

PTERIDOPHYTA

A . G . M I L L E R

The pteridophytes (in Arabia) are herbs with free-living sporophytes containing vascular tissue and bearing sporangia which produce spores and give rise to inconspicuous gametophytes. The gametophytes are thalloid, lack vascular tissue and bear archegonia and antheridia.

There is no general agreement among specialists regarding family limits within the Pteridophyta. Family descriptions and a key to families have therefore been omitted. Short descriptions of the Ferns and Fern Allies are given followed by a synoptical arrangement of the genera according to R.J. Johns (1991, Pteridophytes of Tropical East Africa. RBG, Kew). An artificial key to genera is provided.

THE FERN ALLIES

Leaves small, one-nerved. Sporangia borne in the axils of specialized leaves (the sporophylls) which are solitary or arranged in cone-like strobili or (in *Equisetum*) borne on the underside of stalked scales (sporangiophores) and arranged in terminal cone-like strobili. Sporangia and spores either all similar (homosporous) or dissimilar (heterosporous) with the megasporangia containing megaspores and the microsporangia containing microspores.

THE FERNS

Stems (the rhizomes) usually clothed with scales. Leaves (the fronds) simple or compound with several to many nerves, usually circinate in bud (except *Ophioglossum*), comprising a stalk (the stipe) and a lamina with a central nerve (the rhachis); lamina either simple or divided into pinnae and pinnules. Sporangia homosporous or heterosporous (*Marsilea*), usually borne on the lower surface of the fronds, usually in clusters (the sori); sori naked or covered with a specialized scale-like organ (the indusium) or by the reflexed leaf margin or on specialized organs (*Marsilea* and *Ophioglossum*).

PTERIDOPHYTA

SYNOPTICAL ARRANGEMENT OF THE FAMILIES OF FERNS AND FERN ALLIES

THE FERN ALLIES

Psilotaceae	Equisetaceae
1. Psilotum	3. Equisetum
Selaginellaceae	
2. Selaginella	

THE FERNS

Ophioglossaceae	Polypodiaceae
4. Ophioglossum	17. Pleopeltis
Marsileaceae	18. Loxogramme
5. Marsilea	Dennstaedtiaceae
Parkeriaceae	19. Pteridium
6. Ceratopteris	Oleandraceae
Actiniopteridaceae	20. Nephrolepis
7. Actiniopteris	21. Arthropteris
Adiantaceae	Aspleniaceae
8. Cheilanthes	22. Asplenium
9. Negripteris	23. Ceterach
10. Pellaea	Thelypteridaceae
11. Doryopteris	24. Christella
12. Anogramma	Woodsiaceae
13. Adiantum	25. Cystopteris
14. Onychium	Dryopteridaceae
Acrostichaceae	26. Hypodematum
15. Acrostichum	27. Tectaria
Pteridaceae	28. Polystichum
16. Pteris	29. Dryopteris

KEY TO GENERA OF ARABIAN FERNS AND FERN ALLIES

1. Stems jointed, hollow, with longitudinal ribs; leaves reduced to a short toothed sheath about the nodes; sporangia arranged in terminal cone-like structures **3. Equisetum**
 - + Stems not jointed, hollow, or ribbed; leaves never arranged in a sheath about the nodes; sporangia never arranged in terminal cone-like structures **2**
 2. Plants leafless except for scattered, minute scale-like sporophylls; sporangia 3-lobed **1. Psilotum**
 - + Plants with well-developed leaves, sometimes minute but not scale-like; sporangia not 3-lobed **3**

- 3. Leaves simple, numerous, small and moss-like, 1-nerved; plants heterosporous
2. *Selaginella*
- + Leaves simple or dissected, usually large, never moss-like; plants heterosporous (*Marsilea*) or homosporous 4
- 4. Fronds 4-foliolate; leaflets \pm obovate; aquatic or semi-aquatic plants
5. *Marsilea*
- + Fronds various, never 4-foliolate; aquatic, semi-aquatic or terrestrial plants 5
- 5. Fronds dimorphic; sterile segments simple, narrowly ovate to elliptic, inserted at the base of the fertile fronds or on the petioles; fertile segments simple with two rows of sporangia arranged in a spike near the tip 4. *Ophioglossum*
- + Fronds dimorphic or not; if dimorphic then the sterile segments pinnately divided; sporangia arranged on the underside of the lamina 6
- 6. Fronds fan- or wedge-shaped with linear segments
7. *Actinopteris*
- + Fronds various but never fan-shaped with linear segments 7
- 7. Ephemeral fern; fronds very small, up to 10cm long; indusia absent
12. *Anogramma*
- + Perennial or rarely annual ferns; fronds rarely less than 10cm; indusia present or absent 8
- 8. Fronds succulent, dimorphic; ultimate segments of the fertile fronds linear and of the sterile triangular or ovate; plants of swamps or pools
6. *Ceratopteris*
- + Fronds not succulent, dimorphic or not; fronds not as above; plants terrestrial 9
- 9. Fronds simple 10
- + Fronds pinnately divided 11
- 10. Sori round; lamina with scattered dark-centred peltate scales beneath
17. *Pleopeltis*
- + Sori elongate; lamina without peltate scales beneath 18. *Loxogramme*
- 11. Lamina 1-pinnate, or 1-pinnate above and the basal pinnae lobed 12
- + Lamina 2–5-pinnate 17
- 12. Sori marginal 13
- + Sori superficial on the veins or covering the entire undersurface of the fertile pinnae 14
- 13. Sori borne on the inner surface of reflexed leaf margins; pinnae with flabellate venation
13. *Adiantum*
- + Sori borne on the surface of lamina, hidden by the reflexed leaf margin; pinnae with pinnate venation 16. *Pteris*

14. Large fern; entire undersurface of the fertile pinnae covered with sori
15. **Acrostichum**
- + Small or medium-sized ferns; sori discrete, superficial on the veins, not covering the entire undersurface of the pinnae 15
15. Sori circular, never obscured; pinnae cordate at the base 20. **Nephrolepis**
- + Sori elongate, sometimes obscured by scales; pinnae not cordate at the base 16
16. Pinnae narrowed at the base, stalked to the rhachis 22. **Asplenium**
- + Pinnae broad at the base, auriculate or decurrent along the rhachis
23. **Ceterach**
17. Sori marginal or submarginal 18
- + Sori superficial on the veins 27
18. Sori oval, solitary on ultimate segments, opening towards the margin 22. **Asplenium**
- + Sori numerous, discrete, partly or wholly continuous along pinnules, opening inwards from the margin 19
19. Pinnules fan- or wedge-shaped, with flabellate venation; lamina glabrous; sori borne on inner surface of reflexed leaf margins 13. **Adiantum**
- + Pinnules various (but not as above), with pinnate venation; lamina glabrous or not; sori borne on surface of lamina, hidden by the reflexed leaf margin 20
20. Parsley-like fern; fertile and sterile fronds dissimilar, irregularly pinnate 14. **Onychium**
- + Not parsley-like fern; fronds all similar, regularly pinnate 21
21. Lamina hairy or covered with white powder 22
- + Lamina glabrous 24
22. Large fern, 1–2m; fronds spaced; rhizome densely hairy 19. **Pteridium**
- + Small or medium-sized ferns, up to 50(–100)cm; fronds tufted; rhizome clothed with scales 23
23. Lamina covered with white powder beneath; sporangia black or dark brown, glossy; stipe clothed with scales throughout 9. **Negripteris**
- + Lamina without white powder beneath or if so (*Cheilanthes farinosa*) sporangia pale brown and stipe clothed with scales in the lower part only
8. **Cheilanthes**
24. Stipe pale brown or straw-coloured 16. **Pteris**
- + Stipe reddish brown or reddish black 25
25. Lamina pentagonal; pinnae decurrent along the rhachis 11. **Doryopteris**
- + Lamina triangular or ovate; pinnae not decurrent along the rhachis 26

1. Psilotum

26. Small ferns, fronds to 20cm; sori discrete **8. Cheilanthes**
 + Medium-sized ferns, fronds usually more than 30cm; sori continuous **10. Pellaea**

27. Sori elongate; indusia narrow, opening inwards or obsolete or absent **22. Asplenium**
 + Sori round; indusia hood-like, peltate or reniform 28

28. Indusia hood-like; plant ± glabrous except for a few scales at the base of the stipe **25. Cystopteris**
 + Indusia reniform or peltate; plant hairy or clothed with scales 29

29. Stipe clothed with scales, the scales extending to the tip of the lamina 30
 + Stipe hairy, if clothed with scales then the scales restricted to the base of the stipe 31

30. Sori peltate; pinnules aristate **28. Polystichum**
 + Sori reniform; pinnules dentate **29. Dryopteris**

31. Lamina elliptic to narrowly ovate, pinnate with the pinnae pinnatifid with entire lobes 32
 + Lamina ovate-triangular, 2–4-pinnatifid 33

32. Pinnae articulated to the stipe; lamina often with scattered white glands above; rhizome-scales peltate; pinnae not tapering at the base **21. Arthropteris**
 + Pinnae not articulated to the stipe; lamina without scattered white glands above; rhizome-scales not peltate; lamina tapering at the base **24. Christella**

33. Lamina with gemmae (or their scars) visible on the upper surface; stipe thinly clothed with scales but without a conspicuous tuft at the base; veins anastomosing **27. Tectaria**
 + Lamina without gemmae; stipe with a conspicuous tuft of reddish-brown scales at the base; veins free **26. Hypodematioides**

Family 1. PSILOTACEAE

1. PSILOTUM Swartz

Erect herbs; rhizomes horizontal, rootless. Stems dichotomously branched, rigid. Leaves few, scale-like. Sporangia 3-locular, borne in the axils of minute bilobed bracts on the upper part of the stems.

1. *P. nudum* (L.) P. Beauv., Prodr. aethéogam.: 112 (1805).

Small bushy herb. Stems up to 35cm, erect, branched throughout, triangular in

PSILOTACEAE

section, c.2mm across, glabrous. Leaves minute, widely spaced, narrowly ovate, c.1.5mm. Sporangia c.2.5mm across, 3-lobed. **Map 7, Fig. 2.**

In shade on large boulders and on cliffs in a shady gorge; 1000–1700m.

Saudi Arabia, Yemen (N). Widespread in tropical and subtropical regions.

Very rare in Arabia and known only from near Turbah in Yemen and from a deep gorge in the southern Asir region of Saudi Arabia. Outside Arabia its nearest station is in southern Kenya.

Family 2. SELAGINELLACEAE

2 SELAGINELLA P. Beauvois

Erect or prostrate herbs; stems bearing aerial roots (rhizophores). Leaves small, moss-like, each with a minute ligule at the base, either spirally arranged and similar or 2-ranked and dimorphic with a median above and a lateral on either side. Spores of two kinds: microspores (male) borne in microsporangia and megasporangia (female) borne in megasporangia. Sporangia borne in the axils of specialized leaves known as sporophylls; sporophylls similar or dimorphic, arranged in terminal strobili.

1. Erect, tufted plant; leaves strongly discolorous, dark green above, pale green beneath **1. *S. imbricata***
 - + Prostrate, creeping plants; leaves concolorous, pale or bright green **2**
 2. Leaf margins white, long-ciliate; sporophylls similar **2. *S. yemensis***
 - + Leaf margins green, not or only shortly ciliate; sporophylls dimorphic **3**
 3. Stems 1–3cm long; median leaves acute **3. *S. perpusilla***
 - + Stems up to 40cm long; median leaves with a long setaceous tip c. $\frac{1}{2}$ as long as the leaf **4. *S. goudotana* var. *abyssinica***

1. S. imbricata (Forsskal) Spring in Decne in Arch. Mus. Hist. Nat. 2: 193 (1841).
 Syn.: *Lycopodium imbricatum* Forsskal (1775 p.187). Illustr.: Adumbr. Fl. Aeth. 27: 560, t.3 (1975); Collenette (1985 p.458). Type: Yemen (N). *Forsskal* 620 (C).

Tufted fern-like plant, bright dark green above, pale green or brown beneath, curling into a loose ball when dry. Stems up to 30cm, leafless and unbranched below. Leaves dimorphic: laterals imbricate, oblong-elliptic, $(1.5\text{--})2\text{--}3.5 \times (0.5\text{--})1\text{--}1.3$ mm, obtuse, with entire margins, hyaline on the front edge towards the base; median oblong-ovate, $1.25\text{--}1.5 \times 0.7\text{--}1$ mm, obtuse or acute and falcate, with hyaline margins. Strobili $2.5\text{--}5\text{--}(8)$ mm, male above, female below; sporophylls all similar, ovate-triangular, $c.1.0 \times 0.8$ mm, acute, the margin hyaline and denticulate. **Map 8, Fig. 2.**

In crevices on shady cliffs, rocks and cliff ledges: 100–1500m.

