 cm tall. Rhizome erect and short, apex scaly; scales dark brown, narrowly triangular, entire. Fronds caespitose, subsessile or with extremely short stipe; stipe stramineous, soft; lamina spatulate to very narrowly obovate, 25–60  $\times$  4.5–6.5(–8) cm, gradually reduced into a 1–2 cm wide lateral wing; margin entire, often cartilaginous, apex cuspidate to caudate. Midrib flat to carinate at base abaxially, stramineous, subglabrous but with dark brown lanceolate scales at its base; veins visible on both sides, simple or forked, parallel. Fronds subleathery, brownish green to dark green after drying, subglabrous. Sori restricted to upper part of lamina, linear, 1.5–2.5 cm, borne on acroscopic veinlets and occupying 2/3–3/4 of their length; indusia brownish, linear, membranous, entire, persistent. Spores with lophate (cristate) perispore. Plants sexual tetraploid:  $2n = 144$ .

On limestone rocks or on tree trunks in dense forests; 300–1300 m. Guangdong, Guangxi, Guizhou, Hunan, Sichuan, Yunnan [Laos, Thailand, Vietnam].

*Asplenium antrophyoides* var. *grossidentatum* Bonaparte ex Tardieu (Asplén. Tonkin, 25. 1932; *Neottopteris antrophyoides* var. *cristata* Ching & S. H. Wu) is an aberrant monstrosity with a lacerate frond, known from Vietnam and SE Yunnan. Another form with a very wide frond base and described as *Neottopteris latipes* by Ching is also treated as a synonym; the perispores are similar (Wei & Dong, Nordic J. Bot. 30: 90–103. 2012).

**12. *Asplenium nidus*** Linnaeus, Sp. Pl. 2: 1079. 1753.

巢蕨 chao jue

*Asplenium neohainanense* Viane; *Neottopteris hainanensis* Ching; *N. nidus* (Linnaeus) J. Smith ex Hooker; *N. rigida* Fée; *N. salwinensis* Ching; *N. vulgaris* J. Smith, nom. illeg. superfl.; *Thamnopteris nidus* (Linnaeus) C. Presl.

Plants 1–1.2 m tall. Rhizome erect, thick and short, woody, apex scaly; scales dark to purplish brown, narrowly triangular to linear-subulate, margin ciliate to fimbriate. Fronds caespitose; stipe pale brown, up to 5 cm, woody, when dry semiterete abaxially, base densely scaly; lamina lanceolate, 90–120  $\times$  (8–) 9–15 cm, gradually decurrent on stipe, base cuneate, margin entire, apex acute to acuminate. Midrib raised and semiterete on upper adaxial side but flat abaxially, subglabrous, grayish to pale brown; veinlets simple or forked, parallel and connected at their apex to marginal vein. Fronds papery or thinly leathery, when dry grayish green, glabrous. Sori linear, 3–5 cm, on acroscopic side of veinlets, running from near their base up to 1/2

of their length; basal part of lamina usually sterile; indusia brownish, linear, thickly membranous, entire, persistent. Spores with lophate (costate to cristate) perispore. Plants sexual tetraploid:  $2n = 144$ .

Clustered on tree trunks or rocks in rain forests; 100–1900 m. ?Guangdong, Guangxi, Guizhou, Hainan, Taiwan, Xizang, Yunnan [Cambodia, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Sri Lanka, Vietnam; tropical regions of E Africa and Australia, Pacific islands (Polynesia)].

*Asplenium nidus* is accepted here in a broad sense and constitutes a species complex (e.g., Murakami et al. in M. Kato, Biol. Biodivers. 53–66. 1999; Yatabe et al., Amer. J. Bot. 88: 1517–1522. 2001). The variability of its frond and perispore morphology (e.g., Wei & Dong, Nordic J. Bot. 30: 90–103. 2012), as well as other phenetic characters, is not well studied in relation to its molecular diversity.

*Asplenium setoi* N. Murakami & Serizawa, recently described from Japan, might be present at low elevations in China (Taiwan); typical specimens can be distinguished from *A. nidus* by their keeled to boat-shaped midrib. Another species regularly confused with both *A. setoi* and *A. nidus* is the often cultivated *A. australasicum* (J. Smith) Hooker, a South Pacific taxon.

Based on their particular venation pattern, taxa resembling *Asplenium nidus* have been recognized as a separate section (*A. sect. Thamnopteris* Hooker & Baker), a subgenus (*A. subg. Thamnopteris* C. Presl), or as a genus of its own (*Neottopteris* J. Smith; syn. *Thamnopteris* (C. Presl) C. Presl). Plants are often epiphytes with large simple fronds growing in a close spiral and forming the typical bird's nest. Veins departing from the midrib (rachis) fork anadromously, run almost parallel and straight to the margin where they connect to a common submarginal vein. However, recent molecular studies do not support the separation of this group as a separate genus. The clade consists of 15–30 species, and modern research shows that more taxa may await description. A critical revision of the group is urgently needed. Members occur mainly in rain forests of tropical Asia and the Pacific. A few taxa are widely cultivated as house plants and sold as “bird's-nest fern.” Many plants in commerce belong to *A. australasicum*, which can be distinguished from true *A. nidus* by its abaxially dark brown carinate midrib.

**13. *Asplenium oblanceolatum*** Copeland, Philipp. J. Sci., C, 9: 229. 1914.

黑鳞巢蕨 hei lin chao jue

*Asplenium latibasis* (Ching) Viane (1991), not (Ching & Shing) Nakaïke (1986); *A. phyllitidis* D. Don subsp. *malesicum* Holttum; *A. subantiquum* (Ching ex S. H. Wu) Viane; *Neottopteris latibasis* Ching; *N. subantiqua* Ching ex S. H. Wu.

Plants 60–100 cm tall. Rhizome erect, dark brown, short and thick, woody, apex scaly; scales brown to dark brown, narrowly triangular, membranous, apex acuminate, fimbriate. Fronds caespitose; stipe dark brown, very short, 1–2 cm, when dry semiterete on both sides, base with scales similar to those on rhizome; lamina lanceolate to narrowly lanceolate, 50–60 (–100) × (4–)8–9(–12) cm, gradually decurrent toward stipe, margin entire, with a cartilaginous narrow edge or slightly recurved when dry, apex acute. Midrib prominent on both sides, semiterete to obtusely carinate abaxially, grooved adaxially when dry, dark brown or grayish brown, glabrous; veinlets visible, forked or simple, parallel, at their apex united to marginal vein. Fronds firmly papery to subleathery, green but brownish

when dry, glabrous. Sori linear, 2–3 cm, on acroscopic veinlets, running from near their base up to (1/2–)2/3–3/4 of their length, lower part of lamina usually sterile; indusia brown to dark brown, linear, thickly membranous, entire, persistent. Spores with echinate perispore. Plants tetraploid:  $2n = 144$ .

On tree trunks in dense forests; 100–1100 m. Hainan, SE Yunnan [India, Malaysia, Myanmar, Thailand, Vietnam].

*Asplenium oblanceolatum* is similar to other members of the *A. nidus* complex but differs from all by its echinate perispores (Holttum, Gard. Bull. Singapore 27: 143–154. 1974; Y. L. Zhang et al., Sporae Pterid. Sin. 240–263. 1976; Wei & Dong, Nordic J. Bot. 30: 90–103. 2012). In addition, it differs from small *A. nidus* by its midrib structure and from *A. phyllitidis* and *A. antiquum* by its narrower scales.

We were unable to locate and study the type of *Asplenium anguineum* Christ (J. Bot. (Morot), ser. 2, 1: 265. 1908) from Vietnam; if this has echinate spores, it would be the oldest name for *A. oblanceolatum*/*A. phyllitidis* subsp. *malesicum*.

**14. *Asplenium antiquum*** Makino, J. Jap. Bot. 6: 32. 1929.

大鳞巢蕨 da lin chao jue

*Neottopteris antiqua* (Makino) Masamune; *N. rigida* Fée var. *erubescens* Nakai; *Thamnopteris antiqua* (Makino) Makino.

Plants 80–100 cm tall. Rhizome erect, massive; scales on apex brown to dark grayish brown, ovate-triangular, entire to fibrillose. Fronds caespitose; stipe pale brown to dark brown, 2–5(–7) cm, woody, terete abaxially, adaxially grooved, scales at stipe base numerous, similar to those on rhizome, 15–30 × 2–6 mm; lamina narrowly lanceolate, 75–100 × 6.5–8.5(–15) cm, cuneate at base, margin entire and cartilaginous. Midrib raised on both sides, semiterete abaxially, dark brown, subglabrous; veins slightly raised on both sides, forked or simple, parallel, connected to marginal vein. Fronds leathery, after drying brownish green or brownish. Sori linear, 3–4 cm, on acroscopic veins, occupying 2/3–3/4 of subtending vein, lower parts of lamina usually sterile; indusia brownish or grayish brown, linear, thickly membranous, entire, persistent. Spores with lophate perispore. Plants tetraploid:  $2n = 144$ .

On rocks or tree trunks in forests; 600–1600 m. Fujian, ?Hunan, Taiwan [Japan, Korea].

*Asplenium antiquum* was wrongly reported from Hainan (S. H. Wu, FRPS 4(2): 137. 1999).

**15. *Asplenium phyllitidis*** D. Don, Prodr. Fl. Nepal. 7. 1825.

长叶巢蕨 chang ye chao jue

*Asplenium colaniae* Tardieu; *A. nidus* Linnaeus var. *phyllitidis* (D. Don) Beddome; *A. nidus* var. *simonsianum* (Hooker) Christ; *A. simonsianum* Hooker; *Neottopteris phyllitidis* (D. Don) J. Smith; *N. simonsiana* (Hooker) J. Smith; *Thamnopteris orientalis* C. Presl; *T. phyllitidis* (D. Don) C. Presl; *T. simonsiana* (Hooker) T. Moore.

Plants (50–)70–110 cm tall. Rhizome erect, thick and short, woody, apex with scales; scales brown to blackish brown, triangular to ovate, membranous, entire or fimbriate. Fronds caespitose; stipe pale brown to grayish brown, 3–7 cm, woody, abaxially terete, broadly grooved adaxially when dry, glabrous,

with 2 lateral ridges, base with scales similar to those on rhizome; lamina narrowly lanceolate to lanceolate, (48–)70–105 × 5–8 cm, widest at middle and gradually decurrent toward base, margin entire, apex acute to caudate. Midrib semiterete and grayish to yellowish pale brown abaxially, broadly grooved and pale yellowish brown adaxially when dry, glabrous; veins faintly visible, forked, or simple. Fronds papery or thinly leathery, brownish green when dry, glabrous. Sori linear, 2–3 cm, on acroscopic veinlets, from close to midrib to 1/2–3/4 as long as subtending veinlet, lower part of lamina usually sterile; indusia brownish, linear, membranous, entire, persistent. Spores with lophate (areolate-fenestrate) perispore. Plants tetraploid:  $2n = 144$ .

On rocks or tree trunks in forests by streamsides; 600–1400 m. Guangxi, Guizhou, Hainan, Sichuan, Xizang, Yunnan [Bangladesh, Bhutan, India, Indonesia, Malaysia, Myanmar, Nepal, New Guinea, Thailand].

*Asplenium simonsianum* and *A. colaniae* are reduced to synonymy. Their types have a lamina 3–5 cm wide; we consider them extremely narrow forms of *A. phyllitidis*. The perispores of *A. phyllitidis*, *A. simonsianum*, and *A. colaniae* are closely similar and areolate-fenestrate.

**16. *Asplenium ruprechtii*** Sa. Kurata in Namekata & Kurata, Enum. Jap. Pterid. 338. 1961.

过山蕨 guo shan jue

*Antigramma sibirica* (Ruprecht) J. Smith; *Camptosorus sibiricus* Ruprecht; *Phyllitis sibirica* (Ruprecht) Kuntze; *Scopelodendrium sibiricum* (Ruprecht) Hooker.

Plants up to 20 cm tall. Rhizome erect; scales blackish brown, narrowly triangular, entire. Fronds caespitose, dimorphic, sterile fronds smaller with stipe 1–3 cm and lamina 1–2 × 0.5–0.8 cm, elliptic, base broadly cuneate and slightly decurrent, apex obtuse; fertile fronds larger with stipe 1–5 cm, lamina lanceolate, 10–15 × 0.5–1 cm, base cuneate (cuneate-attenuate), decurrent, margin entire or slightly sinuate, apex acuminate, flagelliform (3–8 cm) and terminating in a gemma or rooting. Veins anastomosing, obscure, with 1–3 rows of areoles, usually a row of areoles close to midrib (rachis), other veinlets free. Fronds herbaceous, dark green after drying, subglabrous. Sori in 1–3 irregular rows on both sides of midrib (rachis), linear to elliptic; indusia gray-green to brownish, linear or elliptic. Spores with lophate (cristate-alate) perispore. Plants sexual diploid:  $2n = 72$ .

On rocks in forests; 300–2000 m. Hebei, Heilongjiang, Henan, Hubei, Jiangsu, Jilin, Liaoning, Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi, Sichuan [Japan, Korea, Russia].

Based on its peculiar morphology and venation pattern, *Asplenium ruprechtii* has often been put in the satellite genus *Camptosorus* Link, containing two species (one in Asia, the other in North America). Modern studies have shown that *Camptosorus* nests within *Asplenium* and does not form a separate clade.

*Asplenium ruprechtii* is diploid (Kurita, J. Jap. Bot. 40: 234–244. 1965; Mitui, J. Jap. Bot. 40: 117–124. 1965) and hybridizes with tetraploid *A. anogrammoides* (“*A. sarelii*” sensu Kurita et auct. Jap., not Hooker) to form the sterile triploid *A. ×kitazawae* Sa. Kurata. It is also ancestral to the following species.

**17. *Asplenium castaneoviride*** Baker, Ann. Bot. (Oxford) 5: 304. 1891 [“*castaneo-viride*”].

东海铁角蕨 dong hai tie jiao jue

*Asplenium kobayashii* Tagawa; ×*Asplenosorus castaneoviridis* (Baker) Nakaike.

Plants 8–20 cm tall. Rhizome erect, short, scaly; scales black, narrowly triangular. Fronds caespitose; stipe adaxially green, abaxially shiny castaneous, subglabrous; lamina pinnatisect, dimorphic and variable; stipe of small fronds 2–4 cm, of large fronds 6–8 cm, lamina of small fronds narrowly triangular to linear, 5–9 × ca. 1 cm; lamina of large fronds ovate-lanceolate, 11–14 × 2–5 cm, attenuate to both ends, apex acuminate; pinnae 7–9 (small fronds) or 10–15 pairs, opposite or subopposite, sessile, lower segments of large fronds reduced and gradually more triangular-deltoid, middle segments narrowly triangular, 1–2 × 0.3–0.5 cm, base asymmetrical and adnate to rachis, acroscopic side (sub)auriculate, basiscopical side decurrent into narrow wing along rachis, margin repand to sinuate, apex obtuse; segments of small fronds elliptic to obovate, lowest segments largest, 5–8 × 0.3–0.5 cm, adnate to rachis, margin serrate, apex obtuse. Veins anadromously pinnate, obscure, veins simple or forked ending in submarginal hydathode. Fronds herbaceous, green to yellowish green when dry; rachis green, (sub)glabrous. Sori 3–6 per pinna, linear-elliptic, ca. 2 mm, on acroscopic veinlets; indusia green, linear-elliptic, entire, opening toward costa.

On rocky cliffs. Jiangsu, Liaoning, Shandong [Japan, Korea].

We consider *Asplenium castaneoviride* to be a good species, not a sterile hybrid (Ching & Iwatsuki, J. Jap. Bot. 57: 129–132. 1982) because Lovis et al. (Brit. Fern Gaz. 10: 263–268. 1972) and Lin and Sleep (in K. H. Shing & K. U. Kramer, Proc. Int. Symp. Syst. Pterid. 111–127. 1989) have shown that this is a fertile allotetraploid, which originated via chromosome doubling in the sterile hybrid between *A. ruprechtii* and *A. incisum*.

**18. *Asplenium dalhousiae*** Hooker, Icon. Pl. 2: t. 105. 1837.

苍山蕨 cang shan jue

*Asplenium alternans* Wallich ex Hooker; *Ceterach alternans* Kuhn; *C. dalhousiae* (Hooker) C. Christensen; *Ceterachopsis dalhousiae* (Hooker) Ching.

Plants 13–15(–25) cm tall. Rhizome erect, short; scales brown to dark brown, narrowly triangular to lanceolate, margin with short teeth. Fronds caespitose; stipe short, less than 2 cm; lamina narrowly elliptical-obovate, 4–15 × 1.8–5 cm, gradually narrowed at base, pinnatipartite, apex acute to obtuse; segments 10–14 pairs, alternate, ovate to narrowly ovate, 8–12 × 5–8 mm, margin entire and hyaline, apex obtuse. Veins obscure, nothocladromous (anadromous base pattern but several middle pinnae with their basal vein pair catadromous), lateral veins 6–8 pairs, often forking near margin. Fronds firmly papery, brownish yellow to dark brownish green when dry, glabrous, average guard cell length 45–54 μm. Sori 5–7 pairs per segment, 3–5 mm, oblique, on acroscopic secondary veinlets; indusia pale brown, linear, membranous, mostly opening toward costa. Spores pale brown, average exospore length 26–30 μm, outer perispore folded (lophate) and with small pores. Plants sexual diploid:  $2n = 72$ .

On rocks; 1000–3000 m. ?Xizang [Afghanistan, India, Kashmir, Nepal, Pakistan; isolated populations in Africa, North America (Mexico, United States)].

*Asplenium dalhousiae* is a relatively common W Himalayan fern expected to occur in Xizang as it has been reported for Nepal (Roy et al., Brit. Fern Gaz. 10: 194. 1971); it is recorded provisionally in the Flora. This and the following three taxa (*A. paucivenosum*, *A. magnificum*, *A. qiujiangense*) were often included in the genus *Ceterachopsis* (J. Smith) Ching (Bull. Fan Mem. Inst. Biol., Bot. 10: 8. 1940; 苍山蕨属 *cang shan jue shu*) on the basis of their peculiar frond morphology. The group consists of four or five species, mainly from the subtropical mountains of SW China, and one (*A. dalhousiae*) more widely distributed taxon. Recent studies have confirmed that this clade does not merit generic rank.

**19. *Asplenium paucivenosum*** (Ching) Bir, Bull. Bot. Surv. India 4: 3. 1962.

疏脉苍山蕨 *shu mai cang shan jue*

*Asplenium paucivenosum* f. *minus* Bir; *Ceterach paucivenosa* Ching; *Ceterachopsis paucivenosa* (Ching) Ching.

Plants 15–25 cm tall. Rhizome erect, short; scales brown, triangular, margins entire or sparsely dentate. Fronds herbaceous, clustered; stipe short; lamina narrowly elliptic-obovate, 11–16 × 1.5–6 cm, gradually narrowed to base, pinnatifid, apex acute; segments 6–13 pairs, alternate, perpendicular to midrib (rachis), basal segments semicircular, upper ones oblong to triangular-ovate, apex obtuse, middle segments 1–2.5 × 1–1.5 cm, entire or slightly sinuate, glaucous or green becoming brown with distinct hyaline narrow margin after drying. Veins faintly visible, nothocladromous (anadromous base pattern but several middle pinnae with their basal vein pair catadromous), average guard cell length 79–93 μm. Sori short, subelliptic to ensiform-semilunulate, 2–8 × 1–2 mm, oblique, usually 2 or 3 pairs per segment, in middle between costa and margin, on acroscopic secondary veinlets; indusia grayish brown, semi-elliptic to ensiform-semilunulate, thinly membranous, entire, persistent. Spores with lophate-reticulate perispore, average exospore length 45–51 μm. Plants sexual tetraploid:  $2n = 144$ .

On rocky cliffs in mixed forests by streamsides; 2000–2700 m. Xizang, Yunnan [Bhutan, N India, Nepal].

*Asplenium paucivenosum* is a tetraploid species similar to the diploid *A. dalhousiae* but has much larger spores (and stomata) with a mean exospore length over 40 μm (less than 35 μm in *A. dalhousiae*) and a different, more fenestrate outer perispore. According to Nakaike (Ferns Nepal 2: 45, 1986), it was confused with *A. dalhousiae* by Itô (in H. Hara, Fl. E. Himal. 1: 487. 1966; Fl. E. Himal. 2: 214. 1971) and Iwatsuki (in Ohashi, Fl. E. Himal. 3: 194. 1975). It is even more easily confused with *A. magnificum* which has a larger mean exospore length (48 μm in *A. paucivenosum* vs. 52 μm in *A. magnificum*). In critical cases, a chromosome count is needed for identification.

**20. *Asplenium magnificum*** (Ching) Bir, Fraser-Jenkins & Lovis, Fern Gaz. 13: 61. 1985.

大叶苍山蕨 *da ye cang shan jue*

*Ceterachopsis magnifica* Ching, Bull. Fan Mem. Inst. Biol., Bot. 11: 56. 1941; *Asplenium paucivenosum* (Ching) Bir f. *majus* Bir.

Plants 15–35 cm tall. Rhizome erect, short; scales brown to reddish brown, triangular. Fronds clustered; stipe brown, 2–4 cm, with brown triangular scales similar to those on rhizome, becoming subglabrous when old; lamina narrowly elliptic to elliptic, (13–)19–32 × 4–5 cm, attenuate to both ends, base cuneate, pinnatifid, apex subobtuse; segments 13–18 pairs, alternate, subperpendicular to midrib (rachis), basal segments semicircular, upper ones oblong to narrowly triangular-ovate, apex obtuse, middle ones (1.2–)2–2.5 × (1–)1.3–1.6 cm, margin hyaline and entire to slightly sinuate. Veins obscure, nothocladromous (anadromous base pattern but several middle pinnae with their basal vein pair catadromous). Fronds subleathery, brownish to grayish green, with minute scales, average guard cell length 84–99 μm. Sori 4 or 5 pairs per segment, elliptic, short, 3–5(–8) mm, median on acroscopic secondary veinlets in middle between costa and margin; indusia brown, semi-elliptic, membranous, entire, persistent. Spores with lophate-reticulate perispore, average exospore length 50–58 μm. Plants octoploid:  $2n = 288^*$ .

On rocks in mixed forests; ca. 2800 m. W Yunnan (Yangbi) [NE India, Nepal].

*Asplenium magnificum* is easily confused with *A. paucivenosum* (see above), but in general, it is a larger plant. In critical cases, a chromosome count will be necessary.

**21. *Asplenium qiujiangense*** (Ching & Fu) Nakaike, Bull. Natl. Sci. Mus., Tokyo, B, 12: 45. 1986.

侏江苍山蕨 *qiu jiang cang shan jue*

*Ceterachopsis qiujiangensis* Ching & Fu, Acta Phytotax. Sin. 22: 411. 1984; *Asplenium dulongjiangense* Viane; *A. latibasis* (Ching & K. H. Shing) Nakaike; *A. latilobum* Viane; *Ceterachopsis latibasis* Ching & K. H. Shing.

Plants up to 40 cm tall. Rhizome erect, short; apex scales brown, triangular, entire. Fronds caespitose; stipe short, 0.5–1.5(–2) cm, winged; lamina narrowly elliptic (lanceolate), (15–)20–30(–35) × 4–6(–8) cm, gradually narrowed to base, pinnatifid, apex acute; segments (11–)14–17 pairs, alternate, perpendicular-oblique to midrib (rachis) and usually falcate, triangular to narrowly triangular, middle segments 3–5 × 1–1.5(–2) cm, margin hyaline and entire, usually with a gemma near pinna base at acroscopic margin, apex obtuse to acute. Veins obscure, nothocladromous (anadromous base pattern but several middle pinnae with their basal vein pair catadromous). Fronds firm, gray-brown after drying, subglabrous, rachis abaxially with sparse small scales, average guard cell length 74–89 μm. Sori 3–5 pairs per segment, linear, up to 1 cm, median on acroscopic secondary veinlets in middle between costa and margin; indusia brown, linear, at maturity obscured by sporangia. Spores with reticulate perispore with large pores and faint crests, average exospore length 41–45 μm.

- On rocks in forests; 1800–2500 m. NW Yunnan.

*Asplenium qiujiangense* is similar to *A. magnificum* but has more falcate and more acute segments, with a gemma at the acroscopic margin at the pinna base. It can also be confused with *A. paucivenosum*, which has a larger mean exospore length (48 μm in *A. paucivenosum* vs. 43 μm in *A. qiujiangense*). In critical cases, a chromosome count will be necessary.

“*Ceterachopsis chiuikiangensis* Ching & S. H. Fu” and “*C. latiloba* Ching & K. H. Shing” (in Y. L. Zhang et al., *Sporae Pterid.* Sin. 256. 1976) are conspecific with *Asplenium quijiangense*, but the two were not validly published because no Latin description or diagnosis, or reference to such, was provided (*Melbourne Code*, Art. 39.1).

**22. *Asplenium ceterach* Linnaeus, Sp. Pl. 2: 1080. 1753.**

药蕨 yao jue

*Ceterach officinarum* Willdenow; *Hemidictyum ceterach* Beddome.

Plants up to 12 cm tall. Rhizome erect, short; scales dark brown in center to pale brown at margin, ovate-triangular, margin sparsely toothed. Fronds caespitose; stipe brown, short, 2–4 cm; lamina narrowly elliptic, 5–8 × 1–1.6 cm, reduced to base, pinnatifid, apex obtuse; segments 6–8 pairs, alternate, triangular, bases adnate to rachis, entire or slightly sinuate, apex obtuse. Veins obscure, nothocladromous (anadromous base pattern but several middle pinnae with their basal vein pair catadromous), anastomosing and forming subhexagonal submarginal areoles. Fronds subleathery, dark green to brownish green after drying, adaxially subglabrous, abaxially densely covered with brownish, ovate-lanceolate to ovate scales, average stomatal guard cell length 40–48 μm. Sori linear, usually on acroscopic secondary veinlets and in middle between costa and margin; indusia rudimentary. Spores with lophate (costate) perispore, average exospore length 37–42 μm. Plants sexual tetraploid:  $2n = 144$ .

In dry rock crevices; 1400–2600 m. Xinjiang, N Xizang [Afghanistan, N India, Kashmir, Pakistan; N Africa, SW Asia, Europe].

*Asplenium ceterach* is widely distributed in S Europe and was often put into the separate genus *Ceterach* Willdenow (Anleit. Selbststud. Bot. 578. 1804, nom. cons.; 药蕨属 yao jue shu) on the basis of its peculiar pinnatifid fronds, submarginally anastomosing veins, and the dense, abaxial scale covering. However, all these characters also occur in other clades within the family, and molecular studies (Van den heede et al., *Amer. J. Bot.* 90: 481–495. 2003) have shown that “*Ceterach*” consists of two separate clades both nested within Aspleniaceae and not meriting generic status. This species is autotetraploid; its diploid ancestor (*A. javorkeanum* Vida), from which it can be distinguished by its larger spores, is only known from the Mediterranean area.

**23. *Asplenium viride* Hudson, Fl. Angl. 385. 1762.**

欧亚铁角蕨 ou ya tie jiao jue

*Asplenium ramosum* Linnaeus, nom. utique rej.

Plants small, 8–15 cm tall. Rhizome erect or ascending, short, apex scaly; scales black, narrowly triangular, often with glandular appendages at base. Fronds caespitose; stipe reddish brown or castaneous only at base, upward green, 2–6 cm, with dark brown narrow scales or subglabrous; lamina linear, 6–15 × 1–1.3 cm, base reduced, apex acute, 1-pinnate; pinnae 14–20 pairs, rhombic-ovate to orbicular, stalked, basal pinnae opposite, upper pinnae alternate, middle pinnae 4–6 × 4–6 mm, margins crenate to (sometimes) deeply incised, apex obtuse, lower 2 or 3 pairs reduced and gradually deltoid, base subtruncate. Vein pattern obscure, anadromously pinnate, veins simple or forked, not reaching margin. Fronds herbaceous, green; rachis green, adaxially longitudinally grooved. Sori 4–8 per segment,

linear, 1–1.5 mm, confluent at maturity; indusia greenish white, semi-elliptic, membranous, entire or slightly toothed, opening toward costa and persistent. Spores with average exospore length 30–33 μm, perispore lophate (alate). Plants sexual diploid:  $2n = 72$ .

In crevices of calcareous, dolomitic, or serpentine rocks; 3300–4500 m. Sichuan, Taiwan, Xinjiang, Xizang [Afghanistan, India, Japan, Kashmir, Nepal, Pakistan, Russia; Europe, North America].

**24. *Asplenium tripteropus* Nakai, Bot. Mag. (Tokyo) 44: 9. 1930.**

三翅铁角蕨 san chi tie jiao jue

*Asplenium anceps* Hooker & Greville var. *proliferum* Nakai; *A. trialatum* C. Christensen; ?*A. trichomanes* Linnaeus var. *centrochinense* Christ.

Plants 15–30 cm tall. Rhizome erect, short, apex scaly; scales narrowly triangular, 3.5(–5) × ca. 0.5 mm, with brown central stripe and paler clathrate borders, entire. Fronds caespitose; stipe shiny brown to black, 3–5 cm, stout, base terete, densely scaly, upward subglabrous and becoming trigonous and then triangular, abaxially carinate to winged and adaxially flat to sulcate with a brown membranous wing along each lateral side, stipe and rachis usually persistent after shedding of pinnae; lamina linear, 12–28 × 1–2.5 cm, attenuate to both ends, 1-pinnate; pinnae 20–35 pairs, (sub)opposite to alternate, usually at right angles to rachis, sessile, middle pinnae oblong to rectangular, 5–13 × 2–7 cm, base asymmetrical, acroscopic side truncate, sometimes auriculate, parallel with or covering rachis, basicopic side narrowly cuneate, margin crenate, apex obtuse; basal pairs of pinnae gradually reduced, flabelliform. Veins pinnate, costa obscure, veins 1-forked. Fronds papery, green or brownish green when dry; rachis stout, shiny dark brown to black, subglabrous, triangular, abaxially winged, adaxially sulcate with 2 entire, lateral, brown membranous wings, often gemmiferous near apex, with 1 or 2 (or 3) scaly axillary buds. Sori 3–6(–11) per pinna, linear, 1–2 mm; indusium grayish green, semi-elliptic, membranous, entire, opening toward costa.

On wet rocks or in acidic soil in forests; 400–2500 m. Anhui, Fujian, Gansu, Guizhou, Henan, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Japan, Korea, Myanmar].

As presently circumscribed, *Asplenium tripteropus* is an aggregate of a diploid and a tetraploid species ( $2n = 72$  or 144) both in China and in Japan (Mitui, *J. Jap. Bot.* 40: 117–124. 1965; Tatuno & Kawakami, *Bot. Mag. (Tokyo)* 82: 436–444. 1969; Wang in K. H. Shing & K. U. Kramer, *Proc. Int. Symp. Syst. Pterid.* 133–134. 1989). Further studies will need to characterize and distinguish them, not only from each other but also from the non-gemmiferous, Macaronesian *A. anceps*.

This species is similar in outline to *Asplenium trichomanes*, but the plants can easily be distinguished by their triangular and winged stipe and rachis and by the presence of a bud on some fronds.

**25. *Asplenium trichomanes* Linnaeus, Sp. Pl. 2: 1080. 1753.**

铁角蕨 tie jiao jue

*Asplenium densum* Brackenridge, p.p.; *A. melanocaulon* Willdenow; *A. melanolepis* Colenso, p.p. (1888), not Franchet & Savatier (1879).

Plants 10–30 cm tall. Rhizome erect, short, scaly; scales narrowly triangular, 3(–4) × ca. 0.5 mm, with opaque, red to dark brown central stripe and paler narrow clathrate borders, entire. Fronds caespitose; stipe shiny castaneous-brown, 2–8 cm, base scaly, upward subglabrous, abaxially semiterete but adaxially grooved, with brown, membranous and subterete narrow wings, texture papery, stipe and rachis usually persisting after shedding of pinnae; lamina linear, 10–25 × 0.9–1.6 cm, base slightly reduced, 1-pinnate, apex acute and 2–4 mm wide; pinnae 20–30 pairs, usually obliquely inserted, sessile, middle pinnae elliptic or ovate to orbicular, 2.5–7.5 × 2–4 mm, base nearly symmetrical, cuneate, margin crenate, apex obtuse; lower pinnae gradually reduced. Veins pinnate, costa obscure, veins obliquely simple or up to 2-forked, basal acroscopic vein usually 2-forked. Fronds papery, green or brown when dry, average stomatal guard cell length 35–42 μm; rachis castaneous, shiny, subglabrous, abaxially terete, adaxially grooved and with a relatively low lateral brown membranous wing. Sori 4–8 per pinna, oval to linear, 1–3.5 mm, usually on acroscopic vein; indusium white or brown after drying, oval to linear, membranous, free margin repand to entire, opening toward costa, persistent. Spores with lophate perispore, average exospore length 27–31 μm. Plants sexual diploid:  $2n = 72$ .

In crevices of non-calcareous (sandstone, granite) rocks, in open or half-shaded situations; 400–3400 m. Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shanxi, Sichuan, Taiwan, Xinjiang, Xizang, Yunnan, Zhejiang [worldwide in all temperate zones, in tropics on high mountains].

*Asplenium trichomanes* is often circumscribed as a collective species consisting of various cytotypes (six taxa are known from C and S Europe). These taxa, for convenience often recognized at the subspecific level, are reproductively isolated (producing sterile hybrids when growing together) and are treated as species in this flora. The species can be distinguished by microcharacters, by flow cytometry, by counting chromosomes, and by their edaphic preference. When the complex is subdivided into species or subspecies, the diploid silicolous taxon has been designated (since Lovis, Brit. Fern Gaz. 9: 147–160. 1964) as *A. trichomanes* s.s. or as subsp. *trichomanes*; the common tetraploid as *A. quadrivalens* or as *A. trichomanes* subsp. *quadrivalens* D. E. Meyer. A lectotype was selected in this sense by Viane (in Jonsell & Jarvis, Nordic J. Bot. 14: 145–164. 1994), but as a result of the Linnean typification project this selection was overruled by Grubov's (Novosti Sist. Vyssh. Rast. 21: 5–21. 1984), who "selected" the tetraploid specimen in the Linnean Herbarium at LINN as type without any argument or fundamental study. However, pending a proposal to conserve the name *A. trichomanes* with a conserved type, based on a diploid plant, we continue to use the name *A. trichomanes* s.s. in its traditional ("2x") sense in compliance with Art. 57.1 of the *Melbourne Code*. However, if such a proposal is not accepted, the correct specific name for the current diploid species will not only have to change to *A. melanocaulon* Willdenow, but the name *A. trichomanes* will have to be given to the following tetraploid taxon, *A. quadrivalens*.

*Asplenium ×lusaticum* D. E. Meyer (the sterile hybrid between *A. trichomanes* and *A. quadrivalens*) is not rare where both parents grow together. It can be easily recognized by its aborted spores. In China, this hybrid is cytologically confirmed for Sichuan ("Longchi").

**26. *Asplenium quadrivalens*** (D. E. Meyer) Landolt, Fl. Indicativa, 268. 2010.

四倍体铁角蕨 si bei ti tie jiao jue

*Asplenium trichomanes* Linnaeus subsp. *quadrivalens* D. E. Meyer, Ber. Deutsch. Bot. Ges. 74: 456. 1962; *A. melanolepis* Colenso, p.p. (1888), not Franchet & Savatier (1879).

Plants 10–30 cm tall. Rhizome erect, short, scaly; scales narrowly triangular, 3.5(–5) × ca. 0.5 mm, with opaque dark brown to black central stripe and paler narrow clathrate borders, entire. Fronds caespitose; stipe shiny castaneous or dark red-brown to black, 2–8 cm, base scaly, upward subglabrous, abaxially semiterete but adaxially sulcate, with brown, membranous and subterete narrow wings, texture papery, stipe and rachis usually not very long persistent after shedding of pinnae; lamina linear, 10–25 × 0.9–1.6 cm, base slightly reduced, 1-pinnate, apex acute and 2–5 mm wide; pinnae 20–30 pairs, usually at right angles to rachis, sessile, middle pinnae oblong to rectangular, 4–6(–12) × 2–4(–5) mm, base asymmetrical, truncate, acroscopic side occasionally auriculate, margin crenate, apex obtuse; lower pinnae gradually reduced, flabellate or triangular. Veins pinnate, costa obscure, veins oblique, simple or up to 2-forked, basal acroscopic vein usually 2-forked. Fronds papery, green or brown when dry, stomatal guard cells 41–48 μm; rachis castaneous, shiny, subglabrous, abaxially terete, adaxially grooved and with a relatively high lateral brown membranous wing. Sori 4–8 per pinna, oval to linear, 1–3.5 mm, usually on acroscopic vein; indusium white or brown after drying, oval to linear, membranous, free margin repand to entire, opening toward costa, persistent. Spores with lophate (costate) perispore, average exospore length 32–37 μm. Plants sexual tetraploid:  $2n = 144$ .

In crevices of various kinds of rocks (often calcareous), in open or half-shaded situations; 400–3400 m. Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shanxi, Sichuan, Taiwan, Xinjiang, Xizang, Yunnan, Zhejiang [worldwide in all temperate zones, in tropics on high mountains].

Tetraploid *Asplenium quadrivalens* has a broader ecological amplitude, i.e., it is not limited to non-calcareous substrates and has a wider range than *A. trichomanes*.