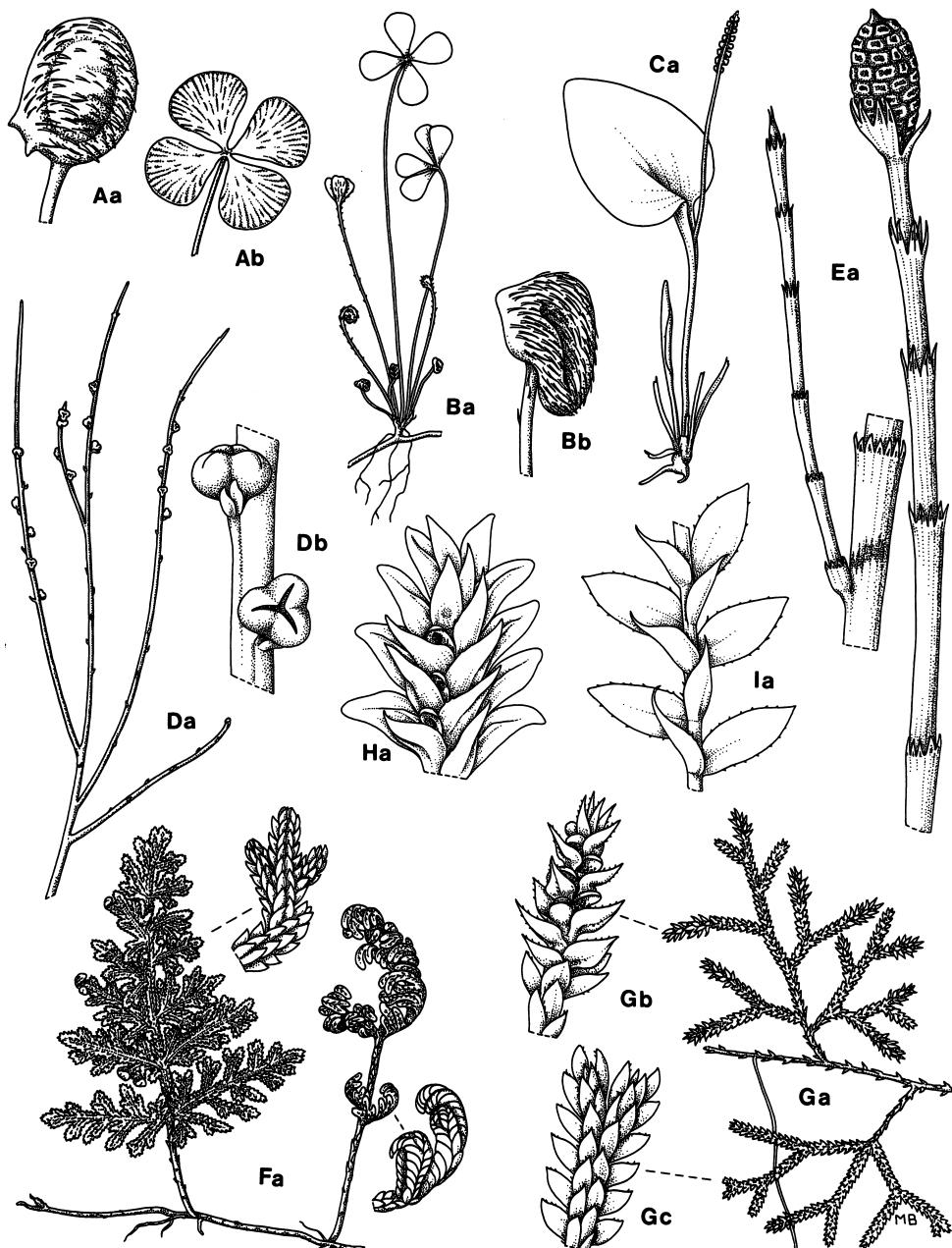


Fig. 2. Ferns. A, *Marsilea coromandeliana*: Aa, sporocarp ($\times 8$); Ab, frond ($\times 1.5$). B, *M. aegyptiaca*: Ba, habit ($\times 1$); Bb, sporocarp ($\times 8$). C, *Ophioglossum polyphyllum*: Ca, habit ($\times 0.6$). D, *Psilotum nudum*: Da, habit ($\times 0.6$); Db, part of fertile branch ($\times 6$). E, *Equisetum ramosissimum*: Ea, fertile branch ($\times 2$). F, *Selaginella imbricata*: Fa, habit ($\times 1$) and leaves ($\times 3$). G, *S. yemensis*: Ga, habit ($\times 1.5$); Gb, strobilus, ($\times 6$); Gc, stem leaves ($\times 6$). H, *S. perpusilla*: Ha, strobilus ($\times 12$). I, *S. goudotana*: Ia, stem leaves ($\times 7$).

SELAGINELLACEAE

Saudi Arabia, Yemen (N & S), Oman. Southern and eastern Africa north to Ethiopia and Madagascar.

2. *S. yemensis* (Swartz) Spring in Decne in Arch. Mus. Hist. Nat. 2: 191 (1841). Syn.: *Lycopodium sanguinolentum* Forsskal (1775 p.CXXV) non L. (1753); *L. yemense* Swartz, Syn. fil. 182 (1806); *S. arabica* Baker, Handb. fern-allies 38 (1887). Illustr.: Adumbr. Fl. Aeth. 27: 567 (1975); Collenette (1985 p.458). Type: Yemen (N), *Forsskal* s.n. (S).

Creeping, often mat-forming, bright green plant. Stems prostrate up to 30cm. Leaves dimorphic: laterals oblong-ovate, $1.8\text{--}2.5 \times 0.75\text{--}1.25$ mm, acute or rounded, with ciliate margins especially near the base, the base unequal \pm amplexicaul; median ovate, $1\text{--}2 \times 0.5\text{--}1$ mm, acuminate at the tip, with ciliate margins, the base rounded or asymmetric with a triangular lobe. Strobili (2-)3-4mm, usually with a solitary megasporangium at the base and microsporangia above; sporophylls all similar, resembling the median leaves. **Map 9, Fig. 2.**

In shady places on rocks, cliffs and under boulders; 950-2800m.

Saudi Arabia, Yemen (N & S). Tropical NE Africa.

3. *S. perpusilla* Bak. in J. Bot. 23: 292 (1885).

Small, moss-like, pale green plant. Stems 0.5-1.5(-2.5)cm long, creeping. Leaves dimorphic: laterals ovate, $1.5\text{--}1.75 \times 0.7\text{--}0.8(-1)$ mm, acute, the margins minutely denticulate, the base \pm rounded; median ovate-elliptic, $0.5\text{--}0.9(-1) \times 0.3\text{--}0.6$ mm, acuminate at the tip, the margins minutely denticulate, the base \pm rounded. Strobili (1.5-)2-3mm, mainly female with only occasional microsporangia at the top; sporophylls dimorphic, slightly larger than the leaves, shortly ciliate on the margins towards the base. **Map 10, Fig. 2.**

Shady, humid gully in *Anogeissus* woodland; 600m.

Oman. Zaire, E. Africa and Madagascar.

Only collected once in our area but easily overlooked. Resembles and grows with mosses on wet clay in dense shade under trees.

4. *S. goudotana* Spring var. *abyssinica* (Spring) Bizzarri in Adumbr. Fl. Aeth.: 585 (1975); Illustr.: op. cit., p.588.

Creeping, moss-like plant. Stems prostrate or \pm erect, up to 40cm. Leaves dimorphic; laterals oblong-ovate, $2\text{--}3.5 \times 1\text{--}2$ mm, apiculate, the margins denticulate, the base oblique and \pm amplexicaul; median $1.5\text{--}2 \times 1$ mm, ovate, drawn into a long setaceous tip which is c. $\frac{1}{2}$ as long as the leaf. Strobili 0.5-1.2mm; sporophylls dimorphic, similar to the leaves; lateral sporophylls male only; median sporophylls male above and female below. **Map 11, Fig. 2.**

Wet rock face by a waterfall; 2900m.

Yemen (N). Tropical Africa.

In Arabia known only from a single locality in Yemen.

Family 3. EQUISETACEAE

3. EQUISETUM L.

Erect rhizomatous herbs. Stems round, hollow, ridged, jointed and often with whorls of branches at the nodes. Leaves reduced to a many-toothed sheath at each node. Sporangia borne on the undersurface of hexagonal stalked scales (sporangiophores) which are arranged in compact terminal cone-like heads.

1. E. ramosissimum Desf., Fl. atlant. 2: 398 (1799). Illustr.: Fl. Zamb., Pteridophyta: 33 (1970); Collenette (1985 p.233).

Rhizomes long-creeping, blackish brown. Stems up to 1m, branched mainly below, grey-green, the internodes with 10–25 ribs, the sheaths about twice as long as broad, the teeth blackish with hair-tips; branchlets slender, hollow, 8-ribbed. Cones terminal on the main stems, ellipsoid, 5–15(–20)mm. **Map 12, Fig. 2.**

By streams, pools and in damp places; 750–2800m.

Saudi Arabia, Yemen (N & S), Oman. Europe, Asia and Africa.

Family 4. OPHIOGLOSSACEAE

4. OPHIOGLOSSUM L.

Perennial herbs with globose or elongated corm-like rhizomes. Fronds 1-several, petiolate, with a simple sterile segment and a fertile segment inserted at the base of the sterile segment or on the petiole. Fertile segments simple, without a lamina; sporangia large, sunken, arranged in two rows on the upper part of the fertile segment, dehiscing by transverse slits.

1. O. polyphyllum A. Braun in Seubert., Fl. azor.: 17 (1844). Syn.: *O. aitchisonii* (C.B. Clarke) D'Almeida in J. Indian Bot. Soc. 3: 63 (1922); *O. capense* sensu Schwartz (1939). Illustr.: Collenette (1985 p.380).

Rhizome erect; leaves (1–)2, surrounded at the base by persistent leaf bases. Petioles 1.5(–10)cm. Sterile lamina narrowly ovate to elliptic, 2–4 × 1–1.5(–2)cm, acute or obtuse, cuneate at the base. Fertile segment 3–8(–10)cm, attached at the base of the sterile lamina, acute at the tip, with 13–30 pairs of sporangia. **Map 13, Fig. 2.**

Appearing after rain in sandy and silty depressions, 20–2900m.

Saudi Arabia, Yemen (N), Socotra, Oman, Bahrain, Kuwait. From tropical and southern Africa to Iran, Afghanistan and Northern India.

2. O. reticulatum L., Sp. pl.: 1063 (1753).

Similar to *O. polyphyllum* but the sterile lamina broadly ovate, 3–6 × 1.5–3cm, with a cordate or truncate base.

MARSILEACEAE

In a damp shady place in an orchard (Yemen) and on granite cliffs (Socotra); 1000–2400m.

Yemen (N), Socotra. Pantropical.

Much rarer in Arabia than the preceding species. The only record from N Yemen (Hepper 6313) may possibly represent an extreme, broad-leaved, form of *O. polyphyllum*.

Family 5. MARSILEACEAE

5. MARSILEA L.

Aquatic or semi-aquatic ferns; rhizomes creeping, slender. Fronds with 4 leaflets arranged in a terminal cluster. Leaflets fan-shaped with a cuneate base and the outer margins entire, sinuate or variously toothed. Heterosporous, the sporangia contained in closed sporocarps (specialized pinnae); sporocarps hard, borne on short pedicels.

A difficult genus. The species cannot be definitely named without sporocarps. Aquatic forms are normally sterile with large, entire leaflets whereas land forms tend to be fertile and have smaller, often toothed, leaflets.

1. Sporocarps broadly-elliptic to oblong-elliptic with two distinct teeth, the lateral walls ribbed; leaflets with pellucid streaks between the veins
 1. **M. coromandeliana**
 - + Sporocarps ± quadrangular with a single tooth, the lateral walls with a single vertical furrow; leaflets without pellucid streaks between the veins
 2. **M. aegyptiaca**

1. M. coromandeliana Willd., Sp. pl., 5(1): 539 (1810).

Leaflets 2–10 × 2–12mm, glabrous or occasionally hairy, with pellucid streaks between the veins. Sporocarps solitary, (2–)2.5–3(–4) × 1.5–2(–2.7)mm, broadly-elliptic to oblong-elliptic with two distinct teeth, the upper acute, the lower obtuse, the lateral walls ribbed. **Map 14, Fig. 2.**

Rooted in mud at the margins of ponds and streams; 30–500m.

Socotra. Tropical and southern Africa, Madagascar and India.

2. M. aegyptiaca Willd., Sp. pl., 5(1): 540 (1810).

Leaflets 2–12(–30) × 2–12(–25)mm, glabrous or hairy, without pellucid streaks between the veins. Sporocarps solitary or grouped, (1–)1.5–2 × (1–)1.5–2mm, ± quadrangular with a single conical to acute tooth, the lateral walls with a single vertical furrow. **Map 15, Fig. 2.**

Rooted in mud at the margins of ponds and streams; 850–3100m.

Saudi Arabia, Yemen (N). North and tropical Africa, Madagascar.

Family 6. PARKERIACEAE

6. CERATOPTERIS Brongn.

Aquatic annual ferns. Rhizomes short, erect. Fronds tufted, strongly dimorphic. Sporangia sessile; sori arranged along the veins on the lower surface of the fronds, protected by the reflexed margins of the pinnules.

Lloyd, R.M. (1974). Systematics of the genus *Ceratopteris* Brongn. (Parkeriaceae) II Taxonomy. *Brittonia* 26: 139–160.

1. C. cornuta (P. Beauv.) Le Prieur in Ann. Sci. Nat. (Paris) 19: 103. pl. 4A (1830).
Syn.: *C. thalictroides* (L.) Brongn. in Bull. Sci. Soc. Philom. Paris 1821: 186 (1821).
Illustr.: Fl. Iraq 2: 71 (1966).

Aquatic fern, usually rooting in mud in shallow water. Stipe about half as long as the frond. Fronds tufted, up to 60cm, light green, succulent, rather brittle, glabrous. Lamina of sterile fronds ovate or ovate-triangular, up to 20×15 cm, pinnate to bipinnate-pinnatifid; lobes triangular or ovate, acute or obtuse; lamina of fertile fronds ovate, up to 60×15 cm, (2-)3-4-pinnate, with linear lobes. **Map 16, Fig. 3.**

In low altitude swamps, pools or sluggish streams; 50–1000m.

Saudi Arabia, Yemen (N), Socotra, Oman. Tropical Africa, Iraq, NE India, Myanmar, Indonesia and N Australia.

Family 7. ACTINIOPTERIDACEAE

7. ACTINOPTERIS Link

Small ferns. Fronds tufted, green when fresh, silvery grey when dry. Rhizomes short, creeping, covered with dense linear-lanceolate scales. Fertile fronds similar or dissimilar to the sterile, often with longer lamina; stipe furrowed, glabrous or with scattered scales; lamina shorter than the stipe, wedge- or fan-shaped, dichotomously branched; segments ± linear, the sterile toothed at the apex, the fertile entire. Sori submarginal, linear-elongated, covered by the reflexed margin of the frond.

Pichi-Sermolli, R.E.G. (1962). On the fern genus *Actiniopteris* Link. *Webbia* 17: 1–32.

1. Lamina fan-shaped, with 26–48 segments; segments ± truncate and toothed at the apex **1. A. radiata**
 - + Lamina wedge-shaped, with 4–18 segments; segments ± acute and laterally toothed at the apex **2. A. semiflabellata**

ACTINIOPTERIDACEAE



Fig. 3. Ferns. A, *Actiniopteris semiflabellata*: Aa, fresh and dried fronds ($\times 0.6$); Ab, tip of frond ($\times 20$). B, *A. radiata*: Ba, fresh and dried fronds ($\times 0.6$); Bb, tip of frond ($\times 20$). C, *Anogramma leptophylla*: Ca, habit ($\times 0.3$); Cb, fertile pinna ($\times 4$). D, *Pleopeltis macrocarpa*: Da, fertile frond ($\times 0.6$) and peltate scales ($\times 40$). E, *Tectaria gemmifera*: Ea, frond ($\times 0.25$). F, *Cystopteris fragilis*: Fa, frond ($\times 0.6$); Fb, fertile pinna ($\times 3$); Fc, sorus ($\times 25$). G, *Onychium divaricatum*: Ga, sterile frond ($\times 0.6$); Gb, fertile frond ($\times 0.6$) and enlargement. H, *Ceratopteris cornuta*: Ha, fertile and sterile fronds ($\times 0.25$).

1. A. radiata (Swartz) Link, Fil. spec.: 80 (1841). Syn.: *A. australis* sensu Schwartz (1939) pro parte non (L.f.) Link. Illustr.: *Webbia* 17: 13 (1962).

Fronds 5–25(–40)cm long. Lamina sharply declinate when desiccated, fan-shaped, 1–3cm long, dichotomously divided 4–6 times into 26–48 ± linear segments; segments ± truncate and toothed at the apex. Stipe 2–5 × as long as the lamina. **Map 17, Fig. 3.**

In shady rock crevices and on rocky, scrub-covered slopes; 350–1400m.

Saudi Arabia, Yemen (N). Throughout tropical Africa to India and Sri Lanka.

Local at low altitudes on the western escarpment mountains.

2. A. semiflabellata Pichi-Sermolli, op. cit. p.24. Syn.: *A. australis* sensu Schwartz (1939) pro parte non (L.f.) Link; *A. dichotoma* sensu Balfour (1888 p.328); *Acrostichum dichotomum* Forsskal (1775 p.184). Illustr.: Collenette (1985 p.406).

Similar to *A. radiata* but the fronds (3–)5–30cm long; lamina twisted sideways, not sharply declinate when desiccated, wedge-shaped, 1–7cm long, dichotomously divided 2–4(–5) times into 4–18 segments; segments ± acute and laterally toothed at the apex; stipe 1.5–2.5 × as long as the lamina. **Map 18, Fig. 3.**

Shady crevices on cliffs, terrace-walls and in bushland; 350–2600m, and down to 50m on Socotra.

Saudi Arabia, Yemen (N & S), Socotra, Oman. NE and tropical E Africa, Madagascar, Réunion and Mauritius.

Much commoner in Arabia than the previous species.

Family 8. ADIANTACEAE

8. CHEILANTHES Swartz

Terrestrial ferns. Rhizomes short-creeping or erect; rhizome-scales linear. Fronds tufted, 1–3-pinnate, hairy, clothed with scales or glabrous. Sori marginal, usually continuous; indusia narrow, formed from the reflexed leaf margins (the soral flaps), rarely the soral flaps obsolete.

- | | |
|--|---------------------------|
| 1. Frond covered with white powder beneath | 1. C. farinosa |
| + Frond glabrous, hairy or clothed with scales beneath, never covered with white powder | 2 |
| 2. Lamina glabrous beneath | 5. C. pteridioides |
| + Lamina hairy or clothed with scales beneath | 3 |
| 3. Lamina triangular-ovate; pinnae pinnatifid, the basal pinnae with a pinnatifid lower lobe | 2. C. coriacea |
| + Lamina narrowly elliptic or narrowly ovate; basal pinnae without a pinnatifid lower lobe | 4 |

- | | |
|---|--|
| 4. Lamina densely clothed with scales beneath
+ Lamina thinly to densely hairy beneath | 3. C. marantae
5 |
| 5. Lamina densely hairy beneath
+ Lamina with a few scattered hairs beneath | 4. C. vellea
5. C. pteridioides |

1. C. farinosa (Forsskal) Kaulf., Enum. filic.: 212 (1824) Syn.: ?*Pteris farinosa* Forsskal (1775 p.187); *P. decursiva* Forsskal (1775 p.186). Type: Yemen (N), *Forsskal* (?lost).

Rhizome erect; rhizome-scales dark brown. Fronds tufted. Stipe 10–23cm, reddish brown, glabrous or with a few scales below. Lamina 2–3-pinnate-pinnatifid, 12–25 (–40) × 6–10(–18)cm, oblong, acuminate, dark green above, covered with white powder beneath; lower pinnae unequally triangular, the upper oblong; pinnules pinnatifid-crenate or with oblong rounded segments. Soral flaps membranous, continuous along the margins. **Map 19, Fig. 4.**

Shrub-covered cliffs, shady gullies and grassland; 2000–2900m.

Yemen (N). Tropical Africa.

See comments under *Negripteris sciona*.

2. C. coriacea Decne in Arch. Mus. Hist. Nat. 2: 190 (1841). Illustr.: Collenette (1985 p.408). Type: Yemen (N), *Botta* s.n. (P).

Rhizome short-creeping; rhizome scales reddish brown with a black midrib. Fronds tufted, leathery. Stipe 5–15cm, reddish brown, covered with pale brown scales. Lamina 2–3-pinnate-pinnatifid, (2–)3.5–6 × 2–4cm, triangular-ovate, dark green and glabrous above, brown and hairy beneath; pinnae oblong, pinnatifid; pinnules oblong, rounded, the margins obscurely crenate; lowest pinnae triangular with a pinnatifid basal segment. Soral flaps continuous along the margin, almost completely obscuring the surface of the pinnae beneath. **Map 20, Fig. 4.**

Rock crevices and terrace-walls; 700–2900m.

Saudi Arabia, Yemen (N & S), Oman. NE tropical Africa and SW Iran.

3. C. marantae (L.) Domin in Biblioth. Bot. 85: 133 (1915). Illustr.: Collenette (1985 p.408).

Rhizome creeping, densely clothed in pale reddish brown scales. Fronds closely spaced. Stipe 3–10cm, reddish brown, covered with pale brown scales. Lamina 2-pinnate-pinnatifid, 10–20cm long, narrowly oblong-elliptic, green and glabrescent above, pale brown and densely clothed with scales beneath; pinnae narrowly oblong to narrowly triangular, pinnatifid; pinnules oblong, rounded, the margins entire. Soral flaps narrow, hidden by scales. **Map 21, Fig. 4.**

Juniperus woodland, grassy slopes and exposed rocky hillsides; 1650–3200m.

Saudi Arabia, Yemen (N). Mediterranean region, Macaronesia, Crimea and the Caucasus.

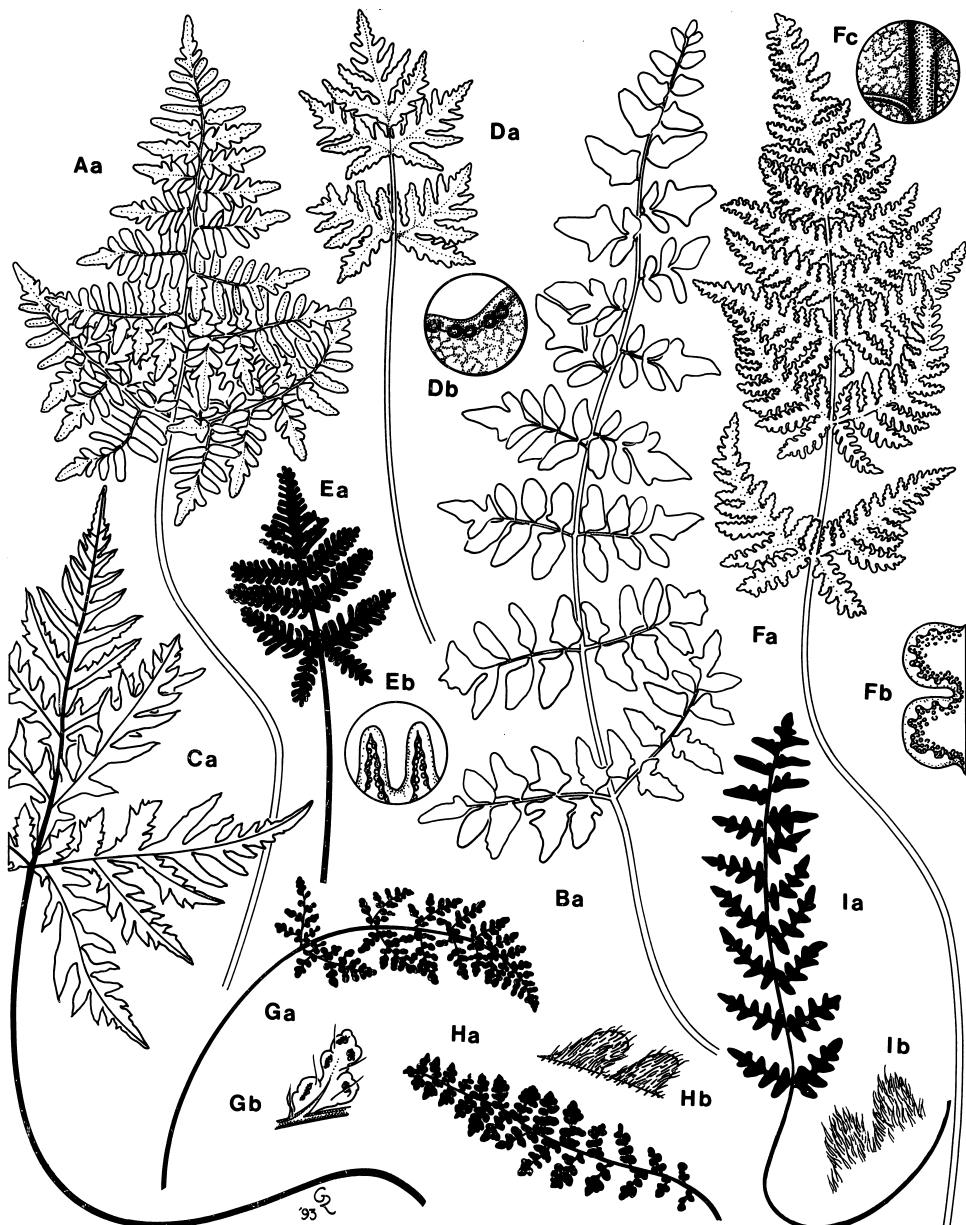


Fig. 4. Ferns. A, *Pellaea quadripinnata*: Aa, frond ($\times 0.6$). B, *P. viridis*: Ba, frond ($\times 0.6$). C, *Doryopteris concolor*: Ca, frond ($\times 0.6$). D, *Negripterus sciona*: Da, frond ($\times 0.6$); Db, part of fertile pinnule ($\times 15$). E, *Cheilanthes coriacea*: Ea, frond ($\times 0.6$); Eb, fertile pinnules ($\times 5$). F, *C. farinosa*: Fa, frond ($\times 0.6$); Fb, fertile pinnules ($\times 10$); Fc, undersurface of frond ($\times 50$). G, *C. pteridoides*: Ga, frond ($\times 0.6$); Gb, fertile pinnule ($\times 10$). H, *C. vellea*: Ha, frond ($\times 0.6$); Hb, fertile pinnule ($\times 10$). I, *C. marantae*: Ia, frond ($\times 0.6$); Ib, fertile pinnule ($\times 10$).