"*Asplenium lovisii*" (Rothmaler, Wiss. Z. Ernst-Moritz-Armdt-Universität Greifswald, Math.-Naturwiss. Reihe 14(1/2): 77. 1965) belongs here but was not validly published because no type was indicated (*Melbourne Code*, Art. 40.1); its "type" was a cultivated plant and not a specimen as required by Art. 8.4. If the proposal to conserve the name *A. trichomanes* with a conserved type, based on a diploid plant according to its traditional ("2x") use and in compliance with Art. 57.1, is not accepted then the name for the current tetraploid species will have to change to *A. trichomanes*.

*Asplenium ×heufleri* Reichardt (the tetraploid sterile hybrid between *A. quadrivalens* and *A. septentrionale*) was recently found in Xinjiang. The authors have not seen any specimens of *A. ×alternifolium* Wulfen (the triploid sterile hybrid between *A. trichomanes* and *A. septentrionale*).

**27. *Asplenium microtum*** Maxon, Contr. U.S. Natl. Herb. 12: 411. 1909.

滇南铁角蕨 dian nan tie jiao jue

Plants 15–20 cm tall. Rhizome erect, short, scaly; scales dark brown, narrowly triangular, ca. 2 mm. Fronds caespitose; stipe shiny or dull blackish purple, 2–3 cm, abaxially terete,

adaxially flat with lateral low ridge of distinctly separate fingerlike (digitiform) projections; lamina linear-lanceolate, 12–17 × 1–1.3 cm, attenuate to both ends, 1-pinnate; pinnae 25–32 pairs, opposite or subopposite, sessile and often deciduous, middle pinnae elliptic-triangular to oblong, ca. 7 × 5 mm, base asymmetrical, basiscopic side narrowly cuneate, acroscopic side truncate and parallel with rachis, often auriculate, margin crenate-sinuate to entire, apex obtuse; lower pinnae gradually reduced, becoming rhomboid-flabellate. Costa obscure, venation anadromously pinnate, with few 1(or 2)-forked or simple veins. Fronds subleathery, grayish green when dry; rachis blackish purple to blackish brown, shiny, abaxially terete, upper part of adaxial side shallowly sulcate and with 2 rows of relatively closely set fingerlike projections forming low ridge (often eroded and not easily visible on older fronds), occasionally with scaly bud in axil of lowest pinna. Sori 2–7 per pinna, linear or linear-elliptic, 1–2.5 mm, medial on subtending vein; indusia grayish brown, linear-elliptic, membranous, entire-sinuate, opening toward costa. Spores with lophate perispore, average exospore length 31–35 μm.

- On rocks in forests; ca. 2000 m. Yunnan.

*Asplenium microtum* is similar to *A. trichomanes* and *A. quadrivalens* but clearly differs by the fingerlike papillae bordering the wings on the rachis. A similar wing structure is also found in *A. glanduliserrulatum* and *A. humistratum*, from which it differs by its gemmiferous rachis. However, not all plants have gemmae, and these species are kept separate, pending future research on this complex. The Mexican *A. hallbergii* Mickel & Beitel, which has a similar rachis but with papillae more perpendicular to the wing, is perhaps distantly related.

**28. *Asplenium humistratum*** Ching ex H. S. Kung, Acta Bot. Yunnan. 4: 339. 1982.

肾羽铁角蕨 shen yu tie jiao jue

Plants (4–)10–23 cm tall. Rhizome erect, short, apex scaly; scales narrowly triangular, with opaque dark brown central stripe and paler clathrate borders, entire. Fronds caespitose; stipe blackish purple to black, shiny, (0.3–)2–3 cm, abaxially terete, adaxially flat but laterally with fingerlike projections; lamina linear, (4–)12–20 × 0.8–1.2 cm, reduced at base, 1-pinnate, apex obtuse with terminal deltoid segment; pinnae (20–)28–42 pairs, opposite, subopposite, or alternate, sessile, middle pinnae oblong, (3–)5–6 × 1.5–4 mm, base asymmetrical, acroscopic side truncate and parallel with rachis, basiscopic side narrowly cuneate, margin entire or slightly sinuate, apex obtuse; basal pinnae slightly deflexed and gradually reduced, orbicular to ovate. Costa obscure, venation anadromously pinnate, with few 1(or 2)-forked or simple veins, basal acroscopic vein usually 2- or 3-forked. Fronds subleathery, grayish green to dark green when dry; epidermis with uniseriate glandular hairs and average guard cell length 46–55 μm; rachis black, shiny, abaxially terete, adaxially flat but laterally with dense fingerlike projections gradually united at their base into a low ridge. Sori brown, linear-elliptic, (0.6–)1–1.5 mm, median to distal on subtending vein, (1 or 2)–5 in apical part of pinna; indusia grayish brown or brownish green, semi-elliptic, membranous, sinuate-entire, opening toward costa. Spores with lophate perispore, average exospore length 30–34 μm.

- On limestone cliffs in forests; 800–2200 m. Guizhou, Hubei, Hunan, Sichuan, Yunnan.

*Asplenium humistratum* is similar to *A. trichomanes* and *A. quadrivalens* but clearly differs by the fingerlike papillae bordering the wings on the rachis. It is more similar to *A. glanduliserrulatum*, from which it differs by its larger size and by the shape of its basal pinnae.

**29. *Asplenium glanduliserrulatum*** Ching ex S. H. Wu, Bull. Bot. Res., Harbin 9(2): 83. 1989 [“*glanduli-serrulatum*”].

腺齿铁角蕨 xian chi tie jiao jue

Plants 10–12 cm tall. Rhizome erect, short, densely scaly; scales narrowly triangular, with opaque dark brown-black central stripe and paler clathrate border, entire. Fronds caespitose; stipe purplish black, shiny, 5–11 mm, abaxially terete, adaxially flat but laterally with separate reddish brown fingerlike projections; lamina linear, 6–12(–14) × 0.9–1.2 cm, apex obtuse with terminal deltoid segment, 1-pinnate; pinnae 20–30 pairs, (sub)opposite to alternate, sessile, middle pinnae elliptic to trapeziform-oblong, 4–6 × 2–3 mm, base asymmetrical, acroscopic side truncate to broadly cuneate, basiscopic side narrowly cuneate, margin entire to repand, apex obtuse; apical pinnae hardly reduced, lower pinnae slightly and gradually reduced, often hastate or becoming subdeltoid. Costa obscure, venation anadromously pinnate, veins 2 or 3 pairs, simple. Fronds herbaceous to subleathery, grayish green when dry; rachis purplish black, shiny, abaxially terete, adaxially flat but laterally with fingerlike projections, these separated and rarely coalescent at their base into a low ridge. Sori 2–5 per pinna, linear-elliptic, ca. 1 mm, median on subtending vein, located in apical part of pinnae; indusia grayish brown, semi-elliptic, entire, opening toward costa.

- On rocks in forests; 1200–2400 m. Guizhou, NW Yunnan.

*Asplenium glanduliserrulatum* differs from *A. trichomanes* and *A. quadrivalens* by the fingerlike papillae bordering the wings on the rachis. It differs from *A. humistratum* by its smaller size and by the shape of its basal pinnae.

**30. *Asplenium kiangsuense*** Ching & Y. X. Jing, Fl. Jiangsu. 1: 465. 1977.

江苏铁角蕨 jiang su tie jiao jue

*Asplenium gulingense* Ching & S. H. Wu; *A. hangzhouense* Ching & C. F. Zhang; *A. parviusculum* Ching.

Plants 6–12 cm tall. Rhizome erect, short, apex scaly; scales narrowly triangular to linear-subulate, with broad opaque black central stripe and narrow paler clathrate borders, margin with uniseriate hairs at scale base. Fronds caespitose; stipe castaneous to dark brown, shiny, terete, 1–3.5 cm, with brownish, hyaline fibrillose paleasters, subglabrous when old; lamina linear, 3–10 × ca. 1 cm, apex acute, 1-pinnate; pinnae 8–20(–22) pairs, lower ones subopposite, hardly reduced, middle pinnae spreading horizontally, elliptic to trapeziform-oblong, 4–5 × 4–5 mm, base asymmetrical, acroscopic side truncate and close to rachis, basiscopic side narrowly cuneate, shortly stalked to subsessile, margin entire to sinuate, apex obtuse. Venation anadromously pinnate or with first basiscopic vein lacking, costa with 2 or 3 acroscopic veins, obscure, veins simple or 1-forked.

Fronds papery, grayish green when dry; rachis castaneous to dark brown, shiny, with small scales, semiterete and adaxially flat or with 2 slightly raised lateral ridges, apical part green on both sides, often deciduous. Sori 3–5 per pinna, linear-elliptic, ca. 1 mm, median on subtending vein; indusia grayish green, elliptic, membranous, entire and opening toward costa. Spores pale brown with lophate (costate) perispore, average exospore length 31–36  $\mu\text{m}$ .

• On rocks in forests; 100–1000 m. Anhui, Fujian, Hunan, Jiangsu, Jiangxi, Yunnan, Zhejiang.

*Asplenium kiangsuense* is similar to a small form of *A. normale* but differs in its scales with wider central band of occluded cells, the adaxially flat rachis, the green rachis tip, the smaller and more elliptic pinnae, and the perispore. The green rachis tip and the pinna shape make it also similar to *A. adulterinum* Milde, from which it differs in the blacker and wider zone of occluded cell lumina of its scales. Due to confusion with *A. normale*, the distribution of this taxon is not well known.

### 31. *Asplenium normale* D. Don, Prodr. Fl. Nepal. 7. 1825.

倒挂铁角蕨 *dao gua tie jiao jue*

*Asplenium boreale* (Ohwi ex Sa. Kurata) Nakaike; *A. minus* Blume; *A. multijugum* Wallich ex Mettenius; *A. normale* var. *boreale* Ohwi ex Sa. Kurata; *A. normale* var. *shimurae* H. Itô; *A. opacum* Kunze; *A. pavonicum* Brackenridge; *A. pseudonormale* W. M. Chu & X. C. Zhang; *A. shimurae* (H. Itô) Nakaike; ?*A. trichomanes* Linnaeus var. *centrochinense* Christ.

Plants 15–40 cm tall. Rhizome erect, short, apex scaly; scales blackish brown, narrowly triangular, costate, with or without median opaque zone, margin fimbriate or entire. Fronds caespitose; stipe castaneous-brown to purplish black, shiny, 5–15(–21) cm, terete to tri- or tetragonous; lamina linear-lanceolate, 12–14(–28)  $\times$  2–3(–3.6) cm, 1-pinnate; pinnae 20–30(–44) pairs, alternate, sessile, middle pinnae trapeziform to oblong, 8–18  $\times$  4–8 mm, base asymmetrical, acroscopic side truncate and subauriculate, basicopic side narrowly cuneate, margin repand or crenate to serrate, apex obtuse; basal pinnae often somewhat reflexed, occasionally reduced. Costa with anadromously pinnate venation but with first basicopic vein lacking, obscure, or faintly visible, veins simple or 2-forked. Fronds herbaceous to thinly papery, brownish green or grayish green when dry, (sub)glabrous; rachis castaneous-brown, subglabrous, often compressed after drying, adaxially with a deep furrow with rounded lateral edges, abaxially terete or keeled, often gemmiferous near apex. Sori 3 or 4(–6) per pinna, linear-elliptic, 2–2.5(–3) mm, median on subtending vein; indusium brown or grayish brown, semi-elliptic, membranous, entire, opening toward costa. Spores with lophate (crispate to alate) perispore, with perforated crests. Plants sexual:  $2n = 72, 144, 216$ , or 288.

In soil or on rocks near streams, forests; 400–2500 m. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hunan, Jiangsu, Jiangxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [Bhutan, India, Japan, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam; tropical Africa, Australia, Pacific islands].

In this *Asplenium normale* aggregate, three distinct taxa have been distinguished on the basis of the presence or absence of one to several buds on the rachis. At the tip of many fronds of typical *A. normale* sits a

single gemma, often developed into a small plant. Plants without such buds have been described as *A. normale* var. *boreale* or *A. boreale*, though the oldest name for non-gemmiferous plants would probably have to be *A. minus* (PRC!). The name *A. shimurae*, or *A. normale* var. *shimurae*, is used for plants with many gemmae per frond. Sterile hybrids between these taxa are known from Japan, and their flavonoid patterns are different. All three morphotypes occur in China (*A. shimurae* mainly in Yunnan), next to intermediate hybrids.

In this aggregate, diploid (China (Taiwan), S India, Malaysia, Nepal) and tetraploid chromosome numbers have been reported. Though Bir (Curr. Sci. 29: 446. 1960) and Nakaike (Bull. Natl. Sci. Mus., Tokyo, B, 12: 37–54. 1986) mainly reported tetraploids for the E Himalaya, and Wang (in K. H. Shing & K. U. Kramer, Proc. Int. Symp. Syst. Pterid. 133–134. 1989) for China, we found tetraploid, hexaploid, and octoploid plants, next to hybrids with intermediate ploidy.

Most of the typical gemmiferous plants of *Asplenium normale* are tetraploid, have scales with a central line of cells with more thickened and darker walls than the more marginal cells, have a deep furrow flanked by relatively broad and rounded edges at the adaxial side of the rachis, and lack the first basicopic vein departing from the costa. Such tetraploid plants, as well as type material of *A. multijugum* from Nepal, have an average exospore length of 26–30  $\mu\text{m}$ . The absence of a basicopic vein is a character *A. normale* shares with *Hymenasplenium*, in which two or more such veins are lacking.

Several morphologically similar plants have scales with the lumina of the central cells occluded and opaque (costate-opaque scales as in e.g., *Asplenium trichomanes* and *A. kiangsuense*), a shallow furrow or a flat rachis bordered by a narrow sharp rim (as in *A. kiangsuense*, not a wing as in *A. trichomanes*), and usually possess the first basicopic vein on the costa. Sterile morphologically intermediates between these plants and true *A. normale* are known from Guangdong. Because no clear correlations were found between the different ploidy levels (4x, 6x, 8x) and the morphotypes called *A. normale*, *A. boreale*, and *A. shimurae*, we refrain from recognizing them as species.

### 32. *Asplenium formosae* Christ, Bull. Herb. Boissier, sér. 2, 4: 613. 1904.

南海铁角蕨 *nan hai tie jiao jue*

*Asplenium loriceum* Christ, nom. illeg. superfl.; *A. maki-noi* Yabe ex Hayata; *A. sublongum* Ching ex S. H. Wu.

Plants (30–)50–80 cm tall. Rhizome erect, short, apex scaly; scales reddish brown in center, narrowly triangular, costate with narrow pale denticulate margin. Fronds caespitose, rarely simple, usually pinnate with terminal pinna conform with lateral ones; stipe 7–10 cm in simple fronds but 20–25(–40) cm in pinnate fronds, grayish green, scaly at base, subglabrous when old, adaxially grooved; lamina (in simple fronds) linear-lanceolate, 15–35  $\times$  1.5–2.5 cm, lamina in pinnate fronds ovate, 18–35(–50)  $\times$  10–26 cm; pinnae 2–6 pairs, lower pinnae subopposite, with stalk 3–5(–10) mm, lanceolate to linear-lanceolate, 12–16(–20)  $\times$  1.5–2.6 cm, base cuneate and decurrent on stalk, margin repand to sinuate, apex acuminate to caudate. Veins obvious, costa stramineous, notably raised on both sides, veins 2- or 3-forked, free. Fronds papery to subleathery when living, grayish green to brown when dry, abaxially with small, dark brown, fimbriate scales along costa, subglabrous when old; rachis grayish green, with small, dark brown, fimbriate scales. Sori linear, 5–10(–15) mm, median to supra-median on acroscopic veinlets; indusium gray, linear, membranous, entire, opening toward costa, persistent.

Shaded places in dense forests or streamsides; 100–2300 m. Guangdong, Hainan, Taiwan [Japan, Vietnam].

Specimens of *Asplenium formosae* with sterile simple fronds are similar to *A. scortechinii*, but their fronds have an even to repand margin (notched in *A. scortechinii*) and a more prominent midrib. *Asplenium loriceum* is a superfluous new name because the epithets “*formosae*” and “*formosanum*” should not be regarded as homonyms.

*Asplenium loriceum* var. *karapinense* (Hayata) Tagawa (Acta Phytotax. Geobot. 2: 200. 1933; “*Diplazium makinoi* var. *karapinense*” Hayata, Icon. Pl. Formosan. 5: 272. 1915), described from Taiwan, is sometimes treated as a synonym of this species. The epithet for *Asplenium makinoi* was taken from “*Diplazium makinoi*” (Yabe, Enum. Pl. Formosa, 600. 1906), which is a nomen nudum and was not therefore validly published (*Melbourne Code*, Art. 38.1(a)).

**33. *Asplenium matsumurae*** Christ, Bot. Mag. (Tokyo) 24: 241. 1910.

兰屿铁角蕨 lan yu tie jiao jue

*Asplenium wightianum* Wallich ex Hooker var. *microphyllum* Matsumura & Hayata (1906), not Beddome (1864); *Diplazium matsumurae* (Christ) Kodama.

Plants 40–80 cm tall. Rhizome erect. Fronds caespitose; stipe greenish stramineous, ca. 15 cm, base with subulate scales; lamina narrowly elliptic to ovate, ca. 35 × 12 cm, 1-pinnate, terminal apical segment similar to subapical pinnae or with 1 or 2 additional basal segments, ca. 4 cm; pinnae ca. 16 pairs, alternate, obliquely spreading, shortly stalked, lower pinnae not reduced, middle pinnae narrowly ovate-trullate, 7–10 × 1–1.3 cm, base asymmetrical, acroscopic side truncate to cuneate, basicopic side narrowly cuneate, margin crenate-serrate, apex acuminate-caudate. Veins hardly visible, first basal basicopic vein on costa lacking, suprabasal veins simple. Fronds herbaceous, grayish green when dry, subglabrous; rachis greenish stramineous. Sori linear, 3–4 mm, rarely diplazoid, medial; indusia linear, hyaline, entire, opening toward costa and persistent but not rolling back at maturity.

• Epiphytic or on rocks in forests; 400–700 m. Probably endemic to Taiwan.

This rare species was confused with *Asplenium vulcanicum* Blume in De Vol and Kuo (Fl. Taiwan 1: 491. 1975). More recently, *A. matsumurae* was treated as a synonym of S Indian *A. serricula* Fée (Kuo, Taiwania 30: 37. 1985; Shieh et al., Fl. Taiwan, ed. 2, 1: 461. 1994; Knapp, Ferns Fern Allies Taiwan, 48, 55. 2011), but that species has a more creeping rhizome, fewer pinnae, and a terminal pinna perfectly conform with the lateral ones. *Asplenium matsumurae* is also superficially similar to members of the *A. wrightii* complex, but it differs in its venation pattern with the first basal basicopic vein lacking and more distal veins simple (not forked), its terminal pinna relatively similar to the subapical lateral pinnae, and its indusia not rolling back at maturity.

**34. *Asplenium wrightii*** Eaton ex Hooker, Sp. Fil. 3: 113. 1860.

狭翅铁角蕨 xia chi tie jiao jue

*Asplenium alatulum* Ching; *A. centrochinense* Christ; *A. centrochinense* var. *major* Bonaparte; *A. centrochinense* f. *maximum* C. Christensen; *A. duplicatoserratum* Ching ex S. H. Wu; *A. fujianense* Ching (1981); *A. fujianense* Ching ex S. H.

Wu (1989); *A. fujianensoides* Viane & Reichstein; *A. laui* Ching; *A. neomultijugum* Ching [“*neomultijugum*”]; *A. pseudowrightii* Ching; *A. serratissimum* Ching ex S. H. Wu; *A. subcrenatum* Ching ex S. H. Wu; *A. taiwanense* Ching ex S. H. Wu; *A. wrightii* var. *aristatoserrulatum* Hayata; *A. wrightii* var. *fauriei* Christ; *A. wrightioides* Christ; *Diplazium centrochinense* (Christ) Tardieu.

Plants 35–70(–120) cm tall. Rhizome erect, short, scaly; scales brown, triangular to narrowly triangular, 5–7 × 1–1.2 mm, often costate with darker central zone and paler, denticulate glandular margin or long fibrillose. Fronds tufted; stipe dull to semi-shiny, grayish green to brown or stramineous-green, (12–)20–40(–50) cm, with scales similar to those on rhizome, subglabrous with age; lamina narrowly ovate-trullate to elliptic, (20–)40–70(–85) × (8–)15–25(–30) cm, base truncate, apex acute, 1-pinnate; pinnae 12–25 pairs, basal pinnae subopposite, others alternate, at an angle of ca. 50°–60° to rachis, with stalks (2–)4–8 mm, lower pinnae not much reduced, suprabasal pinnae narrowly ovate-trullate and often falcate, (5–)10–14(–23) × (0.8–)1.5–1.9(–2.5) cm, base asymmetrical, acroscopic side truncate at an angle of (40°–)55°–75°(–85°) to costa and often auriculate, basicopic side cuneate, at an angle of (20°–)30°–40°(–60°), becoming decurrent on rachis in apical part of lamina, margin variable, from almost entire to crenate-sinuate, denticulate-serrulate or serrate to dentate, more coarsely dentate toward pinna apex, apex acuminate. Veins (1 or)2-forked, with terminal hydathode. Fronds papery, green to brownish green when dry, subglabrous; rachis dull grayish brown to green or purple, with reddish brown, reduced and fimbriate scales or 2 or 3 cellular uniseriate gland-tipped hairs, or subglabrous, terete abaxially, winged toward apex. Sori linear, (3–)9–12(–14) mm, on acroscopic veinlets, medial to supramedial; indusia grayish brown to dark brown, linear, membranous, free margin entire but often glandular and rolling back at maturity, opening toward costa, persistent.

On rocks by streamsides in forests, forested slopes; 200–1800 m. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hunan, Jiangsu, Jiangxi, Sichuan, Taiwan, Yunnan, Zhejiang [Japan, Korea, Vietnam].

Most of the taxa put into synonymy of *Asplenium wrightii* were based on variable characters, often of relatively small plants (nicely fitting a herbarium sheet). Within this aggregate, the name *A. wrightii* is generally applicable to the larger plants, but existing herbarium material is inadequate as it does not cover the morphological variation and cytology is usually unknown. A set of morphological and size characters separates this complex into four major, but probably artificial, groups. A first, including *A. wrightii*, has pinnae more than 10 cm, sori more than 8 mm, and veins in the middle of the pinna 2-forked. A second group, including *A. pseudowrightii*, also has pinnae of more than 10 cm, but shorter sori (less than 8 mm), and veins only 1-forked in the middle of pinnae. Two groups with the largest pinnae less than 10 cm include *A. wrightioides* (with sori 6–11 mm) and *A. centrochinense* with sori less than 6 mm.

Japanese plants (Kurita, Rep. (Annual) Foreign Students' Coll. Chiba Univ. 41–56. 1967; Mitui, Bull. Nippon Dental Coll., Gen. Educ. 4: 221–271. 1975) are octoploids ( $2n = 288$ ), but Z. R. Wang (in K. H. Shing & K. U. Kramer, Proc. Int. Symp. Syst. Pterid. 133–134. 1989) reported tetraploids ( $2n = 144$ ) from Yunnan. Our recent flow-cytometry showed additional ploidy levels (10x and 12x), but because no corre-

lation was found between ploidy levels and gross morphological characters, we refrain from recognizing separate species pending further micromorphological, cytological, and molecular research.

*Asplenium pseudowrightii* was erroneously ascribed to Hainan. This was due to a wrong stamp on the holotype sheet in PE, which is without a collection label. However, all isotypes have the same collectors label (numbered "37818"), and collection labels state the plants origin: "Guangdong: Xin Yi, Har Sick Joun, stream side, 15 Nov. 1934." Some plants from near the type locality are tetraploid (the lowest ploidy level in this complex), while others are 12x (highest ploidy level in this aggregate).

The type of *Asplenium duplicatoserratum* ("S. S. Sin 469A") is also a syntype of *A. centrochinense* f. *maximum*. *Asplenium duplicatoserratum* is a large plant with serrate to biserrate pinnae similar to those of *A. wrightii* but with much shorter sori.

*Asplenium ×wangii* C. M. Kuo (Bot. Bull. Acad. Sin. 29: 109–111. 1988) is a hybrid between *A. wrightii* s.l. and *A. bullatum*; it was described from Taiwan and may be present where these taxa co-occur (Fujian, Guizhou, Hunan, Sichuan, Taiwan, and Yunnan). *Asplenium ×shikokianum* Makino (Bot. Mag. (Tokyo) 13: 13. 1899, pro sp., described from Japan), the natural hexaploid hybrid between octoploid *A. wrightii* and tetraploid *A. ritoense*, is not uncommon where its parents grow together (e.g., Guizhou, Taiwan). *Asplenium ×kenzoi* Kurata (J. Geobot. 11: 68. 1962) is from the cross with *A. prolongatum*.

**35. *Asplenium finlaysonianum*** Wallich ex Hooker, Icon. Pl. 10: t. 937. 1854.

网脉铁角蕨 wang mai tie jiao jue

*Asplendictyum finlaysonianum* (Wallich ex Hooker) J. Smith; *Hemidictyum finlaysonianum* (Wallich ex Hooker) T. Moore.

Plants 30–50 cm tall. Rhizome erect, short, scaly; scales dark brown, narrowly triangular, entire. Fronds caespitose; stipe grayish green or stramineous, 15–26 cm, with scales similar to those on rhizome, toward rachis with paleasters or subglabrous; lamina ovate-elliptic, 20–32 × 10–22 cm, 1-pinnate; pinnae 2–6(–9) pairs, shortly stalked, lower pinnae not (much) reduced, ovate-lanceolate, 7–12 × 2–3.6 cm, base cuneate, gradually decurrent on stalk, margin entire to repand, apex acuminate and sometimes gemmiferous; terminal pinna similar to lateral ones but usually wider and more rhombic or hastate, 8–15 × 5–11 cm, its base often 3-lobed. Venation subflabellate with indistinct costa, veins faintly visible, almost parallel, ± anastomosing near margin. Frond papery or subleathery, brownish green when dry, with small scales along rachis and costa, becoming glabrous when old; rachis stramineous to grayish green, with sparse small narrowly triangular scales. Sori linear, variable in length, 5–45 mm, usually on acroscopic side of acroscopic veins; indusium yellowish to brown, linear, papery, entire, opening toward costa. Plants sexual polyploid:  $2n = 144$  or 288.

On wet rocks or tree trunks in dense forests; 700–1100 m. Guangdong, Guangxi, Hainan, Xizang, S Yunnan [Bhutan, India, Indonesia, Malaysia, Myanmar, Nepal, Vietnam].

*Asplenium finlaysonianum* is a Himalayan species with a typical morphology and venation pattern unlike any other taxon in the family. Though Bir (Curr. Sci. 29: 445–447. 1960) published a chromosome count showing this is a tetraploid ( $n = 72$ ) in Sikkim, India, we found an

octoploid plant in N Myanmar. The cytology of the Chinese plants is not known.

**36. *Asplenium polyodon*** G. Forster, Fl. Ins. Austr. 80. 1786.

镰叶铁角蕨 lian ye tie jiao jue

*Asplenium adiantoides* (Linnaeus) C. Christensen (1905), not Lamarck (1786), nor Raddi (1819), nor Raoul (1844); *A. falcatum* Lamarck; *A. lofouense* Christ; *A. longjinense* Ching & S. H. Wu; *Tarachia falcata* (Lamarck) C. Presl; *Trichomanes adiantoides* Linnaeus.

Plants 20–60(–90) cm tall. Rhizome shortly creeping to erect, scaly; scales dark brown, narrowly triangular with filiform apex, entire. Fronds caespitose; stipe dull or semi-shiny, grayish brown, 10–35(–45) cm, scaly at base, upward subglabrous, semiterete and adaxially grooved; lamina oblong to elliptic, 10–35(–45) × 8–16 cm, pinnate; pinnae (2–)5–10(–15) pairs, opposite or subopposite, distinctly stalked, lower pinnae not or only slightly reduced, median pinnae 4–10(–15) × 1.2–2.2(–2.8) cm, rhomboid to broadly lanceolate, ± falcate, base nearly symmetrical, cuneate, acroscopic side sometimes subauriculate, basispic side narrowly cuneate, margin serrate often with long teeth, apex acuminate, terminal pinna conform with lateral pinnae but often wider than subapical ones or with ascending pinnalike lobes at its base, 5–11 × 2–5(–10) cm. Costa abaxially flat to slightly raised, adaxially with a longitudinal furrow (grooved). Veins prominent, several times forked, subflabellate, almost parallel, reaching margin. Frond (sub)leathery, dark brown when dry, pinna stalk and base with small dark brown scales becoming subglabrous when old; rachis dark gray-brown, semiterete and adaxially grooved. Sori linear, 1–3 cm, on acroscopic veins; indusia brown, linear, entire, opening toward costa. Plants sexual polyploid:  $2n = 144$ , 216, or 360.

On rocks along streams or in forests; sea level to 800 m. Guangdong, Guangxi, Guizhou, Hainan, Taiwan, SE Yunnan [India, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka, Vietnam; tropical Africa, Australia, Indian Ocean islands, Pacific islands (including New Zealand)].

*Asplenium polyodon* is a widespread and variable aggregate species that needs more study before it can be split. Tetraploid chromosome numbers were reported from Australia, India (Darjeeling), Malaysia, New Zealand, and Sri Lanka. We found tetraploids and hexaploids in Uganda and China (Guangxi), and decaploids in Réunion and China (Hainan). Plants with broad pinnae have once been identified as *A. macrophyllum* Swartz (in Schrader, J. Bot. 1800(2): 52. 1801), but the difference between this species and *A. polyodon* requires further study.

**37. *Asplenium lepturus*** J. Smith ex C. Presl, Epimel. Bot. 72. 1851.

热带铁角蕨 re dai tie jiao jue

Plants up to ca. 80 cm tall. Rhizome long creeping, scaly; scales dark brown, narrowly triangular, entire. Fronds separate along rhizome; stipe dull, dark grayish brown, 20–40 cm, subglabrous, semiterete, grooved adaxially; lamina oblong to elliptic, 30–45 × 12–20 cm, pinnate; pinnae 12–25(–30) pairs, opposite or subopposite, distinctly stalked, lower pinnae not or only slightly reduced, median pinnae 7–13 × 0.8–1.5 cm, nar-

rowly rhomboid-lanceolate, falcate, base asymmetrical, acroscopic side cuneate-truncate, basiscopic side narrowly cuneate, margin biserrate often with long teeth, apex long acuminate to caudate, terminal pinna reduced, apex pinnatifid. Costa abaxially slightly raised, adaxially with a shallow longitudinal furrow. Veins prominent, several times forked, distally in pinnae almost running parallel. Fronds (sub)leathery, dark brown when dry, pinna stalk with small dark brown scales and becoming subglabrous when old; rachis dark gray-brown, semiterete, adaxially grooved. Sori linear, 8–12 mm, on acroscopic veins; indusia brown, linear, entire, opening toward costa. Perispore reticulate, without ridges.

On rocks in forests; ca. 1300 m. Hainan [Laos, Philippines, Vietnam].

*Asplenium lepturus* is similar to *A. polyodon* but has more narrow and caudate pinnae, a widely creeping rhizome, and a peculiar perispore pattern. It shares these characters with a number of tropical taxa, e.g., *A. contiguum* Kaulfuss from Hawaii, the neotropical *A. serra* Langsdorff & Fisher, the African *A. friesianum* C. Christensen group, and *A. nitens* Swartz from Réunion.

**38. *Asplenium trapezoideum*** Ching, Bull. Fan Mem. Inst. Biol. 2: 209. 1931.

蒙自铁角蕨 meng zi tie jiao jue

*Asplenium subtrapezoideum* Ching ex S. H. Wu.

Plants 60–70 cm tall. Rhizome suberect to creeping, with narrowly ovate-triangular, dark brown scales with narrow pale margin, up to 3 mm. Fronds approximate, subcaespitose; stipe dull grayish brown to stramineous, 15–25(–35) cm, with scales similar to those on rhizome; lamina narrowly triangular-ovate, 35–40(–45) × (10–)13–22 cm, 1-pinnate, apex triangular and pinnatifid, acute to acuminate; pinnae 12–20 pairs, subopposite, shortly stalked (2–3 mm), basal pinnae only slightly reduced, largest pinnae (8–)10–14 × 1.5–3 cm, narrowly trapeziform-trullate and slightly falcate, base asymmetrical, acroscopic side truncate and often auriculate, basiscopic side narrowly cuneate, margin irregularly crenate-sinuate to crenate-serrate, apex acute-acuminate. Costa slightly sinuous, raised abaxially, adaxially with 2 ridges and sulcate; veins slender, 2- or 3-forked. Fronds firmly herbaceous, glaucous to yellowish brown-green or grayish green when dry, abaxially with minute, brown, hairlike scales; rachis grayish green to stramineous, with sparse scales, narrowly winged below apex, often gemmiferous below terminal segment. Sori linear, (0.8–)1–2 cm, usually on acroscopic vein, at an angle of 10°–25° with costa; indusia grayish brown, linear, membranous, margin with thin hyaline cells, entire, usually opening toward costa, rolling back and erose but persistent. Spores with average exospore length 30–35 μm, perispore echinate.

In soil or on rocks in forests; 600–1600 m. Guangxi, Hunan, Xizang, Yunnan [Myanmar, Vietnam].

*Asplenium trapezoideum* is a rare species, superficially similar to the more common *A. wrightii*, but it has a different rachis and costa structure and is often proliferous near the apex. Flow cytometry of plants from Myanmar show these are probably octoploid. *Asplenium trapezoideum* is closely similar and shares its perispore pattern with the NE Indian *A. khasianum* Sledge, which may even be conspecific.

*Asplenium subtrapezoideum*, distinguished on size differences, is put into synonymy because fertile intermediate plants exist.

**39. *Asplenium adnatum*** Copeland, Philipp. J. Sci., C, 3: 280. 1909.

合生铁角蕨 he sheng tie jiao jue

Plants ca. 30 cm tall. Rhizome erect, short, scaly; scales dark brown to black, narrowly triangular, entire. Fronds caespitose; stipe dull, dark grayish brown, 10–15 cm, with many dark brown, narrowly triangular to linear, fimbriate scales; lamina linear, 15–20 × ca. 3 cm, base truncate and slightly reduced, pinnatisect, apex acute; segments 15–18 pairs, lower segments opposite, upper ones subopposite to alternate, middle pinnae 1.5–2 × 0.5–0.8 cm, narrowly ovate to elliptic, base adnate to rachis, upper segments connected by narrow wing, margin repand to sinuate, apex obtuse. Costa and veins obscure, veins simple or forked, reaching to margin. Fronds herbaceous, greenish brown when dry, abaxially with small hastate-fimbriate scales; rachis dark brown, with many narrowly triangular to linear fimbriate scales. Sori 3 or 4 per pinna, linear, 4–8 mm, approximately median on subtending vein; indusia linear, margin entire, opening toward costa, persistent.

• Guangdong (only known from the type).

*Asplenium adnatum* has scales similar to those of *A. crinicaule* but has adnate and obtuse pinnae. It is probably either a hybrid or an allopolyploid taxon derived from that species.

**40. *Asplenium asterolepis*** Ching, Bull. Fan Mem. Inst. Biol., n.s., 1: 274. 1949.

黑鳞铁角蕨 hei lin tie jiao jue

Plants ca. 30 cm tall. Rhizome erect, short, apex scaly; scales blackish brown, narrowly triangular, with broad, fimbriate and hastate base, apex filiform. Fronds caespitose; stipe castaneous to dark brown, 5–7 cm, with scales similar to those on rhizome; lamina linear, 20–23 × 2–3 cm, attenuate to both ends, 1-pinnate; pinnae ca. 25 pairs, basal ones (sub)opposite, upper ones alternate, sessile, middle pinnae oblong-elliptic, 1–1.5 × ca. 0.4 cm, base asymmetrical, acroscopic side truncate, basiscopic side cuneate, margin crenate-serrate, apex truncate-obtuse; lower pinnae gradually reduced. Venation anadromously pinnate, obscure, veins simple or forked. Fronds herbaceous-leathery, brownish green when dry, both surfaces with hastate-stellate scales; rachis dark purplish brown, semiterete, adaxially sulcate, ridges rounded and without wings, with hastate-stellate scales. Sori 6–8(or 9) per pinna, linear, 3–4 mm, on acroscopic veinlets; indusia yellowish brown, broadly linear, membranous, entire, opening toward costa.

• On rocks in forests; ca. 1000 m. Guizhou (Duyun, Tongren).

*Asplenium asterolepis* is similar, and perhaps conspecific, to *A. crinicaule* but has smaller, more oblong pinnae. Its scales are deltoid-tridentate with a very long central apical tail, as those of *A. crinicaule*. At present, this taxon seems to be known only from the type collection and may represent just a local variant of *A. crinicaule*.

**41. *Asplenium crinicaule*** Hance, Ann. Sci. Nat., Bot., sér. 5, 5: 254. 1866.

毛轴铁角蕨 mao zhou tie jiao jue

*Asplenium beddomei* Mettenius ex Kuhn; *A. hancei* Baker; *A. polytrichum* Christ; *A. saigonense* C. G. Matthew & Christ.