4. *C. vellea* (Aiton) F. Mueller, Fragm. 5: 123 (1866). Syn.: *C. catanensis* (Cosent) H.P. Fuchs in Brit. Fern Gaz., 9: 45 (1961); *Cosentinia vellea* (Ait.) Tod., Syn. pl. acot. vasc.: 15 (1866); *Notholaena vellea* (Aiton) R. Br., Prodr.: 146 (1810). Illustr.: Collenette (1985 p.409).

Rhizome erect, clothed in pale brown scales. Fronds tufted. Stipe short, reddish brown, densely hairy. Lamina 2–3-pinnate, (5–)8–30 × 1–4cm, narrowly elliptic, densely or thinly lanate with white or brown hairs beneath, dark green and thinly hairy above; pinnae oblong, pinnate or pinnatifid; pinnules round to oblong, with undulate margins. Soral flaps obsolete. **Map 22, Fig. 4.**

Rock crevices and amongst boulders; 500–2900m.

Saudi Arabia, Yemen (N), Oman. Mediterranean region and Macaronesia, south to Ethiopia and east to Afghanistan.

Sometimes placed in a genus of its own (*Cosentinia* Tod.) on account of its spore morphology (see Pichi-Sermolli in *Webbia* 39: 178 (1985)).

5. *C. pteridoides* (Reichard) C. Chr., Index filic.: 178 (1905). Syn.: *C. fragrans* Swartz, Syn. fil.: 127 (1806) nom. illegit. Illustr.: Collenette (1985 p.409).

Rhizome erect, with reddish brown scales. Fronds tufted. Stipe 2–9cm, reddish brown, shiny, with reddish brown scales. Lamina bright green, 2–3-pinnate, 1.5–10 × 2–5cm, narrowly ovate, glabrous or with scattered glandular hairs; pinnae triangular below becoming oblong above, pinnate to pinnatifid; pinnules oblong to orbicular, with undulate margins. Soral flaps whitish, fimbriate-margined. **Map 23, Fig. 4.**

Rock crevices, amongst boulders and on terrace-walls; 500–3200m.

Saudi Arabia, Yemen (N), Oman. Macaronesia, Mediterranean region and throughout SW Asia.

9. NEGRIPTERIS Pichi-Sermolli

Similar to *Cheilanthes* but the sporangia dark brown or black and glossy, not pale brown.

1. *N. sciona* Pichi-Sermolli in Nuovo. Giorn. Bot. Ital. 53: 131 (1946). Syn.: *Cheilanthes farinosa* sensu Balfour (1888) non (Forsskal) Kaulf.; *C. farinosa* sensu Schwartz (1939) pro parte non (Forsskal.) Kaulf. Illustr.: Adumbr. Fl. Aeth. 4: 133 (1955).

Rhizome erect with reddish brown scales. Fronds tufted. Stipe 3–11cm, dark brown, shiny, with reddish brown scales. Lamina 2–3-pinnate-pinnatifid, 3–14 × 3–7cm, narrowly ovate or ovate to pentagonal, green above, powdery-white (at least in the young fronds) beneath; pinnae 1–2-pinnatifid, triangular at the base of the frond, oblong above, the ultimate segments oblong to triangular. Sori marginal, interrupted; sporangia dark brown or black, glossy; soral flaps membranous. **Map 24, Fig. 4.**

Shady rock crevices and on soil in dense thickets, often on limestone; 40–1800m.

Yemen (N & S), Socotra, Oman. Ethiopia, Somalia and Kenya.

Negripterus sciona is often confused with *Cheilanthes farinosa*. However, it is readily distinguished by its smaller stature and the conspicuously contrasting dark brown or black sporangia on the powdery-white undersurface of the frond.

10. PELLAEA Link

Terrestrial ferns. Rhizomes short-creeping or erect; rhizome-scales linear. Fronds tufted, 1–4-pinnate, hairy, clothed with scales or glabrous. Sori marginal, continuous; indusia narrow, membranous, formed from the reflexed leaf margins (the soral flaps).

- | | |
|--|-----------------------------------|
| 1. Stipe and rhachis clothed with scales at maturity | 3. <i>P. involuta</i> |
| + Stipe and rhachis glabrous or with a few scales at the base of the stipe at maturity | 2 |
| 2. Lamina triangular, 3–4-pinnate, coriaceous | 1. <i>P. quadripinnata</i> |
| + Lamina ovate, 2-pinnate, sometimes pinnules on lowest pinnae lobed, herbaceous | 2. <i>P. viridis</i> |

1. *P. quadripinnata* (Forsskal) Prantl in Bot. Jahrb. Syst. 3: 420 (1882). Syn.: *Cheilanthes quadripinnata* (Forsskal) Kuhn, Filic. afr.: 74 (1868); *Pteris quadripinnata* Forsskal (1775 p. 186). Type: Yemen (N), *Forsskal* (lost).

Rhizome short, creeping; rhizome scales reddish brown with a dark central stripe. Fronds tufted. Stipe 20–35(–40)cm, reddish brown, shiny, glabrous above, with linear scales at the base. Lamina coriaceous, 3–4-pinnate, 10–20(–60) × 10–18 (–40)cm, pentagonal to triangular, glabrous; pinnae ovate-triangular; ultimate segments oblong, rounded, the margins revolute and crenate. **Map 25, Fig. 4.**

Rare in grassland; 1800–2200m.

Yemen (N). Southern Africa, E tropical Africa, Cameroun, Madagascar and Comoro Is.

2. *P. viridis* (Forsskal) Prantl in Bot. Jahrb. Syst. 3: 420 (1882). Syn.: *Cheilanthes viridis* (Forsskal) Swartz, Syn. fil. 127 (1806); *Pteris viridis* Forsskal (1775 p. 186). Type: Yemen (N), *Forsskal* (lost).

Rhizome short, creeping; rhizome-scales minutely serrulate, pale brown and concolorous or with a dark central stripe. Fronds tufted. Stipe (2.5–)4–20(–40)cm, reddish black, glabrous or clothed with scales below. Lamina herbaceous, 2-pinnate, sometimes pinnules on lowest pinnae lobed, 20(–50) × 8(–24)cm, lanceolate to narrowly ovate, glabrous; ultimate segments ovate to triangular, simple or with 1–3 triangular to ovate basal lobes, the margins minutely crenate. **Map 26, Fig. 4.**

In deep shade on terrace-walls and in semi-deciduous thicket; 600–1800m.

Yemen (N), Socotra. Southern Africa, E tropical Africa, Madagascar and the Mascarenes.

Originally collected by Forsskal at Hadia on J. Raymah. Not now known from

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this locality but found in a single locality on J. Bura. On Socotra found in semi-evergreen thicket.

3. P. involuta (Swartz) Bak., Syn. fil., ed. 2: 148 (1874). Syn.: *Cheilanthes involuta* (Swartz) Schelpe & Anthony in Contr. Bolus Herb. 10: 155 (1982); *Pellaea viridis* sensu Balfour (1888) non (Forsskal) Prantl pro parte.

Similar to *P. viridis* but the rhachis clothed with scales and the rhizome-scales entire not minutely serrulate. **Map 27.**

No habitat details available. 600m.

Socotra. Southern Africa, E tropical Africa and Madagascar.

In Arabia known only from a single gathering from Socotra. *P. involuta* is closely related to, and sometimes considered to be a variety of, *P. viridis*.

11. DORYOPTERIS J.E. Smith

Terrestrial ferns. Rhizomes short-creeping; rhizome-scales linear. Fronds tufted, 2–4-pinnatifid, glabrous. Sori marginal, discrete or continuous; indusia narrow, membranous, formed from the reflexed leaf-margins (the soral flaps).

1. D. concolor (Langsd. & Fisch.) Kuhn in Decken, Reis. Ost-Afr. 3, 3: 19 (1879). Syn.: *Cheilanthes concolor* (Langsd. & Fisch.) R. & A. Tryon in Rhodora 83: 133 (1981); *Doryopteris kirkii* (Hook.) Alston in Bol. Soc. Brot., sér. 2, 30: 14 (1956); *Pellaea concolor* (Langsd. & Fisch.) Bak. in Mart., Fl. bras. 1: 596 (1870).

Rhizome short, creeping; rhizome-scales pale brown with a dark central stripe. Fronds tufted, herbaceous. Stipe longer than the lamina, reddish black, clothed with scales. Lamina pentagonal, 2–4-pinnatifid, up to 20 × 18cm, glabrous; pinnae pinnatifid, the lowest triangular, the upper oblong-ovate; ultimate segments triangular to oblong. Sori continuous or interrupted along the margins; soral flaps membranous. **Map 28, Fig. 4.**

In shade in evergreen thicket and dwarf shrubland; 900–1100m.

Socotra. Throughout the tropics.

12. ANOGRAMMA Link

Small, ephemeral, terrestrial ferns. Rhizomes minute, with hair-like scales. Fronds ± dimorphic, 2–3-pinnate, membranous. Sori borne along the veins; indusia absent.

1. A. leptophylla (L.) Link, Fil. spec. 137 (1841). Illustr.: Fl. Iraq 2: 66 (1966); Collenette (1985 p.407).

Small, ephemeral fern. Rhizome minute with pale brown scales. Fronds erect. Stipe reddish-brown, glabrous or with a few scales below. Lamina membranous, (1–)2–3-pinnate, ovate to narrowly elliptic, 1–10 × 1–3cm; pinnae ovate to triangular, glabrous;

pinnules fan-shaped or wedge-shaped, toothed or lobed, decurrent downwards to the winged rhachis. Sori in lines along the ultimate veins of the pinnules. **Map 29**, **Fig. 3.**

In damp, shady crevices and under boulders; 400–2050m.

Saudi Arabia. Widespread in both the New and Old Worlds.

A small and easily overlooked fern. Strictly speaking it has an annual sporophyte and in suitable habitats a perennial gametophyte.

13. ADIANTUM L.

Terrestrial ferns. Rhizomes short or long-creeping, covered with brown scales. Fronds tufted or spaced, 1–4-pinnate; stipe dark brown, reddish brown or black, polished; segments oblong, trapeziform, fan-shaped or subcircular, glabrous or hairy. Sori borne on the inner surface of the reflexed leaf margins (the soral flaps).

- | | |
|--|-------------------------------|
| 1. Fronds 1-pinnate | 2 |
| + Fronds 2–4-pinnate | 4 |
| 2. Pinnae hairy | 1. A. incisum |
| + Pinnae glabrous | 3 |
| 3. Segments fan-shaped or subcircular with a slightly asymmetric base, subopposite; petioles 0.5–1.5mm | 2. A. balfourii |
| + Segments oblong with a very asymmetric base, alternate; petioles 3–18mm | 3. A. philippense |
| 4. Frond 1–2(–3)-pinnate; segments persistent, shallowly to deeply lobed, the margin crenate-dentate; veins of the sterile segments ending in marginal teeth | 4. A. capillus-veneris |
| + Frond 3(–4)-pinnate; segments deciduous, shallowly lobed, the margin crenate; veins of the sterile segments ending in sinuses | 5. A. poiretii |

1. A. incisum Forsskal (1775 p.187). Syn.: *A. caudatum* sensu Schwartz (1939). Illustr.: Adumbr. Fl. Aeth. 5: 671 (1957); Collenette (1985 p.407). Type: Yemen (N), *Forsskal* (C).

Rhizome short, erect; rhizome-scales narrowly lanceolate, brown. Stipe reddish-brown, hairy. Fronds tufted, dark green, pinnate. Lamina narrowly lanceolate, 15–40 × 1–3(–4)cm, long-attenuate and often rooting at the tips. Pinnae alternate, oblong to trapeziform or wedge-shaped, 5–20 × 2–10mm, with deeply or shallowly toothed margins, hairy; petioles up to 1mm. Soral flaps lunate to oblong, 1–3mm. **Map 30**, **Fig. 5.**

In shade on terrace-walls, rock crevices and amongst boulders; 600–2200m.

Saudi Arabia, Yemen (N & S), Oman. Tropical and southern Africa and India.

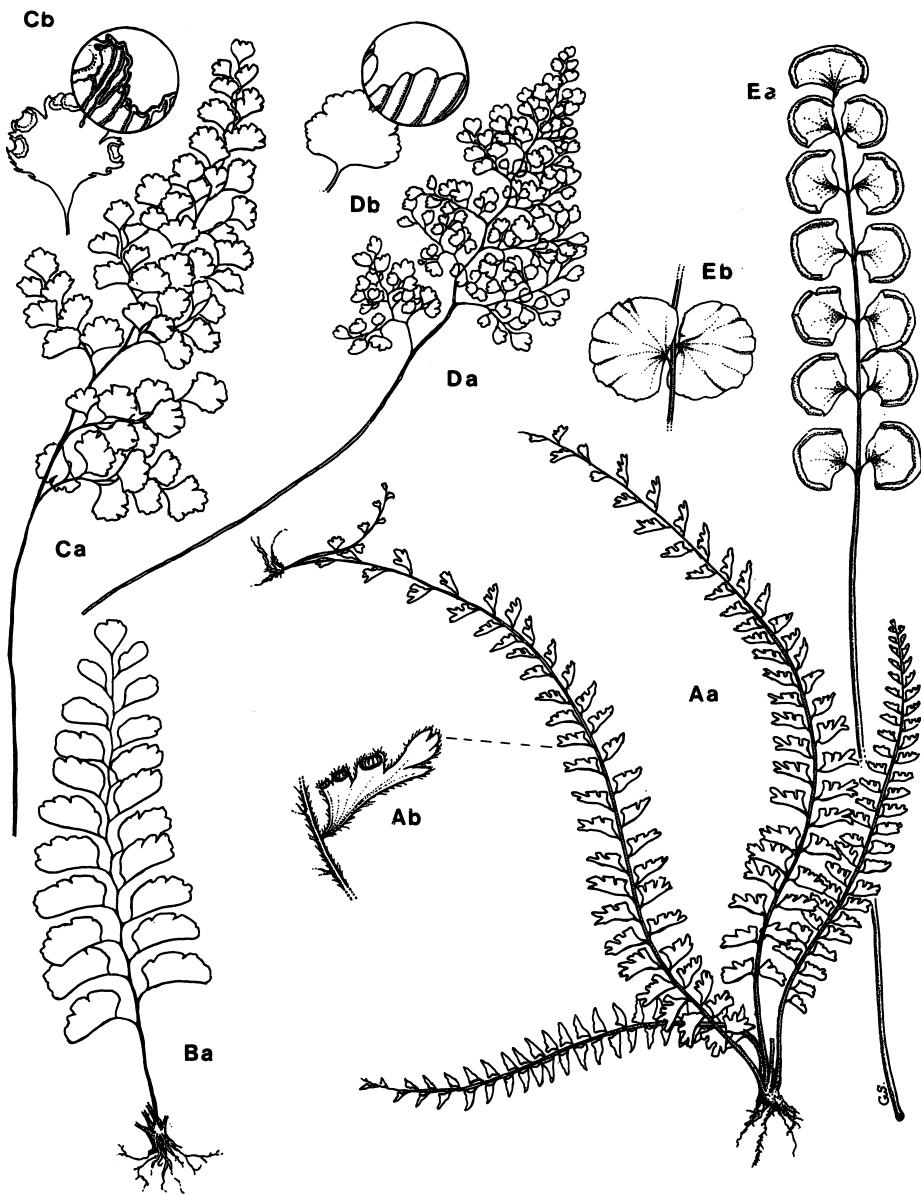


Fig. 5. Ferns. A, *Adiantum incisum*: Aa, habit ($\times 0.3$); Ab, fertile pinna ($\times 1.5$). B, *A. philippense*: Ba, frond ($\times 0.3$). C, *A. capillus-veneris*: Ca, frond ($\times 0.3$); Cb, fertile pinnule ($\times 2$) and enlargement of margin. D, *A. poiretii*: Da, frond ($\times 0.3$); Db, fertile pinnule ($\times 3$) and enlargement of margin. E, *A. balfourii*: Ea, frond ($\times 0.5$); Eb, pinnae ($\times 0.5$).

2. A. balfourii Baker, Diagn. Fil. Nov. Socotr.: 1 (1882); Baker ex Kuhn, Ber. Deutsch. Bot. Ges. 1: 258 (1883); Baker in Hooker's Icon. Pl. 17: t.1630 (1886). Illustr.: Adumbr. Fl. Aeth. 5: 659 (1957); Balfour (1888 t.99). Type: Socotra, *Balfour, Cockburn & Scott* 198 (K).

Rhizome short, creeping or erect; rhizome-scales \pm linear, reddish-brown; fronds densely tufted. Stipe black or dark reddish-brown, glabrous. Lamina pinnate, narrowly oblong, 8–35 \times 2–3.5cm. Pinnae subopposite, fan-shaped to subcircular, 1–2 \times 1–2.75 cm, the margin crenate or \pm entire and sometimes with a hardened black or brown edge, rounded to cuneate at the base, glabrous; petioles up to 1.5mm. Soral flaps \pm continuous around the entire margin. **Map 31, Fig. 5.**

In shade amongst limestone boulders and in rock crevices; 150–850m.

Socotra. Somalia, Ethiopia and Djibouti.

3. A. philippense L., Sp. pl.: 1094 (1753). Illustr.: Adumbr. Fl. Aeth. 5: 667 (1957).

Rhizome short, erect or creeping; rhizome-scales linear, dark brown; fronds loosely tufted. Stipe reddish-brown, glabrous. Lamina pinnate, narrowly ovate, 20–40 \times 4–8cm, sometimes rooting at the tip. Pinnae alternate, oblong, the tips rounded, 1–3 (-4.5) \times 0.8–2cm, the margin shallowly incised into truncate lobes, unequally and broadly cuneate at the base, glabrous; petioles 3–18mm. Soral flaps linear-oblong, 3–8mm. **Map 32, Fig. 5.**

On heavy clay soils on limestone in deciduous *Anogeissus* thicket; 200–600m.

Oman, ?Yemen (S). Pantropical.

In Arabia, found only in the monsoon-affected coastal mountains of Oman and probably extending into Yemen.

4. A. capillus-veneris L., Sp. pl.: 1096 (1753). Illustr.: Fl. Iraq 2: 64, (1966); Collenette (1985 p.406).

Rhizome short, creeping; rhizome-scales linear, pale brown; fronds shortly spaced, arching. Stipe blackish-brown or reddish-brown, glabrous. Lamina 1–2(-3)-pinnate, narrowly ovate to ovate-triangular, 10–40 \times 3–12cm, drooping. Pinnules alternate, fan- or wedge-shaped, 7–20(-25) \times 4–18mm, shallowly to deeply lobed, glabrous; sterile pinnules crenate-dentate, the veins ending in teeth; petiolules 1–1.5mm. Soral flaps oblong to lunate, 2–4 \times 0.75–1.75mm. **Map 33, Fig. 5.**

On rocks and cliffs in shade near permanent water and seepages; 10–3050m.

Saudi Arabia, Yemen (N & S), Socotra, Oman, UAE, Bahrain. Widely distributed in warm temperate and tropical areas of the world.

5. A. poiretii Wikstr. in Köngl. Vetensk. Akad. Handl. 1825: 443 (1826). Syn.: *A. thalictroides* Willd. ex Schlechtend., Adumbr. Pl. 5: 53 (1832); *A. aethiopicum* sensu Balfour (1888) non L. Illustr.: Adumbr. Fl. Aeth. 5: 689 (1957), as *A. thalictroides*.

Rhizome far-creeping; rhizome-scales brown, lanceolate, minutely ciliate; fronds closely spaced. Stipe reddish-brown, glabrous or with a few scales below. Lamina

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3(–4)-pinnate, broadly-ovate to ovate-triangular, 20–30 × 8–16cm, arching. Pinnules alternate, fan-shaped or semi-circular, 5–10 × 5–10mm, shallowly lobed, glabrous, articulated on the petiolules, deciduous; sterile pinnules crenate, the veins ending in sinuses; petiolules 2–6mm. Soral flaps lunate, 1.25–2.25 × 1cm. **Map 34, Fig. 5.**

In shade on terrace-walls and cliffs; 2000–3000m.

Yemen (N), Socotra. Tropical and southern Africa, India, Central and South America.
A local fern of high-rainfall and misty areas.

14. ONYCHIUM Kaulfuss

Terrestrial ferns; rhizomes creeping, densely clothed with scales. Fronds irregularly 3–4-pinnate. Sori marginal, covered by the reflexed leaf margins.

1. O. divaricatum (Poir.) Alston in Bol. Soc. Brot. 30: 21 (1956). Syn.: *Allosorus melanolepis* Decne in Arch. Mus. Hist. Nat. 2: 189 (1841); *Onychium melanolepis* (Decne) Kunze, Farrnkräuter 2: 9, t.104, f.2 (1848). Illustr.: Adumbr. Fl. Aeth. 9: 310 (1963); Collenette (1985 p. 409).

Small parsley-like fern; rhizome-scales linear, entirely black or with a pale margin. Stipe straw-coloured, 4–18cm, glabrous or rarely with scattered scales below. Fronds tufted, dimorphic. Lamina ovate, 7–20 × 5–13cm, glabrous; ultimate segments of the sterile fronds ovate or wedge-shaped, 4–7 × 3–5mm, divided into 2–5 narrowly elliptic lobes; ultimate segments of the fertile fronds narrowly oblong, 1.5–15 × 1–1.25mm, entire, acute. Sori linear. **Map 35, Fig. 3.**

Rock crevices, terrace-walls and cliffs; 50–3000m.

Saudi Arabia, Yemen (N & S), Socotra, Oman, UAE. Trop. N & NE Africa; Iran to SE & E Asia.

Family 9. ACROSTICHACEAE

15. ACROSTICHUM L.

Large mangrove or marsh ferns. Rhizomes erect or creeping; rhizome-scales large; roots thickened. Fronds tufted, pinnate, glabrous. Sori covering the lower surface of the upper pinnae.

1. A. aureum L., Sp. pl.: 1069 (1753).

Large, tufted fern; rhizome massive; rhizome-scales c.1cm. Fronds coriaceous, up to 1.5m. Stipe 10–75cm, pale brown, glabrous. Lamina simply pinnate; pinnae narrowly oblong, (8–)15–25(–50) × 1–4(–5)cm, rounded, with entire or undulate margins, petio-

late, the upper pinnae fertile, the lower sterile; sori completely covering the under-surface of the fertile pinnae. **Map 36, Fig. 6.**

By brackish seepages on cliffs and hillsides; 350–850m.

Saudi Arabia. Widespread around tropical coasts.

Acrostichum aureum is usually a plant of mangrove swamps. In Arabia it is only known from two populations in Saudi Arabia where it grows in very atypical habitats by brackish seepages on a hillside and on a cliff-ledge.

Family 10. PTERIDACEAE

16. PTERIS L.

Rhizomes erect, short- or long-creeping; rhizome-scales linear to ovate. Fronds tufted to widely spaced, 1-pinnate to 4-pinnatifid, glabrous. Sori marginal, usually continuous except for the sterile apex, covered by the reflexed membranous leaf margins (soral flaps).

- | | | |
|----|--|---------------------------|
| 1. | Lamina 1-pinnate or 1-pinnate above and with the basal pinnae 2-lobed | 2 |
| + | Lamina 2–4-pinnatifid | 3 |
| 2. | Basal pinnae simple; lamina with 10–40 pairs of pinnae | 1. P. vittata |
| + | Basal pinnae 2-lobed; lamina with 2–8 pairs of pinnae | 2. P. cretica |
| 3. | Tips of sterile pinnules minutely crenate-serrate; upper surface of lamina lacking minute spines | 3. P. dentata |
| + | Tips of sterile pinnules entire; upper surface of lamina with minute spines on the midribs (costae) and veins (costules) | 4. P. quadriaurita |

1. P. vittata L., Sp. pl.: 1074 (1753). Syn.: *P. obliqua* Forsskal (1775 p.185); *P. longifolia* sensu Balfour (1888) non L.; *P. longifolia* sensu Schwartz (1939) non L.; ? *P. subciliata* Forsskal (1775 p.185). Illustr.: Collenette (1985 p.410).

Rhizome short-creeping; rhizome-scales pale-brown. Fronds tufted, leathery. Stipe usually short, 2–30cm, straw-coloured, with pale brown scales below. Lamina narrowly elliptic to elliptic-oblong, 1-pinnate, 12–80(–100) × 4–25(–40)cm, glabrous; pinnae simple, 10–40 pairs, oblong to linear-oblong, 1–15 × 0.5–1.8cm, rounded to attenuate at the tip, the sterile pinnae serrulate. **Map 37, Fig. 6.**

Terrace-walls, wadi-sides and cliffs etc., usually in shade and near permanent water, sometimes as a weed of man-made habitats; 5–2700m.

Saudi Arabia, Yemen (N & S), Socotra, Oman. Southern and tropical Africa.

2. P. cretica L., Mant. pl. 1: 130 (1767). Syn.: *P. semiserrata* Forsskal (1775 p.186). Rhizome short-creeping; rhizome-scales brown. Fronds tufted. Stipe long, 20–40



Fig. 6. Ferns. A, *Pteris quadriaurita*: Aa, frond ($\times 0.25$); Ab, pinnules showing costal spines ($\times 1$). B, *P. dentata*: Ba, frond ($\times 0.25$). C, *P. vittata*: Ca, frond ($\times 0.25$); Cb, fertile pinna ($\times 1$). D, *P. cretica*: Da, frond ($\times 0.25$). E, *Acrostichum aureum*: Ea, fertile frond ($\times 0.25$). F, *Pteridium aquilinum*: Fa, part of frond ($\times 2$).

(–60)cm, straw-coloured, glabrous except for a few scales at the base. Lamina light green, ovate-triangular, 1-pinnate above and with the lowest pinnae 2-lobed, 12–20 × 12–25cm, glabrous; pinnae and lobes of the lowest pinna linear-elliptic, 6–13(–20) × 0.5–1.5(–2.5)cm, attenuate, the sterile pinnae minutely serrulate. **Map 38, Fig. 6.**

Sandstone cliffs and grassland; 2100–2800m.