Plants 20–40 cm tall. Rhizome erect, short, scaly; scales blackish brown, narrowly triangular to deltoid-tridentate with long apical tail. Fronds caespitose; stipe grayish brown to purplish black, 5–12 cm, semiterete, adaxially grooved, with blackish brown deltoid-tridentate scales with long apical tail; lamina lanceolate to linear-lanceolate, 10–30 × 3.5–8 cm, gradually reduced at base, apex acute, 1-pinnate; pinnae 18–30(–40) pairs, alternate or lower ones (sub)opposite, almost sessile to shortly stalked; basal pinnae slightly reduced, deltoid-triangular to ovate, apex obtuse; middle pinnae narrowly subtriangular to rhomboid-elliptic, 2–4(–5.5) × 0.8–1.5 cm, base asymmetrical, acroscopic side truncate and auriculate, basicopic side narrowly cuneate, margin irregularly biserrate-crenate, apex acute. Veins obvious, mostly 2-forked, 3-forked, or simple, not reaching margin. Fronds papery, dark brown when dry, both surfaces with dark brown stellate or hairlike small scales, subglabrous when old; rachis grayish brown, semiterete, adaxially grooved, with rigid hairlike scales, rarely with subapical gemma. Sori linear to crescent-shaped, 4–8 mm, on acroscopic veinlets; indusia yellowish brown to grayish brown, linear, membranous, entire, opening toward costa or to first acroscopic vein, often rolling back at maturity, persistent. Perispore costate, with average exospore length 40–44 (dodecaploids). Plants sexual polyploid:  $2n = 144, 288, \text{ or } 432$ .

On rocks at streamsides, in forests; 100–3000 m. Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hunan, Jiangxi, Sichuan, Xizang, Yunnan [India, Malaysia, Myanmar, Philippines, Thailand, Vietnam; Australia].

Tetraploid plants ( $n = 72$ ) of *Asplenium crinicaule* were reported from India (Bir, Curr. Sci. 29: 445–447. 1960), but in China, this is an aggregate of octo- and dodecaploid taxa. At present, octoploids are known from S India (Kuriachan, Cytologia 32: 500–506. 1968), Sichuan (Wang in K. H. Shing & K. U. Kramer, Proc. Int. Symp. Syst. Pterid. 133–134. 1989), Guangdong, and Guizhou, and dodecaploids from Guizhou and Guangdong.

Plants are variable in frond and pinna shape, even at the type locality at Dinghu Shan, Guangdong, where the species is dodecaploid. Members of this aggregate are similar to *Asplenium pellucidum* Lamarck, which is octoploid in Réunion, but has more narrow pinnae with an acuminate apex and many strongly reduced basal pinnae. *Asplenium horridum* Kaulfuss has similar scales. We prefer to treat this taxon as an aggregate species until the ploidy of plants at the different type localities is better known.

The name *Asplenium adiantoides* (here treated as a synonym of *A. aethiopicum*) was misapplied to this species by Y. C. Wu et al. (Bull. Dept. Biol. Sun Yatsen Univ. 3: t. 88–89. 1932).

**42. *Asplenium indicum*** Sledge, Bull. Brit. Mus. (Nat. Hist.), Bot. 3: 264. 1965.

胎生铁角蕨 tai sheng tie jiao jue

*Asplenium laciniatum* D. Don var. *planicaule* C. Christensen; *A. planicaule* Wallich ex Mettenius (1859), not E. J. Lowe (1858); *A. wuyishanicum* Ching; *A. yoshinagae* Makino subsp. *indicum* (Sledge) Fraser-Jenkins; *A. yoshinagae* var. *indicum* (Sledge) Ching & S. K. Wu; *A. yoshinagae* var. *planicaule* (C. Christensen) C. V. Morton.

Plants 10–25 cm tall. Rhizome erect, short, scaly; scales dark to reddish brown, narrowly triangular, entire, apex acuminate. Fronds caespitose; stipe grayish brown or grayish green to stramineous, 5–10 cm, adaxially grooved longitudinally, with small scales similar to rhizome scales, subglabrous when old; lamina narrowly triangular, 7–25 × 2–5 cm, apex acuminate, 1-pinnate; pinnae 8–20 pairs, alternate or lower ones opposite, shortly stalked, basal pinnae not or slightly reduced, middle pinnae 1–2.5 × 0.5–1.3 cm, rhomboid to trapezoid or submidiate, ± falcate, base asymmetrical, first acroscopic lobe larger than first basicopic lobe, acroscopic side truncate, almost parallel to rachis and auriculate, basicopic side narrowly cuneate (1/4–1/3 cut off) to almost parallel to costa, margin irregularly bicrenate, apex acute to acuminate, rarely obtuse. Veins obvious, grooved adaxially, basal acroscopic vein multi-forked, other veins 1- or 2-forked. Fronds subleathery, grass-green to stramineous when dry, adaxially with wrinkles above veins, with small, brown, narrowly triangular and apically filiform scales on abaxial surface and pinna stalks, subglabrous when old; rachis (when dry) abaxially grayish castaneous to green-stramineous for most of its length, and with small narrowly triangular and apically filiform scales, adaxially longitudinally valliculate, often with scaly gemmae or juvenile plants on pinna stalks or rachis. Sori linear, 3–7 mm, from near costa running nearly to margin, distal sori close to rachis; indusia grayish brown, linear, entire, opening toward costa or first acroscopic vein. Spores with lophate (costate) perispore, average exospore length 31–36 μm. Plants tetraploid:  $2n = 144$ .

On wet rocks or tree trunks in forests; 600–2700 m. Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hunan, Jiangxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [Bhutan, India, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam].

*Asplenium indicum* is a sexual tetraploid plant in India, the Himalaya (Mehra & Bir, Curr. Sci. 26: 151–152. 1957; Bir, Curr. Sci. 29: 445–447. 1960; Curr. Sci. 31: 248–250. 1962; Caryologia 18: 107–115. 1965), and China (Guizhou, Xizang). It is morphologically very variable and similar to *A. yoshinagae* with which it is often united to form an aggregate taxon. Because they are genetically isolated and form sterile hybrids when growing together, we treat these taxa as separate species. In China, *A. indicum* is usually a smaller plant, with smaller spores and stomata than *A. yoshinagae*, from which it can also be distinguished by a chromosome count or flow-cytometry. The distinction based on the presence of gemmae is highly unreliable, at least in China, where all tetraploids checked were gemmiferous. The gemmae are formed on the pinna stalks, close to the rachis, rarely on the rachis itself. Another very similar taxon, *A. gueinzianum*, is also gemmiferous but produces buds on the surface of the pinnae. Due to confusion among these taxa, the exact distribution of this species is not well documented.

**43. *Asplenium yoshinagae*** Makino, Phan. Pter. Jap. Icon. t. 64. 1900.

棕鳞铁角蕨 zong lin tie jiao jue

*Asplenium indicum* Sledge var. *yoshinagae* (Makino) Ching & Wu; *A. planicaule* E. J. Lowe var. *yoshinagae* (Makino) Tagawa; *A. tibeticum* Ching; *Tarachia yoshinagae* (Makino) H. Itô.

Plants 20–45 cm tall. Rhizome erect, short, scaly; scales dark to reddish brown, narrowly triangular, entire, apex acuminate. Fronds caespitose; stipe grayish brown or grayish green to

stramineous, 10–20 cm, adaxially grooved longitudinally, with small scales similar to rhizome scales, subglabrous when old; lamina narrowly triangular, 12–30 × 4–7 cm, apex acuminate, 1-pinnate; pinnae 8–20 pairs, alternate or lower ones opposite, shortly stalked, basal pinnae not or slightly reduced, middle pinnae 2–3.5 × 1–1.3 cm, rhomboid to trapezoid or subdimidiate, ± falcate, base asymmetrical, first acroscopic lobe much larger than first basiscopic lobe, acroscopic side truncate, almost parallel to rachis and auriculate, basiscopic side narrowly cuneate (1/4–1/3 cut off) to almost parallel to costa, margin irregularly bicrenate, apex acute to acuminate, rarely obtuse. Veins obvious, grooved adaxially, basal acroscopic vein multi-forked, other veins 1- or 2-forked. Fronds subleathery, grass-green to stramineous when dry, adaxially with wrinkles above veins, small, brown, narrowly triangular and apically filiform scales on abaxial surface and pinna stalks, subglabrous when old; rachis (when dry) abaxially grayish castaneous to green-stramineous for most of its length, and with small narrowly triangular and apically filiform scales, adaxially longitudinally vallecule, gemmae or juvenile plants near rachis on pinna stalks. Sori linear, 4–8 mm, from near costa running nearly to margin, distal sori close to rachis; indusia grayish brown, linear, entire, opening toward costa or first acroscopic vein. Spores with lophate (costate) perispore, average exospore length 36–40 μm. Plants sexual octoploid:  $2n = 288$ .

On wet rocks or tree trunks; 600–2500 m. Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Sichuan, Xizang, Yunnan, Zhejiang [India, Japan, Vietnam].

*Asplenium yoshinagae* is a sexual octoploid plant in S India (Kuriachan in Fabbri, *Caryologia* 18: 675–731. 1965), Japan (Shimura & Takiguchi, *J. Jap. Bot.* 54: 311–318. 1979), and China (Guangdong, Guangxi, Xizang, and Yunnan). It is morphologically very variable and similar to *A. indicum* (see above). In China, *A. yoshinagae* is usually a larger and more vigorous plant with larger spores and stomata than *A. indicum*. They can easily be distinguished by a chromosome count or by flow-cytometry. The presence of gemmae is a highly unreliable character, at least in China, where most octoploids checked were not gemmiferous. Due to confusion among these taxa, the exact distribution of this species is not well documented.

*Asplenium tibeticum*, only known from the type collection from Xizang, has leathery fronds morphologically almost intermediate between *A. yoshinagae* and *A. gueinzianum*; however, its long slender stipe scales and epidermal and soral cell patterns agree with those of *A. yoshinagae*, and its average exospore length of 40 μm also fits for this taxon.

**44. *Asplenium gueinzianum*** Mettenius ex Kuhn, *Filic. Afr.* 103. 1868.

撕裂铁角蕨 si lie tie jiao jue

Plants 25–35 cm tall. Rhizome erect, short, apex scaly; scales brown or reddish brown, narrowly triangular, entire. Fronds caespitose; stipe dull gray-brown, 4–6 cm, with many narrowly triangular, costate scales with dark brown central zone and almost hyaline margin, adaxially sulcate; lamina narrowly triangular to linear, 20–30 × 3–4 cm, apex acuminate, 1-pinnate to pinnate-pinnatifid; pinnae 20–26 pairs, alternate or subopposite, shortly stalked, middle pinnae obliquely rhomboid, 1.4–2 × 0.6–0.9 cm, apex acute, base asymmetrical, acroscopic side

truncate and auriculate-cordate, basiscopic side narrowly cuneate, margins irregularly and deeply bisinuate-bicrenate, basal acroscopic segment most developed, flabellate-obdeltoid, often almost free from rest, first basiscopic segment below second acroscopic lobe; basal pinnae gradually and slightly reduced, often deflexed. Veins visible, basal 1/3–2/3 of costa forming lower margin, lateral veins 2-forked. Fronds herbaceous, green when dry, glabrous adaxially but usually with a small gemma near apex, abaxially with brown small scales or subglabrous; rachis gray-brown to stramineous, with scales similar to those of stipe, subglabrous when old, adaxially sulcate. Sori 5–8 per pinna, linear, 2–3.5 mm, median on acroscopic veinlets; indusia yellowish green to grayish brown, oval-linear, entire, mostly opening toward costa. Spores with lophate (crystate-alate) perispore. Plants sexual:  $2n = 144$ .

On wet rocks at streamsides; 1100–2600 m. Taiwan, Xizang, Yunnan [Bhutan, N India, N Myanmar, Nepal, Vietnam].

The name *Asplenium laciniatum* D. Don (*Tarachia laciniata* (D. Don) C. Presl) has been widely and persistently misapplied to this species; see the comment under *A. varians* (species no. 77).

Fronds of *Asplenium gueinzianum* are similar to those of *A. indicum* and *A. yoshinagae*, as well as to those of the *A. varians* complex, but have costate scales with hyaline borders and small buds or plantlets on the frond surface near the pinna apex (not on the rachis as in *A. indicum/yoshinagae*).

**45. *Asplenium aethiopicum*** (N. L. Burman) Becherer, *Candollea* 6: 23. 1935.

西南铁角蕨 xi nan tie jiao jue

*Trichomanes aethiopicum* N. L. Burman, *Fl. Indica*, 28. 1768; *Asplenium adiantoides* Lamarck; *A. denticulatum* Blume; *A. furcatum* Thunberg; *A. praemorsum* Swartz; *Tarachia furcata* (Thunberg) C. Presl.

Plants 25–45 cm tall. Rhizome short, erect to shortly creeping, scaly; scales dark reddish brown to black, narrowly triangular with a long filiform apical tail. Fronds caespitose; stipe 5–15(–22) cm, adaxially grayish green and sulcate, abaxially dark brown to black, with many reddish to dark brown, narrowly triangular scales with a long filiform apex; lamina narrowly ovate to narrowly triangular, 10–28 × 4.5–8 cm, apex acuminate, pinnate-pinnatifid to 2-pinnate; pinnae 10–15 pairs, subopposite or alternate, lower 1 or 2 pairs slightly reduced, sessile, trullate-rhomboid with 1 or 2 (almost) free pinnules at base, 2.5–4.5 × 1–2.5 cm, base asymmetrical, broadly cuneate, apex acuminate; pinnules 2–4 pairs, obtusate-elliptic or subflabellate, 4–12 × 2–5 mm, margin dentate, lateral sides entire, apex obtuse. Venation subflabellate, obvious abaxially, veins slender and forked, not reaching margin, costa grooved adaxially. Fronds leathery, adaxially dark green when dry and often grooved, abaxially brownish green, with reddish brown, fibrillose scales, subglabrous when old; rachis green but often becoming dark toward base abaxially, adaxially sulcate and densely scaly with fibrillose scales. Sori 2–5 per segment, linear, 3–8 mm, median on subtending veins; indusia grayish yellow, linear, membranous, entire, opening toward major veins or to costa, persistent. Plants polyploid, sexual or agamosporous.

On rocks in mixed forests; 1000–2600 m. Hunan, Jiangxi, Sichuan, Yunnan [India, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Vietnam; tropical Africa, tropical America, Australia, Macaronesia, Pacific islands (Hawaii)].

*Asplenium aethiopicum* is a morphologically, ecologically, and karyologically very variable aggregate for which we prefer to use the oldest available epithet. Braithwaite (Cytotax. Invest. *Asplenium aethiopicum* Complex Africa, Ph.D. Thesis, University of Leeds. 1964; Bot. J. Linn. Soc. 93: 348–378. 1986), Panigrahi (Phytologia 31: 251–258. 1975), Manton et al. (Bull. Brit. Mus. (Nat. Hist.), Bot. 15: 123–161. 1986), and Ormonde (Bol. Mus. Munic. Funchal 43: 177–189. 1991; Acta Bot. Malac. 16: 293–315. 1991) have shown that *A. aethiopicum* s.l. is an aggregate of at least three sexual (*A. aethiopicum* subsp. *tripinnatum* (Baker) A. F. Braithwaite (4x), *A. aethiopicum* subsp. *aethiopicum* (8x), and *A. aethiopicum* subsp. *dodecaploideum* A. F. Braithwaite (12x)) and up to five apomictic taxa. Most of these cytotypes are common in Africa, but sexual tetraploids and dodecaploids are also known from Asia and America, where Swartz's name, *A. praemorsum*, is used for the aggregate. Besides differing in chromosome number and pairing behavior, the members of this aggregate can also be separated on the basis of their exospore size. The agamosporous taxa can be distinguished from the sexual by the length/width ratio of their spores: agamosporous taxa have subglobose spores with a ratio smaller than 1.4, sexual taxa have reniform to plano-convex spores with a ratio larger than 1.4. Based on Braithwaite's (Bot. J. Linn. Soc. 93: 343–378. 1986) key, Chinese specimens are probably sexual *A. aethiopicum* subsp. *dodecaploideum* but need cytological confirmation. We found hybrids with *A. austrochinense* in Jiangxi.

**46. *Asplenium pseudopraemorsum*** Ching, Acta Phytotax. Sin. 9: 361. 1964.

斜裂铁角蕨 xie lie tie jiao jue

Plants 40–45 cm tall. Rhizome erect, short, scaly; scales brown, narrowly triangular, margins dentate to fimbriate. Fronds caespitose; stipe grayish brown, 20–35 cm, sulcate adaxially, when young with dark brown, narrowly triangular to ovate scales with several rows of marginal cells less thickened than in central zone, subglabrous when old; lamina ovate-elliptic, 20–30 × 6–8 cm, apex acute, pinnate-pinnatifid; pinnae 10–15 pairs, with stalks 2–4 mm, not much reduced toward base, narrowly triangular to rhomboid, 3–3.5 × 1–2.2 cm, base asymmetrical, broadly cuneate, margin dentate, apex acuminate; segments 3 or 4 pairs, rectangular to elliptic, 6–11 × 3–8 mm, basal acroscopic segment largest, flabellate, apex obtuse and dentate, lateral sides entire. Veins obvious on both sides, costa shallowly sulcate adaxially, veins 2- or 3-forked, running almost to margin. Fronds herbaceous to papery, brownish green when dry, with supravascular ridges on lamina adaxially, rachis greenish gray, sulcate adaxially, abaxially grayish brown, with sparse dark brown, narrowly triangular scales. Sori 2–4 per segment, linear, 2.5–5 mm, median on subtending veins; indusia gray-brown, linear, entire, opening toward major veins or costa, persistent. Plants sexual tetraploid:  $2n = 144^*$ .

- On rocky cliffs in forests; 500–1000 m. Hainan.

*Asplenium pseudopraemorsum* is similar to *A. aethiopicum* in general aspect and outline but lacks the reddish brown fimbriate scales and has shorter sori. *Asplenium protractum* Tardieu & Ching is also similar but has more subleathery fronds with shorter sori.

**47. *Asplenium saxicola*** Rosenstock, Repert. Spec. Nov. Regni Veg. 13: 122. 1914.

石生铁角蕨 shi sheng tie jiao jue

*Asplenium affine* Swartz var. *sinense* Christ; *A. comptum* Hance (1866), not Kunze ex T. Moore & Houlston (1852); *A. dimidiatum* Swartz var. *comptum* Baker.

Plants 20–50 cm tall. Rhizome erect, short, scaly; scales dark brown, narrowly triangular, margins dentate-fimbriate. Fronds caespitose; stipe grayish green to black, 10–22 cm, base scaly, more sparsely so upward, adaxially sulcate; lamina triangular-ovate to narrowly triangular, 12–28 × 5–11 cm, pinnate or pinnate-pinnatifid to 2-pinnate at base and gradually becoming pinnate toward apex, apex acute; terminal apical pinna simple or pinnatifid; pinnae 5–12(–14) pairs, simple or pinnate (basal pinnae), opposite or alternate, stalk 5–12 mm; basal pinnae usually largest, 3–6 × 2–3 cm, rhomboid or triangular to narrowly triangular, base asymmetrical, acroscopic side truncate to cuneate, basicopic side cuneate, margin irregularly crenate-sinuate, apex acute to acuminate; segments 1–3, rhomboid to elliptic or obovate, 0.6–2 × 0.3–1.2 cm, basal acroscopic segment largest. Costa shallowly sulcate adaxially, lateral veins flabellately forking, not reaching margin. Fronds leathery, dark brown when dry; rachis dark brown to grayish black at base, becoming green toward apex, with dark brown, narrowly triangular scales with lateral fimbriae and filiform apex, subglabrous when old, adaxially sulcate. Sori 3–6 per segment (8–12 on basal acroscopic segment), linear, 4–15 mm; indusia brown, linear, thickly membranous, entire, opening toward costa or major veins. Spores with dark brown, lophate perispore, average exospore length 26–29 μm (in tetraploids) or 40–45 μm (in octoploids).

On limestone rocks in forests; 300–1300 m. Guangdong, Guangxi, Guizhou, S Hunan, Sichuan, Yunnan [Vietnam].

*Asplenium saxicola* is an aggregate of tetraploid and octoploid plants with fronds similar, though more divided at the base, to those of *A. dimidiatum* Swartz (America) and *A. hemitomum* Hieronymus and *A. megalura* Hieronymus (Africa). The scales are similar to those of *A. aethiopicum* but have thicker cell walls and a shorter apical tail. The ploidy level of plants from the type locality in Guizhou is not known. Tetraploids were found in Guangxi and octoploids in Guangxi and in Yunnan.

**48. *Asplenium oldhamii*** Hance, Ann. Sci. Nat., Bot., sér. 5, 5: 256. 1866 [“*oldhami*”].

东南铁角蕨 dong nan tie jiao jue

*Asplenium formosanum* Baker; *A. hancockii* Baker (1885), not Maximowicz (1883).

Plants 15–20 cm tall. Rhizome erect, short, scaly; scales dark brown, narrowly triangular, subentire. Fronds caespitose; stipe green or base brownish gray, 4–10 cm, adaxially sulcate, with small reddish brown narrowly triangular scales or subglabrous; lamina ovate-triangular, 6–10 × 3–4 cm, apex acute, pinnate-pinnatisect to almost bipinnate; pinnae 5–9 pairs, subopposite or alternate, stalk 2–3 mm, basal pinnae not reduced, rhombic, 1.8–3 × 1–2 cm, base slightly asymmetrical, broadly cuneate, apex subacute; segments 1 or 2 pairs, elliptic, 3–11 × 2.5–5 mm, basal acroscopic lobe largest, base decurrent on costa, crenate to sinuate, apex obtuse to truncate. Costa shallowly grooved adaxially, veins anadromously forking. Fronds

leathery, dark green when dry; rachis grayish stramineous or green, sulcate adaxially, with dark brown, narrowly triangular scales, subglabrous when old. Sori 1–4 per segment, median to distal on subtending veins, not reaching margin, oval-linear, 3–5 mm; indusia brown, oval-linear, membranous, entire, opening toward costa, persistent.

• On wet or moss-covered rocks in forests; 100–900 m. Anhui, Fujian, Jiangxi, Taiwan, Zhejiang.

The relationship of *Asplenium oldhamii* to *A. austrochinense* requires further study.

**49. *Asplenium affine*** Swartz, J. Bot. (Schrader) 1800(2): 56. 1801.

匙形铁角蕨 shi xing tie jiao jue

*Asplenium spathulinum* J. Smith ex Hooker (1860), not Kunze (1848).

Plants 30–65 cm tall. Rhizome erect or ascending, scaly; scales brown, narrowly triangular, margins subdentate. Fronds caespitose; stipe dull grayish brown to gray-green, semiterete, 13–30 cm, subglabrous, adaxially sulcate; lamina triangular to ovate, 21–36 × 10–20 cm, not much reduced at base, apex acute-acuminate, bipinnate; pinnae 12–18 pairs, subopposite to alternate, stalks 2–3 mm, basal pinnae largest or slightly reduced, narrowly triangular, 7–14 × 3.5–4.5 cm, apex variable, from acute to caudate, 1-pinnate; pinnules 4–8 pairs, anadromous, free to sessile, from ovate-elliptic to rhombic or cuneiform, apex obtuse, basal acroscopic pinnule ± equal to basal basicopic pinnule, basal pair largest, 1.5–3 × 1–1.3 cm, base nearly symmetrical, cuneate, distal segments decurrent on rachis, lateral sides entire, outer margin dentate to crenate. Costa obvious on both sides, raised abaxially, adaxially shallowly grooved with raised supravascular ridge, veins 2- or 3-forked and not reaching margin. Fronds herbaceous, brownish green when dry, subglabrous; rachis grayish brown to gray-green, adaxially sulcate, apical part of rachis often gemmiferous. Sori 1–4 per pinnule, not reaching margin, linear, 5–10 mm; indusia brownish, linear, membranous, entire, opening toward costa or costule, persistent.

Epiphytic in forests; 600–1400 m. Hainan [Indonesia, Malaysia, Philippines, Sri Lanka; Mascarene Islands].

Hooker's name, *Asplenium spathulinum*, has often been used to describe this variable taxon (e.g., Beddome, Ferns S. India, t. 226. 1864; Tardieu & Ching, Notul. Syst. (Paris) 5: 134–154. 1936; Holttum, Revis. Fl. Malaya 2: 439. 1954; Copeland, Fern Fl. Philipp. 3: 445. 1960; Chun et al., Fl. Hainan. 1: 116. 1964; S. H. Wu, FRPS 4(2): 70. 1999; T. L. Wu et al., Fl. Guangdong 7: 198. 2006). Manton and Sledge (Philos. Trans., Ser. B, 238: 127–185. 1954) showed that *A. affine* is an aggregate of an octoploid and a dodecaploid species (S India and Sri Lanka). Plants from closer to the type locality of Mauritius, in Réunion, were dodecaploid. Because specimens from the Hainan populations have the same ploidy level (12x), we use the name *A. affine* following Sledge's (Bull. Brit. Mus. (Nat. Hist.), Bot. 3: 235–277. 1965) concept, based on morphological and cytological study. Mature *A. affine* plants can be very similar to juvenile specimens of *A. pseudolaserpitiifolium* and its relatives.

**50. *Asplenium cuneatiforme*** Christ, Bull. Herb. Boissier, sér. 2, 4: 613. 1904.

乌来铁角蕨 wu lai tie jiao jue

*Asplenium arisanense* Tagawa; *Tarachia cuneatiformis* (Christ) H. Itô.

Plants 50–60 cm tall. Rhizome ascending or shortly creeping, scaly; scales brown to black, narrowly triangular, entire. Fronds subcaespitose; stipe dull, dark purplish to gray-brown, semiterete, 19–24 cm, adaxially sulcate, base scaly, upward subglabrous; lamina narrowly triangular to ovate, 15–30 (–40) × 5–8 cm, bipinnate at base, apex acuminate; pinnae 14–20 pairs, opposite to alternate, stalks ca. 2 mm, basal pinnae not reduced, narrowly triangular to ovate, 5–6 × ca. 2 cm, apex obtuse to subacute, serrate; basal pinnae 1-pinnate, free pinnules 1–3 (or 4) pairs, basal acroscopic pinnule largest, ovate-trullate, 10–14 × 5–6 mm, apex obtuse or truncate, base cuneate, adnate to costa toward apex, apical pinnae pinnatifid or simple, acroscopic side auriculate. Costa flat to slightly raised adaxially. Veins obvious on both surfaces, anadromous, 2- or 3-forked, not reaching margin. Fronds papery, brown when dry, lamina subglabrous; rachis semiterete, dull, dark purplish to gray-brown abaxially, green toward apex, with small subhastate to stellate reduced scales or hairs to subglabrous, adaxially sulcate and often gemmiferous near apex. Sori 1–3 on basal pinnule, median on subtending vein, not reaching margin, linear, 5–9 mm; indusia brown to dark brown, linear, membranous, entire, opening toward costa or costule, persistent.

• On wet rocks or epiphytic, often near streams; 100–1200 m. Taiwan.

*Asplenium cuneatiforme* is similar to *A. affine*, which has a wider and more-divided frond, and to the Pacific *A. lobulatum* Mettenius ex Kuhn with a creeping rhizome and a less-divided lamina.

**51. *Asplenium rockii*** C. Christensen, Contr. U.S. Natl. Herb. 26: 332. 1931.

瑞丽铁角蕨 rui li tie jiao jue

*Asplenium laciniatum* D. Don var. *crinigerum* Beddome.

Plants up to 20 cm tall. Rhizome short, erect, or ascending; scales dark brown to black, narrowly triangular, entire or sub-fimbriate. Stipe stramineous, 2–4 cm, semiterete to terete, with spreading, narrowly triangular, dark brown scales, with long acuminate apex. Lamina narrowly elliptic to lanceolate, 12–18 × 2–3.5 cm, base reduced, 2-pinnate to 3-pinnatifid, apex acute; pinnae 15–20 pairs, subopposite to alternate, stalk ca. 1 mm, lower pinnae reduced, middle pinnae elliptic-subtriangular, 1.5–2.3 × 0.9–1.2 cm, base asymmetrical, acroscopic side truncate, basicopic side cuneate, apex obtuse to subacute, 1-pinnate or pinnatisect; pinnules 3 pairs, anadromous, basal acroscopic pinnule largest, cuneate-spatulate, 6–8 × 3–4 mm, base cuneate and decurrent on costa wing, apex obtuse-truncate and serrate-lacerate, with 2–4 teeth up to 7 × 3.5 mm. Fronds subleathery, green, edges often revolute when dry, with narrow scales on veins, lamina subglabrous; rachis stramineous or green, sulcate adaxially, with dark brown, narrowly triangular, caudate scales. Costa minutely scaly abaxially, sulcate but with raised supravascular ridge, veins anadromous, not reaching margin. Sori 1 or 2 (or 3) per pinnule, median on subtending veinlets, elliptic, 2–4 mm; indusia gray, elliptic, membranous, entire, opening toward costa or costule.

On rocks. Yunnan [Bhutan, NE and S India, N Myanmar, N Thailand].

*Asplenium rockii* is a distinct but rare species, which, according to flow cytometric analysis, is hexaploid in China.

**52. *Asplenium austrochinense*** Ching, Bull. Fan Mem. Inst. Biol. 2: 209. 1931.

华南铁角蕨 hua nan tie jiao jue

*Asplenium consimile* Ching ex S. H. Wu (1989), not Rémy (1854); *A. jiulungense* Ching; *A. nanchuanense* Ching & Z. Y. Liu; *A. pseudowilfordii* Tagawa; *A. wilfordii* Mettenius ex Kuhn var. *austrochinense* (Ching) Tagawa; *Tarachia austrochinensis* (Ching) H. Itô.

Plants 30–40 cm tall. Rhizome erect, short, apex scaly; scales dark to medium brown, narrowly triangular, fimbriate in basal part to subentire near apex. Fronds caespitose; stipe up to 20 cm, semiterete, base abaxially dull, dark purplish to gray-yellow when dry, adaxially green and sulcate, base with scales similar to those on rhizome, toward rachis with gradually smaller and more hastate-stellate scales with fimbriae; lamina triangular-ovate to narrowly triangular, 18–26 × 6–10 cm, base cuneate to truncate, apex acute-acuminate, 2-pinnatifid to 3-pinnatifid; pinnae 10–15 pairs, subopposite to alternate, stalk 3–4 mm, basal pinnae not reduced, narrowly triangular-ovate, 4.5–8 × 1.7–3 cm, apex acute to caudate, pinnate to 2-pinnatifid; pinnules 3–5 pairs, anadromous, basal acroscopic pinnule largest, free or adnate to costa, rhombic, 1–2 × 0.6–1.2 cm, apex obtuse-truncate to subacute, basal pinnule simple to pinnatifid and with 2 or 3 segments, base cuneate or decurrent on costa in upper pinnae, margin serrate-crenate to sinuate, teeth usually obtuse, costa sulcate adaxially, narrowly winged. Veins obvious abaxially, obscure but occasionally raised adaxially, venation anadromous, veins subflabellate, not reaching margin. Fronds herbaceous to leathery, green, or yellowish brown when dry, lamina with reduced, hastate-stellate, and fimbriate scales or subglabrous; rachis semiterete, green, or more rarely purplish brown or gray, sulcate and green adaxially. Sori 2–6(–9) per pinnule, short, linear, 3–5 mm; indusia pale brown, linear, firm, membranous, entire, opening toward costule or costa, persistent. Plants octoploid:  $2n = 288$ .

On wet rocks or moss cushions on trees in dense forests; 400–1100 m. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangxi, Sichuan, SE Yunnan, Zhejiang [Japan, Vietnam].

Plants of *Asplenium austrochinense* from Guangdong are octoploid like the Japanese (Shimura & Takiguchi, J. Jap. Bot. 54: 311–318. 1979), and scales are similar in Chinese and Japanese specimens. Upon drought stress, the margins of the frond tend to roll inward, protecting the abaxial epidermis with the stomata. The name *A. consimile* Ching was used to describe plants with a somewhat thinner lamina.

**53. *Asplenium hainanense*** Ching, Notul. Syst. (Paris) 5(2): 140. 1936.

海南铁角蕨 hai nan tie jiao jue

Plants 24–40 cm tall. Rhizome erect, short, apex scaly; scales dark brown, narrowly triangular, entire. Fronds caespitose; stipe gray to dark brown, 4–10(–15) cm, adaxially sulcate,

with brown narrowly triangular or stellate scales, often becoming subglabrous; lamina narrowly triangular to ovate, 13–26 × 3–8 cm, apex acuminate-caudate, bipinnate; pinnae 10–16 pairs, subopposite to alternate, stalk up to ca. 2 mm, basal pinnae largest or slightly reduced, middle pinnae ovate, 2.5–4(–7) × 1.2–1.6 cm, apex obtuse to subacute, 1-pinnate; pinnules 2–4(–7) pairs, anadromous, first acroscopic pinnule largest, narrowly obovate-obtrullate, 8–10 × 4–6 mm, distal pinnules narrowly cuneiform, basisopic pinnules cuneiform-falcate, base narrowly cuneate, almost sessile, lateral side entire, apex serrate and obtuse. Costa sulcate with raised supravascular ridge adaxially, green. Veins distinct, raised adaxially, anadromously branching, not reaching margin. Fronds firmly herbaceous, brownish green when dry; rachis gray to dark brown abaxially, becoming green toward apex, subglabrous, adaxially sulcate. Sori 2–5 per pinnule, linear, 2–6 mm; indusia pale brown, linear, membranous, entire, opening toward costule, persistent.

On wet rocks at streamsides in forests; 400–700 m. Hainan [Thailand, Vietnam].

*Asplenium hainanense* is similar to *A. gracilifolium* Copeland and to small forms of *A. affine* but never proliferous.

**54. *Asplenium subspathulinum*** X. C. Zhang, Lycophytes Ferns China, 301. 2012.

侏江铁角蕨 qiu jiang tie jiao jue

*Asplenium qiujiangense* Ching ex S. H. Wu, Bull. Bot. Res., Harbin 9(2): 90. 1989, not (Ching & Fu) Nakaike (1986); *A. dulongjiangense* Y. F. Deng (2003), not Viane (1991).

Plants 50–100 cm tall. Rhizome shortly creeping or erect, scaly; scales purplish brown, narrowly triangular, entire. Fronds caespitose; stipe 30–38 cm, semiterete, base scaly, upward subglabrous, dull, grayish green, adaxially sulcate; lamina ovate-triangular, 45–60 × 26–30 cm, apex acute-acuminate, bipinnate to 3-pinnatifid; pinnae 15–20 pairs, subopposite to alternate, stalk 6–19 mm, basal pinnae slightly reduced, narrowly triangular-ovate, 14–16 × 3.8–4.2 cm, apex caudate, 1-pinnate to 2-pinnatifid; pinnules 8–10 pairs, anadromous, stalks 2–3 mm, basal pinnules ± equal in size and shape, rhomboid, 1.5–2 × 1–1.5 cm, apex obtuse, base cuneate-truncate, almost symmetrical to asymmetrical, margin dentate. Veins obvious, raised adaxially, veins flabellately anadromous, not reaching margin. Costa green, with reduced scales or subglabrous, adaxially sulcate with broad supravascular ridge. Fronds papery, green, subglabrous; rachis dull grayish brown, with reduced scales or subglabrous, adaxially sulcate. Sori 3–8 per pinnule, basal on subtending vein, linear, 3–8 mm; indusia brownish, membranous, entire, opening toward costule or costa.

• Dense forests; ca. 1200 m. NW Yunnan (Dulongjiang Valley).

*Asplenium subspathulinum* is a distinctive species, similar to *A. pseudolaserpitiifolium*, known only from a restricted region. It is also close to *A. nitidum* Swartz, but that taxon has more trullate and acute pinnules.

**55. *Asplenium bullatum*** Wallich ex Mettenius, Abh. Senckenberg. Naturf. Ges. 3: 150. 1859.

大盖铁角蕨 da gai tie jiao jue

*Asplenium cavalerianum* Christ; *A. grandifrons* Christ; *A. latucuneatum* Christ; *A. viridissimum* Hayata.

Plants 60–100 cm tall. Rhizome erect, apex scaly; scales medium to dark brown, lanceolate, margin subentire. Fronds caespitose; stipe dull gray-brown to gray-green, semiterete, 20–43 cm, adaxially sulcate, base scaly, becoming subglabrous near rachis; lamina triangular-ovate, 45–70 × 18–35 cm, apex acute, 2-pinnate to 4-pinnatifid; pinnae 16–19 pairs, subopposite to alternate, stalked, basal pinnae slightly reduced, middle pinnae largest, narrowly triangular, 11–19 × 4–8 cm, often slightly falcate, apex acuminate, base asymmetrical, acroscopic side truncate, basiscopic side cuneate, 2- or 3-pinnate; pinnules 8–13 pairs, anadromous, basal pinnules free and stalked, distal pinnae adnate to costa, basal acroscopic pinnule largest, ovate-triangular, 2.5–4 × 1.6–2.2 cm, base cuneate, asymmetrical and often decurrent along costule, apex obtuse to subacute; ultimate pinnules 2–5 pairs, basal acroscopic segment largest, ovate, 12–15 × 6–8 mm, apex obtuse to truncate, base cuneate and decurrent on costule or free, margin dentate, teeth deltoid-triangular and often submucronate. Veins obscure, anadromous, rarely simple with distinct terminal hydathode on adaxial side, not reaching margin. Fronds herbaceous, green; rachis gray-green, semiterete, lamina with 2–4 cellular uniseriate hairs with apical gland or subglabrous, adaxially sulcate but with distinct supra-vascular ridge; costa pale brown to green, terete-semiterete, adaxially sulcate with distinct supra-vascular ridge, winged near its apex. Sori 1–25 per pinnule, median on subtending vein, subelliptic, ca. 4 mm; indusia yellowish brown, semi-elliptic, membranous, with thin hyaline margin with short 1–3-celled uniseriate hairs, rolling back at maturity, opening toward costule, persistent.

Streamsides, forests; 900–2600 m. Fujian, Guizhou, Hunan, Sichuan, Taiwan, Xizang, Yunnan [Bhutan, N India, N Myanmar, Nepal, N Vietnam].

*Asplenium bullatum* was confused with *A. bulbiferum* G. Forster by, e.g., Hooker (Sp. Fil. 3: 196. 1860) p.p., Beddome (Ferns Brit. India 1: 65. 1865; Handb. Ferns Brit. India, 159. 1883), Clarke (Trans. Linn. Soc. London, Bot. 1: 485. 1880), Christensen (Index Filic. 103. 1905) p.p., Panigrahi (Bull. Bot. Surv. India 2: 313. 1960), and Ching and Wu (Fl. Xizang, 1: 184. 1983).

Plants of *Asplenium bullatum* from Nepal are octoploid (Matsumoto & Nakaike in Watanabe & Malla, Cryptog. Himalayas 1: 179. 1988), unlike the tetraploids known from the E Himalaya (Bir, Curr. Sci. 29: 446. 1960). Further studies are needed to find out possible correlations with the dissection of the lamina, which varies from 2-pinnate to 4-pinnatifid, and with the more divided forms considered typical and recognized as *A. bullatum* var. *bullatum* (大盖铁角蕨(原变种) da gai tie jiao jue (yua bian zhong)). Bipinnate forms have been called *A. bullatum* var. *shikokianum* (Makino) Ching & S. H. Wu (FRPS 4(2): 75. 1999; 稀羽铁角蕨 xi yu tie jiao jue). However, *A. ×shikokianum* Makino (Bot. Mag. (Tokyo) 13: 13. 1899, pro sp., described from Japan) is the name for the natural hexaploid (Shimura & Matsumoto, J. Jap. Bot. 51: 235–244. 1976) hybrid between *A. wrightii* and *A. ritoense* and should not be used to describe the less-divided forms of *A. bullatum* (e.g., H. S. Kung, Fl. Sichuan, 6: 381. 1988; Wu, FRPS 4(2): 75. 1999; P. S. Wang & X. Y. Wang, Pterid. Fl. Guizhou, 139. 2001, p.p.; Li, Fl. Hunan 1: 288. 2004, p.p.). Many specimens currently filed in Chinese herbaria as *A. shikokianum* or as *A. bullatum* var. *shikokianum* have good spores and are not hybrids. True *A. ×shikokianum* is not uncommon

where its parents grow together (e.g., Guizhou, Taiwan). *Asplenium ×wangii* C. M. Kuo (Bot. Bull. Acad. Sin. 29: 109–111. 1988), the hybrid between *A. bullatum* and *A. wrightii*, is morphologically similar to *A. ×shikokianum* and could be confused. *Asplenium ×wangii* was described from Taiwan and may be present where the parent taxa grow together (Fujian, Guizhou, Hunan, Sichuan, Taiwan, and Yunnan).

**56. *Asplenium wilfordii*** Mettenius ex Kuhn, Linnaea 26: 94. 1869.

闽浙铁角蕨 min zhe tie jiao jue

*Asplenidictyum wilfordii* (Mettenius ex Kuhn) Nakai; *Asplenium curtidentis* (Christ) Koidzumi; *A. fengyangshanense* Ching & C. F. Zhang; *A. laserpitiifolium* Lamarck var. *morrisonense* Hayata; *A. morrisonense* (Hayata) Hayata; *A. wilfordii* var. *curtidens* Christ; *Tarachia wilfordii* (Mettenius ex Kuhn) H. Itô.

Plants 30–40 cm tall. Rhizome erect, scaly; scales red-brown to black, narrowly triangular, 3–6 mm, entire. Fronds caespitose; stipe dull to semi-shiny, dark brown abaxially, green and sulcate adaxially, semiterete, 12–25 cm, base with brown narrow scales; lamina ovate to narrowly triangular, 10–30 × 5–13 cm, apex acute, 2-pinnate to 4-pinnate; pinnae 8–15 pairs, subopposite to alternate, with distinct stalk 3–8(–10) mm, basal pair largest or slightly reduced, triangular-ovate, 3–8 × 2–4(–6) cm, base asymmetrical, broadly cuneate, 2- or 3-pinnatifid, apex obtuse to acuminate-caudate; pinnules 4–6 pairs, anadromous, basal acroscopic pair largest, ultimate pinnules or segments 2 or 3 pairs, basal acroscopic pair largest, rhombic-cuneiform to linear, 4–12 × (1.5–)4–5 mm, base cuneate and decurrent on costule, 2- or 3-partite, lateral side entire, apex serrate with linear to triangular teeth, apex obtuse to truncate. Veins distinct on both sides, raised adaxially, veinlets 1–4 per segment, not reaching margin. Fronds herbaceous to subleathery, dark green, paler abaxially, yellowish green to brown when dry; rachis dull to semi-shiny, dark brown abaxially becoming green toward apex, green adaxially with raised median ridge, semiterete, scaly; costa green, adaxially shallowly sulcate with prominently raised supra-vascular ridge, abaxially flat, with small fibrillar scales. Sori 1–3 per segment, linear to oval, 1–3 mm; indusia grayish white, membranous, entire, often opening toward each other. Plants tetraploid:  $2n = 144$ .

On rocks in forests, also epiphytic; 200–2300 m. Fujian, Jiangxi, Taiwan, Zhejiang [Japan, Korea].

**57. *Asplenium sublaserpitiifolium*** Ching, Notul. Syst. (Paris) 5: 146. 1936.

拟大羽铁角蕨 ni da yu tie jiao jue

Plants up to 1 m tall or more. Rhizome erect, apex scaly; scales dark brown, narrowly triangular, entire. Fronds caespitose; stipe dull to semi-shiny, purplish black to brown-gray, 20–45 cm, adaxially sulcate, base with brown narrowly triangular scales, glabrous toward rachis; lamina triangular to ovate-elliptic, 40–70 × 15–30 cm, apex acute, 3-pinnate to 4-pinnatifid; pinnae up to 16 pairs, basal pinnae not reduced and subopposite, upper ones alternate, with stalk up to 1.5 cm, triangular to narrowly triangular, 7–15 × 4–11 cm, base broadly

cuneate, bipinnate to tripinnatifid, apex acute; pinnules 10–14 pairs, anadromous, stalks 5–7 mm, less than twice as long as wide, basal acroscopic and basicopic pinnules  $\pm$  equal, basal pair largest, triangular to rhombic,  $2-7 \times 1.5-4$  cm, base obliquely truncate, pinnate to 2-pinnatifid, apex acute; ultimate pinnules 2–6 pairs, anadromous, basal segment pair on basal pinnules subequal, largest, rhombic to cuneate,  $1.5-2 \times 1.5-1.7$  cm, base broadly cuneate to cuneate, shortly stalked, 2- or 3-partite or simple, apex obtuse; segment rhombic to cuneate, lateral sides entire, apex bicrenate, apex obtuse to truncate. Veins distinctly raised adaxially, venation anadromous, veins almost reaching margin, pseudovein in first acroscopic sinus of basal pinnules. Fronds soft papery, brown-green when dry, subglabrous; rachis and costa dull purplish black to gray-brown, semiterete, adaxially sulcate; costule green. Sori linear, 4–6 mm; indusia membranous, entire, opening toward main vein of segment, persistent.

On rocks at streamsides in forests; 800–900 m. Guangdong, Guangxi, Taiwan, Yunnan [Vietnam].

**58. *Asplenium pseudolaserpitifolium*** Ching, Notul. Syst. (Paris) 5: 150. 1936.

假大羽铁角蕨 *jia da yu tie jiao jue*

*Asplenium neolaserpitifolium* Tardieu & Ching.

Plants up to 1 m tall. Rhizome shortly creeping to ascending, thick, apex scaly; scales pale to dark brown, narrowly triangular to linear, entire. Fronds subcaespitose to caespitose; stipe dull gray to gray-brown or almost black, 15–40 cm, semiterete, adaxially sulcate, base scaly, upward subglabrous; lamina triangular-ovate,  $15-55(-70) \times (9-)25-40$  cm, apex acute, tripinnate to 4-pinnatifid; pinnae 10–15 pairs, subopposite to alternate, stalk up to 1 cm, basal pair largest or slightly reduced, triangular to narrowly triangular, often slightly falcate,  $10-25 \times 6-15$  cm, base broadly cuneate, 2-pinnate to 3-pinnatifid, apex acuminate to caudate; pinnules 10–12 pairs, anadromous, stalk up to 4 mm, more than twice as long as wide, basal acroscopic and basicopic pinnules  $\pm$  equal, narrowly triangular-ovate,  $4-10 \times 1.5-4.5$  cm, base asymmetrical, acroscopic side truncate, basicopically cuneate, pinnate to 2-pinnatifid at base of frond, apex acute to caudate; ultimate segments rhombic to obovate or oblong,  $8-11 \times 3-5.5$  mm, base cuneate or segments adnate to costa, apex crenate to sinuate, with blunt teeth, apex obtuse. Costa dull gray to gray-brown abaxially, often becoming green toward apex, adaxially sulcate and often green, with gradually more prominent supravascular ridge toward apex; costule green, sulcate with median ridge adaxially; veins adaxially raised and obvious or flat and hardly visible, anadromous to sublabelately branching, not reaching margin; all axes with reduced scales to subglabrous. Fronds herbaceous to subleathery, dark green to grayish or brown-green after drying; rachis dull gray to brown-gray, semiterete, adaxially sulcate, with supravascular ridge and becoming green toward apex. Sori (1 or) 2–4(–7) per ultimate segment, linear, 3–6(–8) mm; indusia pale yellow-brown, linear, membranous, entire, opening toward costule or main vein of segment, persistent. Spores pale brown with lophate (costate) perispore. Plants octoploid:  $2n = 288$ .

On rocks at streamsides or epiphytic in forests; 100–1400 m.

Fujian, Guangdong, Guangxi, Hainan, Hunan, Taiwan, Xizang, Yunnan [India, Indonesia, Japan, Malaysia, Myanmar, Philippines, Thailand, Vietnam].

*Asplenium pseudolaserpitifolium* was often misidentified as *A. laserpitifolium* auct. non Lamarck, e.g., by Kunze (Bot. Zeitung (Berlin) 6: 521–526. 1848), Hayata (Bot. Mag. (Tokyo) 23: 24–34. 1909), Bonaparte (Notes Ptérid. 7: 135–139. 1918), Nakai (Bot. Mag. (Tokyo) 39: 120. 1925), Tardieu (Asplén. Tonkin, 48. 1932), Ogata (Icon. Fil. Jap. 6: t. 256. 1935), H. Itô (Index Spec. Typic. Herb. Japon. 4. 1959; J. Jap. Bot. 49: 97–104. 1974), Iwatsuki (Ferns Japan, 147. 1992), Iwatsuki et al. (Fl. Japan. 1: 105. 1995); or as *A. cuneatum* auct. non Lamarck by De Vol and Kuo (Fl. Taiwan 1: 482. 1975).

*Asplenium pseudolaserpitifolium* belongs to a group of large 3- or 4-pinnate species similar to *A. laserpitifolium* Lamarck and revised by Tardieu and Ching (Notul. Syst. (Paris) 5: 134–154. 1936), who described five new Indochinese species. Study of the types shows that characters used to describe or key out their taxa are variable and not diagnostic. Our field studies show that habitat conditions and plant age may strongly influence frond morphology and lamina texture. Frond segments of plants collected after desiccation stress are  $\pm$  curled inward and have a more narrowly cuneate form instead of their original rhombic shape. In the same paper, *A. pseudolaserpitifolium* was described and keyed out as a terrestrial plant, but data on the labels of several paratypes state plants were epiphytic. Flow cytometric analyses show plants are octoploids in Guangdong, Guangxi, and Hainan; no data are available from the literature. Spores of the type specimens of *A. neolaserpitifolium* and *A. pseudolaserpitifolium* are identical.

**59. *Asplenium lushanense*** C. Christensen, Acta Horti Gothob. 1: 80. 1924.

庐山铁角蕨 *lu shan tie jiao jue*

Plants 3–15 cm tall. Rhizome erect, scaly; scales dark brown, narrowly triangular, margin fimbriate at base. Fronds caespitose; stipe purplish black to castaneous, semi-shiny, 0.5–4 cm, adaxially sulcate, with dark brown narrowly triangular scales mixed with filiform scales; lamina linear or linear-lanceolate,  $3-15 \times 0.5-2.5$  cm, attenuate to both ends, apex pinnatifid or long flagelliform with terminal budlet, 1-pinnate to 2-pinnatifid; pinnae 10–20 pairs, pinnae sessile or shortly stalked, basal pinnae usually smaller and flabellate, middle pinnae largest, distinctly separated from each other, linear-elliptic,  $(2-)5-10(-15) \times 1.5-5(-7)$  mm, base almost symmetrical to asymmetrical, acroscopic side truncate, basicopic side broadly cuneate, pinnatifid, apex obtuse and with 1 gemma in apical sinus; segments 1–4 pairs, apex obtuse but with 2 or 3 teeth, basal acroscopic segment not much enlarged. Veins not prominent, anadromously forking, not reaching margin. Fronds herbaceous, green, lamina with uniseriate gland-tipped hairs or subglabrous, average guard cell length 34–39  $\mu$ m; rachis with purplish brown to castaneous color extending from basal part up to 1/2–2/3 its length on abaxial side, apical part green or stramineous when dry, with purplish black hairlike scales, adaxially green or stramineous, flat or slightly sulcate, green. Sori usually 1 per segment, often confluent at maturity, subelliptic, 0.3–1 mm, basal to submedial on subtending veinlets, close to costa; indusia grayish green to grayish brown, subelliptic, membranous, repand to entire, mainly opening toward costa. Spores with lophate (costate-cristate) perispore, average exospore length 24–28  $\mu$ m. Plants sexual, diploid:  $2n = 72$ .

In rock (limestone) crevices in forests; 1100–2800 m. Sichuan, Yunnan [Nepal, Vietnam].

*Asplenium lushanense* is the diploid ancestor of autotetraploid *A. exiguum* (Viane & Reichstein, Pterid. New Millennium, 91–94. 2003; Wang, Acta Bot. Sin. 45: 1–14. 2003), see below.

**60. *Asplenium exiguum*** Beddome, Ferns S. India, 49, t. 146. 1863.

云南铁角蕨 yun nan tie jiao jue

*Asplenium fontanum* (Linnaeus) Bernhardt var. *exiguum* Beddome; *A. fontanum* var. *yunnanense* (Franchet) Beddome; *A. glenniei* Baker; *A. kangdingense* Ching & H. S. Kung; *A. loherianum* Christ; *A. moupinense* Franchet; *A. moupinense* var. *dareiforme* Franchet [“*dareaeformis*”]; *A. woodsioides* Christ; *A. yunnanense* Franchet; *A. yunnanense* var. *dareiforme* (Franchet) H. S. Kung [“*dareaeforme*”].

Plants 5–25 cm tall. Rhizome erect, scaly; scales dark brown to black, narrowly triangular, margin fimbriate at base. Fronds caespitose; stipe 1–5 cm, abaxially purplish black to reddish brown and semi-shiny, adaxially sulcate, with blackish brown narrowly triangular scales mixed with filiform scales; lamina lanceolate, 3–15 × 0.8–2.5(–4) cm, attenuate to both ends, apex pinnatifid or shortly flagelliform and rooting, 1- or 2-pinnate, up to 3-pinnatifid in large specimens; pinnae 10–20 pairs, shortly stalked, basal pinnae opposite and often strongly reduced or flabellate, upward becoming alternate; middle pinnae largest, narrowly triangular to ovate-elliptic or oblong, (2–)10–15(–20) × 2–7 mm, base almost symmetrical to asymmetrical, acroscopic side truncate, basiscopical side cuneate, pinnatisect to pinnatifid, apex obtuse and with 1 gemma in apical sinus; segments 2–4 pairs, apex obtuse and dentate-serrate with 2–4 teeth; teeth obtuse, mucronate or acute. Veins not prominent, anadromously forking, not reaching margin. Fronds firmly herbaceous, green, lamina with uniseriate gland-tipped hairs or subglabrous, average guard cell length 43–50 μm; rachis with purplish brown to castaneous color extending from basal part up to 2/3 its length on abaxial side, apical part green or stramineous, with purplish black hairlike scales, adaxially green or stramineous, flat or slightly sulcate, green. Sori usually 2–4 on basal acroscopic segment, on others 1 per segment, often confluent at maturity, basal to submedial on subtending veinlets, close to costa, subelliptic to elongate, ca. 1 mm; indusia grayish green to grayish brown, narrowly elliptic, membranous, repand to entire, opening toward costa or major vein. Spores with lophate (costate-cristate) perispore, average exospore length 31–35 μm. Plants sexual, autotetraploid: 2n = 144.

In crevices of (limestone) rocks in forests; 1100–3300 m. Guangxi, Guizhou, Hebei, Henan, Hunan, Shanxi, Sichuan, Taiwan, Xizang, Yunnan [India, Mongolia, N Myanmar, Nepal, Philippines, Russia (SW Siberia), Thailand, N Vietnam; North America (Mexico, United States)].

Large specimens of *Asplenium exiguum* are similar to well-developed plants of *A. nesii* and can best be distinguished by the presence of gemmae in the apical notch of the pinnae.

*Asplenium exiguum* is an autotetraploid taxon that most probably originated via chromosome doubling in diploid *A. lushanense*. It is a variable species with an easily overlooked, tiny bud in the sinus at the pinna apex, well illustrated in Ching (Icon. Filic. Sin. 4: pl. 174, 2b.

1937). The morphological variability, both within China and throughout the Himalaya, is relatively large, though mainly restricted to size differences. Growing conditions may strongly influence frond length and the shape of pinnae (from almost oblong to triangular). In some populations (S India, China, Philippines), the rachis is flagelliform and terminates in a slender tail with a terminal budlet. This variation led to much confusion and the description of several (local) species, e.g., *A. glenniei*, *A. loherianum*, *A. moupinense*, *A. woodsioides*, and *A. yunnanense*. *Asplenium moupinense* var. *dareiforme* represents a luxurious, well-developed plant that does not differ in any essential character from other members of this group. Since there are no fundamental morphological, nor cytological, differences between these taxa, we treat them as synonyms of tetraploid *A. exiguum* following Hope (Bull. Torrey Bot. Club 26: 58–62. 1899; J. Bombay Nat. Hist. Soc. 13: 657–671. 1901), Ching (Icon. Filic. Sin. 4: pl. 174. 1937), Maxon (Amer. Fern J. 28: 141. 1938), Tagawa (Acta Phytotax. Geobot. 8: 91–100. 1939), Tagawa and Iwatsuki (in Smitinand et al., Fl. Thailand 3(2): 261–291. 1985), and Mickel and Smith (Pterid. Mexico, 94. 2004). The diploid and tetraploid species within this complex can be separated by microcharacters (Viane & Reichstein, Pterid. New Millennium, 91–94. 2003): *Asplenium lushanense* (diploid) with an average exospore length of 24–28 μm and stomata 32–40 μm, and tetraploid *A. exiguum* with average exospore length of 30–36 μm and stomata 43–52 μm. Where both species grow together (China, Nepal, Vietnam), their sterile triploid hybrid, with aborted spores, an intermediate morphology, and often showing hybrid vigor, is common. ***Asplenium ×mickelii*** Viane & Reichstein, **nothosp. nov.** Type: China. Yunnan: Kunming, Xishan, Longman, ca. 2120 m, on steep limestone cliff, under forest, 29 Sep 1986, Z. R. Wang & M. Chu C806-b1 (=TR-6605-b1) (holotype, PE). *Planta hybrida, inter parentes A. exiguum et A. lushanense quoad divisionem laminae atque dimensiones cellularum accessoriarum stomatum intermedia, ab eis sporis abortivis necnon chromosomatium numero triploideo (2n = 108, meiose trivalentibus 0–4, bivalentibus 32–36 et univalentibus 29–36) differt.* This hybrid is named after J. Mickel, who collected it in Mexico (Oaxaca: Destricto Ixtlán, 16 Sep 1972, J. T. Mickel & L. Pardue 6488-A [NY]) and sent us living plants for our research on the *A. exiguum* complex.

From their changing concept of this complex, it is not clear if Fraser-Jenkins, Pangtey and Khullar’s *Asplenium exiguum* nothosubsp. *luyunense* Z. R. Wang ex Fraser-Jenkins, Pangtey & Khullar (Indian Fern J. 27(1–2): 198. 2011), a validation at the subspecific level of “*A. ×luyunense*” (Wang, Acta Bot. Sin. 45: 11. 2003, nom. nud.), also refers to this hybrid.

**61. *Asplenium incisum*** Thunberg, Trans. Linn. Soc. London 2: 342. 1794.

虎尾铁角蕨 hu wei tie jiao jue

*Asplenium elegantulum* Hooker.

Plants 10–30 cm tall. Rhizome short, erect to shortly creeping, occasionally gemmiferous, apex scaly; scales dark brown to black, narrowly triangular, margin fimbriate with short glandular hairs or entire. Fronds caespitose; stipe 4–10 cm, semiterete, basal part abaxially shiny castaneous but upward becoming green, adaxially green and sulcate, with dark brown hairlike scales or subglabrous; lamina lanceolate, 10–27 × 2–4(–5.5) cm, reduced at both ends, apex acute to acuminate, 1- or 2-pinnate; pinnae 12–22 pairs, subopposite to alternate, shortly stalked, lower pinnae gradually reduced, deltoid to semi-orbicular, less than 5 mm, middle pinnae narrowly triangular, 1–2 × 0.6–1.2 cm, apex acute, pinnatifid to 1-pinnate, its upper segments gradually more adnate to costa; pinnules or segments

4–6 pairs, anadromous, alternate, basal acroscopic pair largest, elliptic or ovate, 4–7 × 3–5 mm, base cuneate, free or decurrent on costa, margin serrate, apex obtuse. Costa distinct, veins obscure, anadromously 2-forked or simple, terminal hydathode distinct and not reaching margin. Fronds herbaceous, often dimorphic and sterile fronds small, green, subglabrous; rachis green or stramineous when dry or base shiny castaneous abaxially, subglabrous, adaxially sulcate, apical part with narrow lateral wings. Sori median to submedian on veinlet, linear, ca. 1 mm; indusia grayish, semi-elliptic, membranous, entire to expand, opening toward costa. Plants sexual, diploid:  $2n = 72$ .

On wet rocks in forests or on buildings or walls; sea level to 1900 m. Anhui, Fujian, Gansu, Guangdong, Guizhou, Hebei, Heilongjiang, Henan, Hunan, Jiangsu, Jiangxi, Liaoning, Shaanxi, Shandong, Shanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Japan, Korea, Russia].

*Asplenium incisum* is an ancestral diploid (Kurita, J. Jap. Bot. 35: 269–272. 1960; Rep. (Annual) Foreign Students' Coll. Chiba Univ. 41–56. 1967) that hybridized with *A. ruprechtii* to form a diploid sterile hybrid, which via polyploidy led to the tetraploid *A. castaneoviride* (= *A. kobayashii*).

**62. *Asplenium nesii*** Christ, Nuovo Giorn. Bot. Ital., n.s., 4: 90. 1897.

西北铁角蕨 xi bei tie jiao jue

*Asplenium barkamense* Ching; *A. tianshanense* Ching.

Plants (2–)6–12(–25) cm tall. Rhizome erect, short, apex scaly; scales dark brown to black, narrowly triangular, 2.5–3 mm, entire. Fronds caespitose; stipe 2.5–8(–10) cm, basal part semi-shiny, castaneous or dark brown to black, toward rachis green or stramineous, sparsely covered with small, black, hairlike scales, adaxially sulcate but compressed when dry; lamina lanceolate, 4–6(–16) × 1–2(–5) cm, reduced at base, 2- or 3-pinnatifid; pinnae 7–9(–15) pairs, alternate or subopposite, shortly stalked, middle pinnae largest, elliptic, 5–15(–25) × 3–8(–15) mm, base nearly symmetrical to asymmetrical, truncate to cuneate, 1- or 2-pinnatifid in large plants, apex acute and pinnatifid, without gemma; pinnules or segments 3–5(–7) pairs, alternate, basal acroscopic pinnule largest, oblong to linear, 4–6 × 1–2(–4) mm, apex obtuse, base cuneate, decurrent and adnate to costa, margin serrate-dentate, teeth often long, obtuse to subacute; other pinnules or segments smaller, many adnate to costa. Veins obscure, 2-forked or simple, not reaching margin. Fronds herbaceous to subleathery, gray-green; rachis green or stramineous when dry, rarely brown at base abaxially, adaxially sulcate, with small, dark brown, hairlike scales. Sori 2–4 per pinnule, basal to submedian on subtending vein and thus close to costa or costule, confluent at maturity, linear, 1–1.5 mm; indusia grayish brown to whitish, linear-elliptic, membranous, entire, opening toward costa or costules. Spores with lophate (costate) perispore. Plants tetraploid:  $2n = 144$ .

Crevices of relatively dry rocks; 1000–4000 m. Gansu, Hebei, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, Xinjiang, Xizang, Yunnan [Afghanistan, N India, Nepal, N Pakistan].

*Asplenium nesii* is similar to larger forms of *A. exiguum*, but its pinna apices are without gemmae, the stipe is green toward the rachis, and the rachis itself is usually entirely green. *Asplenium barkamense* is a luxurious form from Sichuan, but locally not rare in Xizang. Type

specimens of *A. ×mainlingense* Ching & S. K. Wu (Fl. Xizang 1: 184. 1983, pro sp.) are hybrids with aborted spores. They probably represent a cross between *A. nesii* and *A. varians* or *A. tenuicaule*, which all occur in the area close to the type locality near Mainling, Xizang.

**63. *Asplenium fontanum*** (Linnaeus) Bernhardt subsp. **pseudofontanum** (Kossinsky) Reichstein & Schneller, Candollea 37: 124. 1982.

西藏铁角蕨 xi zang tie jiao jue

*Asplenium pseudofontanum* Kossinsky, Bot. Mater. Gerb. Glavn. Bot. Sada R.S.F.S.R. 3: 122. 1922.

Plants (5–)13–20 cm tall. Rhizome erect, short, apex scaly; scales dark gray-brown, narrowly ovate-triangular, 3–4 × 0.5–0.6 mm. Fronds caespitose; stipe (1–)4–8 cm, base semi-shiny, castaneous to dark brown for 0.2–2 cm on adaxial side, abaxially often whole stipe brown, green toward apex, base scaly, subglabrous toward rachis; lamina lanceolate, 8–10(–15) × 1–3 cm, widest slightly above middle, gradually tapering to both ends, bipinnate to tripinnatifid at base, apex acute; pinnae 10–20(–30) pairs, subopposite to alternate, stalk 0.2–1 mm, lower pinnae reduced, sessile and more remote, middle pinnae narrowly ovate to triangular, 5–12(–25) × (2–)5–8(–12) mm, pinnatifid to pinnate, apex acute, base broadly cuneate, nearly symmetrical, basal acroscopic pinnule largest, broadly ovate, 2–4(–7) mm, close to or covering rachis, anadromous; pinnules 3–5(–7) pairs, with triangular-ovate lobes, 4–5 × 3–4 mm, base broadly cuneate and decurrent on short stalk, palmate or subpinnatifid, apex obtuse; segments elliptic, ca. 1 mm, teeth mucronate or acute. Veins obvious, raised adaxially, 1 per segment, not reaching margin. Fronds herbaceous, pale green to grayish green when dry, lamina subglabrous, average stomatal guard cell length 30–38 μm; rachis semiterete, green, or occasionally brown at base abaxially, adaxially sulcate. Sori 1–3 per pinnule, median on acroscopic veins, linear to oval, rarely J-shaped, 1–1.5 mm; indusia whitish green or hyaline, semi-elliptic, membranous, entire, opening toward costa or costule. Spores lophate (reticulate), average exospore length 30–35 μm. Plants sexual, diploid:  $2n = 72$ .

On limestone rocks in forests; 1500–2100 m. Xinjiang [N Afghanistan, N India, Kashmir, E Kazakhstan, E Kyrgyzstan, Nepal, N Pakistan, E Tajikistan, Turkmenistan, Uzbekistan; SW Asia (Iran)].

*Asplenium fontanum* consists of two morphologically slightly different but geographically widely separated, diploid subspecies with homologous chromosomes (Reichstein & Schneller, Candollea 37: 117–128. 1982; Gibby, Candollea 37: 235–242. 1982). The typical subspecies, *A. fontanum* subsp. *fontanum*, only grows on limestone rocks in C and S Europe. In Asia, it is replaced by this slightly different subspecies with somewhat wider fronds, deeply incised pinnae, and narrower segments. Its perispore is also slightly different with an outer perispore layer with numerous small holes (fenestrate-reticulate).

**64. *Asplenium capillipes*** Makino, Bot. Mag. (Tokyo) 17: 77. 1903.

线柄铁角蕨 xian bing tie jiao jue

*Asplenium varians* Wallich ex Hooker & Greville var. *sakurarii* Rosenstock.

Plants 3–8(–13) cm tall. Rhizome erect, short, apex scaly;

scales dark brown to black, triangular-ovate, margin shortly fimbriate glandular. Fronds caespitose; stipe green, slender, threadlike, 0.3–2.5(–9) cm, subglabrous, adaxially sulcate; lamina triangular to narrowly triangular, (0.6–)1.5–6 × 0.5–2.5 cm, apex obtuse to subacute, 2-pinnate to almost 3-pinnate; pinnae (3–)5–7 pairs, alternate or basal ones subopposite, stalk slender, threadlike, often at least one stalk with tiny gemma in acroscopic axil, basal pinnae not reduced, broadly ovate to triangular, 4(–12) × 4(–6) mm, pinnate to 2-pinnatifid, upper pinnae trifid to bifid; pinnules 2 or 3(or 4) pairs or 1 pair and a trifid apex, usually bifid, trifid, or simple, basal acroscopic pinnule largest, cordiform or elliptic, 2–3 × 1–2 mm, base cuneate, decurrent on costa, margin entire, apex variable, obtuse or mucronate to acute; pinnae near apex simple or bifid. Veins obscure, anadromously pinnate, simple, 1 per segment or pinnule, with hydathode at end, not reaching margin. Frond herbaceous, green; rachis green, subglabrous, adaxially shallowly sulcate, apex not flagelliform, lamina subglabrous, average guard cell length 45–49  $\mu\text{m}$ . Sori 1 per segment or pinnule, basal to median on subtending vein, subelliptic, 1–2 mm; indusia grayish green, elliptic, membranous, entire, opening toward costa or costule, persistent. Sporangia with 32 spores, perispore lophate (alate), average exospore length 38–42  $\mu\text{m}$ . Plants sexual, diploid:  $2n = 72$ .

Moss cushions on shaded, wet limestone rocks and crevices; 1800–3300 m. ?Gansu, Guizhou, Hunan, ?Shaanxi, Sichuan, Taiwan, Yunnan [Bhutan, India, Japan, Korea, Nepal].

*Asplenium capillipes* is the smallest species of the genus in China and may be overlooked since it often grows hidden among moss. It is reported from Gansu (Tianshui), Hunan, and Shaanxi (Tibia Shan), but we have seen no specimens; however, it should be noted that large plants of this species are similar to small plants of *A. tenuicaule* and may be confused with it. Identification of vouchers from Bhutan (Itô in H. Hara, Fl. E. Himalaya, 486–489, 1966) needs verification since some belong to *A. fugax*, which has a flagelliform apex in contrast to *A. capillipes*. Plants growing in thick moss cushions may have stipes up to 9 cm. *Asplenium capillipes* is diploid with  $n = 36^{\text{II}}$  during meiosis (Mitui, J. Jap. Bot. 45: 84–90, 1970) and  $2n = 72$  chromosomes in vegetative cells. It is remarkable that it has only 32 relatively large spores per sporangium.

**65. *Asplenium fugax*** Christ, Bull. Soc. Bot. France 52(Mém. 1): 53, 1905.

易变铁角蕨 yi bian tie jiao jue

Type: China. Yunnan: shaded rocks in forest of “San-tchaho,” above “Mo-so-yn,” 17 May 1887, *Delavay s.n.*, sheet 1, plant 7 (lectotype, designated here, P!).

Plants 3–8 cm tall. Rhizome erect, short, scaly; scales dark brown to black, narrowly triangular, margins fimbriate. Fronds caespitose; stipe green, thin, threadlike, 0.5–1.5(–2.5) cm, subglabrous, adaxially shallowly sulcate; lamina narrowly triangular to linear, 2–6 × 0.7–1.2 cm, base slightly or not reduced, bipinnate, apex acute or truncate, usually flagelliform with terminal small bud; pinnae 6–13 pairs, alternate or subopposite, shortly stalked and only occasionally with a gemma in upper axil, ovate, 4–6 × 3–4 mm, pinnate; pinnules 1 or 2 pairs, usually simple, elliptic, 2–3 × 1–2 mm, base cuneate, margin entire, apex acute; pinnae near apex less divided. Veins simple, 1 per pinnule or segment, not reaching margin. Fronds thinly

herbaceous, green to grayish green when dry; rachis green, subglabrous, adaxially sulcate. Sori 1 per segment or pinnule, subelliptic, 0.5–1 mm; indusia grayish green, subelliptic, membranous, entire, opening toward costa, persistent. Sporangia with 32 spores, perispore lophate (alate), average exospore length 44–48  $\mu\text{m}$ .

In deep crevices of shaded (limestone) rocks; 2500–3500 m. Guizhou, Sichuan, Yunnan [Bhutan, Nepal].

*Asplenium fugax* is easily overlooked as it is a small species hidden in moss cushions under boulders. Plants are often identified or reported as *A. capillipes* (e.g., Itô in H. Hara, Fl. E. Himalaya, 486–489, 1966; Nakaike, Bull. Natl. Sci. Mus., Tokyo, B, 12: 37–54, 1986), but that taxon never has a flagelliform apex. Christ (Bull. Soc. Bot. France 52(Mém. 1): 1–69, 1905) cited two syntypes: one collection by Delavay and another by Farges, both kept in Paris (P). Delavay's gathering is a mixture mounted on three separate sheets numbered 1, 2, and 3. Most plants fit Christ's description and belong to *A. fugax*, but there is also a *Woodsia* specimen on sheet 2. Plant “7” on sheet 1 (bearing Delavay's original label) is well pressed, the most fertile and best developed, and it is selected here as lectotype. The other syntype (Sichuan [Chongqing], Tchen-kéou-tin, 2000 m, August, *Farges* 657 [P!]) belongs to *A. capillipes*.

**66. *Asplenium tenuifolium*** D. Don, Prodr. Fl. Nepal. 8, 1825.

细裂铁角蕨 xi lie tie jiao jue

*Asplenium tenuissimum* Hayata.

Plants (10–)20–45 cm tall. Rhizome erect, short, apex scaly; scales dark brown, triangular, margin dentate-fimbriate or entire. Fronds caespitose; stipe semiterete, 7–21 cm, abaxially green or castaneous up to middle, with scales or subglabrous, adaxially shallowly sulcate with supravascular ridge; lamina triangular to ovate, 12–30 × 6–13 cm, apex acute, 2- or 3-pinnate or up to 4-pinnatifid; pinnae 10–16 pairs, alternate, stalk short, basal pair almost not reduced, narrowly triangular, 3–8 × 1.6–3 cm, base truncate to cuneate, up to tripinnatifid, apex acute-acuminate; pinnules (4–)6–12(–16) pairs, alternate, anadromous, shortly stalked, usually acroscopic segment larger, ovate, 1.3–2.8 × 1–1.3 cm, up to 2-pinnatifid; secondary pinnules 3 or 4 pairs, 5–8 × 4–6 mm, base cuneate and decurrent on costule, 2–4-partite, apex obtuse; ultimate segments ovate-lanceolate, ca. 1.5 mm wide, with a single vein, apex acute. Costa slender, adaxially sulcate with supravascular ridge to almost flat when dry, terminal hydathode obvious, not reaching margin. Fronds thinly herbaceous, green; rachis green, adaxially shallowly sulcate with median supravascular ridge or flat, adaxial side of costae or costules with small gemma or plantlet. Sori 1 per ultimate segment, median on subtending vein, elliptic, 1.5–2 mm; indusia whitish to grayish green, linear to elliptic, membranous, entire, opening toward margin costule or central veinlet, persistent. Spores with lophate (alate) perispore. Plants sexual, diploid or tetraploid:  $2n = 144$ .

On wet rocks in mixed forests; 800–2900 m. Guangxi, Guizhou, Hainan, Hunan, Sichuan, Taiwan, S Xizang, Yunnan [Bhutan, India, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam].

“*Asplenium concinnum*” (Wallich, Numer. List, no. 216, 1829) belongs here but is a nomen nudum and was not therefore validly published (*Melbourne Code*, Art. 38.1(a)).