Yemen (N). Widespread in the Old World tropics and subtropics.

3. *P. dentata* Forsskal (1775 p.186). Syn.: ? *P. regularis* Forsskal (1775 p.186); *P. serrulata* Forsskal (1775 p.187). Illustr.: Collenette (1985 p.409). Type: Yemen (N), Forsskal (lost), Schweinfurth 1402 (neotype C).

Rhizome erect; rhizome-scales reddish brown. Fronds tufted, thin-textured. Stipe 15–50cm, straw-coloured becoming reddish brown at base, glabrous or with a few scales below. Lamina ovate, 2–4-pinnatifid, 15–60(–100) × 15–25(–40)cm, glabrous; middle and upper pinnae narrowly oblong, acute, pinnatifid; lower pinnae triangular, 1–3-pinnatifid; ultimate segments angled forwards, narrowly oblong, 1–5 × 0.2–0.5cm, crenate-serrate. **Map 39, Fig. 6.**

Terrace-walls and cliffs, usually by permanent water and in shade; 900–3050m.

Saudi Arabia, Yemen (N & S). S Africa, tropical Africa and the Mascarenes.

A very common fern of the SW escarpment mountains.

4. *P. quadriaurita* Retz., Observ. bot. 6: 38 (1791). Syn.: *P. catoptera* Kunze in Linnaea 18: 119 (1844).

Rhizome erect; rhizome-scales reddish brown. Fronds tufted, membranous-textured. Stipe 25–50(–90)cm, straw-coloured, glabrous except for a few scales at the base. Lamina oblong-ovate, 3-pinnate-pinnatifid, c.50(–90) × 25(–60)cm, glabrous but with minute spines on the surface above; upper pinnae narrowly oblong, acute, pinnatifid; lowest pinnae with the basal pinnules pinnatifid and resembling the upper pinnae; ultimate segments patent, narrowly oblong, 1–2.5 × 0.3–0.4cm, entire. **Map 40, Fig. 6.**

Rock crevices, terrace-walls and dense montane woodland, in shade; 1100–1800m.

Yemen (N), Socotra. Tropical Africa.

A difficult species complex in need of revision. All Arabian and Socotran material is referable to subsp. *catoptera* (Kunze) Schelpe.

Family 11. POLYPODIACEAE

17. PLEOPELTIS Humb. & Bonpl. ex Willd.

Terrestrial ferns; rhizomes creeping, clothed in clathrate scales. Fronds simple, entire. Sori round, with dark-centred peltate scales (paraphyses). Indusia absent.

POLYPODIACEAE

1. P. macrocarpa (Bory ex Willd.) Kaulf. in Berlin Jahrb. Pharm. Verbundenen Wiss. 21: 41 (1820).

Rhizome far-creeping, with brown scales. Fronds coriaceous, thickened, shortly spaced. Stipe 2–5(–8)cm, glabrous or with scattered scales. Lamina simple, narrowly elliptic, 10–12(–20) × 0.5–1.4(–1.7)cm, entire, gradually attenuate into the stipe below, glabrous above, with dark-centred peltate scales beneath. **Map 41, Fig. 3.**

Damp rocks on shaded cliffs and epiphytic on trees; 2300–2800m.

Saudi Arabia, Yemen (N), Socotra. Southern Africa, tropical Africa, Madagascar, the Mascarenes, India and America.

Easily confused with *Loxogramme lanceolata*. See comment under that species.

18. LOXOGRAMM E (Blume) C. Presl.

Terrestrial ferns; rhizomes creeping, clothed in clathrate scales. Fronds simple, entire. Sori elongate. Indusia absent, without paraphyses.

1. L. lanceolata (Swartz) C. Presl, Tent. pterid.: 215, t.9 f.8 (1836).

Rhizome long-creeping, with dark greyish brown scales. Fronds coriaceous, thickened, shortly spaced. Stipe 1–3cm, glabrous. Lamina simple, narrowly elliptic, 10–12(–35) × 0.5–1.5(–2.8)cm, entire, narrowing gradually into the stipe below, glabrous. Sori linear-oblong. **Map 42.**

Damp rocks in shaded gullies; 1700–1900m.

Yemen (N). Southern Africa, tropical Africa, Madagascar and the Mascarenes.

Easily confused with *Pleopeltis macrocarpa* which, however, can be distinguished by its rounded not elongate sori and the presence of dark-centred peltate scales on the underside of the fronds.

Family 12. DENNSTAEDIACEAE

19. PTERIDIUM Scop.

Terrestrial ferns; rhizomes long-creeping, densely clothed with hairs. Fronds spaced, 3–4-pinnate, hairy. Sori linear, continuous along the leaf margins, covered by the reflexed leaf margin and an inner indusium.

1. P. aquilinum (L.) Kuhn in Decken, Reis. Ost-Afr. 3, 3: 11 (1879).

Rhizome clothed with brown hairs. Fronds up to 2m, closely spaced. Stipe 20(–40)cm, straw-coloured, hairy and swollen at the base, glabrous above. Lamina broadly triangular to broadly ovate, glabrescent above, tomentose below. Pinnae ovate-triangular to oblong, acute; pinnules oblong, acute, pinnate to 2-pinnatifid. Indusia and reflexed leaf margins membranous and ciliate. **Map 43, Fig. 6.**

Grassland; 2000–2300m.

Yemen (N). Cosmopolitan.

Known only from an area of grassland on the outer escarpment mountains of Yemen (N). The Yemen populations belong to subsp. *aquelinum*.

Family 13. OLEANDRACEAE

20. NEPHROLEPIS Schott

Rhizomes short, erect, often forming tubers and producing thin stolons; rhizome-scales peltate. Fronds pinnate. Sori circular, intramarginal; indusia reniform.

1. N. undulata (Afzel. ex Swartz) J. Sm. in Bot. Mag. 72, Comp.: 35 (1846). Syn.: *N. cordifolia* sensu Balfour (1888) non C. Presl.

Tubers up to 2.5cm across. Fronds pinnate, up to 30–70(–100)cm, herbaceous. Stipe brown, with sparse brown scales. Lamina narrowly elliptic, 20–85 × 4–11cm, glabrous; pinnae narrowly oblong, acute, weakly crenate, cordate at the base, sessile. Sori in a row either side of the midrib; indusia membranous, entire. **Map 44, Fig. 8.**

Semi-deciduous thicket; 850m.

Socotra. Tropical Africa, Madagascar and the Mascarenes.

21. ARTHROPTERIS J. Smith

Terrestrial ferns; rhizomes creeping; rhizome-scales peltate. Fronds 2-pinnatifid. Sori circular, intramarginal; indusia reniform.

1. A. orientalis (J.F. Gmelin) Posthumus in Rec. Trav. Bot. Néerl. 21: 218 (1924). Syn.: *Dryopteris orientalis* (J.F. Gmelin) C. Chr., Index fil.: 281 (1905); *Nephrodium pectinatum* (Forsskal) Hier in Bot. Jahrb. Syst. 28: 341 (1900); *Polypodium pectinatum* Forsskal (1775 p.185).

Rhizome thin, far-creeping; rhizome-scales few, brown. Fronds widely spaced, thinly coriaceous, up to 40cm. Stipe brown, thinly hairy and with scattered scales at the base. Lamina 2-pinnatifid, narrowly ovate, 15–25(–40) × 6–10(–17)cm, acuminate, thinly hairy, often with scattered white glands above; pinnae narrowly oblong, pinnatifid into narrowly oblong and rounded lobes, the lobes 2–5(–9) × 1–2.5 (–3.5)mm. Sori almost covering the under-surface of the lobes; indusia glabrous, entire. **Map 45, Fig. 8.**

Rocky banks and gullies; 1000–2000m.

Yemen (N). Tropical Africa, Madagascar and the Mascarenes.

Local in the high rainfall areas of the SW escarpment mountains.

Family 14. ASPLENIACEAE

22. ASPLENIUM L.

Terrestrial ferns; rhizomes short-creeping, clothed in clathrate scales. Fronds 2-pinnatifid (in Arabia). Sori elongate, borne along the veins; indusia narrow, opening inwards towards the midrib or rarely towards the margin, membranous or absent or obsolete.

- | | |
|---|------------------------------|
| 1. Frond 1-pinnate, the pinnae shallowly toothed or entire | 2 |
| + Frond 2–3-pinnate or 1-pinnate with pinnatifid pinnae | 3 |
| 2. Pinnae up to 1cm long; rhachis reddish-brown to black | 1. <i>A. trichomanes</i> |
| + Pinnae 1–5cm long; rhachis green | 7. <i>A. schweinfurthii</i> |
| 3. Sori appearing marginal, 1 per lobe; indusia opening towards the margin | 6. <i>A. rutifolium</i> |
| + Sori superficial on the lamina, not appearing marginal, 2 or more per lobe; indusia opening towards the midrib | 4 |
| 4. Frond proliferous (bearing young plants) at the tip; lamina pinnate-pinnatifid with oblong segments, but if the segments deeply lobed or serrate towards the tips then see <i>A. aethiopicum</i> | 5. <i>A. protensum</i> |
| + Frond not proliferous at the tip; lamina 2–3-pinnate-pinnatifid with obovate or wedge-shaped segments | 5 |
| 5. Stipe and rhachis densely covered (at least below) with a mixture of hairs and hair-like scales | 2. <i>A. aethiopicum</i> |
| + Stipe and rhachis glabrous or with scattered scales | 6 |
| 6. Stipe reddish-brown, green above, swollen at the base | 3. <i>A. adiantum-nigrum</i> |
| + Stipe green, sometimes dark brown below, not swollen at the base | 4. <i>A. varians</i> |

1. *A. trichomanes* L., Sp. pl.: 1080 (1753). Illustr.: Collenette (1985 p.407).

Rhizome erect; rhizome-scales dark brown, linear-lanceolate. Fronds dark green, wiry, tufted, persistent. Stipe short, reddish-brown to almost black, glabrous, glossy. Lamina 1-pinnate, linear-lanceolate, 5–13(–30) × 0.8–2cm; pinnae oblong, 3.5–9 × 2–5mm, rounded at the tip, crenate-dentate, unequal and broadly cuneate, subsessile at the base, glabrous. Sori linear, borne along the veins between the midrib and margin, almost completely covering the surface of the pinnae at maturity. **Map 46, Fig. 7.**

Rock crevices and cliffs in the mist-affected regions of the SW escarpment mountains; 1950–3050m.

Saudi Arabia, Yemen (N & S), Socotra. Widely distributed in temperate regions and on tropical mountains throughout the world.