*Asplenium tenuifolium* is common in the Himalaya. It is probably an aggregate of diploid plants with  $2n = 72$  chromosomes (reported from India; Bir, Curr. Sci. 29: 445–447. 1960; Caryologia 18: 107–115. 1965) and tetraploids (specimens from Guangxi and Guangdong). More studies are needed. Most plants have small dormant buds (one or more) on the adaxial side of the costa (near the first acroscopic costule or more distal) or on the costules. It is often fertile when still young (var. *minor* S. H. Wu) and can then be confused with *A. capillipes* (gemmae in axil between costa and rachis) or with *A. tenuicaule* (without gemmae). The presence and position of its gemmae are diagnostic. We agree with Tagawa (Acta Phytotax. Geobot. 8: 91–100. 1939) that there are no significant differences between *A. tenuissimum* and *A. tenuifolium*.

**67. *Asplenium dolomiticum*** (Lovis & Reichstein) A. Löve & D. Löve, Preslia 46: 125. 1974.

圆叶铁角蕨 yuán yè tiè jiǎo jué

*Asplenium ruta-muraria* Linnaeus subsp. *dolomiticum* Lovis & Reichstein, Brit. Fern Gaz. 9: 143. 1964; *A. degenense* Ching; *A. suborbiculare* Ching.

Plants 2–10(–15) cm tall. Rhizome erect to shortly creeping, scaly; scales blackish brown, narrowly triangular, occasionally with marginal glands, glands also on apex, subentire. Fronds caespitose; stipe (0.5–)2–5(–6) cm, green or grayish green to stramineous when dry, base castaneous to dark purplish or blackish brown, with numerous short (4-cellular) glandular hairs and hairlike scales, subglabrous toward rachis; lamina deltoid-triangular to ovate, (1–)2–5(–8) × 1–3(–5) cm, apex obtuse to subacute, 2-pinnate or pinnate-pinnatifid; pinnae 1–4 pairs, subopposite or alternate, basal pinnae largest, (4–)8–12 × (4–)8–10 mm, stalked, pinnae triangular, apex obtuse, imparipinnate or ternate with up to 3 lateral segments, segments often similarly divided; ultimate segments broadly flabellate to rhombic-ovate or trapeziform, (3–)4–6 × 2–5 mm, base broadly cuneate and decurrent on costa, margin irregularly dentate, apex obtuse. Veins obscure, flabellately anadromous, and almost parallel. Fronds subleathery, grayish green when dry; rachis and costa green, with (partly) deciduous glandular hairs, subglabrous when old, adaxially sulcate, when dry often flat. Sori 5–12 per pinna, median on subtending vein, confluent at maturity, subelliptic to linear, 1–5 mm; indusia gray-glaucous to brown, linear, thinly membranous, margin with long hairs, opening toward major veins or costa, concealed by sporangia at maturity. Perispore lophate (costate-cristate), average exospore length 35–40 μm. Plants sexual, diploid:  $2n = 72$ .

In rock crevices (often dolomite); 1500–3300 m. Hebei, Sichuan, Xizang, Yunnan [Afghanistan, Mongolia, Russia (E Siberia); SW Asia (Iran, Turkey), S Europe].

Contrary to previous reports, new and more extensive research in S Europe has shown that there are no gross morphological differences between *Asplenium dolomiticum* and *A. ruta-muraria* (see below). *Asplenium degenense* and *A. suborbiculare*, both with an average exospore length of 39–40 μm, are considered juvenile, depauperate forms of *A. dolomiticum*. Small juvenile forms with simple or ternate fronds are not rare in populations of both *A. ruta-muraria* and *A. dolomiticum*.

**68. *Asplenium ruta-muraria*** Linnaeus, Sp. Pl. 2: 1081. 1753.

卵叶铁角蕨 luǎn yè tiè jiǎo jué

*Asplenium ruta-muraria* var. *subtenuifolium* Christ; *A. subtenuifolium* (Christ) Ching & S. H. Wu; *Tarachia ruta-muraria* (Linnaeus) C. Presl.

Plants 2–10(–15) cm tall. Rhizome erect to shortly creeping, scaly; scales blackish brown, narrowly triangular, occasionally with marginal glands, glands also on apex, subentire. Fronds caespitose; stipe (0.5–)2–5(–6) cm, green or grayish green to stramineous when dry, base castaneous to dark purplish or blackish brown, with numerous short (4-cellular) glandular hairs and hairlike scales, subglabrous toward rachis; lamina deltoid-triangular to ovate, (1–)2–5(–8) × 1–3(–5) cm, apex obtuse to subacute, 2-pinnate or pinnate-pinnatifid; pinnae 1–4 pairs, subopposite or alternate, basal pinnae largest, (4–)8–12 × (4–)8–10 mm, stalked, pinnae triangular, apex obtuse, imparipinnate or ternate with up to 3 lateral segments, segments often similarly divided; ultimate segments broadly flabellate to rhombic-ovate or trapeziform, (3–)4–6 × 2–5 mm, base broadly cuneate and decurrent on costa, margin irregularly dentate, apex obtuse. Veins obscure, flabellately anadromous, and almost parallel. Fronds subleathery, grayish green when dry; rachis and costa green, with (partly) deciduous glandular hairs, subglabrous when old, adaxially sulcate, when dry often flat. Sori 5–12 per pinna, median on subtending vein, confluent at maturity, subelliptic to linear, 1–5 mm; indusia gray-glaucous to brown, linear, thinly membranous, margin with long hairs, opening toward major veins or costa, concealed by sporangia at maturity. Perispore lophate (costate-cristate), average exospore length 41–49 μm. Plants sexual, autotetraploid:  $2n = 144$ .

On limestone rocks; 800–3300 m. Gansu, Guizhou, Hunan, Liaoning, Nei Mongol, Shaanxi, Shanxi, Sichuan, Taiwan, Xinjiang, Yunnan [Afghanistan, India, Japan, Kashmir, Kazakhstan, Korea, Kyrgyzstan, Nepal, Pakistan, Russia, Tajikistan; NW Africa, SW Asia, Europe, North America].

*Asplenium ruta-muraria* is an autotetraploid species, very common and widespread in Europe, where it often grows on buildings and walls. It has originated by chromosome doubling in its diploid ancestor *A. dolomiticum* (see above), from which is genetically isolated, and which has smaller spores and half the number of chromosomes. Their triploid sterile hybrid, *A. ×baldense* Sleep et al., is usually found where both species grow together. There is considerable variation in frond shape, and size and degree of dissection, best known and mainly described from Europe (e.g., von Heufler, Verh. Zool.-Bot. Vereins Wien 6: 235–354. 1856; Luerssen in Rabenhorst, Krypt.-Fl., 218–228. 1889; Christ, Farnkr. Schweiz, 75–79. 1900; Hedwigia 42: 153–177. 1903; Rosenstock, Allg. Bot. Z. Syst. 8: 116–120. 1902; Fiori, Fl. Ital. Crypt. 5: 193–209. 1943) and illustrated in Christ (loc. cit. 1903), Ogata (Icon. Fil. Jap. 3: 108. 1930), Khullar (Ill. Fern Fl. W. Himalaya 1: 432–435. 1994), and Wu (FRPS 4(2): 84. 1999). A hexaploid is known from Japan (Reichstein, Bot. Helv. 91: 89–139. 1981).

**69. *Asplenium interjectum*** Christ, Bull. Acad. Int. Géogr. Bot. 11: 241. 1902.

贵阳铁角蕨 guì yáng tiè jiǎo jué

*Asplenium cuneifolium* Viviani var. *vegetius* Christ; *A. interjectum* var. *elatum* Christ; *A. longkaense* Rosenstock.

Plants (10–)20–30 cm tall. Rhizome erect, short, apex scaly; scales black, linear, entire. Fronds caespitose; stipe 12–18 cm, semiterete, abaxially shiny castaneous, often green toward

rachis, subglabrous, adaxially sulcate and with median ridge; lamina broadly triangular to deltoid, 8–17 × 5–7 cm, apex acuminate-caudate, bipinnate to tripinnate at base; pinnae 5–7 pairs, alternate or basal pinnae subopposite, long stalked, basal pair largest, triangular, 4–9 × 3–6 cm, base truncate, nearly symmetrical, 1- or 2-pinnate, apex acute to acuminate-subcaudate; pinnules (1 or) 2 or 3 (or 4) pairs, alternate, anadromous, stalked; basal pinnules largest, ovate-triangular, 1.5–3 × 1–2.6 cm, base cuneate, pinnatisect, apex obtuse to acute; ultimate pinnules 1 or 2 pairs, basal acroscopic segment largest, ovate-oblong, 6–14 × 4–9 mm, base cuneate and decurrent on costule, margins serrate, apex obtuse. Costa and basal part of veins raised adaxially, flat abaxially, veins anadromous-subflabellately branching, terminal hydathode visible, not reaching margin. Fronds herbaceous, green; rachis semiterete, abaxially green or shiny castaneous up to middle, subglabrous, adaxially sulcate with green lateral wings and median supravascular ridge. Sori 2–4 per ultimate segment, median on veinlets, linear, up to 6 mm; indusia gray to brownish, linear, membranous, repand to entire, opening toward costa or costule.

In rock crevices in forests; 700–900 m. Guizhou, Yunnan [N Thailand, N Vietnam].

**70. *Asplenium tenuicaule*** Hayata, Icon. Pl. Formosan. 4: 228. 1914.

细茎铁角蕨 xi jing tie jiao jue

Plants (2.5–)6–15(–25) cm tall. Rhizome erect, short, apex scaly; scales brown to dark brown, triangular to narrowly triangular, 1–3.5 × 0.3–0.7 mm, base fimbriate or entire. Fronds caespitose; stipe (0.7–)1.5–5(–10) cm, green but base castaneous, brown color occasionally extending into rachis, with small dark brown, fimbriate scales and uniseriate hairs, subglabrous when old, adaxially sulcate; lamina triangular to narrowly triangular-ovate, (2–)4–9(–16) × (0.8–)1.2–3(–6.5) cm, base broadly cuneate and slightly reduced, rarely pinnate-pinnatifid, usually bipinnate but occasionally up to 4-pinnatifid, apex acute-acuminate; pinnae (5–)7–10(–15) pairs, alternate or opposite, stalk narrow and up to 3 mm, lower pinnae usually slightly reduced, largest pinnae triangular-ovate, (4–)6–14(–26) × (3–)5–9(–18) mm, rarely up to 45 × 25 mm, base asymmetrical, acroscopic side truncate, basiscopic side cuneate, 1- or 2-pinnate, rarely up to 3-pinnatifid, apex obtuse; pinnules 2–4 pairs (rarely up to 7 pairs), alternate, anadromous, free or adnate, basal acroscopic segment largest and often pinnatifid to almost 2-pinnate in basal part of large fronds, fan-shaped or ovate to triangular-ovate, margin serrate to crenate with acute to mucronate teeth, apex obtuse. Veins obscure, veinlets 1- or 2-forked, not reaching margin. Fronds thinly herbaceous, green to gray-green or brown when dried, rachis green or occasionally with castaneous base (abaxially), adaxially sulcate, subglabrous, lamina with 3- or 4-celled uniseriate gland-tipped hairs, average guard cell length 41–45 μm. Sori 1–3(or 4) per pinnule, median on acroscopic veinlets, occasionally confluent at maturity, oval-linear, (0.8–)1.1–2(–3) mm; indusia whitish to pale brown, oval-linear, membranous, entire to repand, opening toward major veins or toward costa. Spores with lophate or reticulate perispore, average exospore length 28–32 μm. Plants sexual diploid:  $2n = 72$ .

On trees or rocks in forests; 200–3600 m. Chongqing, Gansu, Guizhou, Hebei, Heilongjiang, Henan, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Nei Mongol, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [Bhutan, India, Japan, Korea, Nepal, Pakistan, Philippines, Russia (S Siberia), Thailand; E Africa, Pacific islands (Hawaii)].

*Asplenium tenuicaule* is an ancestral diploid species involved in a reticulate pattern of relationships unraveled in the 1980's–1990's (Sleep & Reichstein, *Candollea* 39: 675–691. 1984; Viane & Reichstein, *Pterid. New Millennium*, 73–105. 2003) by micromorphological studies and cytological research in China (Y. X. Lin, Z. R. Wang), England (A. Sleep), Germany (H. Rasbach), and Switzerland (T. Reichstein, R. Viane). This reticulate evolution, with its inherent general morphological fuzziness, has led to much misunderstanding and confusion. *Asplenium tenuicaule* is parental to the following taxa with which it can easily be confused: *A. kansuense*, *A. varians*, *A. alajense*, *A. anogrammoides*, *A. mae*, and *A. kukkonenii*. The name *A. varians* auct. non Wallich ex Hooker was often used for, or included in, this taxon (e.g., Franchet & Savatier, *Enum. Pl. Jap.* 220–221. 1877; Beddome, *Handb. Ferns Brit. India*, 158. 1883; Hillebrand, *Fl. Hawaiian Isl.* 591. 1888; Hope, *J. Bombay Nat. Hist. Soc.* 13: 657–671. 1901; Mori, *Enum. Pl. Corea*, 4. 1922; Ogata, *Icon. Fil. Jap.* 1: t. 10. 1928; Tardieu, *Asplén. Tonkin*, 45–46. 1932; *Bull. Mus. Natl. Hist. Nat.*, sér. 2, 5: 480–487. 1933; Ohwi, *Fl. Japan*, 140. 1957; 95. 1965; Stewart, *Biologia* 3: 133–164. 1957; Tagawa, *Index Pterid. Jap.* 179. 1959; *Col. Ill. Jap. Pterid.* t. 64–343, 152. 1959; Grubov, *Rast. Tsentral. Azii* 1: 81. 1963; Stewart in Nasir & Ali, *Fl. W. Pakistan*, 18. 1972; Iwatsuki, *Acta Phytotax. Geobot.* 25: 69–78. 1972; in Ohashi, *Fl. E. Himalaya*, 3rd report, 195. 1975; Mitui, *Bull. Nippon Dental Coll.*, *Gen. Educ.* 4: 221–271. 1975; Nakaike, *Enum. Pterid. Jap.* 111. 1975; De Vol & Kuo in Li et al., *Fl. Taiwan* 1: 490. 1975; Kurata & Nakaike, *Illustr. Pterid. Japan* 2: 226–227. 1981; Ling et al. in Liu et al., *Fl. Taiyuan*. 41. 1990; in Liu, *Fl. Shanxi*. 1: 91. 1992; Nakaike & Malik, *Cryptog. Fl. Pakistan* 1: 270. 1992; *Cryptog. Fl. Pakistan* 2: 332. 1993). During sporogenesis, plants of this species may produce relatively high numbers of diplospores (a spore containing a double set of chromosomes), which may have played a role in the production of polyploid offspring, e.g., *Asplenium kansuense*, *A. mae* (see below).

In places where *Asplenium tenuicaule* and *A. varians* grow together, their sterile hybrid is not uncommon.

This is a widespread and variable species ranging from the E African highlands (rare) via the Himalaya to S (Altai) and SE Siberia, Korea, China, Japan, and Hawaii. It can be divided into three varieties, with overlapping ranges in China and Japan. Few but fertile intermediates have been found. Hybridization experiments have shown that the varieties are genetically very similar (Viane & Reichstein, *Pterid. New Millennium*, 73–105. 2003). Kuo (*Taiwania* 30: 5–100. 1985) was probably the first to apply the name correctly.

- 1a. Perispore lophate and middle perispore layer reduced or absent between folds ..... 70b. var. *subvariens*
- 1b. Perispore reticulate, or if lophate then middle perispore layer present between folds of outer perispore.
  - 2a. Pinnae with marginal teeth rounded to mucronate, outer perispore a perforated reticulum without distinct ridges ..... 70a. var. *tenuicaule*
  - 2b. Pinnae with marginal teeth acute, outer perispore lophate with rounded ridges (costate-cristate) ..... 70c. var. *argutum*

**70a. *Asplenium tenuicaule* var. *tenuicaule***

细茎铁角蕨(原变种) xi jing tie jiao jue (yuan bian zhong)

*Asplenium borealichinense* Ching & S. H. Wu; *A. hebeiense* Ching & S. H. Wu.

Marginal teeth of pinnae obtuse to (sub)mucronate. Spores with a typical reticulate perispore, consisting of a thin basal endoperispore surrounding smooth exospore, an extensive middle perispore of rodlets (collumellae) subtending outer perispore network of wide pori (1–3 µm) but only faint or no crests.

On trees or rocks in forests; 200–2900 m. Hebei, Shaanxi, Shanxi, Sichuan, Taiwan, Xizang, Yunnan [Japan, Korea, Thailand; E Africa, Pacific islands (Hawaii)].

See spore illustrations in Y. L. Zhang et al. (Sporae Pterid. Sin. t. 77 b–c, t. 81 c–d; Pl. 51: 19–20; Pl. 52: 17–20. 1976).

The following names belong here but were not validly published because no Latin description or diagnosis, or reference to such, was provided (*Melbourne Code*, Art. 39.1): “*Asplenium hopehense*” (Ching in Y. L. Zhang et al., Sporae Pterid. Sin. 249. 1976), “*A. miyunense*” (Ching, Fl. Beijing, rev. ed., 1: 30. 1984), and “*A. pseudovarians*” (Ching, Fl. Beijing 1: 82. 1962).

**70b. *Asplenium tenuicaule* var. *subvarians* (Ching) Viane, Pterid. New Millennium, 100. 2003.**

钝齿铁角蕨 dun chi tie jiao jue

*Asplenium subvarians* Ching in C. Christensen, Index Filic., Suppl. 3: 38. 1934, based on *Gymnogramma fauriei* Christ, Bull. Herb. Boissier, sér. 2, 2: 561. 1902, not *A. fauriei* Christ (1899); *Anogramma fauriei* Christ; *Asplenium chengkouense* Ching ex H. S. Kung; *A. conmixtum* Ching [“*conmixtum*”]; *A. siobarensense* Koidzumi, nom. illeg. superfl.; *A. tianmushanense* Ching.

Marginal teeth of pinnae mucronate to acute. Spores with lophate (crystate) perispore, middle perispore lacking in areoles between outer perispore folds, with few narrow (less than 1 µm) pori (see illustration of pattern in, e.g., Y. L. Zhang et al., Sporae Pterid. Sin. (1976) or Spore Morphol. Chin. Pteridophytes (1990): Pl. 51: 22–23; t. 77 j–l).

On rocks in forests; 600–3100 m. Chongqing, Gansu, Guizhou, Hebei, Heilongjiang, Henan, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Nei Mongol, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Xizang, Yunnan, Zhejiang [Bhutan, India, Japan, Korea, Nepal, Pakistan, Philippines, Russia (S Siberia)].

*Asplenium tenuicaule* var. *subvarians* was often mentioned under *A. anogrammoides* auct. non Christ (e.g., in Komarov, Izv. Imp. S.-Peterburgsk. Bot. Sada 16: 145–151. 1916; Komarov & Klobukova-Alisova, Oprod. Rast. Dal’nevost. Kraia 1: 82. 1931; Fomin, Fl. Sibir. Orient. Extremi 5: 152–154. 1930; in Komarov & Iljin, Fl. URSS 1: 66. 1934; Ching, Fl. Pl. Herb. Chin. Bor.-Or. 1: 37. 1958), a mistake caused by Christensen’s interpretation of *A. anogrammoides* based on wrong type material (BM!). Small specimens of this taxon can be similar to *A. capillipes*, but that species usually has a small bud on the stalk of one of its basal pinnae and also has larger spores with an alate perispore. A narrow form of *A. tenuicaule* var. *subvarians* grows in the Altai mountains and is often misidentified either as *A. anogrammoides* auct. non Christ, or as *A. altajense* auct. non Grubov. A luxurious form was des-

cribed as *A. chengkouense*. In the W Himalaya, plants tend to have less mucronate, but more slender and sharper teeth. Due to confusion with similar taxa, the distribution of this taxon is not well known.

**70c. *Asplenium tenuicaule* var. *argutum* Viane, nom. nov.**

尖齿铁角蕨 jian chi tie jiao jue

Replaced synonym: *Asplenium argutum* Ching, Acta Phytotax. Sin. 23: 9. 1985, not *A. argutum* Kaulfuss, Enum. Filic. 176. 1824.

Pinnae with acute marginal teeth. Spores with lophate perispore with rounded crests (costate to costate-cristate) and very few pori (less than 1 µm in diam.), middle perispore present in areoles between outer perispore folds.

- On rocks in forests; 2600–3600 m. Sichuan.

All specimens of *Asplenium tenuicaule* var. *argutum* come from relatively high elevations in C Sichuan. They have slightly longer stipes and relatively long marginal teeth; perispore characters are constant. Due to confusion with similar taxa, the distribution of this taxon is not well known.

**71. *Asplenium semivarians* Viane & Reichstein, Pterid. New Millennium, 78. 2003.**

近变异铁角蕨 jin bian yi tie jiao jue

Rhizome erect, short, scaly; scales brown to dark brown, 2–4(–5) × ca. 0.5 mm. Fronds caespitose, (5–)10–25(–30) × (1–)3(–7) cm; stipe semiterete, (1.2–)2–5(–8) cm, adaxially green and sulcate, abaxially entirely green (small fronds) or dark brown for 1/4–3/4 of its length (in large fronds into lower part of rachis), with scales similar to those on rhizome; lamina ovate, apex acute-acuminate, 2- or 3-pinnate at base; pinnae (6–)10(–14), subopposite to alternate, with stalks 1–2 mm, triangular to ovate, 2–4(–5) cm, lowest usually reduced, base asymmetrical, acroscopically truncate, basiscopic side cuneate, apex obtuse to acute; segments 2–4 pairs, alternate, anadromous, basal acroscopic segment largest and free, others usually adnate to costa, broadly ovate to orbicular. Fronds herbaceous, green; rachis green, sulcate adaxially, abaxially often shiny castaneous at base but green toward apex; lamina with 3- or 4-celled uniseriate gland-tipped hairs, average guard cell length 37–40 µm. Sori several on each pinna, medial on subtending vein, often confluent at maturity, oval-linear, 1.5–3 mm; indusia membranous, repand to entire, opening toward costule or to costa. Spores with lophate (cristate-alate) perispore, average exospore length 24–27 µm. Plants diploid sexual: 2n = 72.

On rocks or trees in forests; 1200–2500 m. Yunnan [India, Philippines, Sri Lanka; mountains of tropical Africa].

The range of *Asplenium semivarians* is not well known due to confusion with similar species of the *A. varians* complex. It may also occur in Malaysia (Johore), but the single specimen, cited by Morton under *A. varians*, needs further study. Experimental hybridization and micromorphology have shown (Viane & Reichstein, Pterid. New Millennium, 73–105. 2003) that it is different from diploid *A. tenuicaule* and that it is an ancestor of true *A. varians*. *Asplenium semivarians* is known from S India as diploid *A. varians* (e.g., Manickam & Irudayaraj, Cytol. Ferns W. Ghats, 38, 71. 1988; Pterid. Fl. Nilgiris, 130–131. 2003) or as diploid *A. laciniatum* (Bir & Irudayaraj, Fern Gaz. 16: 186–187. 2001). Luxurious plants become almost tripinnate. This

species can be distinguished from similar taxa by its diploid chromosome number, its alate perispore with the middle perispore lacking in the areoles (zones between the ridges), and the smaller exospore and guard cells.

**72. *Asplenium aitchisonii*** Fraser-Jenkins & Reichstein, *Candollea* 37: 341. 1982.

西部铁角蕨 xi bu tie jiao jue

*Asplenium atuntzeense* Viane & Reichstein; *A. daghestanicum* Christ subsp. *aitchisonii* (Fraser-Jenkins & Reichstein) Fraser-Jenkins; *A. minutum* Chang Y. Yang (1993), not Willdenow ex Klotsch (1847); *A. subdigitatum* Ching (1985), not Mettenius ex Kuhn (1868); *A. xinjiangense* Ching.

Plants 8–18 cm tall. Rhizome short, erect to ascending, apex scaly; scales dark brown, ovate-triangular, 2–4 mm, often with marginal fimbriae. Fronds caespitose, bright to dark green, (2–)7–11(–15) cm; stipe usually as long as (up to 1/3 of) lamina, 2–6 cm, semiterete, base dark brown for 2–15 mm but green toward rachis, with narrow scales and uniseriate hairs, subglabrous when old; lamina narrowly triangular to ovate, base widest, (2–)3–6 × (0.5–)1–2(–3) cm, bipinnate at base, apex acute; pinnae 5–10 pairs, subopposite or alternate, basal pinnae with short stalks 0.5–2(–3) mm, upper pinnae sessile, basal pinnae usually largest, triangular to deltoid, 3–12(–18) × 3–10(–15) mm, apex obtuse, lowest pinnae 0.5–2 cm apart, each usually with 2 pinnules and broad, deeply pinnatifid apex, upper pinnae smaller, less divided and entire near apex; ultimate segments with cuneiform base and obtuse apex, margin dentate, with 3–5(–7) spreading teeth. Costa obvious but veins obscure, veins anadromously branching. Frond herbaceous, green to brown-green when dried, rachis semiterete, green, with narrow scales and uniseriate hairs; average guard cell length 56–61 μm. Sori submedian to median on subtending vein, confluent when mature, 2–3 mm; indusia membranous, repand to entire, opening toward costule or toward costa. Spores with lophate (costate to cristate) perispore, average exospore length 38–42 μm. Sexual hexaploid species:  $2n = 216$ .

On half-shaded, non-calcareous rocks; 1700–4200 m. S Gansu, Sichuan, Xinjiang, Xizang, Yunnan [Bhutan, N India, Nepal, Pakistan].

*Asplenium aitchisonii* is similar to other members of the *A. varians* complex (i.e., *A. altajense*, *A. kukkonenii*, *A. semivarians*, *A. tenuicaule*, *A. varians*) and was often included in *A. varians*, e.g., by Beddome (*Handb. Ferns Brit. India*, 158. 1883), Hope (*J. Bombay Nat. Hist. Soc.* 13: 667. 1901), Stewart (*Biologia* 3: 133–164. 1957), and Stewart in Nasir and Ali (*Fl. W. Pakistan*, 18. 1972); however, it is usually widest at the base and has longer stomata and spores due to its higher number of chromosomes. This is an allohexaploid (not an octoploid as stated in the original description). *Asplenium daghestanicum* Christ, a tetraploid from the Caucasus and Libya (Tibesti), is genetically isolated from this species and thus better kept as a separate species. Plants from isolated populations, growing in sheltered conditions in regions with an extreme climate, are often less developed and have been described as separate species (i.e., *A. xinjiangense*, *A. subdigitatum*, *A. minutum*).

**73. *Asplenium neovarians*** Ching, *Acta Phytotax. Sin.* 23: 7. 1985.

朗木铁角蕨 lang mu tie jiao jue

Plants 5–8 cm tall. Rhizome erect, short, apex scaly; scales dark brown, narrowly triangular, subentire to denticulate. Fronds caespitose; stipe 1.5–3.5 cm, slender, adaxially sulcate, base dark brown and with scales, upward green, with fibrillar scales; lamina narrowly triangular, 4–5 × 1.4–1.8 cm, base slightly reduced, apex acute-acuminate with triangular apical segment ca. 12 × 6 mm, 2-pinnate at base; pinnae 5 or 6 pairs, opposite to subopposite, shortly stalked, basal pinnae slightly reduced, middle pinnae trapeziform-elliptic, 6–9 × 4–9 mm, base nearly symmetrical, truncate to cuneate, 1-pinnate at base or simple, apex obtuse; basal pinnae with up to 2 pinnule pairs, basal acroscopic pinnules largest and free, 3–4 × 2–2.5 mm, base broadly cuneate, apex serrate with long and sharp teeth, apex obtuse. Veins slightly raised adaxially, 2-forked or simple, not reaching margin. Fronds firmly herbaceous, green, brown-green when dry; rachis green, adaxially sulcate, lamina subglabrous, average guard cell length 45–52 μm. Sori 1–3 per segment, median on subtending vein, confluent at maturity, linear, 2–3 mm; indusia white-gray, semi-elliptic, membranous, entire, opening toward costa or costule, persistent. Spores with lophate (costate) perispore, average exospore length 33–36 μm.

• *Juniperus* forests; 3300–3600 m. S Gansu, NW Sichuan.

*Asplenium neovarians*, known from few collections, needs more study. Based on the length of its stomata and exospore, it should at least be tetraploid. It is similar to *A. altajense* (but different in its more distinct apical pinna), *A. aitchisonii* (but different in its putative ploidy level), and *A. kukkonenii*, and from all of which it differs in perispore morphology.

**74. *Asplenium mae*** Viane & Reichstein, **sp. nov.**

内蒙铁角蕨 nei meng tie jiao jue

Type: China. Nei Mongol: Hulunbuir, Balin, Beishan, in rock crevices, 460 m, 2 Aug 1983, *Y.-Q. Ma et al.* 83-7 (holotype, HMC).

*Planta morphologia* *Asplenio tenuicaulis*. *Rhizoma breve adscendens vel erectum, squamis 1.5–2 mm longis et ca. 0.5 mm latis. Folia caespitosa, maturitate (4–)6–15(–20) cm longa, basi 1–3 cm lata; petiolus lamina 2-plo brevior, pro parte abaxiali basali 1/4 ad 3/4 fuscus, basi squamis eis rhizomatis similibus vestitus; lamina papyracea, anguste triangulari-ovata, basi bipinnata, paribus pinnarum suboppositarum vel alternarum 5 ad 10; jugum primum vel secundum maximum, pinnis (5–)8–12(–20) mm longis, triangularis-ovatis inaequilateris acroscopice truncatis, basiscopice cuneatis, apice obtusis, petiolulis usque ad 1 mm longis, stomatibus 49–53 μm longibus. Sori 0.8–2.5 mm longi, maturitate confluentes. Sporae exosporium 34–39 μm longum, perisporium costatum.*

Plants (4–)6–15(–20) cm tall. Rhizome erect, short, apex scaly; scales brown to dark brown, triangular to narrowly triangular, 1.5–2 × 0.4–0.5 mm, base hastate-cordate, margin glandular, fimbriate or entire. Fronds caespitose; stipe green but base castaneous, brown color occasionally extending into rachis, (1–)1.5–5.5(–7) cm, with small dark brown, fimbriate scales and uniseriate hairs, subglabrous when old, adaxially sulcate; lamina triangular to narrowly triangular-ovate, (2.5–)3.5–6.5(–9) × 1–3 cm, base truncate to broadly cuneate, pinnate-

pinnatifid to bipinnate, apex acute-acuminate; pinnae 5–10 pairs, subopposite to alternate, stalk up to ca. 1 mm, basal or first suprabasal pinnae pair largest, triangular-ovate, (5–)8–12 (–20) × (3–)5–7(–8) mm, base asymmetrical, acroscopic side truncate, basiscopic side cuneate, pinnate, rarely 2-pinnatifid, apex obtuse; pinnules 2 or 3 pairs, anadromous, basal pinnules free or adnate to costa, margin serrate with acute to mucronate teeth, apex obtuse. Veins obscure, veinlets 1- or 2-forked, not reaching margin. Fronds thinly herbaceous, green to gray-green or brown when dried, rachis green, only rarely with castaneous base (abaxially), adaxially sulcate, subglabrous, lamina with 3- or 4-celled uniseriate gland-tipped hairs, average guard cell length 49–53  $\mu\text{m}$ . Sori 1–3 per pinnule, median on acroscopic veinlets, occasionally confluent at maturity, oval-linear, 0.8–2.5 mm; indusia whitish to pale brown, oval-linear, membranous, entire to repand, opening toward costule or costa. Spores with lophate (costate-cristate) perispore, average exospore length 34–39  $\mu\text{m}$ .

- Rock crevices; 400–1800 m. Liaoning, Nei Mongol (Da Xing'an Ling), Shanxi.

This species is named after Professor Yu-Quan Ma, principal editor of *Flora Intramongolica*.

*Asplenium mae* is mainly known from the Da Xing'an Ling. It is a putative autotetraploid which probably originated via chromosome doubling in *A. tenuicaule* var. *subvarians*, which it strongly resembles. Average spore size indicates that it is probably tetraploid, but no chromosome counts are yet available. In herbaria, *A. mae* is either filed under *A. tenuicaule*, *A. subvarians*, *A. anogrammoides*, or *A. sarelii*.

Several names have been misapplied to this species, e.g., *Asplenium subvarians* by Ling et al. (in Liu, Fl. Shanxi. 1: 84–97. 1992), *A. tenuicaule* by Wu and Bai (Fl. Intramongol. 1: 49–117. 1985), and *A. sarelii* by Li and Wang (Fl. Liaoning 1: 73–79. 1988).

**75. *Asplenium kukkonenii*** Viane & Reichstein, Pterid. New Millennium, 81. 2003.

新疆铁角蕨 xi jiang tie jiao jue

Plants (3.5–)6–15(–25) cm tall. Rhizome erect, short, apex scaly; scales brown to dark brown, triangular to narrowly triangular, (2–)2.2–3.5(–4.5) × 0.4–0.7 mm, fimbriate or entire. Fronds caespitose; stipe green (small fronds) but base dark brown, color occasionally extending into rachis, (1–)2–6(–9) cm, with small dark brown, often linear scales and uniseriate hairs, subglabrous when old, adaxially sulcate; lamina narrowly oblong to ovate, (2.3–)5–10(–20) × (0.7–)1–2.5(–4) cm, base truncate-cuneate, bipinnate at base, pinnate-pinnatisect(-pinnatifid) in upper part, apex acute-acuminate to caudate; pinnae 7–13 pairs, alternate or opposite, stalk ca. 1 mm, lower pinnae slightly reduced, lowest pair 0.8–1.8 cm from next pair, more distal pinnae closer but usually not overlapping, median and upper pinnae often at an angle of 45°–75° to rachis, largest pinnae triangular-ovate, 10–20 × 5–10(–12) mm, base asymmetrical, acroscopic side truncate, basiscopic side cuneate, basal acroscopic pinnule largest, often shortly (ca. 0.5 mm) stipitate and nearly parallel to rachis, fan-shaped or ovate to triangular-ovate, margin serrate to crenate with acute to mucronate teeth, apex obtuse; basiscopic pinnules often adnate and directed outward, almost perpendicular to rachis. Fronds herba-

ceous, green to gray-green or brown when dried, rachis green or occasionally with castaneous base (abaxially), adaxially sulcate, with small, dark brown, linear scales, lamina with 3- or 4-celled uniseriate gland-tipped hairs, epidermis cells with sinuous pseudomamillate anticlinal walls, average guard cell length 45–50  $\mu\text{m}$ . Sori 1–3(or 4) per pinnule, median on acroscopic veinlets, often confluent at maturity, oval-linear, 1.4–2.4(–3) mm; indusia whitish to pale brown, oval-linear, membranous, entire to repand, opening toward major veins or costa. Spores with lophate (costate-cristate) perispore, average exospore length 32–36  $\mu\text{m}$ . Plants sexual, allotetraploid:  $2n = 144$ .

On rocks in forests; 2100–3300 m. Xizang, Yunnan [India, Nepal, Pakistan].

*Asplenium kukkonenii* is most similar to *A. tenuicaule* and *A. varians*. Crossing experiments and micromorphology have shown that *A. tenuicaule* is one of its ancestors (Viane & Reichstein, Pterid. New Millennium, 73–105. 2003). The second ancestor of *A. kukkonenii* is still unknown. The fact that *A. kukkonenii* and *A. varians* share a genome explains why these taxa are difficult to differentiate from each other. The lamina of *A. kukkonenii* is usually slightly narrower and more acuminate (occasionally even caudate) at the apex. The mean length of the rhizome scales is usually less than 3.5 mm in *A. kukkonenii* and more than 3.5 mm in *A. varians*. Reliable differentiation is also possible by examination of epidermal cells, which are thickened or pseudomamillate in their sinuses in *A. kukkonenii*, but not so in *A. varians*. In herbaria, *A. kukkonenii* is often identified as *A. varians* or as *A. fontanum* and was included in *A. varians* by, e.g., Beddome (Handb. Ferns Brit. India, 158. 1883), Hope (J. Bombay Nat. Hist. Soc. 13: 667. 1901), Stewart (Biologia 3: 133–164. 1957), Stewart in Nasir & Ali (Fl. W. Pakistan, 18. 1972), Nakaïke and Malik (Cryptog. Fl. Pakistan) 1: 270. 1992; Cryptog. Fl. Pakistan 2: 332. 1993), and G. F. Zhang (Fl. Yunnan. 20: 673. 2006).

**76. *Asplenium kansuense*** Ching, Fl. Tsinling. 2: 220. 1974.

甘肃铁角蕨 gan su tie jiao jue

*Asplenium fimbriatum* Kunze var. *leptophyllum* Zenker ex Kunze; *A. propinquum* Ching; *A. sarelii* Hooker [“*saulii*”] var. *latius* Christ, p.p.

Plants 5–15(–25) cm tall. Rhizome erect, short, apex scaly; scales dark brown, narrowly triangular, 2–3.5 mm, fimbriate at base or entire. Fronds caespitose; stipe semiterete, 2–8(–10) cm, adaxially green and sulcate, abaxially shiny castaneous, brown color occasionally extending into rachis, with small dark brown, fimbriate scales and uniseriate hairs, subglabrous when old; lamina triangular-ovate, (2–)5–12(–15) × 1–3(–6) cm, apex acute-acuminate, 2- or 3-pinnate; pinnae 8–12 pairs, alternate or basal ones opposite, stalks 1–2 mm, lower pinnae usually somewhat reduced, middle pinnae triangular-ovate, 8–17(–25) × 7–12 mm, base asymmetrical, acroscopically truncate, basiscopic side cuneate, 1- or 2-pinnate, apex obtuse; pinnules 2–4 pairs, alternate, anadromous, basal acroscopic pinnule largest and most divided, broadly ovate, 6–8 × 4–6 mm, base broadly cuneate, shortly stalked, pinnatifid or pinnate, apex obtuse; other pinnules oval to cuneiform, 3 or 4 pairs, reduced toward pinna apex, apical margin serrate and with long, sharp teeth. Costa obvious but veins obscure, veins anadromously branching, often with terminal submarginal hydathode. Fronds thinly herbaceous, when dry grass-green; rachis same color as stipe and sulcate adaxially, abaxially often shiny castaneous at

base, becoming green toward apex; lamina with 3- or 4-celled uniseriate gland-tipped hairs, average guard cell length 46–52  $\mu\text{m}$ . Sori 1–3 per pinnule, submedian to median on subtending vein, shortly linear, 1–3 mm; indusia membranous, repand to entire, opening toward costule or costa. Spores with reticulate perispore, average exospore length 33–37  $\mu\text{m}$ .