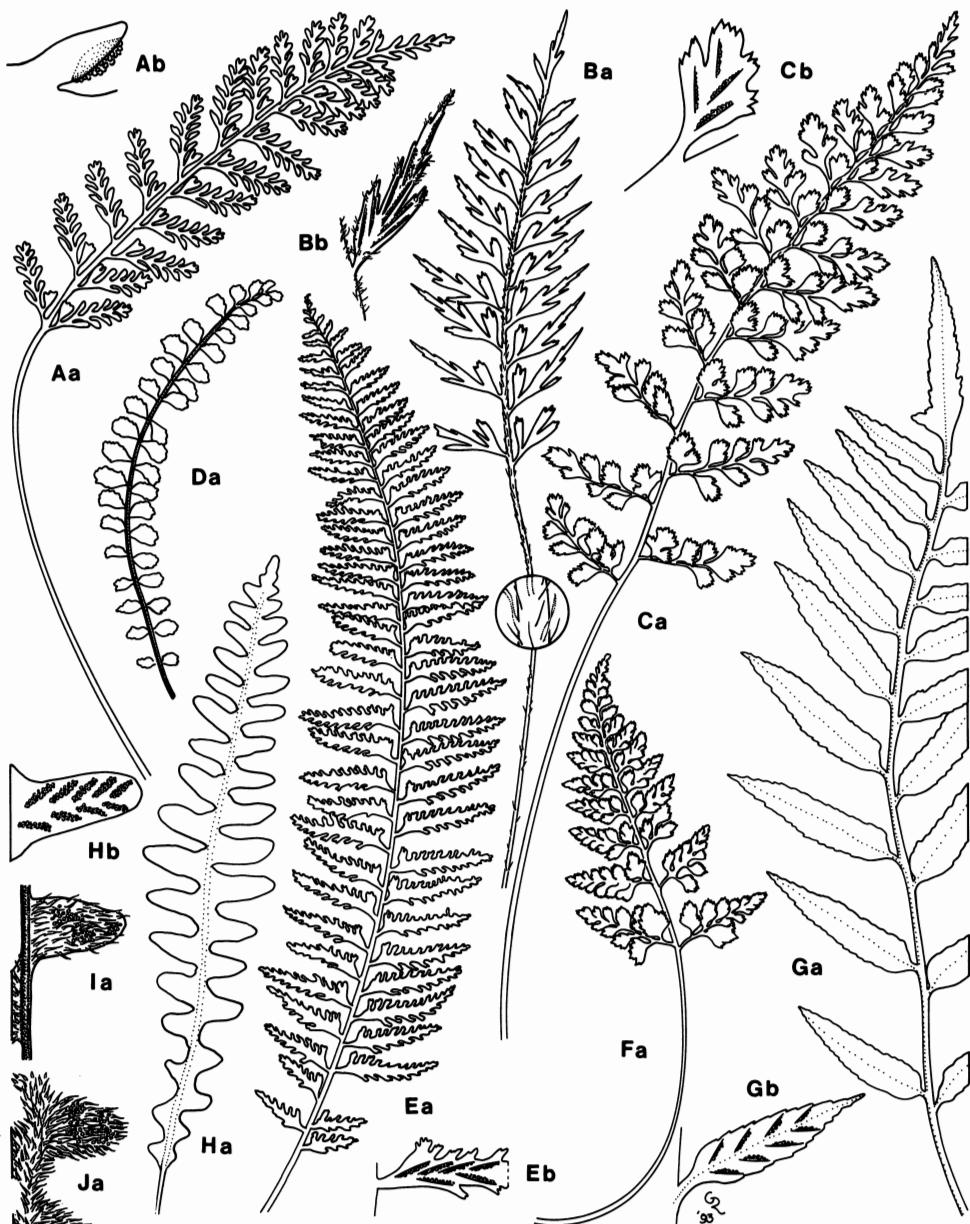


Fig. 7. Ferns. A, *Asplenium rutifolium*: Aa, frond ($\times 0.6$); Ab, pinnule ($\times 6$). B, *A. aethiopicum*: Ba, frond ($\times 0.6$); Bb, pinna ($\times 2$). C, *A. varians*: Ca, frond ($\times 0.6$); Cb, pinnule ($\times 6$). D, *A. trichomanes*: Da, frond ($\times 1$). E, *A. protensum*: Ea, frond ($\times 0.6$); Eb, pinna ($\times 6$). F, *A. adiantum-nigrum*: Fa, frond ($\times 0.6$). G, *A. schweinfurthii*: Ga, frond ($\times 0.6$); Gb, pinna ($\times 2$). H, *Ceterach dalhousiae*: Ha, frond ($\times 0.6$); Hb, pinna ($\times 2$). I, *C. phillipsianum*: Ia, pinna ($\times 2$). J, *C. officinarum*: Ja, pinna ($\times 2$).

2. A. aethiopicum (Burm. f.) Becherer in Candollea 6: 23 (1935). Syn.: *Acrostichum filare* Forsskal (1775 p.184); *Asplenium filare* (Forsskal) Alston in J. Bot. 72 suppl.: 4 (1934); *A. lanceolatum* Forsskal (1775 p.185); *A. praemorsum* Swartz, Prodr.: 130 (1788). Illustr.: Collenette (1985 p.407).

Rhizome erect; rhizome-scales dark brown. Fronds dark green, thinly coriaceous, densely tufted. Stipe short, dark brown becoming green above, with mixed scales and hairs. Lamina pinnate with 1–2-pinnatifid pinnae, narrowly ovate, (5–)10–30 × 5–10cm, thinly covered with hair-like scales densely so on the rhachis; pinnae narrowly ovate to trapeziform-acuminate, 1.5–6 × 0.5–2cm, acute or acuminate; segments obovate, wedge-shaped to narrowly oblong, unevenly deeply lobed, serrate towards the tips. Sori 3–8mm, linear. **Map 47, Fig. 7.**

In shade amongst rocks and on terrace-walls; 1050–3200m.

Saudi Arabia, Yemen (N & S), Socotra. Tropical and southern Africa.

3. A. adiantum-nigrum L., Sp. pl.: 1081 (1753).

Rhizome short or creeping; rhizome-scales hair-like, blackish brown. Fronds shiny green, somewhat coriaceous, up to 25cm, tufted or shortly spaced. Stipe blackish or reddish brown, green above, often polished, equal in length to the lamina, the base swollen, with scattered hairs. Lamina 2–3-pinnate, ovate-triangular, 5–15 × 3–8cm, glabrous or with scattered hairs; pinnae ovate-triangular, (5–)10–55 × (3–)5–25mm, acute or rounded at the tip; pinnules and pinnule-lobes wedge-shaped to obovate, the outer margins dentate. Sori linear, 1–2mm, often almost covering the surface of the pinnule at maturity. **Map 48, Fig. 7.**

Rock crevices, terrace-walls, cliffs and under trees; often by water; 2000–3500m.

Saudi Arabia, Yemen (N). Europe, Africa, SW Asia, Taiwan, Hawaii and N America.

4. A. varians Wall. ex Hook. & Grev. subsp. **fimbriatum** (Kunze) Schelpe in Bol. Soc. Brot. 41: 11 (1967). Illustr.: Fl. Zamb., Pteridophyta: 171 (1970).

Rhizome erect; rhizome-scales lanceolate with long hair-points. Fronds tufted, pale green, ± herbaceous, up to 15cm. Stipe green or the base brown, shorter than the blade, with scattered hairs. Lamina 2–3-pinnate, narrowly elliptic, 5–8(–13) × 1–3.5 (–5)cm, glabrous; pinnae ovate to oblong, 5–18 × 3–8mm; pinnules and pinnule-lobes obtuse to obovate, the outer margins dentate. Sori linear, almost covering the surface of the pinnule at maturity. **Map 49, Fig. 7.**

Rocks in a deeply shaded gully; 1880m.

Yemen (N). Tropical East Africa and eastern southern Africa.

Very rare in Arabia; known only from a single, frequently mist-filled gully in the outer SW escarpment mountains.

5. A. protensum Schrad. in Gött. Gel. Anz. 1818: 916 (1818).

Rhizomes creeping; rhizome-scales lanceolate, brown. Fronds herbaceous, up to 60cm, tufted or shortly spaced, often proliferous at the tips. Stipe short, dark brown

or blackish brown, densely covered with brown scales and hairs. Lamina pinnate with pinnatifid pinnae, narrowly oblong-elliptic, 20–65 × 4–10cm; pinnae narrowly oblong or trapeziform, acute or acuminate, unequal at the base, pinnately divided into oblong lobes, the lobes acute or shallowly incised at the tips, thinly pubescent and with scattered scales beneath. Sori linear. **Map 50, Fig. 7.**

Rocks in a shaded gully; 1700m.

Yemen (N). Tropical and southern Africa.

Very rare in Arabia; known only from a single, frequently mist-filled gully in the outer SW escarpment mountains.

6. A. rutifolium (Berg.) Kunze in Linnaea 10: 521 (1836). Syn.: *Asplenium achilleifolium* (Lam.) C. Chr. var. *bipinnatum* (Forsskal) C. Chr. (1922 p.30); *A. rutifolium* (Berg) Kunze var. *bipinnatum* (Forsskal) Schelpe in J. S. Afr. bot. 30: 194 (1964); *Lonchitis bipinnata* Forsskal (1775 p.184). Illustr.: Fl. Zamb., Pteridophyta: 186 (1970).

Rhizome erect; rhizome-scales lanceolate, dark brown. Fronds green, somewhat fleshy, up to 20cm, tufted. Stipe green (drying brownish green), with pale brown scales below. Lamina pinnate with deeply 1–2-pinnatifid pinnae, narrowly oblong, up to 15 × 7.5cm; pinnae narrowly oblong, the ultimate segments oblong-obtuse, glabrous or with scattered scales. Sori linear, one per lobe, appearing marginal, opening towards the margin. **Map 51, Fig. 7.**

Rocks in a shaded gully; 1800m.

Yemen (N). Southern Africa, E tropical Africa, Madagascar and the Mascarenes.

Very rare in Arabia; known only from a single, frequently mist-filled gully in the outer SW escarpment mountains.

7. A. schweinfurthii Baker, Diagn. Fil. Nov. Socotr.: 1 (1882); Baker ex Kuhn, Ber. Deutsch. Bot. Ges. 1: 258 (1883); Balfour (1888 p.328); Illustr.: Balfour (1888 t. 100). Type: Socotra, *Schweinfurth* 490 (K).

Rhizome erect or creeping; rhizome-scales narrowly triangular, blackish brown. Fronds dark green, coriaceous, 10–40cm, tufted. Stipe green, covered with brown scales. Lamina pinnate, oblong, 8–20 × 2–8cm; pinnae oblong, 10–50 × 3–12mm, acute or obtuse, with serrate margins, truncate at the base, with scattered hair-like scales below. Sori linear. **Map 52, Fig. 7.**

Rock crevices and beneath shrubs; 1050–1100m.

Socotra. Endemic.

23. CETERACH DC.

Terrestrial ferns; rhizomes short-creeping, clothed in clathrate scales. Fronds pinnatifid, glabrous or densely clothed with scales beneath. Sori elongate, borne along the veins; indusia obsolete.

Included by some authors in *Asplenium* (see Bir, Fraser-Jenkins & Lovis (1985) in *Brit. Fern Gaz.* 13: 53–65).

- | | |
|--|----------------------------|
| 1. Lamina glabrous or with scattered scales beneath | 2. C. dalhousiae |
| + Lamina densely clothed with scales beneath, ± glabrous above | 2 |
| 2. Pinnae triangular-ovate to oblong, decurrent at the base, the lower surface completely hidden by scales | 1. C. officinarum |
| + Pinnae oblong, auriculate or weakly decurrent at the base, the lower surface partly visible, never completely hidden by scales | 3. C. phillipsianum |

1. C. officinarum DC. in Lam. & DC., Fl. franç., ed. 3, 2: 566 (1805). Syn.: *Asplenium ceterach* L., Sp. pl.: 1080 (1753). Illustr.: Fl. Iraq 2: 75 (1966); Collenette (1985 p.408).

Rhizome-scales narrowly lanceolate, acuminate, blackish brown. Fronds coriaceous, tufted. Stipe 1–3cm, densely clothed with scales. Lamina pinnatifid, narrowly elliptic, 3–15 × 1–2cm, the lower surface hidden by overlapping pale brown or silvery scales, ± glabrous above; pinnae alternate, triangular-ovate to oblong, 5–10 × 3–6mm, rounded at the tip, with entire or weakly crenate margins, decurrent at the base. Sori linear, hidden by scales. **Map 53, Fig. 7.**

Terrace-walls and rock crevices; 1850–3300m.

Saudi Arabia, Yemen (N). Europe, N Africa, Somalia, SW and C Asia.

2. C. dalhousiae (Hook.) C. Chr., Index fil. 1: 170 (1905); Syn.: *Asplenium dalhousiae* Hook. in Hooker's Icon. Pl. 2: t. 105 (1837).

Similar to *C. officinarum* but the lower surface of the lamina glabrous or with a few scales on the midrib; stipe up to 1cm; lamina up to 20 × 3.5cm; pinnae up to 15 × 7mm. **Map 54, Fig. 7.**

In shade on cliffs and terrace-walls; 1100–2000m.

Yemen (N). Ethiopia and India.

3. C. phillipsianum Kümmerle, Bot. Közlem 6: 287 (1909). Syn.: *Asplenium philipsianum* (Kümmerle) Bir, Fraser-Jenkins & Lovis, op. cit.: 62 (1985); *Gymnogramma cordata* sensu Balfour (1888) non (Thunb.) Schlecht.

Rhizome-scales narrowly lanceolate, acuminate, blackish brown. Fronds coriaceous, tufted. Stipe up to 5mm, densely clothed with scales. Lamina deeply pinnatifid, narrowly elliptic, 10 × 2cm, densely clothed with scales beneath but the surface visible at least at the margins, ± glabrous above; pinnae alternate, narrowly oblong, 5–12 × 5–9mm, rounded at the tip, with weakly crenate margins, auriculate or weakly decurrent at the base. Sori linear, hidden by scales. **Map 55, Fig. 7.**

In shrubland; 800m.

Socotra. Tropical and southern Africa.

In our area known only from a single, rather atypical gathering which has weakly crenate pinnae and thus resembles *C. officinarum*. Typical plants from Africa have distinctly crenate to pinnatifid pinnae.

Family 15. THELYPTERIDACEAE

24. CHRISTELLA Léveillé

Terrestrial ferns; rhizomes erect or creeping, clothed with scales; scales not peltate. Fronds 2-pinnatifid. Sori circular, intramarginal; indusia reniform.

1. *C. dentata* (Forsskal) Brownsey & Jermy in Brit. Fern Gaz. 10: 338 (1973). Syn.: *Cyclosorus dentatus* (Forsskal) Ching in Bull. Fan Mem. Inst. Biol. 8: 206 (1938); *Dryopteris dentata* (Forsskal) C. Chr. in Kongel. Danske Vidensk. Selsk. Naturvidensk. Math. Afh. 8, 6: 24 (1920); *D. mauritiana* sensu Schwartz (1939) non (Fée) C. Chr.; *Polypodium dentatum* Forsskal (1775 p.185); *Nephrodium molle* sensu Balfour (1888) non Desv.; *N. parasitica* sensu Vierhapper (1907) non (L.) C.B. Clarke. Type: Yemen (N), Forsskal (C).