On rocks in forests; 1100–2000 m. Hebei, Hubei, Shaanxi, Shanxi, Sichuan, Yunnan [S India].

*Asplenium kansuense* is a putative autotetraploid, which probably originated via chromosome doubling in *A. tenuicaule* var. *tenuicaule*. Its general morphology and perispore are very similar to those of that taxon, but its spore size indicates that it is probably tetraploid. No chromosome counts are available. In China, *A. kansuense* was often misidentified as *A. varians* or as *A. sarelii* s.l. Large tripinnate plants resemble tetraploid *A. anogrammoides* with which they share half of their genome.

The S Indian (Nilgiri) plants belonging to this species (*Asplenium fimbriatum* var. *leptophyllum*) occur at higher elevations, are smaller than the Chinese plants, and are similar to both *A. varians* and *A. semivarians*. Several chromosome reports of S Indian “tetraploid *Asplenium varians*” may refer to this species. Large specimens of African *A. fimbriatum* Kunze are closely similar, also in perispore characters. Hybridization experiments have shown that true *A. fimbriatum* is an allotetraploid with the same genome composition as *A. varians* and is thus best considered a variety of the latter (Viane & Reichstein, Pterid. New Millennium, 73–105. 2003): **Asplenium varians** Wallich ex Hooker & Greville var. **fimbriatum** (Kunze) Viane **stat. nov.** (Basionym: *Asplenium fimbriatum* Kunze, Linnaea 18: 117. 1844; *A. varians* subsp. *fimbriatum* (Kunze) Schelpe).

**77. *Asplenium varians*** Wallich ex Hooker & Greville, Icon. Filic. 2: t. 172. 1830.

变异铁角蕨 bian yi tie jiao jue

*Asplenium lankongense* Ching; *A. paucijugum* Ching (1985), not F. Ballard (1935).

Plants (4–)8–20(–35) cm tall. Rhizome erect, short, apex scaly; scales dark brown to black, narrowly triangular, (1.5–)3–4.2(–5)  $\times$  0.5–1 mm, fimbriate at base or subtire. Fronds caespitose; stipe semiterete, (0.5–)2–7(–12) cm, adaxially green and sulcate, abaxially shiny castaneous, brown color occasionally extending to rachis, with small dark brown, very narrow scales and uniseriate hairs, subglabrous when old; lamina triangular-ovate, (3–)6–13(–25)  $\times$  (1–)2–4(–8) cm, base slightly reduced, bipinnate, apex acute-acuminate; pinnae (5–)8–12(–18) pairs, lower pinnae (sub)opposite, upper alternate, stalk ca. 1 mm, largest pinnae triangular-ovate, 8–17(–30)  $\times$  (3–)6–10(–15) mm, base asymmetrical, acroscopically semicordate-truncate, basispic side cuneate, 1-pinnate, apex obtuse; pinnules 2 or 3 pairs, alternate, anadromous, basal acroscopic pinnule largest, fan-shaped to orbicular-obovate, 3.5–5.5  $\times$  2.5–4(–6) mm, base cuneate, sessile to almost free, lateral side entire, apex serrate and obtuse; other segments smaller, usually adnate to costa. Veins not obvious, slightly raised adaxially when dry, anadromously forking, not reaching margin. Frond herbaceous, green or grayish green when dry; lamina with 3- or 4-celled uniseriate gland-tipped hairs, average guard cell length 46–52  $\mu\text{m}$ ; rachis semiterete, grayish green and sulcate adaxially, occasionally brown at base abaxially, subglabrous. Sori 2–4 per pinnule, sub-

median to median on subtending vein, often confluent at maturity, oval to linear, (1–)1.5–3(–4.5) mm; indusia gray, linear, membranous, repand to entire, opening toward costule or costa, persistent. Spores with cristate-alate perispore, average exospore length 31–35  $\mu\text{m}$ . Plants sexual allotetraploid:  $2n = 144$ .

On wet rocks or cliffs in forests, or on buildings and walls; 500–4200 m. Chongqing, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Shaanxi, Sichuan, Xizang, Yunnan [Bhutan, India, Nepal, Vietnam; S Africa].

Sleep and Reichstein (Candollea 39: 675–691. 1984), following Morton (Contr. U.S. Natl. Herb. 38: 215–281. 1973), discussed the problem of the application of the name *Asplenium laciniatum* D. Don (Prodr. Fl. Nepal. 8. 1825). That name applies to a taxon closely related to *A. varians*, but its type is merely a depauperate single frond with a few spores and is not adequate for the precise application of the name. Moore (Index Fil. 139. 1857) and Hooker (Sp. Fil. 3: 164–165. 1860) misapplied the name *A. laciniatum* to another Himalayan fern species not related to *A. varians*, i.e., *A. gueinzianum*. Most later authors then followed that misapplied concept of *A. laciniatum*. Viane and Reichstein (Taxon 35: 605–606. 1986) formally proposed *A. laciniatum* for rejection, but their proposal was rejected by the Nomenclature Committee for Pteridophyta (Pichi Sermolli, Taxon 36: 740–741. 1987).

*Asplenium varians* is variable, very similar to, and often confused with its ancestors, *A. semivarians* and *A. tenuicaule* (see above). Its relationships were discovered using hybridization experiments, chromosome counts, and micromorphology (Sleep & Reichstein, loc. cit.; Viane & Reichstein, Pterid. New Millennium, 73–105. 2003), showing it is an allotetraploid species that arose by chromosome doubling in the diploid hybrid between *A. tenuicaule* (*A. tenuicaule* var. *subvariens* in *A. varians* var. *variens*, and *A. tenuicaule* var. *tenuicaule* in the African *A. varians* var. *fimbriatum*) and *A. semivarians*. Two varieties are distinguished: *A. varians* var. *variens*, occurring in the Himalaya from N India into China (not in Japan), and var. *fimbriatum*, which is mainly found in S Africa (though its occurrence in S India needs further study). *Asplenium paucijugum* Ching is similar to *A. semivarians* but has larger spores and stomata. Further study is needed to show if this and related forms are autotetraploids of *A. semivarians*.

In places where *Asplenium tenuicaule* and *A. varians* grow together, their sterile hybrid is not uncommon.

In an outdated understanding of this complex, Fraser-Jenkins et al. (Indian Fern J. 27(1–2): 188. 2011) confusingly combined ancestral diploid and derived allotetraploid species and hybrids under a single amalgamate called *Asplenium laciniatum*, apparently ignoring hybridization experiments and cytological studies.

**78. *Asplenium altajense*** (Komarov) Grubov, Bot. Mater. Gerb. Bot. Inst. Komarov Akad. Nauk S.S.S.R. 20: 33. 1960.

阿尔泰铁角蕨 a er tai tie jiao jue

*Asplenium sarelii* Hooker [“*saulii*”] f. *altajense* Komarov, Izv. Imp. Bot. Sada Petra Velikago 16: 150. 1916; *A. chingianum* Chang Y. Yang.

Plants 5–15 cm tall. Rhizome erect, short, apex scaly; scales dark brown to black, narrowly triangular, 2–3.5  $\times$  0.3–0.5 mm, entire. Fronds caespitose; stipe 2.5–3.5(–6) cm, base scaly and brown abaxially, green upward, adaxially green, sulcate, subglabrous; lamina 2-pinnatifid to 2-pinnate, narrowly triangular-ovate, 8–9  $\times$  2–2.5 cm, base slightly reduced, apex acute; pinnae (5–)10–15 pairs, lower pinnae subopposite, often del-

toid-flabellate or almost orbicular, upper alternate and gradually fused into 0.5–1 cm pinnatifid apex, second to fourth pair usually largest, stalk up to 1 mm and adaxially sulcate with raised supravascular ridge, middle pinnae triangular-ovate, ca. 11 × 8–10 mm, base asymmetrical, acroscopic side truncate, basiscopic side cuneate, 1-pinnate, apex obtuse; pinnules 2 or 3 pairs, anadromous, basal acroscopic pinnule free, largest, subovate, 4–5 × 2–4 mm, base cuneate, other pinnules adnate to costa and confluent into pinna apex, margins dentate-serrate, apex obtuse. Veins obscure, flabellately anadromous, slightly raised adaxially. Fronds papery, green to grayish green when dry, lamina subglabrous, average stomatal guard cell length 44–48 μm; rachis semiterete, green, adaxially sulcate and with raised supravascular ridge. Sori 2–4 per pinnule, basal to medial on pinnae, at maturity confluent, linear-elliptic, 1–2.5 mm; indusia grayish green, linear-elliptic, membranous, entire, opening toward costa or costules. Spores with lophate (crustate) perispore, average exospore length 32–34 μm. Plants sexual, allotetraploid:  $2n = 144$ .

In crevices of shaded rocks; 400–1500 m. Nei Mongol, Ningxia, Sichuan, Xinjiang [Mongolia, Russia (Altai, S Siberia)].

*Asplenium altajense* is relatively common in the area bordering China, the Altai Mountains, Mongolia, and Russia, but future research will have to show if the area given by Grubov (Rast. Tsentral. Azii 1: 82. 1963) is correct. In general shape, this taxon is similar to *A. pekinense* Hance. However, most pinnae of *A. altajense* have only the basal acroscopic pinnule free, the others are confluent and form the pinna apex, while in *A. pekinense* several segments are free or just slightly adnate to the costa. The stipe is less scaly in *A. altajense*, and its texture is more herbaceous. *Asplenium altajense* is also similar to *A. tenuicaule*, from which it can be distinguished by the more narrow and acute teeth (obtuse to mucronate in *A. tenuicaule*). Due to confusion between *A. tenuicaule*, *A. pekinense*, and *A. anogrammoides*, the distribution of this taxon is not well known. *Asplenium chingianum* (type fragment in IBSC!) is a submature plant with immature sporangia, few and unripe spores, and almost no scales; it is also similar to *A. nesii* specimens from N Pakistan. The hybrid between *A. altajense* and *A. tenuicaule* is relatively common where they grow together.

**79. *Asplenium adiantum-nigrum* Linnaeus, Sp. Pl. 2: 1081. 1753.**

黑色铁角蕨 hei se tie jiao jue

*Asplenium adiantum-nigrum* subsp. *yuanum* (Ching) Reichstein et al.; *A. adiantum-nigrum* var. *yuanum* (Ching) Ching; *A. yuanum* Ching.

Plants 15–40 cm tall. Rhizome ascending, apex scaly; scales dark brown, narrowly triangular, up to 6 mm, hairlike in upper half, without black middle stripe, entire. Fronds caespitose; stipe 8–15(–20) cm, base conspicuously swollen, thickened, semiterete, abaxially shiny castaneous to blackish purple, with scattered brownish black hairlike scales or subglabrous, adaxially sulcate; lamina triangular-ovate, 9–25 × 4–6(–10) cm, apex acute to acuminate, tripinnate; pinnae 8–13 pairs, alternate, stalked, basal pair largest, triangular, 4–6 × 1.8–2.4 cm, base truncate, bipinnate, apex acute to acuminate; pinnules 5–8 pairs, anadromous, basal pairs largest, triangular, 1.5–3.2 × 0.6–1 cm, base cuneate-truncate, shortly stalked or subsessile, pinnate, apex acute; ultimate pinnules 4–6 pairs,

alternate, anadromous, basal pair largest, elliptic to oblong or linear, 5–7 × 2.5–3.5 mm, margin serrate, apex obtuse. Costa obvious, sulcate adaxially, veins obscure, anadromously branching, simple or 2-forked, not reaching margin. Fronds firmly herbaceous to papery, green but brown-green when dry, lamina with 4- or 5-celled, uniseriate hairs, average stomatal guard cell length 54–60 μm; rachis semiterete, lower half abaxially usually shiny castaneous to dark brown, apical part green or stramineous, adaxially sulcate. Sori 1–3(or 4) pairs per pinnule or segment, median on subtending veinlet, confluent at maturity, linear, 1–2.5(–5) mm; indusia white or brownish, linear, membranous, repand to entire, opening toward costa or costule. Spores brown to dark brown, perispore lophate (crustate-alate), with average exospore length 32–37 μm. Plants sexual allotetraploids:  $2n = 144$ .

On rocks or on forest floor near streams; 2000–3000 m. Shaanxi, Taiwan, E Xizang, NW Yunnan [Afghanistan, N India, Pakistan; Europe (Mediterranean to SW Asia), W North America].

*Asplenium adiantum-nigrum*, an allotetraploid species that originated via chromosome doubling in a hybrid (*A. ×ligusticum* Bernardello et al.) between *A. cuneifolium* Viviani and *A. onopteris* Linnaeus, is unrelated to the distantly similar *A. interjectum*. *Asplenium adiantum-nigrum* differs by the thickened stipe base (trophopod) and the less deltoid lamina.

**80. *Asplenium anogrammoides* Christ, Repert. Spec. Nov. Regni Veg. 5: 11. 1908.**

广布铁角蕨 guang bu tie jiao jue

*Asplenium leiboense* Ching; *A. sarelii* Hooker var. *anogrammoides* (Christ) Tagawa; *A. sepulchrale* Hooker, p.p.

Plants 10–30 cm tall. Rhizome short, erect or ascending, apex scaly; scales dark brown to black, narrowly triangular, 3–8 × 0.3–0.7 mm, margins denticulate; scale base hyaline, cordate, with numerous yellow-brown, unicellular hairs 1–5 × ca. 0.02 mm, similar to root hairs. Fronds caespitose; stipe 7–15 cm, semiterete, dark brown abaxially or becoming green toward rachis, upward green, adaxially green, shallowly sulcate with supravascular ridge, with similar scales as on rhizome, reduced hairlike scales toward rachis or subglabrous; lamina ovate, 6–13 × 2.5–7(–8) cm, base truncate, apex acute, tripinnatifid-tripinnate; pinnae 8–12 pairs, basal pairs subopposite to alternate, stalk 2–4 mm, sulcate adaxially; several basal pinnae pairs ± equal in length, ovate-triangular, 1.5–3 × 0.5–1.5 cm, base nearly symmetrical, truncate to broadly cuneate, 2-pinnatifid-bipinnate, apex acute; pinnules 4–6 pairs, anadromous, acroscopic and basiscopic pinnules ± equal in size, narrowly triangular to ovate, 5–10 × 3–6 mm, base asymmetrical, acroscopic side truncate, basiscopic side cuneate, largest pinnules stalked, others decurrent on costa, pinnatifid-pinnate, apex acute; segments 2 or 3 pairs, linear to narrow elliptic, apex with 2 or 3 teeth. Costa sulcate adaxially, without median ridge, veins slightly raised adaxially, anadromously forked. Fronds firmly herbaceous, green to grayish green, lamina subglabrous, average stomatal guard cell length 48–52 μm; rachis green, semiterete, abaxially green or base castaneous becoming green toward apex, adaxially sulcate with raised median supravascular ridge, with reduced scales or subglabrous. Sori 2–4 per ultimate segment, median to subterminal on acroscopic vein,

subconfluent at maturity, subelliptic, 1–2.5 mm; indusia grayish green, subelliptic, membranous, entire, opening toward costule or central veinlet, persistent. Spores brown, perispore lophate (cristate), average exospore length 33–36  $\mu\text{m}$ . Plants sexual, allotetraploids:  $2n = 144$ .

Wet cliffs, in crevices of limestone rocks, on buildings and walls; 300–2800 m. Anhui, Fujian, Guangdong, Guizhou, Hebei, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Ningxia, Shaanxi, Shandong, Shanxi, Sichuan, Yunnan, Zhejiang [?India, Japan, Korea, Vietnam].

*Asplenium anogrammoides* is an (allo)tetraploid (Kurita, J. Jap. Bot. 35: 269–272. 1960; Mitui, Sci. Rep. Tokyo Kyoiku Daigaku, B, 13: 285–333. 1968) and originated via chromosome doubling in the sterile hybrid between *A. sarelii* and *A. tenuicaule* (Lin & Sleep in K. H. Shing & K. U. Kramer, Proc. Int. Symp. Syst. Pterid. 111–127. 1989; Murakami et al., Amer. Fern J. 89: 232–243. 1999; Viane & Reichstein, Pterid. New Millennium, 73–105. 2003; Wang, Acta Bot. Sin. 45: 1–14. 2003). Their morphological similarity led to much confusion and misapplication of the name *A. sarelii* to this taxon (also called “tetraploid sarelii”) (e.g., Christensen, Acta Horti Gothob. 1: 41–110. 1924; Ogata, Icon. Fil. Jap. 1: t. 8. 1928; Tardieu, Asplén. Tonkin, 46. 1932; Ching, Icon. Fil. Sin. 3: t. 111. 1935, p.p.; Fl. Pl. Herb. Chin. Bor.-Or. 1: 37. 1958; De Vol, Mus. Heude. Notes Bot. Chin. 7: 93. 1945, p.p.; Tagawa, Col. Ill. Jap. Pterid. 151. 1959; Kurata, J. Geobot. 11: 66–69. 1962; Mitui, loc. cit. 1968; Bull. Nippon Dental Coll., Gen. Educ. 4: 221–271. 1975; Kurata & Nakaike, Ill. Pterid. Jap. 2: 164–173. 1981; Ding & Gao, Fl. Henan 1: 67. 1981; Sleep & Reichstein, Candollea 39: 675–691. 1984; Ching & S. H. Wu, Acta Phytotax. Sin. 23: 1–10. 1985; Jiang, Fl. Anhui 1: 136. 1985, p.p.; Bir, Biol. Indian Pterid. 215–221. 1987; Jamir & Rao, Ferns Nagaland, 289–290. 1988; H. S. Kung, Fl. Sichuan. 6: 377. 1989; Chen, Fl. Shandong 1: 96. 1990; Li, Fl. Liaoning 1: 77. 1990, p.p.; L. K. Lin, Fl. Fujian. 1: 131. 1991; Iwatsuki, Ferns Jap. 146. 1992; Fl. Jap. 1: 104. 1995; Murakami et al., loc. cit.; S. H. Wu, FRPS 4(2): 98. 1999, p.p.; P. S. Wang & X. Y. Wang, Pterid. Fl. Guizhou, 138. 2001, p.p.; Li et al., Fl. Hunan 1: 287. 2004, p.p.; G. F. Zhang, Fl. Yunnan. 20: 669. 2006). Moreover, less-divided plants of *A. anogrammoides* are similar to large plants of *A. pekinense* (the autotetraploid arisen from *A. sarelii*).

On the other hand, the name *Asplenium anogrammoides* has been misapplied (e.g., Komarov, Izv. Imp. S.-Peterburgsk. Bot. Sada 16: 145–151. 1916; Komarov & Klobukova-Alisova, Opređ. Rast. Dal'nevost. Kraia 1: 82. 1931; Fomin, Fl. Sibir. Orient. Extremi 5: 152–154. 1930; in Komarov & Iljin, Fl. URSS 1: 68. 1934; Ching, loc. cit.: 37. 1958) to S Siberian and Mongolian *A. tenuicaule* var. *subvarians*.

Yellow-brown (root)hairs are present on the rhizome, stipe base, and scale base of *Asplenium altajense*, *A. anogrammoides*, *A. pekinense*, *A. sarelii*, *A. tenuicaule*, and other related taxa, and thus cannot be used to distinguish them. The average exospore and stomata length are the most reliable characters discriminating between diploid and tetraploids in this complex. *Asplenium anogrammoides* can often be separated from *A. pekinense* by its largely not-reduced lamina base and its ovate-triangular (vs. deltoid) pinnae with stalks 2–4 mm (vs. 0.5–2 mm).

Where *Asplenium anogrammoides* grows together with *A. tenuicaule*, their sterile triploid hybrid, *A.  $\times$ mitsutae*, is common. **Asplenium  $\times$ mitsutae** Viane & Reichstein, **nothosp. nov.** Type: China. Sichuan: Qingcheng Shan, ca. 70 km WNW of Chengdu, mixed evergreen forest with *Rhododendron*, on wall inside temple yard together with *A. anogrammoides* and *A. tenuicaule*, 1050 m, 16 Sep 1988, Viane 4046-B (= TR-7177) (holotype, GENT). *Planta hybrida, inter parentes A. anogrammoides et A. tenuicaule quoad divisionem laminae atque pinnularum segmentorumque formam necnon dimensiones cellularum accessoriarum stomatum intermedia, ab eis sporis abortivis necnon*

*chromosomatum numero triploideo ( $2n = 108$ , meiose bivalentibus univalentibusque 36) differt.* Meiotic chromosome behavior in this hybrid shows that *A. anogrammoides* contains one chromosome set of *A. tenuicaule*. This hybrid is named after S. Mitsuta, who collected it for us in Japan with several other living plants in 1985. *Asplenium sarelii* var. *magnum* H. S. Kung, described from Sichuan, is probably the same hybrid combination.

“*Asplenium wudangense*” (Z. R. Wang & X. Hou, Acta Bot. Sin. 45: 4. 2003) belongs here but was not validly published because no Latin description or diagnosis, or reference to such, was provided (*Melbourne Code*, Art. 39.1).

**81. *Asplenium sarelii* Hooker in Blakiston, Five Months Yang-Tsze, App. VI: 363. 1862.**

华中铁角蕨 hua zhong tie jiao jue

*Asplenium blakistonii* Baker; *A. pekinense* Hance var. *foeniculaceum* Christ.

Plants 10–23 cm tall. Rhizome short, erect or ascending, apex scaly; scales dark brown to black, narrowly triangular, 2–4(–6)  $\times$  0.3–0.7 mm, margins denticulate; scale base hyaline, cordate, with yellow-brown, unicellular hairs 1–5  $\times$  ca. 0.02 mm, similar to root hairs. Fronds caespitose; stipe 7–10 cm, semiterete, base dark brown abaxially, upward green, adaxially yellow-green, sulcate with pronounced supravascular ridge, with similar scales as on rhizome, reduced hairlike scales toward rachis or subglabrous; lamina triangular-ovate, 6–15  $\times$  2.5–7 cm, base truncate, apex acute, tripinnatifid-tripinnate; pinnae 8–12 pairs, basal pairs subopposite to alternate, stalk 1–3 mm, sulcate but with median supravascular ridge adaxially; basal pinnae equal or slightly shorter than next, ovate-triangular, 1.5–4.5  $\times$  1.5–3 cm, base nearly symmetrical, truncate to broadly cuneate, bipinnatifid-bipinnate, apex acute; pinnules 4–6 pairs, anadromous, basal pinnules  $\pm$  equal in size, narrowly triangular to ovate, 5–20  $\times$  4–7 mm, base asymmetrical, acroscopic side truncate, basiscopical side cuneate, stalk up to 1 mm or decurrent on costa, pinnatifid-pinnate, apex acute; segments 3 or 4 pairs, linear, 1.5–5  $\times$  0.5–2 mm, basal segments forked or up to pinnatisect with 2 or 3 ultimate segments, apex of segments with 2 or 3 teeth. Costa sulcate adaxially, with distinctly raised median supravascular ridge, veins raised adaxially, veins anadromously forked. Fronds thinly to firmly herbaceous when dry, green to grayish green, lamina subglabrous, average stomatal guard cell length 35–43  $\mu\text{m}$ ; rachis green, semiterete, adaxially sulcate with raised median supravascular ridge, with reduced scales or subglabrous. Sori 1 or 2 per ultimate segment, median to subterminal on acroscopic vein, near segment teeth but not reaching margin, subconfluent at maturity, subelliptic, 1–2 mm; indusia grayish green, subelliptic, membranous, entire, opening toward costule or central veinlet, persistent. Spores brown, perispore lophate (cristate), average exospore length 28–30  $\mu\text{m}$ . Plants sexual diploids:  $2n = 72^*$ .

• In rock crevices; 300–1000(–2100) m. Anhui, Chongqing, N Guizhou, ?Henan, Hubei, Hunan, Jiangsu, Shaanxi, Sichuan, Zhejiang.

“*Asplenium saulii*” (Hooker & Baker, Syn. Fil., ed. 2, 216. 1874) is evidently a mere orthographic variant of *A. sarelii*.

*Asplenium sarelii* is endemic to C China. All reports of this species from outside China are erroneous and usually refer to the very

similar tetraploid *A. anogrammoides*. Hybridization experiments, including cytological study of meiotic behavior in artificially produced hybrids (Lin & Sleep in K. H. Shing & K. U. Kramer, Proc. Int. Symp. Syst. Pterid. 111–127. 1989), and micromorphological study of type material have shown that *A. sarelii* is one of the parental species of allotetraploid *A. anogrammoides*; the other parent being diploid *A. tenuicaule*. These findings were confirmed by cytological and isozyme studies (Wang, Acta Bot. Sin. 45: 1–14. 2003). The morphological similarity between these taxa has led to great confusion, also with true *A. pekinense*, which is the autotetraploid that originated from true *A. sarelii*. In *A. sarelii*, the ultimate segments are less than 1.2 mm wide, the pinnae stalks less than 1 mm wide, and its pinnae are distant from each other and hardly overlap so that the frond silhouette is more open than in *A. anogrammoides*. Important differential characters are the chromosome number and the average exospore and stomata size. Identification based on morphology alone is very difficult when *A. sarelii* grows with *A. pekinense* and *A. anogrammoides*. At such locations, e.g., Wudang Shan (Hubei) and Huping Shan (Hunan), the sterile triploid hybrids, *A. ×wudangshanense* (*A. pekinense* × *A. sarelii*) and *A. ×huawuense* (*A. anogrammoides* × *A. sarelii*), are relatively common and recognizable by their aborted spores and often undeveloped sporangia. **Asplenium ×wudangshanense** Viane, Reichstein, Rasbach & Y. X. Lin, **nothosp. nov.** Type: China. Hubei: Wudang Shan, ca. 2050 m, Sep 1907, *Silvestri* 6 (pl. 5) (holotype, FI). *Planta hybrida, inter parentes A. pekinense et A. sarelii quoad divisionem laminae atque pinnularum segmentorumque formam necnon dimensiones cellularum accessoriarum stomatum intermedia, ab eis sporis abortivis necnon chromosomatum numero triploideo (2n = 108, meiose trivalentibus 0–5, bivalentibus 33–37 et univalentibus 29–40) differt.* Meiotic chromosome behavior in *A. ×wudangshanense* confirms that *A. pekinense* is the autotetraploid of *A. sarelii*. Meiotic chromosome behavior (Wang in K. H. Shing & K. U. Kramer, Proc. Int. Symp. Syst. Pterid. 133–134. 1989; loc. cit. 2003) in *A. ×huawuense* confirms that *A. anogrammoides* is allotetraploid and contains one chromosome set of *A. sarelii*. **Asplenium ×huawuense** Z. R. Wang ex Viane & Y. X. Lin, **nothosp. nov.** Type: China. Hubei, Wudang Shan, ca. 850 m, 18 Jul 1987, Z. R. Wang C843 (holotype, PE). *Planta hybrida, inter parentes A. anogrammoides et A. sarelii quoad divisionem laminae atque pinnularum segmentorumque formam necnon dimensiones cellularum accessoriarum stomatum intermedia, ab eis sporis abortivis atque chromosomatum numero triploideo (2n = 108, meiose bivalentibus univalentibusque 36) differt.* All of Z. R. Wang's new names (Wang, loc. cit. 2003) are nomina nuda and were not therefore validly published (*Melbourne Code*, Art. 38.1(a)).

## 82. *Asplenium pekinense* Hance, J. Bot. 5: 262. 1867.

北京铁角蕨 bei jing tie jiao jue

*Asplenium abbreviatum* Makino; *A. sarelii* Hooker subsp. *pekinense* (Hance) Fraser-Jenkins, Pangtey & Khullar; *A. sarelii* var. *pekinense* (Hance) C. Christensen; *A. sepulchrale* Hooker.

Plants 3–20 cm tall. Rhizome erect, short, apex scaly; scales dark brown to black, triangular, 1–5(–8) × 0.3–0.7 mm, scale base with numerous yellow-brown, unicellular hairs 1–5 × ca. 0.02 mm, similar to root hairs, apical part subentire, acuminate. Fronds caespitose; stipe green, 2–8(–10) cm, semiterete to terete, base densely scaly, with reduced hairlike scales toward rachis or subglabrous, adaxially sulcate with pronounced supravascular ridge; lamina lanceolate to narrowly ovate-trullate, 5–15 × 1.5–4 cm, base often gradually reduced, 2-pinnate to 3-pinnatifid, apex acute; pinnae 6–12 pairs, lower pinnae often reduced, 1–2.5 cm, stalk 0.5–1.5(–2) mm, adaxially sulcate and with distinct supravascular ridge; basal pinnae remote, opposite,

often flabellate to deltoid-triangular, apex obtuse to acute, base symmetrical, truncate, 2-pinnate, with 2–4 pinnule pairs, basal pinnules nearly parallel to rachis; middle pinnae often largest, triangular-ovate, base asymmetrical, pinnate to bipinnatifid with 2–4 pairs of pinnules, basal pinnules largest, 5–8 × 2–4 mm, pinnatisect with 1 or 2 pairs of narrowly cuneiform to sublinear segments, 0.5–2 mm wide, apex subacute to truncate with 2 or 3 acute, 0.5–1 mm teeth. Costa sulcate adaxially, with distinctly raised median supravascular ridge, veins obvious, raised adaxially, flabellately anadromous, not reaching margin. Fronds firmly herbaceous, dark green to grayish green when dry, lamina subglabrous, average stomatal guard cell length 45–52 μm; rachis and costa green, semiterete, adaxially sulcate and with prominent median supravascular ridge, with black fibrillar scales or subglabrous. Sori 1 or 2(–4) per pinnule, often spreading at maturity, subelliptic to linear, 1–2 mm; indusia white-gray, subelliptic, membranous, margin irregularly sinuate, opening toward costa or costule, persistent. Spores brown with lophate (costate) perispore, average exospore length 34–38 μm. Plants autotetraploid:  $2n = 144$ .

In rock crevices, on buildings and walls; 100–3900 m. Anhui, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hebei, Henan, Hubei, Hunan, Jiangsu, Liaoning, Nei Mongol, Ningxia, Shaanxi, Shandong, Shanxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [India, Japan, Korea, Pakistan, Russia (E Siberia)].

*Asplenium pekinense* is an autotetraploid (Mitui, J. Jap. Bot. 40: 117–124. 1965; Lin & Sleep in K. H. Shing & K. U. Kramer, Proc. Int. Symp. Syst. Pterid. 111–127. 1989; Wang, Acta Bot. Sin. 45: 1–14. 2003) species arisen by chromosome doubling in diploid *A. sarelii*. Allotetraploid *A. anogrammoides* is very similar because true *A. sarelii* is one of its ancestors, the second being *A. tenuicaule* (Lin & Sleep, loc. cit.). Reticulate hybridizations between diploid *A. tenuicaule*, *A. sarelii*, and *A. semivarians* led to the evolution of many confusingly similar taxa defying description. These can be grouped into the *A. pekinense*-complex consisting of *A. altajense*, *A. anogrammoides*, *A. pekinense*, and *A. sarelii*, and the *A. varians* group containing *A. aitchisonii*, *A. kukkonenii*, *A. semivarians*, and *A. varians*. Their close relationship and similarity has led to many wrong identifications, as well as incorrect and unreliable citations. In many places where *A. pekinense* grows with *A. anogrammoides*, their sterile tetraploid hybrid is relatively common. **Asplenium ×kidoi** Sleep ex Viane, Y. X. Lin & Reichstein, **nothosp. nov.** Type: China. Hebei: ca. 20 km NW of Beijing, Xiangshan park, natural pine forest above Fragrant Hill Hotel, among grasses on shaded hillside with *A. anogrammoides*, *A. pekinense*, and *Athyrium niponicum* (Mettenius) Hance, 190 m, 27 Sep 1997, *Viane* 7047 (holotype, GENT). *Planta hybrida, inter parentes A. anogrammoides et A. pekinense quoad divisionem laminae atque pinnularum segmentorumque formam necnon dimensiones cellularum accessoriarum stomatum intermedia, ab eis sporis abortivis necnon chromosomatum numero tetraploideo (2n = 144, meiose trivalentium bivalentium univalentiumque numeris valde irregularibus) differt.* This morphologically intermediate plant often shows hybrid vigor; it was first studied by A. Sleep (a.o., in Lin & Sleep, loc. cit.) who collected it in Japan (Kyushu: Ashi-Kita-cho, 1 Nov 1968, *A. Sleep & M. Kido AS/605*; BM, PE, TI, Z).

Z. R. Wang and K. Q. Wang (Acta Bot. Sin. 45: 8. 2003) reported a hybrid between *Asplenium pekinense* and *A. exiguum* (as *A. yunnanense*), "*A. ×jingyunense*," and one between *A. pekinense* and *A. varians*, "*A. ×longmenense*," but the two names were not validly published because no Latin description or diagnosis, or reference to such, was provided (*Melbourne Code*, Art. 39.1).

**83. *Asplenium coenobiale*** Hance, J. Bot. 12: 142. 1874.

线裂铁角蕨 xian lie tie jiao jue

*Asplenium bodinieri* Christ; *A. fuscipes* Baker; *A. subtoramanum* Ching ex S. H. Wu; *A. toramanum* Makino.

Plants 12–35 cm tall. Rhizome erect, short, apex scaly; scales dark brown to black, narrowly triangular to linear-subulate, margin fimbriate to subentire. Fronds caespitose; stipe shiny, purplish black, 6–15(–18) cm, terete, rigid and threadlike, with brown, multicellular uniseriate hairs or subglabrous; lamina triangular, 7–12 × 5–10 cm, base truncate, bipinnate to tripinnate-pinnatifid, apex acuminate to caudate; pinnae 10–15 pairs, subopposite to alternate, lower pinnae stalked, upper almost sessile, stalk dark brown abaxially, basal 1 or 2 pinnae longest and often falcate, narrowly triangular to oblong, 2.5–7 × 1.5–2 cm, base asymmetrical, on acroscopic side auriculate-truncate, basispic side cuneate, up to bipinnate-pinnatifid, apex obtuse; pinnules 6–8 pairs, anadromous, usually sessile but shortly stalked in more divided fronds, basal acroscopic pinnule largest, ovate, 7–9 × 4–7 mm, base asymmetrical, acroscopic side truncate, basispic side cuneate, apex obtuse to truncate; ultimate segments ovate-oblong to linear, apex with 2–4 short and broadly triangular, obtuse to submucronate or sharp teeth. Costa sulcate adaxially, green, veins often raised adaxially when dry, anadromously branching, (1 or)2–6 veins per ultimate segment, terminal hydathode obvious, and not reaching margin. Frond firmly herbaceous, green, lamina with multicellular uniseriate hairs or subglabrous; rachis shiny purplish black, becoming green in upper half toward apex, with brown, multicellular uniseriate hairs or subglabrous, sulcate adaxially. Sori (1 or)2–4 per pinnule or segment, medial to subterminal on acroscopic veinlets, confluent at maturity, oval to linear, 1–2 mm; indusia grayish green, oval to linear, membranous, repand to entire, opening toward costa or costule, persistent. Spores brown to dark brown, lophate (crystate-alate) perispore. Plants tetraploid:  $2n = 144$ .

On limestone rocks, on buildings and walls; 300–1700 m. Fujian, Guangdong, Guizhou, Hunan, Sichuan, Yunnan [Japan, Vietnam].

*Asplenium coenobiale* has a variable frond division probably depending on growing conditions with large and more divided plants often growing on rocks in forests. Plants are tetraploid but often produce some aborted spores. Further study will have to show whether they are sexual or agamosporous. In Chinese literature, this name has often been misapplied to the next species (*A. pulcherrimum*). Due to this confusion, its distribution is not well known.

**84. *Asplenium pulcherrimum*** (Baker) Ching ex Tardieu, *Asplén. Tonkin*, 52. 1932.

叶基宽铁角蕨 ye ji kuan tie jiao jue

*Davallia pulcherrima* Baker, Bull. Misc. Inform. Kew 1895: 53. 1895; *Asplenium billettii* Christ; *A. calcicola* Tagawa.

Plants 10–25 cm tall. Rhizome erect, apex scaly; scales dark brown to black, narrowly triangular to linear-subulate, margin fimbriate to subentire. Fronds caespitose; stipe shiny, purplish black, 6–18(–25) cm, terete, rigid and threadlike, with brown, multicellular uniseriate hairs or subglabrous; lamina

deltoide-triangular, 6–15 × 3–7(–9) cm, base truncate, (3 or)4-pinnate, apex acuminate; pinnae (8–)12–16 pairs, subopposite to alternate, overlapping, stalk up to ca. 1.3 mm and dark brown abaxially, basal pinnae largest, triangular to ovate, 2–5 × 0.7–2 cm, base auriculate-truncate, tripinnate, apex obtuse to subacute; pinnules 6–10 pairs, anadromous, basal acroscopic pinnule largest, triangular-ovate, 5–12 × 5–8 mm, stalk up to ca. 1 mm, base asymmetrical, acroscopic side truncate, basispic side cuneate, apex obtuse, 2-pinnate; ultimate segments 2–4 pairs, basal acroscopic segment most developed, 2–4 × 2–4 mm, 2- or 3-partite (fertile) or simple (sterile) and linear-subulate, ultimate fertile segments 0.5–1.5 mm wide, ultimate sterile segments 0.2–0.4 mm wide, apex acute. Costa and costules sulcate adaxially, green, veins slightly raised or flat adaxially, anadromous, 1 vein per segment, terminal hydathode not reaching margin. Fronds firmly herbaceous, green, lamina with multicellular uniseriate hairs or subglabrous; rachis shiny purplish black, becoming green in upper half toward apex, sulcate adaxially, with brown, multicellular uniseriate hairs or subglabrous. Sori 1 per fertile, forked and pouch-shaped segment, median on acroscopic veinlet, often spreading and obscuring indusium at maturity, oval, 1–1.5 mm; indusium white or gray, semi-elliptic, membranous, hyaline, entire, opening toward costules and margin, persistent. Spores brown to dark brown, lophate (crystate-alate) perispore. Plants tetraploid:  $2n = 144$ .

On rocks in open areas, on rocks in forests; 300–1800 m. Chongqing, Fujian, Guangdong, Guangxi, Guizhou, Sichuan, Taiwan, Yunnan [Malaysia (Sarawak), Vietnam].

Plants of *Asplenium pulcherrimum* are tetraploid, but further study will have to show if they are sexual or agamosporous. Due to confusion with the preceding species, *A. coenobiale* (e.g., H. S. Kung, Fl. Sichuan. 6: 375. 1989; L. K. Lin, Fl. Fujian. 1: 129. 1991; P. S. Wang & X. Y. Wang, Ching Mem. Vol. 79. 1999; Pterid. Fl. Guizhou, 123. 2001; S. H. Wu, FRPS 4(2): 115. 1999; T. L. Wu et al., Fl. Guangdong 7: 201. 2006), its distribution is not well known.

**85. *Asplenium cornutissimum*** X. C. Zhang & R. H. Jiang, *Brittonia* 63: 83. 2011.

壮乡铁角蕨 zhuang xiang tie jiao jue

Plants 5–15 cm tall. Rhizome erect, apex scaly; scales dark brown to black, narrowly triangular to subulate, margin fimbriate to subentire. Fronds caespitose; stipe shiny castaneous to purplish black, 0.7–4 cm, semiterete, threadlike, with brown, multicellular uniseriate hairs or subglabrous; lamina oblong-ovate, 3–12 × 1–3.5 cm, 3-pinnate, apex acute; pinnae 8–17 pairs, subopposite to alternate, overlapping, shortly stalked, median pinnae largest, ovate, 0.5–2 × 0.4–1.5 cm, base truncate, 2-pinnate, apex obtuse; pinnules 2–4 pairs, anadromous, basal acroscopic pinnule largest, triangular-ovate, stalked, apex obtuse, pinnate; ultimate segments bifid or simple (sterile) and linear-subulate, 1–2.5 × 0.2–0.5 mm, apex acute; fertile segments wider than sterile. Costa and costules sulcate adaxially, green, veins anadromous, 1 vein per segment, terminal hydathode not reaching margin. Fronds thinly herbaceous, green, lamina with multicellular uniseriate hairs or subglabrous; rachis shiny castaneous to purplish black, becoming green in upper half toward apex, sulcate adaxially, with brown, multicellular uniseriate

hairs or subglabrous. Sori 1 per fertile segment, basal on acroscopic veinlet, often spreading and hidden by indusium at maturity, oval, 0.5–0.9 mm; indusium semi-elliptic, hyaline, entire to repand, opening toward costules and margin, persistent. Spores brown, with lophate (crystate-alate) perispore.

- In crevices of karst caves; 700–800 m. Guangxi.

**86. *Asplenium prolongatum*** Hooker, Sec. Cent. Ferns, t. 42. 1860.

长叶铁角蕨 chang ye tie jiao jue

*Asplenium bipinnatum* Roxburgh var. *prolongatum* (Hooker) Bonaparte; *A. rutifolium* (Bergius) Kunze var. *prolongatum* (Hooker) Christ.

Plants 20–40 cm tall. Rhizome erect, short, apex scaly; scales dark brown to black, narrowly triangular, with narrow pale brown edges, entire or denticulate. Fronds caespitose; stipe green, 8–18 cm, sulcate adaxially, sparsely covered with small dark brown fimbriate scales when young, later subglabrous; lamina linear-ovate, 10–25 × 3–4.5 cm, bipinnate, apex caudate; pinnae 20–24 pairs, basal pinnae opposite or subopposite, upper alternate, subsessile, lower pinnae usually not reduced, middle pinnae narrowly elliptic to oblong, 1–3 × 0.8–1.5 cm, base nearly symmetrical, cuneate-truncate, pinnate, apex obtuse; pinnules alternate, anadromous, 2–5 pairs, linear, 4–10 × 1–1.5 mm, base adnate to costa, entire, apex obtuse; first acroscopic pinnule 2- or 3-fid. Veins and costa raised adaxially, 1 vein per pinnule or segment, with terminal hydathode, not reaching margin. Fronds subfleshy but thin when dried, green to yellow-green when dry; rachis green, usually prolonged into flagelliform and gemmiferous apex, flat or shallowly sulcate with raised supravascular ridge on adaxial side, abaxially flat. Sori 1 per pinnule or segment, median on acroscopic side of subtending vein, linear, 2.5–5 mm; indusia grayish green, linear, membranous, entire, opening toward costa and margin, persistent.

On tree trunks in forests or on wet rocks; 100–2000 m. Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hubei, SW Hunan, Jiangxi, Sichuan, Taiwan, Xizang, SW Yunnan, Zhejiang [India, Japan, S Korea, Malaysia, Myanmar, Sri Lanka, Vietnam; Pacific islands (Fiji)].

*Asplenium prolongatum* was confused with *A. rutifolium* (Bergius) Kunze by Franchet and Savatier (Enum. Pl. Jap. 222. 1876), Makino (Phan. Pter. Jap. Icon. t. 65. 1900), and others, and with *A. achil-leifolium* (Lamarck) C. Christensen by Ogata (Icon. Fil. Jap. 2: t. 55. 1929) and Y. C. Wu et al. (Bull. Dept. Biol. Sun Yatsen Univ. 3: 202. 1932).

Though Japanese plants of *Asplenium prolongatum* were reported to be tetraploid with  $2n = 144$  (Iwatsuki, Fl. Jap. 1: 103. 1995), all Chinese plants (Guangdong, Guizhou, Hainan) checked by flow cytometry are hexaploid and may have to be ascribed to a new taxon. *Asplenium ×kenzoi* Kurata, the hybrid with *A. wrightii*, may also occur in China where its parents often grow together.

**87. *Asplenium sampsonii*** Hance, Ann. Sci. Nat., Bot., sér. 5, 5: 257. 1866.

岭南铁角蕨 ling nan tie jiao jue

*Asplenium tenerum* G. Forster var. *stenophyllum* Bonaparte [“*stenophilla*”].

Plants 15–35 cm tall. Rhizome erect, short, apex scaly; scales dark brown to black with pale brown narrow edge, triangular to ovate, margin glandular denticulate or fimbriate. Fronds caespitose; stipe 3–8 cm, semiterete, fleshy, adaxially sulcate but with prominent median supravascular ridge, green or stramineous when dry, base abaxially often dull brown, with dark brown to black triangular scales with filiform apex and smaller hastate-stellate scales; lamina lanceolate, 13–25 × 2–5 cm, attenuate to both ends, apex acute-acuminate, bipinnatisect; pinnae 17–28 pairs, subopposite or alternate, stalk ca. 1 mm, at base reduced and often triangular, middle pinnae oblong-elliptic, slightly falcate, 1.2–2.5 × 0.6–1.2 cm, base symmetrical, truncate, pinnatisect, apex obtuse; segments 5–9 pairs, alternate, anadromous, linear-oblong, 2–4 × 1–1.5 mm, apex obtuse, base confluent with costa and forming costal wing, entire, basal acroscopic segment larger and 2–5-fid. Costa distinct and raised adaxially, obscure abaxially, venation anadromously pinnate, 1 vein per segment, not reaching margin. Frond usually subfleshy, green to stramineous when dry, with dark brown stellate-hastate scales with filiform tail on abaxial surface; rachis sulcate but with prominent supravascular ridge on adaxial side, green or stramineous when dry, fleshy. Sori 1 per segment, on acroscopic side of subtending vein, linear, 2–2.5 mm; indusia whitish to gray-stramineous, oval-linear, membranous, entire, opening toward costa and margin, persistent. Spores with medium to dark brown lophate (costate-cristate) perispore. Plants decaploid:  $2n = 360$ .

On limestone rocks in open forests; 300–800 m. Guangdong, Guangxi, S Guizhou, Hainan, SE Yunnan [Vietnam].

*Asplenium sampsonii* is similar to *A. thunbergii* Kunze (= *A. belangeri* (Bory) Kunze (1848), not Bory (1833)) from Malaysia and Indonesia, but it is smaller, not gemmiferous on the rachis; the lower pinnae are reduced; and the perispore is different. The distinction between *A. sampsonii* and *A. thunbergii* in Chinese floras (e.g., S. H. Wu, FRPS 4(2): 124. 1999; T. L. Wu et al., Fl. Guangdong 7: 190, 203–204. 2006) is based largely on size differences. Manton (in Holttum, Revis. Fl. Malaya 2: 623–627. 1954) found that plants from Malaysia are tetraploid, but since specimens from Hainan and Guangxi are decaploid, we are confident that they are different from true *A. thunbergii*, which probably does not occur in China. Plants of *A. tenerum* with bipinnatifid fronds can be similar to this species.

**88. *Asplenium tenerum*** G. Forster, Fl. Ins. Austr. 80. 1786.

膜连铁角蕨 mo lian tie jiao jue

*Asplenium caudatum* Cavanilles (1802), not G. Forster (1786); *A. elongatum* Swartz (1806), not Salisbury (1796); *A. productum* C. Presl; *A. tenerum* var. *terminans* Kunze ex Mettenius; *Darea tenera* (G. Forster) Sprengel.

Plants 30–65 cm tall. Rhizome erect, short, apex scaly; scales blackish brown, with pale reddish brown edges, triangular, 3–5 mm, margin fimbriate to subentire. Fronds caespitose; stipe green or stramineous when dry, 12–30 cm, adaxially sulcate with median supravascular ridge, base scaly, or subglabrous; lamina narrowly triangular to linear, 20–38(–50) × 7–10(–14) cm, apex caudate, 1-pinnate to rarely bipinnatifid; pin-

nae 15–25(–35) pairs, subopposite to alternate, shortly stalked, lower pinnae not reduced, narrowly triangular, 3–5 × 1–1.5 cm, simple, base asymmetrical, acroscopic side truncate, basicopic side cuneate, margin crenate, apex acute or obtuse. Costa stramineous, raised on both sides, venation obvious, pinnate, basal acroscopic vein 2–4 times forked, other veins simple, not reaching margin. Fronds subleathery, grayish green when dry; rachis stramineous when dry, with hastate-stellate fibrillar scales or subglabrous, sulcate with median supravascular ridge on adaxial side, sometimes gemmiferous near apex. Sori median on veins, linear, ca. 3 mm; indusia whitish to gray-brown, linear, membranous, entire, opening toward costa.

On rocks in dense forests; 400–1000 m. Hainan, Taiwan [India, Indonesia, Japan, Korea, Malaysia, Myanmar, Philippines, Sri Lanka, Vietnam; Pacific islands].

*Asplenium tenerum* is a variable taxon. Plants with gemmiferous rachis are known from China (Taiwan), Indonesia, Japan (Ryukyu Islands), and Malaysia and may represent a different taxon. As presently circumscribed, this species is probably an aggregate needing further monographic study. Plants with pinnate-pinnatisect fronds, similar to *A. sampsonii* but without reduced basal pinnae, most probably belong to this species. Indian plants are tetraploid, but the chromosome number of Chinese material is unknown.

**89. *Asplenium ritoense* Hayata, Icon. Pl. Formosan. 4: 226. 1914.**

骨碎补铁角蕨 *gu sui bu tie jiao jue*

?*Asplenium dareoideum* (Mettenius) Makino; *A. davalloides* Hooker (1857), not Tausch (1839); ?*Humata dareoidea* Mettenius.

Plants 20–40 cm tall. Rhizome erect, short, apex scaly; scales dark brown, narrowly triangular, margin fimbriate. Fronds caespitose, dimorphic, sterile fronds reduced in size and division; stipe green, base dull purplish or green, 7–22 cm, base scaly, upward with hairlike scales or subglabrous, sulcate and with supravascular ridge and narrow lateral wings on adaxial side; lamina triangular to broadly triangular-ovate, 11–17 × 5–7 cm, apex acuminate or caudate, tripinnate-pinnatifid; pinnae 10–12 pairs, alternate, stalked, basal pair largest, narrowly triangular, 3–7.5 × 1.6–3 cm, base broadly cuneate, nearly symmetrical, 2-pinnate, apex acute-acuminate; pinnules 5–9 pairs, anadromous, acroscopic pinnules larger than basicopic, ovate-triangular, 1–2.5 × 0.7–1.3 cm, base cuneate and decurrent on pinnule stalk, pinnate, apex subacute; ultimate segments 4 or 5 pairs, basal acroscopic segment largest and 5–8 × 3–6 mm, 2- or 3-lobate, ultimate segments oblong, up to 2 mm, furcate or simple, apex subobtuse to mucronate or acute. Costa and veins with raised supravascular ridge on adaxial side, 1 vein per seg-

ment, not reaching margin. Frond subfleshy when living, thin, green when dry; rachis raised on both sides, narrowly winged. Sori 1 per segment, distal on subtending vein and ± as long as subtending segment but not reaching its apex, oval to linear, 2–4 mm; indusia yellowish brown, semi-elliptic, membranous, margin with reddish glands, often rolling back at maturity, opening toward its costule and margin. Plants tetraploid:  $2n = 144$ .

On rocks in lowland forests; 100–1900 m. Fujian, Guangdong, Guizhou, Hainan, Jiangxi, Taiwan, Zhejiang [Japan, Korea].

We were unable to trace Mettenius's type specimen of *Humata dareoidea* in Berlin (B). If it belongs to *Asplenium ritoense*, then Makino's combination is to be used. *Asplenium ×shikokianum* Makino, the hybrid between *A. ritoense* and octoploid *A. wrightii*, is not uncommon where the parents grow together (e.g., Guizhou, Taiwan).

**90. *Asplenium trigonopterum* Kunze, Bot. Zeitung (Berlin) 6: 524. 1848.**

台南铁角蕨 *tai nan tie jiao jue*

*Asplenium mertensianum* Kunze.

Plants 50–90 cm tall. Rhizome shortly creeping to erect, scaly. Stipe terete to semiterete, sulcate toward rachis, ca. 40 cm, base dull brown or green, with pale brown, narrowly triangular scales, 8–10 × 1.5–2 mm with basal margin fimbriate. Lamina ovate-oblong, 40–50 × 22–25 cm, apex acute, 3-pinnate or 4-pinnatifid; pinnae 10–15 pairs, lower pinnae opposite or subopposite, close to each other, stalk 0.6–1 cm, upper pinnae alternate, 1–3 pairs of basal pinnae not reduced, ovate-triangular, 12–17 × 3–7 cm, base broadly cuneate, 2-pinnate, apex acute; pinnules 9–11 pairs, anadromous, stalked, basal pair longest, narrowly triangular to ovate, 5–7 × 2–2.5 cm, base cuneate, pinnate, apex subacute; ultimate segments alternate, basal acroscopic segment largest, oblong, 3–4 × 1–5 mm, bifurcate or simple, apex subacute to obtuse. Veins raised on adaxial surface, 1 per ultimate segment, not reaching margin. Fronds fleshy, green, with small hastate-stellate scales on abaxial surface; rachis and costa green, sulcate adaxially, with narrow lateral wings. Sori 1 per pinnule, median on subtending veinlet, oval to linear, 3–5 mm; indusia grayish, oval to broadly linear, membranous, entire, opening toward costule and margin, persistent. Plants agamosporous, octoploid:  $2n = 286$ .

Taiwan [Japan (Bonin Islands, Ryukyu Islands)].

*Asplenium trigonopterum* has not been found recently and was not included in modern floras of Taiwan (De Vol & Kuo, Fl. Taiwan 1: 1–562. 1975; Shieh et al., Fl. Taiwan, ed. 2, 1–648. 1994; Knapp, Ferns Fern Allies Taiwan, 1–1052. 2011), and its actual occurrence on the island requires confirmation.

#### Uncertain taxa

*Asplenium fangii* Ching (Bull. Fan Mem. Inst. Biol., n.s., 1: 276. 1949), described from Sichuan. The type in PE(!) represents a species of *Diplazium* s.l.

*Asplenium pekinense* Hance var. *nanum* Christ (Nuovo Giorn. Bot. Ital., n.s., 17(2): 225. 1910), described from Hubei. Type (*Silvestri* 7, FI) not seen, probably a dwarf form of *A. pekinense*.

*Asplenium pseudofalcatum* Hillebrand f. *obtusatum* Rosenstock (Hedwigia 56: 334. 1915), described from Taiwan. Type (*Faurie* 455bis) not seen, probably a form of *A. cuneatifforme*.

*Asplenium pseudofalcatum* Hillebrand var. *subintegrum* Rosenstock (Hedwigia 56: 334. 1915), described from Taiwan. The isotype in

MICH (photo!) is probably *A. cuneatiforme* but is close to *A. lobulatum* Mettenius ex Kuhn. The relationship of these taxa needs more study.

(photo!) resembles *A. austrochinense*, but this taxon should be confirmed for Taiwan.

*Asplenium wilfordii* Mettenius ex Kuhn var. *densum* Rosenstock (Hedwigia 56: 334. 1915), described from Taiwan. The isotype in NY

*Neottopteris longistipitata* R. H. Miao (Acta Sci. Nat. Univ. 1: 99. 1980), described from Hainan.

## 2. HYMENASPLENIUM Hayata, Bot. Mag. (Tokyo) 41: 712. 1927.

膜叶铁角蕨属 mo ye tie jiao jue shu

*Boniniella* Hayata.

Herbs, epilithic, epiphytic, or terrestrial. Rhizome dorsiventral, thin, up to ca. 5 mm in diam., widely creeping, with clathrate scales. Fronds herbaceous, remote; stipe usually shiny and castaneous to dark purplish or black, rarely grayish green, semiterete abaxially, sulcate adaxially; lamina 1-pinnate, rarely simple; rachis sulcate adaxially, basispic margin of pinnae often decurrent and forming narrow abaxial wings on rachis; pinnae asymmetrical with basal basispic part cut away and becoming dimidiate; basispic margin entire, acrosopic margin crenate, undulate, or serrate, sometimes with retuse teeth. Veins free, rarely anastomosing, anadromously branching, becoming simple toward pinna apex, not reaching margin, 1 to several basal basispic veins lacking. Sori solitary, rarely double, linear to subelliptic, indusiate; indusium thinly membranous to papery, free margin entire to erose; stalks of sporangia long uniseriate, annuli of 20–28 hardened cells. Spores bilateral, elliptic, perispore elaborate, exospore smooth; in sexual plants 64 spores per sporangium. Plants sexual or agamosporous.  $x = (36), 38, 39$ .

More than 30 species: pantropical; 18 species complexes (eight endemic) in China.

*Hymenasplenium* was described by Hayata for *Asplenium unilaterale* Lamarck and based on the peculiar vascular system of its dorsiventral rhizome. It was later reduced to a section of *Asplenium* by Iwatsuki (Acta Phytotax. Geobot. 27: 44. 1975). Recent molecular phylogenetic analyses show that *Hymenasplenium* is the most basally diverged genus in Aspleniaceae, not closely related to any of the other members (Murakami, J. Plant Res. 108: 257–268. 1995).

Chromosome numbers of *Hymenasplenium* were first reported, by Manton and Sledge (Philos. Trans., Ser. B, 238: 138, 167. 1954) in *H. unilaterale* (Lamarck) Hayata s.l. from Sri Lanka, to be  $n = 80$  and  $2n = ca. 158$ . However, Mitui et al. (Amer. J. Bot. 76: 1691. 1989) showed that the basic chromosome number of *Hymenasplenium* is  $x = 39$ , with one exception being  $x = 38$  in *H. subnormale*. Apomictic reproduction was discovered in three unrelated Asian species, indicating that such reproductive mode evolved at least three times in the Asian group.

In a cytological study of *Asplenium cardiophyllum* s.l. (*Hymenasplenium ikenoi*, see p. 309), Kato et al. (Bot. Mag. (Tokyo) 103: 461–468. 1990) found that its basic number is also  $x = 39$  ( $n = 78$ ) and concluded that “*A. cardiophyllum*” should be included in *Hymenasplenium*, although this species has cordate simple leaves quite different from those of the other members of *Hymenasplenium*. The close relation between “*A. cardiophyllum*” and *Hymenasplenium* is supported by molecular studies (Murakami, loc. cit.: 267).

SW China (Yunnan) is the center of diversity of *Hymenasplenium*. The reports of morphologically intermediate or “transitional” forms as well as the existence of different cytotypes (ancestral sexual diploids and tetraploids next to agamosporous taxa) in this area suggest that *Hymenasplenium* is still in an active state of diversification. Reticulate evolution is not yet reported in this genus but may explain some of the intermediate forms and the difficulty in describing them as clearly and morphologically separate taxa. Because the distribution and relationships of the Asian “*unilaterale*” group are not well understood, the present treatment probably underestimates the number of species and reflects our limited knowledge of this group.

The name (*Hymen*)*asplenium unilaterale* has been used erroneously in SE Asia for several other taxa, such as *H. apogamum*, *H. hondoense*, and *H. murakami-hatanakae*. True *H. unilaterale* differs in its more strongly dimidiate pinnae, lacking (5–)7 or 8 basal basispic veins, its teeth that are not retuse, and the dark blackish rachis color that distinctly continues onto the costa abaxially. We have not so far found true *H. unilaterale* occurring in China. All Asian-Himalayan taxa require further study to discover their relationships with Chinese taxa. In particular, **Hymenasplenium rivulare** (Fraser-Jenkins) Viane & S. Y. Dong, **comb. nov.** (Basionym: *Asplenium rivulare* Fraser-Jenkins, Taiwania 53: 190. 2008, based on *A. unilaterale* var. *rivale* Beddome, Handb. Ferns Brit. India, 153. 1883, not *A. rivale* Baker (1867); “*A. hindusthanensis*” [sic!] Bir, Fern Gaz. 14: 309. 1994, not validly published, *Melbourne Code*, Art. 41.5) from S India needs attention, as Beddome’s drawing (Suppl. Ferns S. Ind. t. 356. 1876, under *A. resectum* var. *rivale*) shows both the venation pattern and the marginal retuse teeth with veins ending just below the minute notch, which are characteristic for the E Asian *H. retusulum*-*H. latidens* group.

- 1a. Frond simple ..... 1. *H. cardiophyllum*  
 1b. Frond pinnate.  
   2a. Sorus with a double indusium: an inner below sporangia and an outer covering them ..... 18. *H. pseudobscurum*  
   2b. Sorus with a single indusium, overlying sorus.  
     3a. Sori terminal on subtending vein and situated in marginal teeth ..... 2. *H. cheilosorum*  
     3b. Sori medial or inframedial, not in marginal teeth.  
       4a. Marginal teeth entire, rarely (semi)retuse, veins ending just below marginal teeth.  
         5a. Rachis abaxially dull, grayish green to brown.  
           6a. Pinnae usually less than 10(–15) pairs ..... 11. *H. subnormale*  
           6b. Pinnae usually more than 15 pairs ..... 12. *H. obscurum*  
       5b. Rachis abaxially shiny, castaneous to purplish black.

- 7a. Middle pinnae with usually more than 3 basal basispic veins lacking; dark rachis color abaxially extending onto basal part of costa.
- 8a. Lamina usually broadest at base, up to 18 cm wide; rachis abaxially blackish purple to black ..... 16. *H. excisum*
- 8b. Lamina widest near middle, less than 10 cm wide; rachis abaxially purplish castaneous ..... 17. *H. obliquissimum*
- 7b. Middle pinnae with up to 3 basal basispic veins lacking; dark rachis color abaxially extending into stipicel, rarely along costa (in *H. hondoense*).
- 9a. Pinnae spreading or deflexed, obtuse ..... 15. *H. apogamum*
- 9b. Pinnae ascending, subacute-acute.
- 10a. Stipes more than 5 mm apart; pinnae falcate; sori suprasedial-marginal; 1 or 2 basal basispic veins missing; 64 spores per sporangium ..... 13. *H. murakami-hatanakae*
- 10b. Stipes less than 5 mm apart; pinnae trapeziform to narrowly triangular-falcate; sori medial; 2 or 3 basal basispic veins missing; 32 spores per sporangium ..... 14. *H. hondoense*
- 4b. Marginal teeth retuse to emarginate due to a (shallow or deep) notch at their apex, most veins ending just below these notches.
- 11a. Margin shallowly and regularly incised, deepest incisions equal to less than 4 × deeper than notch above veins ..... 3. *H. wuliangshanense*
- 11b. Margin more deeply and irregularly incised, deepest incisions usually more than 4 × deeper than notch above veins.
- 12a. Marginal teeth 2.5–3.5 mm and obscurely retuse ..... 4. *H. retusulum*
- 12b. Marginal teeth up to 2 mm and distinctly retuse.
- 13a. Stipe and rachis floccose-scaly, pinnae acute ..... 5. *H. furfuraceum*
- 13b. Stipe and rachis subglabrous, pinnae subacute to truncate-obtuse.
- 14a. Pinnae lunate-falcate, apex subacute to acute, rarely obtuse.
- 15a. Acroscopic pinna margin bicrenate, rachis abaxially purplish castaneous ..... 9. *H. adiantifrons*
- 15b. Acroscopic pinna margin bicrenate-serrate, rachis abaxially purple ..... 10. *H. changputungense*
- 14b. Pinnae trapeziform, apex usually truncate or obtuse, rarely subacute.
- 16a. Pinnae spreading, up to 20 pairs; stipe castaneous-purple ..... 8. *H. quercicola*
- 16b. Pinnae ascending, more than 20 pairs; stipe dark purplish.
- 17a. Sori inframedial; pinna margin coarsely crenate-serrate; purple rachis color continued into stipicel abaxially ..... 6. *H. szechuanense*
- 17b. Sori medial; pinna margin regularly bicrenate-serrate; purple rachis color not continued into stipicel abaxially ..... 7. *H. latidens*

**1. *Hymenasplenium cardiophyllum*** (Hance) Nakaike, Ill. Pterid. Jap. 8: 419. 1997.

细辛膜叶铁角蕨 xi xin mo ye tie jiao jue

*Micropodium cardiophyllum* Hance, J. Bot. 21: 268. 1883; *Antigramma cardiophylla* (Hance) Tardieu; *Asplenium cardiophyllum* (Hance) Baker; *Boniniella cardiophylla* (Hance) Tagawa; *Phyllitis cardiophylla* (Hance) Ching.

Plants up to 30 cm tall. Rhizomes long creeping, with scales and some yellowish brown hairs; scales blackish brown, ovate-triangular, small, margins sparsely toothed, and caducous on older rhizome parts. Fronds well separated, simple, thinly papery, dark to brownish green when dry, subglabrous; stipe shiny, dark brown to black, 10–20 cm, terete but with adaxial groove, base with scales and hairs; lamina simple, ovate, 9–14 × 5–9 cm, base cordate, margin entire or shallowly sinuate, apex acute to acuminate. Midrib (rachis) obvious abaxially, shiny and black to ca. middle of leaf, lateral veins anadromous, slender, and hardly visible on adaxial side, occasionally connected and forming elongate areoles near margin, vein ends

free. Sori linear, usually solitary on acroscopic veins, rarely opposite; indusia persistent, brownish, linear, thinly membranous, entire. Spores elliptic, average exospore length 21–24 μm, perispore with narrow crests (alae). Plants sexual and diploid.

On rocks or sandy soils in forests near streams. Hainan [Vietnam (Cao Bang)].

*Hymenasplenium cardiophyllum* is often classified under *Boniniella* Hayata (Bot. Mag. (Tokyo) 41: 709. 1927), an endemic genus of E Asia here included in *Hymenasplenium*. Recent flow cytometric and cytological studies show that this taxon includes two cytologically different species: tetraploid *Hymenasplenium ikenoi* (Makino) Viane, **comb. nov.** (Basionym: *Scolopendrium ikenoi* Makino, Bot. Mag. (Tokyo) 13: 130. 1899; *Boniniella ikenoi* (Makino) Hayata; *Phyllitis ikenoi* (Makino) C. Christensen), from Japan (Ryukyu Islands and Bonin Islands), and diploid *H. cardiophyllum* from China. Apart from their different chromosome number these taxa can also be separated by their average exospore length (21–24 μm for diploid *H. cardiophyllum* vs. 28–32 μm for tetraploid *H. ikenoi*). However, further studies need to unravel their exact relationships. Plants from Vietnam and Thailand (Boonkerd & Pollawatn, Sci. Asia 38: 125–128. 2012) require further study as to their ploidy level and true identity, as spore size of the Thai plants suggest a hexaploid situation.

A study of its dorsiventral dictyostele, raphides, chromosome number, and perispore led Kato et al. (Bot. Mag. (Tokyo) 103: 461–468. 1990) to include *H. ikenoi* in *Hymenasplenium*. The chromosome number of  $2n = 156$  (Kato et al., loc. cit.: 463) indicates that *H. ikenoi* is a tetraploid with a basic chromosome number of  $x = 39$ ; this recent count is in agreement with the  $n = 78$  bivalents that can be counted on the photograph published by Kurita (Rep. (Annual) Foreign Students' Coll. Chiba Univ. 7: 48. 1972). A base chromosome number of  $x = 38$  or 39 coincides with that of *Hymenasplenium*.

Kato et al. (loc. cit.: 467) suggested a closer affinity of *Hymenasplenium ikenoi* to *H. excisum*, *H. apogamum*, and *H. obscurum* than to *H. cheilosorum* and the group of *H. cataractarum*, *H. hondoense*, and *H. obliquissimum*. However, recent molecular studies seem to show that *H. ikenoi* is more closely related to the *H. hondoense*, *H. apogamum*, and *H. cataractarum* clade, and that it originated recently from the ancestor of the above three species (Murakami, J. Plant Res. 108: 257–268. 1995).

## 2. *Hymenasplenium cheilosorum* (Kunze ex Mettenius) Tagawa, Acta Phytotax. Geobot. 7: 84. 1938.

齿果膜叶铁角蕨 *chi guo mo ye tie jiao jue*

*Asplenium cheilosorum* Kunze ex Mettenius, Abh. Senckenberg. Naturf. Ges. 3: 133. 1859; *A. heterocarpum* Wallich ex Hooker (1859), not Blume (1828).

Plants 25–60 cm tall. Rhizome long creeping, 2.5–4 mm in diam., apex scaly; scales narrowly triangular to triangular, entire or sparsely fimbriate at base. Fronds up to ca. 5 mm apart, dark green when dry, membranous-herbaceous, subglabrous; stipe grayish black to dark purplish, shiny, 10–20 cm, base with scales similar to those on rhizome; lamina 1-pinnate, narrowly oblong-triangular, 15–35 × 3–5(–7) cm, truncate at base, acuminate-caudate at apex; rachis shiny, dark purplish; pinnae 25–40 pairs, almost sessile, rectangular to trapeziform or lunate, 1.8–2.5(–3.6) × 0.5–0.9 cm, dimidiate, apex obtuse, base asymmetrical, acroscopic side truncate to cuneate and parallel to rachis, basicopic side cut away and narrowly cuneate and entire, acroscopic margin deeply crenate to dentate with lobes (ca. 1 mm wide) cut up to 1/4–2/5 of way to costa, lower pinnae spreading or deflexed, upper pinnae ascending. Veins distinct, forking and free, 1 vein per marginal lobe and ending below sharp tooth, basicopic side with 6 or 7 veins lacking. Sori linear, 1–3 mm, at tip of subtending veins and located in marginal teeth; indusia persistent, yellowish brown to deep brown, semi-elliptic, membranous, entire. Plants sexual diploids ( $2n = 78$ ), agamosporous triploids with " $n$ " =  $2n = 117$ , or tetraploids ( $2n = 156$ ).

In soil or on wet rocks along streams in forests; 500–1800 m. Fujian, Guangdong, Guangxi, Guizhou, Hainan, Taiwan, Xizang, Yunnan, Zhejiang [Bhutan, India, Indonesia, Japan, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam].

As presently circumscribed, *Hymenasplenium cheilosorum* is an aggregate of a widespread triploid agamosporous taxon and probably more local (Yunnan) sexual (diploid) and tetraploid (Guizhou) taxa. This distinctive complex was examined cytologically by Mehra and Bir (Cytologia 25: 17–27. 1960) using Himalayan material and later again by Mitui et al. (Amer. J. Bot. 76: 1689–1697. 1989) using Japanese plants. Mehra and Bir (loc. cit.) listed E Himalayan *H. cheilosorum* as a triploid agamosporous plant but with the incorrect chromosome number of " $n$ " = 108 (based on  $x = 36$ ). Mitui et al. (loc. cit.: 1690–1691)

showed that both Himalayan and Japanese *H. cheilosorum* are apomictic and triploid, but with " $n$ " =  $2n = 117$  (based on  $x = 39$ ) chromosomes. Cheng and Murakami (J. Plant Res. 111: 495–500. 1998) found an ancestral sexual diploid taxon in Yunnan, with spore mother cells showing 39 bivalents at metaphase I, but without describing it formally as a separate species. We found a single tetraploid population in Guizhou (Yaoren Shan). Species of this alliance can be distinguished from the closely related, also sexually reproducing, *H. inthanonense* N. Murakami & J. Yokoyama from N Thailand, by their more terminal sori and more dimidiate pinnae.

## 3. *Hymenasplenium wuliangshanense* (Ching) Viane & S. Y. Dong, **comb. nov.**

无量山膜叶铁角蕨 *wu liang shan mo ye tie jiao jue*

Basionym: *Asplenium wuliangshanense* Ching, Acta Phytotax. Sin. 10: 186. 1965.

Plants 20–30 cm tall. Rhizome long creeping, 1.5–2 mm in diam., apex scaly; scales narrowly triangular to triangular. Fronds remote, up to 10 mm apart, green to brown-green when dry, herbaceous, subglabrous; stipe shiny, dark purplish black, 5–10 cm, base with scales similar to those on rhizome or subglabrous; lamina 1-pinnate, narrowly oblong-triangular, 12–19 × 3.5–5 cm, truncate at base, acuminate to caudate at apex; rachis shiny, purple to purplish black; pinnae 20–30 pairs, almost sessile, rectangular to trapeziform or slightly lunate, middle pinnae 1.6–2.6 × 0.5–0.7 cm, dimidiate, apex obtuse, base asymmetrical, acroscopic side truncate to cuneate and parallel to rachis, basicopic side cut away and narrowly cuneate and entire, acroscopic margin crenate-serrate with deeply retuse teeth; pinnae spreading, basal pinnae slightly reduced. Veins distinct, forking and free, each vein ending below a marginal notch, basicopic side with 3 or 4 veins lacking. Sori medial to inframedial, elliptic, 2–5 mm; indusia persistent, yellowish brown to deep brown, semi-elliptic, membranous, entire, opening toward costa.

- On shaded wet rocks by streams; 1900–2700 m. W Yunnan.

*Hymenasplenium wuliangshanense* is most similar to the following taxa: *H. furfuraceum* to *H. changputungense*. The upper margin of its pinnae is finely and regularly denticulate, with relatively deep notches (often as deep as the teeth) so that there is no obvious difference between a notch and a "normal" sinus. *Hymenasplenium latidens* has slightly coarser teeth and more medial sori. It is also similar to *H. adiantifrons*, which has a more coarsely cut margin and a more castaneous-purple rachis. Future research will have to establish the true relationships in this group. This and the following seven species form a group of related taxa that can best be distinguished by their veins that terminate below a notch in each marginal tooth. A similar taxon, *Asplenium ofeliae* Soldago, is known from the Philippines.

## 4. *Hymenasplenium retusulum* (Ching) Viane & S. Y. Dong, **comb. nov.**

微凹膜叶铁角蕨 *wei ao mo ye tie jiao jue*

Basionym: *Asplenium retusulum* Ching, Acta Phytotax. Sin. 10: 185. 1965.

Plants 20–30 cm tall. Rhizome long creeping, 1.5–3 mm in diam., apex scaly; scales narrowly triangular to triangular. Fronds remote, up to 12 mm apart, green when dry, membra-

nous-herbaceous, subglabrous; stipe shiny, dark purplish black, 4–12 cm, base with yellowish brown indument, some scales similar to those on rhizome, or subglabrous; lamina 1-pinnate, narrowly oblong-triangular, 15–20 × 3–4.5 cm, truncate at base, apex acuminate; rachis shiny, purplish; pinnae 18–25 pairs, almost sessile, rectangular to trapeziform, middle pinnae 2.2–2.6 × 0.5–0.7 cm, dimidiate, apex obtuse, base asymmetrical, acroscopic side truncate to cuneate and parallel to rachis, basiscopic side cut away and narrowly cuneate and entire, acroscopic margin with deep crenate incisions (1–2 × ca. 1 mm) with lobes minutely retuse; pinnae spreading, basal pinnae slightly reduced. Veins distinct, forking and free, 1 vein per marginal lobe, vein ending below marginal notch, basiscopic side with 3 or 4 veins lacking. Sori inframedial, elliptic, 3–4 mm; indusia persistent, yellowish brown to brown, semi-elliptic, membranous, entire, opening toward costa. Plants sexual.

- On rocks in mixed forests; ca. 2000 m. SE Yunnan.

*Hymenasplenium retusulum* is similar to the following taxa from which it differs in its more deeply cut acroscopic margins with relatively long and obtuse teeth, which are only minutely retuse at their tips. Due to confusion with similar taxa, the relationships and the distribution of this species are not well known.

##### 5. *Hymenasplenium furfuraceum* (Ching) Viane & S. Y. Dong, **comb. nov.**

绒毛膜叶铁角蕨 *rong mao mo ye tie jiao jue*

Basionym: *Asplenium furfuraceum* Ching, Acta Phytotax. Sin. 10: 190. 1965.

Plants 20–30 cm tall. Rhizome long creeping, 1.5–2 mm in diam., apex scaly; scales narrowly triangular to triangular. Fronds remote, up to 12 mm apart, green when dry, herbaceous, subglabrous; stipe slightly shiny, purplish castaneous, 4.5–12 cm, with orange-brown woolly-floccose indument of reduced scales, or subglabrous; lamina 1-pinnate, narrowly oblong-triangular, 12–19 × 3.5–5 cm, base truncate and slightly reduced, apex acuminate to caudate; rachis shiny and purple to purplish castaneous, with similar indument to that of stipe or subglabrous; pinnae 20–25 pairs, almost sessile and color of rachis entering base of stipicel abaxially, trapeziform, middle pinnae 1.6–2.6 × 0.5–0.9 cm, dimidiate, apex acute, base asymmetrical, acroscopic side truncate and parallel to rachis, basiscopic side cut away and narrowly cuneate and entire, acroscopic margin crenate-serrate with retuse teeth; pinnae spreading to slightly erect, basal pinnae slightly reduced and deflexed. Veins distinct, forking and free, each vein ending below a marginal notch, basiscopic side with 3 or 4 veins lacking. Sori medial, elliptic, 2–4.5 mm; indusia persistent, brown, semi-elliptic, membranous, entire, opening toward costa.

- On rocks by streams. W Yunnan.

*Hymenasplenium furfuraceum* differs from similar taxa by its more densely floccose rachis and stipe. Due to confusion with similar species, the relationships and distribution of this species are not well known. Sporangia contain 64 spores, thus the plants are probably sexual.

##### 6. *Hymenasplenium szechuanense* (Ching) Viane & S. Y. Dong, **comb. nov.**

天全膜叶铁角蕨 *tian quan mo ye tie jiao jue*

Basionym: *Asplenium szechuanense* Ching, Acta Phytotax. Sin. 10: 188. 1965.

Plants 25–40 cm tall. Rhizome long creeping, 1.5–2.5 mm in diam., apex scaly; scales dark brown to blackish, narrowly triangular to triangular. Fronds remote, up to 13 mm apart, green to brownish dark green when dry, herbaceous, subglabrous; stipe shiny, dark purplish, 7–15 cm, base with narrow scales similar to those on rhizome, with brownish indument or subglabrous; lamina 1-pinnate, narrowly oblong-triangular, 15–25 × 3–5 cm, base truncate, apex acuminate to caudate; rachis shiny and purple to castaneous-purple, subglabrous; pinnae 20–25 pairs, almost sessile and color of rachis entering stipicel and base of costa abaxially, trapeziform to trapeziform-lunate, middle pinnae 1.5–2.3 × 0.7–1 cm, dimidiate, apex truncate to obtuse, base asymmetrical, acroscopic side truncate and parallel to rachis, basiscopic side cut away and narrowly cuneate and entire, acroscopic margin coarsely crenate-serrate with retuse teeth; pinnae erect, basal pinnae slightly reduced. Veins distinct, forking and free, each vein ending below a marginal notch, basiscopic side with 3 or 4 veins lacking. Sori inframedial, elliptic, 3–4.5 mm; indusia persistent, brown, semi-elliptic, membranous, entire, opening toward costa.

- On rocks by streams. Sichuan, Yunnan.

*Hymenasplenium szechuanense* is similar to *H. furfuraceum* from which it differs in its much less floccose to subglabrous rachis and stipe, its inframedial sori, and its more reddish purple rachis. It differs from *H. quercicola* in its inframedial sori and more dark purple stipe. *Hymenasplenium latidens* is also similar but differs by the characters given in the key and by its slightly more numerous pinna pairs; future research will have to show their relationship. All these taxa also resemble *H. obliquissimum* but that species has its veins ending in marginal teeth, not below a notch in a marginal tooth as in this group. Due to confusion with similar taxa, the relationships and the distribution of this species are not well known.

##### 7. *Hymenasplenium latidens* (Ching) Viane & S. Y. Dong, **comb. nov.**

阔齿膜叶铁角蕨 *kuo chi mo ye tie jiao jue*

Basionym: *Asplenium latidens* Ching, Acta Phytotax. Sin. 10: 187. 1965 [*latidens*].

Plants 25–40 cm tall. Rhizome long creeping, 1.5–2.5 mm in diam., apex scaly; scales dark brown, narrowly triangular to triangular. Fronds remote, up to 13 mm apart, green to brownish dark green when dry, herbaceous, subglabrous; stipe shiny, dark purplish, 9–10(–15) cm, base with narrow scales similar to those on rhizome, with brownish indument or subglabrous; lamina 1-pinnate, narrowly oblong-triangular, 15–25 × 3–5 cm, base truncate, apex acuminate to caudate; rachis shiny, purple, subglabrous; pinnae up to 30 pairs, almost sessile and color of rachis not entering stipicel abaxially, trapeziform to trapeziform-lunate, middle pinnae 2–2.6 × 0.5–0.9 cm, dimidiate, apex truncate to obtuse, base asymmetrical, acroscopic side truncate and parallel to rachis, basiscopic side cut away and narrowly cuneate and entire, acroscopic margin shallowly and regularly biconcave-serrate with retuse teeth; pinnae ascending, basal pin-

nae slightly reduced. Veins distinct, forking and free, each vein ending below a marginal notch, basiscopic side with 3 or 4 veins lacking. Sori medial, elliptic, 2–4 mm; indusia persistent, brown, semi-elliptic, membranous, entire, opening toward costa.

- On rocks; 1800–1900 m. SE Yunnan (Wenshan).

Due to confusion with similar taxa, the relationships and the distribution of *Hymenasplenium latidens* are not well known. *Hymenasplenium szechuanense* is very similar but differs by the characters given in the key and above.

**8. *Hymenasplenium quercicola* (Ching) Viane & S. Y. Dong, *comb. nov.***

镇康膜叶铁角蕨 *zhen kang mo ye tie jiao jue*

Basionym: *Asplenium quercicola* Ching, Acta Phytotax. Sin. 10: 188. 1965.

Plants 20–35 cm tall. Rhizome long creeping, 1.5–2.5 mm in diam., apex scaly; scales dark brown to blackish, narrowly triangular to triangular. Fronds remote, up to 12 mm apart, green to brownish dark green when dry, herbaceous, subglabrous; stipe shiny, castaneous-purple, 7–14 cm, base with scales similar to those on rhizome, or subglabrous; lamina 1-pinnate, narrowly oblong-triangular, 15–22 × 3–5 cm, base truncate and slightly reduced, apex acuminate to caudate; rachis shiny, purple to castaneous-purple, pinnae 15–20 pairs, almost sessile and color of rachis not entering base of stipicel abaxially, trapeziform, middle pinnae 1.5–2.5 × 0.7–1 cm, dimidiate, apex truncate to obtuse, base asymmetrical, acroscopic side truncate and parallel to rachis, basiscopic side cut away and narrowly cuneate and entire, acroscopic margin crenate-serrate with retuse teeth, pinnae spreading, basal pinnae slightly reduced and deflexed. Veins distinct, forking and free, each vein ending below a relatively shallow marginal notch, basiscopic side with 3 veins lacking. Sori medial, linear, 3–4 mm; indusia persistent, brown, semi-elliptic, membranous, entire, opening toward costa.

- Epiphytic on *Quercus* trees; 2400–2700 m. Yunnan.

*Hymenasplenium quercicola* is most similar to *H. szechuanense* from which it differs in its more castaneous-purple stipe, more spreading pinnae, and more medial sori. Several sporangia of the type have an orange color and appear collapsed or not fully developed, typical features of hybrids in this family. Due to confusion with similar species, the relationships and the distribution of this taxon are not well known.

**9. *Hymenasplenium adiantifrons* (Hayata) Viane & S. Y. Dong, *comb. nov.***

阿里山膜叶铁角蕨 *a li shan mo ye tie jiao jue*

Basionym: *Asplenium resectum* Smith f. *adiantifrons* Hayata, Icon. Pl. Formosan. 4: 226. 1914; *Asplenium adiantifrons* (Hayata) Ching.

Plants 18–40(–45) cm tall. Rhizome long creeping, 1.5–2.5 mm in diam., apex scaly; scales narrowly triangular to triangular. Fronds remote, up to 12 mm apart, green to brownish dark green when dry, herbaceous, subglabrous; stipe shiny, castaneous-purple, 5–20 cm, base with scales similar to those on rhizome or subglabrous; lamina 1-pinnate, narrowly oblong-

triangular, 10–25 × 2–5 cm, base truncate and slightly reduced, apex acuminate to caudate; rachis shiny, castaneous-purple; pinnae 20–30 pairs, almost sessile and color of rachis not entering base of stipicel abaxially, trapeziform to slightly lunate, middle pinnae 1.2–2.2 × 0.5–0.7 cm, dimidiate, apex subacute to obtuse, base asymmetrical, acroscopic side truncate and parallel to rachis, basiscopic side cut away and narrowly cuneate and entire, acroscopic margin crenate with retuse teeth; pinnae spreading, basal pinnae slightly reduced and deflexed. Veins distinct, forking and free, each vein ending below relatively shallow marginal notch, basiscopic side with 3 or 4 veins lacking. Sori inframedial, linear, 3–4 mm; indusia persistent, brown, semi-elliptic, membranous, entire, opening toward costa.

- Forests, often on slopes in moist to wet conditions; 1000–2200 m. Taiwan.

Our description of *Hymenasplenium adiantifrons* differs from Ching's, which was solely based on the type and the drawing of Hayata. Although Ching (Acta Phytotax. Sin. 10: 187–188. 1965) compared this taxon essentially to *H. latidens*, it is morphologically also similar to *H. changputungense* and *H. szechuanense*. In the literature (Kurata, J. Geobot. 11: 67–68. 1962; Sugimoto, Keys Herb. Pl. Jap. Pterid. 356, 406. 1966; Nakaike, Enum. Pterid. Jap. 97. 1975), this species has sometimes been synonymized or confused (Taiwan) with *H. filipes* (Copeland) Sugimoto (Philippines) from which it differs, i.a., by its retuse marginal teeth (entire in *H. filipes*), its shiny stipe and rachis (almost dull in *H. filipes*), and spreading pinnae (pointing upward in *H. filipes*).

**10. *Hymenasplenium changputungense* (Ching) Viane & S. Y. Dong, *comb. nov.***

贡山膜叶铁角蕨 *gong shan mo ye tie jiao jue*

Basionym: *Asplenium changputungense* Ching, Acta Phytotax. Sin. 10: 188. 1965.

Plants 28–40 cm tall. Rhizome long creeping, 2–3 mm in diam., apex scaly; scales dark brown, narrowly triangular to triangular. Fronds remote, up to 12 mm apart, green to brownish dark green when dry, herbaceous, subglabrous; stipe shiny, dark purple, 10–20 cm, with yellowish hairs or subglabrous; lamina 1-pinnate, narrowly oblong-triangular, 12–18 × 2.5–4.5 cm, base truncate and slightly reduced, apex acuminate to caudate; rachis shiny, purple, with yellowish hairs or subglabrous; pinnae 20–25 pairs, almost sessile and color of rachis entering stipicel and base of costa abaxially, trapeziform to slightly lunate or upper pinnae subfalcate, middle pinnae 1.3–2.7 × 0.4–0.7 cm, dimidiate, apex subacute to obtuse, base asymmetrical, acroscopic side truncate and parallel to rachis, basiscopic side cut away and narrowly cuneate and entire, acroscopic margin bicrenate to biserrate with retuse teeth; pinnae spreading to ascending, basal pinnae slightly reduced and deflexed. Veins distinct, forking and free, vein ending below relatively shallow marginal notch, basiscopic side with (3 or)4 veins lacking. Sori inframedial to medial, linear, 2.5–4 mm; indusia persistent, brown, semi-elliptic, membranous, entire, opening toward costa.

- Mountain slopes; ca. 2000 m. NW Yunnan.

*Hymenasplenium changputungense* is morphologically closest to *H. adiantifrons*, *H. szechuanense*, and *H. furfuraceum*. However, the relationships and the distribution of these taxa are not well known and need further study.

**11. *Hymenasplenium subnormale*** (Copeland) Nakaike, New Fl. Japan, 841. 1992.

小膜叶铁角蕨 xiao mo ye tie jiao jue

*Asplenium subnormale* Copeland in Perkins, Fragm. Fl. Philipp. 183. 1905.

Plants 15–20 cm tall. Rhizome long creeping, ca. 3 mm in diam., apex scaly; scales narrowly triangular to triangular. Fronds remote, up to 5 mm apart, brown grayish green when dry, herbaceous, subglabrous; stipe slightly shiny, dark purple-brown to black abaxially, 5–6 cm, sparsely scaly to subglabrous; lamina 1-pinnate, ovate-triangular, 9–12 × 5–6 cm, base truncate and slightly reduced, apex acute; rachis grayish green, base slightly shiny and purple, with scales or subglabrous; pinnae up to 10 pairs, distinctly stalked, stipel broadly falcate-trapeziform, up to 0.3 cm, middle pinnae 2.5–3 × 0.8–1.3 cm, dimidiate, apex obtuse, base asymmetrical, acroscopic side semicordate to truncate and parallel to rachis, basicopic side of basal pinnae excavate (cut away), in middle pinnae becoming narrowly cuneate and entire, acroscopic margin serrate, teeth not retuse; pinnae spreading to ascending, basal pinnae slightly reduced and deflexed. Veins distinct, forking and free, ending below marginal tooth, basicopic side with 1 (or 2) vein(s) lacking. Sori medial, linear, 2–6 mm; indusia persistent, pale brown, semi-elliptic to linear, membranous, entire, mainly opening toward costa.

Moss-covered rocks in shaded humid ravines in forests; near sea level to 1000 m. Taiwan, SW Yunnan [Indonesia, Japan, Malaysia, Philippines].

The description of *Hymenasplenium subnormale* is based on the Yunnan material, which might represent an undescribed species. The type of *H. subnormale*, collected in the Philippines, is a smaller plant in general and differs also essentially from other members of *Hymenasplenium* in its venation pattern with none of the basicopic veins lacking (isotypes in MICH!, B!). Morphological variation within this taxon has been pointed out by Holttum (Revis. Fl. Malaya 2: 437–438. 1954) and Iwatsuki (Acta Phytotax. Geobot. 27: 51. 1975; Fl. Jap. 1: 108. 1995). Mitui et al. (Amer. J. Bot. 76: 1691. 1989) reported a base chromosome number of  $x = 38$  instead of the “normal”  $x = 39$  for most of the other species in the genus. They also found both diploids ( $n = 38$ ,  $2n = 78$ ) and tetraploids ( $n = 78$ ) in a collection from Ceram (Indonesia). Cheng and Murakami (J. Plant Res. 111: 495–500. 1998) reported a related diploid taxon (“*Asplenium latipinnum*,” nom. nud.) with  $n = 39$  from Yunnan, differing by its more inframedial sori, but without formally publishing it as a new taxon. This taxon is thus clearly an aggregate, and plants from outside of the Philippines may represent one or more related species. The whole complex needs a thorough revision.

**12. *Hymenasplenium obscurum*** (Blume) Tagawa, Acta Phytotax. Geobot. 7: 83. 1938.

绿杆膜叶铁角蕨 lü gan mo ye tie jiao jue

*Asplenium obscurum* Blume, Enum. Pl. Javae 2: 181. 1828; *A. erosodentatum* Blume; *A. obscurum* var. *angustum* Tagawa; *Hymenasplenium obscurum* var. *angustum* (Tagawa) Tagawa.

Plants 20–40 cm tall. Rhizome long creeping, 3–4.5 mm in diam., apex scaly; scales dark brown, narrowly triangular to triangular. Fronds remote, up to 10 mm apart, grayish green

when dry, papery to herbaceous, subglabrous; stipe dull green to grayish green when dry, not shiny or purple, 20(–25) cm, sparsely scaly to subglabrous; lamina 1-pinnate, narrowly ovate-triangular, 20–30 × 5–10 cm, base truncate, apex acuminate to caudate; rachis grayish green, subglabrous; pinnae 20–30 pairs, sessile to obscurely stalked, trapeziform-falcate, middle pinnae 3.5–7 × 0.8–1.3 cm, dimidiate, apex obtuse to subacute, base asymmetrical, acroscopic side truncate and parallel to rachis, basicopic side of basal pinnae excavate, in middle pinnae narrowly cuneate and entire, acroscopic margin serrate to crenate, teeth not retuse, pinnae spreading to ascending. Veins distinct, forking and free, ending below a marginal tooth, basicopic side with (3 or 4) (or 5) veins lacking. Sori medial, linear, 3–5 mm; indusia persistent, pale brown, semi-elliptic to linear, membranous, entire, opening toward costa.

Wet places in dense forests, on rocks along streams; 100–1600 m. Fujian, Guangdong, Guangxi, Guizhou, Hainan, ?Taiwan, Yunnan [India, Indonesia, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam; Africa].

Mitui et al. (Amer. J. Bot. 76: 1690–1691. 1989) reported that this species is a sexual tetraploid with  $2n = 156$  in Java (Indonesia). Cheng and Murakami (J. Plant Res. 111: 496. 1998) and Kato et al. (Bot. Mag. (Tokyo) 105: 105–124. 1992) reported related sexual diploid and tetraploid taxa from Yunnan (see under *Hymenasplenium pseudobscurum*), and we found hexaploids in Hainan; consequently, the taxon as here circumscribed is a complex with different cytotypes involved. Contrary to literature citations, *Asplenium serriforme* Mettenius is not listed here as a synonym because the drawing and the description by Mettenius (Abh. Senckenberg. Naturf. Ges. 3: 163. 1859) clearly state that it has retuse (“serraturae obtusae emarginato”) teeth, and thus it represents another taxon probably more related to the *H. adiantifrons* group.

In Taiwan most specimens formerly identified as *Hymenasplenium obscurum* have an inner and outer indusium and are *H. pseudobscurum* (Ralf Knapp, pers. comm.); the detailed occurrence of true *H. obscurum* in China needs more study, and its presence in Taiwan requires confirmation.

**13. *Hymenasplenium murakami-hatanakae*** Nakaike, New Fl. Japan, 841. 1992.

单边膜叶铁角蕨 dan bian mo ye tie jiao jue

*Asplenium cataractarum* Rosenstock (1915), not Blume (1828); *Hymenasplenium cataractarum* N. Murakami.

Plants 25–40 cm tall. Rhizome shortly creeping, 2–3 mm in diam., apex densely scaly; scales castaneous to dark brown, narrowly triangular; phyllopodia distinct, ca. 2 mm, ca. 10(–40) mm apart. Fronds grayish green when dry, herbaceous; lamina 1-pinnate, narrowly triangular to lanceolate, 10–20 × 3–5 cm, widest in basal 1/3, gradually narrowing toward apex, glabrous; stipe shiny, purple, 10–25 × 0.05–0.15 cm, subglabrous, base sparsely scaly; rachis shiny, purplish abaxially, adaxial side grooved and with 2 grayish green narrow wings; pinnae almost sessile to shortly stalked with purple rachis color extending via stipel up to 3 mm onto basal part of costa abaxially, 15–25 pairs, alternate, usually ascending, falcate to trapeziform, 2–3.5 × 0.6–1 cm, base asymmetrical, acroscopic side truncate, basicopic side attenuate-cuneate with ca. 1/2 cut away, acroscopic margin serrate, teeth usually not retuse, pinna apex (sub)acute. Veins forking and terminating in marginal teeth, only 1 or 2 basal basicopic veins lacking. Sori linear, 2–3 mm, supra-

medial to (sub)marginal, indusia brownish, linear, membranous, entire, opening toward costa. Plants diploid, sexual with  $2n = 78$ .

Usually on wet rocks near or in streams in forests. Jiangxi, Taiwan, Yunnan [Japan].

Due to the previous confusion in the *Hymenasplenium unilaterale* s.l. group, the distribution of *H. murakami-hatanakae* is not well known. As an ancestral diploid, it may have played an important role in the reticulate evolution of *Hymenasplenium* in Asia and along the Pacific. However, the elucidation of relationships in the “*unilaterale*” group will require much more micromorphological and molecular studies. True *H. unilaterale* may be largely absent from India, the Himalaya, and the Pacific region, where its nomenclature urgently needs to be brought in line with data published by Cheng and Murakami (J. Plant Res. 111: 495–500. 1998).

*Asplenium pubirhizoma* Ching & Z. Y. Liu, described from Sichuan, may represent a species of its own although it was considered a synonym of *A. unilaterale* s.l. by Wu (FRPS 4(2): 38. 1999); it is similar to *Hymenasplenium murakami-hatanakae* but differs in its gray, hairy scales and its more medial sori.

**14. *Hymenasplenium hondoense*** (N. Murakami & Hatanaka) Nakaike, New Fl. Japan, 841 1992.

东亚膜叶铁角蕨 dong ya mo ye tie jiao jue

*Asplenium hondoense* N. Murakami & Hatanaka, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 14: 191. 1988.

Plants 25–40 cm tall. Rhizomes shortly creeping, 2–3 mm in diam., apex densely scaly; scales castaneous to dark brown, narrowly triangular; phyllopodia distinct, ca. 2 mm tall, ca. 10 mm apart. Fronds grayish green when dry, herbaceous; lamina 1-pinnate, narrowly triangular to lanceolate, 10–20 × 3–5 cm, widest in basal 1/3, gradually narrowing toward apex, glabrous; stipe shiny, purple, 10–25 × 0.05–0.15 cm, subglabrous, base sparsely scaly; rachis shiny, purplish abaxially, adaxial side grooved and with 2 grayish green narrow wings; pinnae almost sessile to shortly stalked with rachis color extending via stipicel onto base of costa abaxially, 15–25 pairs, alternate, usually ascending, trapeziform to falcate, 2–3.5 × 0.6–1 cm, base asymmetrical, acroscopic side truncate, basicopic side attenuate-cuneate with 1/3–1/2 cut away, acroscopic margin serrate, teeth not retuse, pinna apex subacute to obtuse. Veins forking and terminating in marginal teeth, 2 or 3 (or 4) basal basicopic veins lacking. Sori linear, 4–5 mm, medial; indusia brownish, linear, membranous, entire, opening toward costa. Plants usually agamosporous.

Usually on wet rocks near streams in forests. Fujian, Guangxi, Sichuan [NE India, Japan, Korea, Nepal].

The distribution of *Hymenasplenium hondoense* is not well known due to confusion with other members of the genus. As presently circumscribed, this is a cytologically variable, aggregate species. Usually plants are agamosporous diploids (“ $n$ ” =  $2n = 72$ ) or triploids (“ $n$ ” =  $2n = 117$ ), but in China, sexual diploids and tetraploids exist. The elucidation of this aggregate and its relationships to the other SE Asian members of the “*unilaterale*” group will require more study.

**15. *Hymenasplenium apogamum*** (N. Murakami & Hatanaka) Nakaike, New Fl. Japan, 841. 1992.

无配膜叶铁角蕨 wu pei mo ye tie jiao jue

*Asplenium apogamum* N. Murakami & Hatanaka, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 14: 193. 1988.

Plants 25–40 cm tall. Rhizomes shortly creeping, 2–3 mm in diam., apex densely scaly; scales dark brown, narrowly triangular, entire; phyllopodia distinct, ca. 2 mm tall, 2–3 mm apart. Fronds grayish green when dry, herbaceous; lamina 1-pinnate, narrowly triangular to lanceolate, 10–20 × 3–5 cm, widest in basal 1/3, gradually narrowing toward apex, glabrous; stipe shiny, purple, 10–25 × 0.05–0.15 cm, subglabrous, base sparsely scaly; rachis shiny and purplish abaxially, adaxial side grooved and with 2 grayish green narrow wings; pinnae almost sessile to shortly stalked with rachis color extending via stipicel onto base of costa abaxially, 15–25 pairs, alternate, spreading or deflexed near stipe, quadrangular-trapeziform, 2–3.5 × 0.6–1 cm, base asymmetrical, acroscopic side truncate and parallel to rachis, subauriculate, basicopic side attenuate-cuneate, with 1/3–1/2 cut away, acroscopic margin serrate to sinuate, teeth not retuse, pinna apex obtuse to subacute. Veins forking and terminating in marginal teeth, only 1 or 2 basal basicopic veins lacking. Sori linear, 3–4 mm, medial; indusia brownish, linear, membranous, entire, opening toward costa.

Usually terrestrial along streams, broad-leaved forests, shaded areas, wet places; 200–500 m (in Taiwan). Taiwan, Yunnan [Japan (Ryukyu Islands), Laos, Thailand, Vietnam].

As circumscribed, *Hymenasplenium apogamum* is an aggregate species, which, according to Cheng and Murakami (J. Plant Res. 111: 496. 1998), is both morphologically and cytologically variable. In China (Yunnan), it consists of sexual diploids ( $n = 39$ ), sexual tetraploids ( $n = 78$ ), and the more widespread agamosporous triploids (“ $n$ ” =  $2n = 117$ ). In their 1998 publication (loc. cit.), Cheng and Murakami also recognized another triploid agamosporous taxon (“*H. laterpens*,” nom. nud) related to *H. apogamum* but differing in its more triangular leaves. As the distribution and relationships of the Asian “*unilaterale*” group are not well understood, the present treatment only reflects the current state of limited knowledge.

**16. *Hymenasplenium excisum*** (C. Presl) S. Lindsay, Thai Forest Bull., Bot. 37: 69. 2009.

切边膜叶铁角蕨 qie bian mo ye tie jiao jue

*Asplenium excisum* C. Presl, Epimel. Bot. 74. 1851; *A. resectum* Smith var. *rahaoense* Hayata; *A. subresectum* Copeland; *A. unilaterale* Lamarck f. *majus* C. Christensen; *A. unilaterale* var. *majus* (C. Christensen) Sledge; *A. unilaterale* var. *rahaoense* (Hayata) Hayata; *Hymenasplenium rahaense* (Hayata) H. Itô ex Tuyama; *H. unilaterale* (Lamarck) Hayata var. *rahaense* (Hayata) Nemoto.

Plants 40–60 cm tall. Rhizome long creeping, 3–5 mm in diam., apex scaly; scales blackish brown, narrowly triangular to triangular. Fronds remote, up to 8 mm apart, grayish to dark green when dry, herbaceous, subglabrous; stipe shiny and dark purple to black, 15–32 cm, sparsely scaly to subglabrous; lamina 1-pinnate, narrowly triangular to triangular, 20–40 × 10–18 cm, base truncate and widest, apex acuminate to caudate; rachis shiny, purplish black, subglabrous; pinnae 18–25 pairs, shortly stalked and blackish brown rachis color extending via stipicel onto costa abaxially, trapeziform-oblong to falcate, middle pin-

nae 5–8(–10) × 1.3–1.8(–2) cm, dimidiate, apex acute, base asymmetrical, acroscopic side truncate and often almost parallel to rachis, basiscopic side of basal pinnae excavate, in middle pinnae narrowly cuneate and entire, acroscopic margin serrate, teeth not retuse; pinnae spreading to ascending. Veins distinct, forking and free, ending below a marginal tooth, basiscopic side with (3 or)4–6 veins lacking. Sori medial, linear, 4–6 mm; indusia persistent, pale brown, semi-elliptic to linear, membranous, entire, opening toward costa.

Shaded wet places in dense forests, on rocks by streams, on tree trunks; 200–1700 m. Guangdong, Guangxi, Guizhou, Hainan, Taiwan, Xizang, Yunnan [Bhutan, India, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam; tropical Africa].

*Hymenasplenium excisum* represents a distinct species complex with sexual diploids ( $2n = 78$ ) and tetraploids ( $2n = 156$ ) in China (Yunnan) and Indonesia (Mitui et al., Amer. J. Bot. 76: 1691. 1989; Cheng and Murakami, J. Plant Res. 111: 496. 1998). Cheng and Murakami (loc. cit.) mentioned a new endemic species complex, "*H. costarisorum*," from two localities in S Yunnan, said to be similar to *H. excisum* in gross morphology but different in smaller size, larger number of pinnae, more strongly reflexed lower pinnae, and sori restricted to the distal part of the pinnae. This undescribed taxon containing two cytotypes, a sexual diploid ( $n = 36$ ) and a sexual tetraploid ( $n = 72$ ), has a basic chromosome number of  $x = 36$ , which is universal in Aspleniaceae, except *Hymenasplenium* (with  $x = 38$  and  $x = 39$ ). Molecular data (Murakami, J. Plant Res. 108: 257–268. 1995) showed that this "species" is closely related to *H. obscurum* (with a chromosome number of  $x = 39$ ).

"*Asplenium rahaoense*" (Y. Yabe ex Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo 22: 605. 1906) belongs here but is a nomen nudum and was not therefore validly published (*Melbourne Code*, Art. 38.1(a)).

**17. *Hymenasplenium obliquissimum*** (Hayata) Sugimoto, Keys Herb Pl. Jap. Pterid. 356, 406. 1966.

荫湿膜叶铁角蕨 yin shi mo ye tie jiao jue

*Asplenium unilaterale* Lamarck var. *obliquissimum* Hayata, Icon. Pl. Formosan. 4: 230. 1914; *A. obliquissimum* (Hayata) Sugimoto & Sa. Kurata; *A. resectum* Smith var. *obliquissimum* (Hayata) Hayata; *A. unilaterale* Lamarck var. *udum* Atkinson ex C. B. Clarke; *Hymenasplenium unilaterale* (Lamarck) Hayata var. *obliquissimum* (Hayata) Hayata ex Sasaki.

Plants 20–30 cm tall. Rhizomes shortly creeping, 1.5–2.5 mm in diam., apex densely scaly; scales grayish brown, broadly ovate-triangular; phyllopodia distinct, ca. 2 mm tall, up to 10 mm apart. Fronds very thin to translucent, brown-green when dry; lamina 1-pinnate, narrowly triangular to lanceolate, 15–24 × 2.5–5 cm, widest in basal 1/3, apex gradually narrowing, subglabrous; stipe shiny, dark castaneous-purple, 10–20 cm, subglabrous, base sparsely scaly; rachis shiny, dark castaneous-purple abaxially, adaxial side grooved and with 2 grayish green narrow wings; pinnae strongly dimidiate, shortly stalked and purplish rachis color extending via stipicel onto costa abaxially, 15–25 pairs, alternate, ascending, trapeziform to falcate, 1.5–3.5 × 0.4–0.7 cm, base asymmetrical, acroscopic side truncate, basiscopic side straight with more than 1/2 cut away, acroscopic margin (bi)crenate-sinuate, teeth obtuse and not retuse, apex subacute to obtuse. Veins forking and terminating in mar-

ginal teeth, (2 or)3 or 4 basal basiscopic veins lacking. Sori linear, 3–4 mm, basal on subtending vein and appearing subcostal; indusia brownish, linear, membranous, entire, opening toward costa. Plants sexual or agamosporous.

On rocks near or in streams, in forests; 800–2800 m. Guangdong, Guangxi, Guizhou, Hunan, Jiangxi, Sichuan, Taiwan, Yunnan [India, Indonesia, Japan, Nepal, Vietnam].

*Hymenasplenium obliquissimum* is an aggregate of species with different chromosome number and life strategy; three cytotypes, based on  $x = 39$ , are known. A diploid sexual ( $2n = 78$ ), a tetraploid sexual ( $2n = 156$ ), and a triploid agamosporous type ( $2n = 117$ ) which is probably a hybrid between the diploid and the tetraploid (Murakami, Pl. Spec. Biol. 13: 51–56. 1998). A thin lamina (only 2 epidermal layers) is characteristic for this taxon but occurs elsewhere in the genus and is influenced by growing conditions; using it as a diagnostic character may lead to wrong identifications.

In the literature (Iwatsuki, Ferns Japan, 151. 1992; Hasebe et al., Amer. Fern J. 85: 134–181. 1995; Iwatsuki et al., Fl. Japan 1: 109. 1995), this species has sometimes been put into synonymy with *Hymenasplenium filipes* (Philippines), but considering cytological and morphological differences, we prefer to keep these taxa distinct. *Hymenasplenium obliquissimum* differs from *H. filipes* by its thinner lamina, thicker rhizome (up to 0.15 cm in *H. filipes*), shinier stipe and rachis (almost dull in *H. filipes*), rachis color extending onto the costa, larger number of pinnae (up to 15 in *H. filipes*), larger number of reduced basal basiscopic veins (1 or 2 in *H. filipes*), and sori position along the subtending vein (median in *H. filipes*).

*Asplenium unilaterale* Lamarck var. *decurrens* (Beddome) H. S. Kung (Fl. Sichuan. 6: 357. 1988; *A. resectum* Smith var. *decurrens* Beddome, Suppl. Ferns S. Ind. 10. 1876) was treated as a synonym of *A. unilaterale* var. *udum* in FRPS (4(2): 38–40. 1999).

**18. *Hymenasplenium pseudobscurum*** Viane, sp. nov.

尖峰岭膜叶铁角蕨 jian feng ling mo ye tie jiao jue

Type: China, Hainan: Ledong County ("Kan-en District"), Jianfeng Ling ("Chim Fung Ling"), "near Sam Mo Watt village, Shan Mong," 23 Apr 1934, S.-K. Lau 3841 (holotype, PE).

*Planta morphologia* *Hymenasplenio obscuris*. *Rhizoma longe repens, squamis 2.5–3.5 mm longis et ca. 0.25–0.7 mm latis. Petiolus rachisque pro parte abaxiali griseo-virides; lamina papyracea. Sori 2–3 mm longi. Sporae exosporium 29–34 μm longum.*

Plants 20–50 cm tall. Rhizome long creeping, 3–5 mm in diam., apex scaly; scales narrowly triangular to triangular, 2.5–3.5 mm. Fronds remote, 3–5 mm apart, grayish green when dry, papery to herbaceous, subglabrous; stipe dull green to grayish green when dry, not shiny or purple, (5–)15–20(–25) cm, sparsely scaly to subglabrous; lamina 1-pinnate, narrowly ovate-triangular, 20–25 × 5–10 cm, base truncate, apex acuminate to caudate; rachis grayish green, subglabrous; pinnae 15–30 pairs, sessile to stalked, trapeziform-falcate, middle pinnae 2.5–4 × 0.8–1.8 cm, dimidiate, apex obtuse to subacute, base asymmetrical, acroscopic side truncate and parallel to rachis, basiscopic side excavate to narrowly cuneate, entire, acroscopic margin (bi)serrate, teeth not retuse, suprabasal pinnae spreading to ascending. Veins distinct, forking and free, ending below a marginal tooth, basiscopic side with (3 or)4 or 5 veins

lacking. Sori medial to supramedial, linear, 2–3 mm; indusia persistent, allantodioid, double and consisting of an outer and an inner part (between lamina and sporangia), pale brown, semi-elliptic to linear, membranous, entire, opening toward costa.

Shaded forest floors near water courses; 500–800 m. Guizhou, Hainan, Taiwan, Yunnan [N Thailand, N Vietnam].

Murakami (J. Plant Res. 108: 261. 1995) used, but did not validly publish, the name "*bilabiatum*" for this taxon; he reported it from N Thailand to N Vietnam and from Taiwan. *Hymenasplenium pseudobscurum* is an aggregate of a diploid and a tetraploid taxon (Kato et al., Bot. Mag. (Tokyo) 105: 105–124. 1992; Cheng & Murakami, J. Plant

Res. 111: 498. 1998), and further research is needed to discriminate between them. Molecular studies of Murakami (loc. cit.: 266) demonstrated that *H. pseudobscurum* is closely related to *H. obscurum*.

The special allantodioid sorus, with an inner and an outer indusium, is also found in ***Hymenasplenium bivalvatum*** (B. K. Nayar & Geevarghese) Viane, **comb. et stat. nov.** (Basionym: *Asplenium unilaterale* Lamarck var. *bivalvatum* B. K. Nayar & Geevarghese, Fern Fl. Malabar, 292. 1993; 双盖膜叶铁角蕨 *shuang gai mo ye tie jiao jue*), a sexual diploid with  $2n = 78$  chromosomes and differing from *H. pseudobscurum* by the abaxial color of its stipe (shiny and dark purple to black). The occurrence of *H. bivalvatum* in S China needs to be verified; however, according to Ralf Knapp (pers. comm.), most Taiwanese specimens formerly identified as *H. obscurum* are *H. pseudobscurum*.