Rhizome short-creeping; rhizome-scales dark brown. Fronds tufted, herbaceous, up to 80cm. Stipe pale brown, shortly hairy. Lamina pinnate with pinnatifid pinnae, elliptic to narrowly elliptic, (10–)15–60(–100) × (3–)6–18(–40)cm, acuminate, thinly hairy especially on the costae beneath; pinnae narrowly oblong, gradually decreasing in size and more widely spaced below, acuminate, deeply pinnatifid into oblong rounded lobes. Sori borne midway between the costule and margin; indusia hairy. **Map 56, Fig. 8.**

In shade on terrace-walls and cliffs, usually near water; 450–1900m.

Yemen (N), Socotra. Macaronesia, S Europe and widespread in Africa.

Family 16. WOODSIACEAE

25. CYSTOPTERIS Bernh.

Terrestrial ferns; rhizomes short-creeping, clothed with scales. Fronds tufted, 2–3-pinnate, glabrous. Sori round; indusia attached at the base of the sori, covering the sori until maturity, later shrivelling.

1. *C. fragilis* (L.) Bernh. in Neues J. Bot. 1, 2: 26, t.2, f.9 (1806). Illustr.: Fl. Iraq 2: 78 (1966).

Rhizome-scales narrowly ovate, pale brown. Fronds softly herbaceous, light green, up to 30cm. Stipe straw-coloured or pale green, $\frac{1}{4}$ – $\frac{1}{3}$ as long as the lamina, clothed with scales below. Lamina narrowly ovate, thin-textured. Pinnae narrowly ovate, the longest at the middle of the lamina, the lowest pair usually distant. Pinnules ovate to

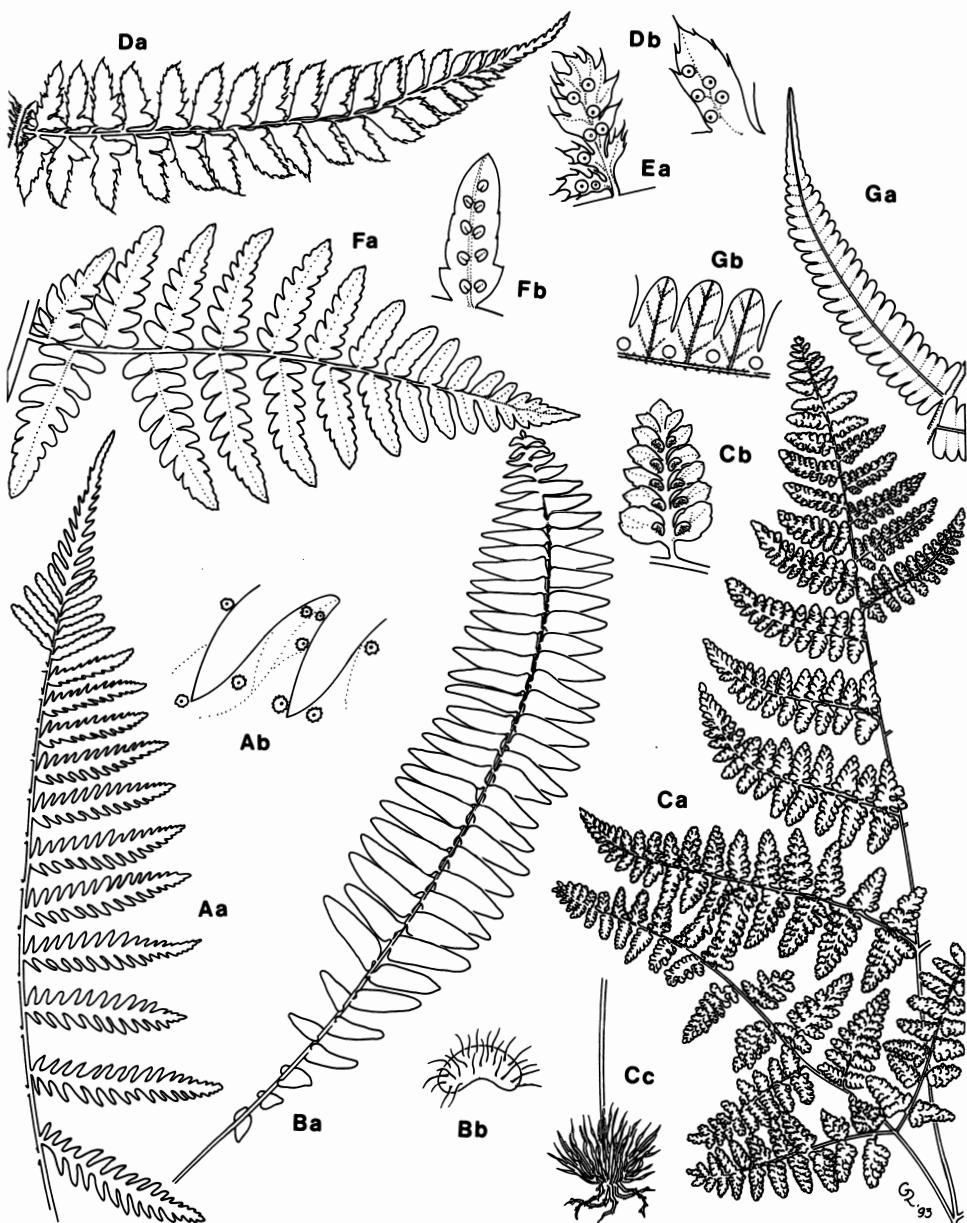


Fig. 8. Ferns. A, *Arthropteris orientalis*: Aa, frond ($\times 0.5$); Ab, close-up of pinnules showing glands ($\times 10$). B, *Nephrolepis undulata*: Ba, frond ($\times 0.5$); Bb, indusium ($\times 10$). C, *Hypodematum crenatum*: Ca, frond ($\times 0.5$); Cb, pinnule ($\times 3$); Cc, base of stipe showing scales. D, *Polystichum* sp. A: Da, pinna ($\times 1$); Db, pinnule ($\times 3$). E, *P. fuscopaleaceum*: Ea, pinnule ($\times 3$). F, *Dryopteris schimperiana*: Fa, pinna ($\times 1$); Fb, pinnule ($\times 3$). G, *Christella dentata*: Ga, pinna ($\times 1$), Gb, pinnules ($\times 4$).

oblong, dentate or pinnatifid with toothed lobes. Sori in two rows; indusia membranous, inflated, hood-like, often disappearing with age. **Map 57, Fig. 3.**

Damp rocks in shaded gullies; 2200–2900m.

Saudi Arabia, Yemen (N). Cosmopolitan.

Family 17. DRYOPTERIDACEAE

26. HYPODEMATIUM Kunze

Terrestrial ferns; rhizomes creeping, densely clothed with scales. Fronds tufted, 2–4-pinnatifid, pilose. Stipe densely clothed with scales at the base. Sori subcircular; indusia reniform.

1. H. crenatum (Forsskal) Kuhn in Decken, Reis. Ost-Afr. 3, 3: 37 (1879). Syn.: *Nephrodium crenatum* (Forsskal) Bak., Fl. Mauritius: 497 (1877); *Polypodium crenatum* Forsskal (1775 p.185); *Dryopteris crenata* (Forsskal) O. Kuntze, Revis. gen. pl. 2: 811 (1891). Type: Yemen (N), Forsskal (?lost).

Rhizome short; rhizome-scales very dense, golden brown, c.1cm long. Fronds tufted, softly herbaceous. Stipe 20–23cm, straw-coloured, with a dense tuft of scales at the base, hairy above. Lamina ovate-triangular, very finely 2–4 times pinnately divided, 12–30(–33) × 15–25(–30)cm, hairy. Lowest pinnae triangular-ovate, 1–3-pinnate, sometimes enlarged; upper pinnae pinnate, oblong-acute; ultimate segments oblong, shortly incised with crenate-serrate margins. Sori in two rows on the pinnules; indusia hairy. **Map 58, Fig. 8.**

Shady cliffs and terrace-walls; 100–2600m.

Saudi Arabia, Yemen (N & S), Socotra, Oman. Tropical and southern Africa eastwards to Japan.

Arabian plants are all referable to the diploid subsp. *crenatum*.

27. TECTARIA Cav.

Terrestrial ferns. Rhizome creeping to erect, densely clothed with large scales. Fronds tufted, 3-pinnatifid. Sori circular, borne at vein intersections or terminal on the veins; indusia reniform.

1. T. gemmifera (Fée) Alston in J. Bot. 77: 288 (1939). Illustr.: Fl. Zamb., Pteridophyta: 227 (1970).

Medium-sized fern, often with gemmae (or their scars) on the upper surface of the lamina. Rhizome erect; rhizome-scales dense, dark brown. Fronds tufted, arching, herbaceous. Stipe light-brown, thinly hairy with minute hairs and with a few scales at the base. Lamina triangular-ovate, up to 50(–90) × 30(–60)cm, 2-pinnate with pinnatifid pinnules below and bipinnatifid above, the lobes crenate, glabrescent, the costa

hairy; upper pinnae oblong with acuminate tips; lowest pair of pinnae unequally triangular, up to 15(–48) × 10(–38)cm. Sori up to 2mm across, circular; indusia c.1mm across, reniform. **Map 59, Fig. 3.**

On rocks in a shaded gully; 1700m.

Yemen (N). E tropical Africa, southern Africa and Madagascar.

In Arabia known only from a single, frequently mist-filled gully on the outer SW escarpment mountains.

28. POLYSTICHUM Roth

Terrestrial ferns; rhizomes erect or creeping, densely clothed with scales. Fronds pinnate to 4-pinnatifid; ultimate segments asymmetric at the base, often dentate-aristate. Sori circular; indusia peltate.

1. Pinnules pinnatisect, at least at the base; the margins serrate with bristles more than 1mm **1. P. fuscopaleaceum**
- + Pinnules not pinnatisect, the margins serrate with bristles less than 1mm **2. P. sp. A**

1. **P. fuscopaleaceum** Alston in Bol. Soc. Brot. ser. 2, 30: 22 (1956).

Rhizome creeping; rhizome-scales brown. Fronds tufted, herbaceous, up to 100cm. Stipe pale-brown or greenish brown, with a mixture of broad and hair-like scales. Lamina 2-pinnate, narrowly ovate, 20–55 × 7–25cm, glabrous except for hair-like scales on the veins; pinnae narrowly oblong, attenuate to the tips; pinnules (at least the basal ones) pinnatisect, narrowly oblong, acute, serrate with long aristate bristles, the bristles more than 1mm, the base asymmetric with an enlarged lobe. Sori in two rows, one each side of the midrib; indusia pale brown, disappearing at maturity. **Map 60, Fig. 8.**

Densely shaded gullies; 2900m.

Yemen (N). Tropical Africa.

According to Fraser-Jenkins (pers. comm.) the Arabian plants, here placed in *P. fuscopaleaceum*, may in fact be referable to *P. yunnanense* Christ. or *P. woronowii* Christ.

2. **P. sp. A**

Similar to *P. fuscopaleaceum* but generally with fewer scales, the pinnules never pinnatisect and the marginal teeth terminating in short (less than 1mm) bristles. **Map 61, Fig. 8.**

Densely shaded gully; 1700m.

Yemen (N). Apparently only known from a single gully in Yemen.

29. DRYOPTERIS Adans.

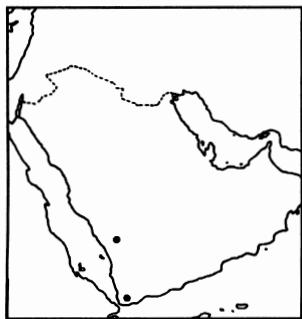
Terrestrial ferns; rhizomes erect or creeping, often massive, densely clothed with broad soft scales. Fronds 2–4-pinnate. Sori circular; indusia reniform.

1. *D. schimperiana* (A. Br.) C. Chr., Index fil.: 291 (1905). Syn.: *Dryopteris rigida* sensu Schwartz (1939) non (Hoffm.) Und.

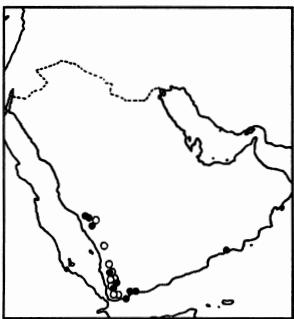
Rhizome creeping; rhizome-scales dense, reddish-brown. Fronds tufted, herbaceous, up to 75cm. Stipe straw-coloured, thinly clothed with pale reddish brown scales. Lamina 2-pinnate with pinnatifid pinnules, narrowly to broadly oblong-ovate, 20–50(–90) × 12–28(–33)cm, glabrous except for hair-like scales on the veins; pinnae narrowly oblong acuminate; pinnules narrowly oblong, pinnatifid; lobes rounded, weakly crenate-serrate. Sori in two rows, one either side of the mid-vein of the pinnule; indusia brown, membranous. **Map 62, Fig. 8.**

Terrace-walls, cliffs and grassy slopes; 2000–3000m.

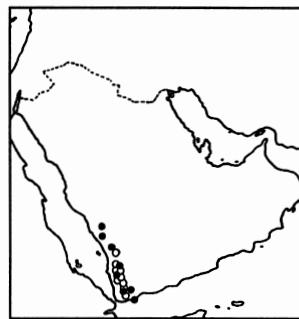
Yemen (N). NE tropical Africa.



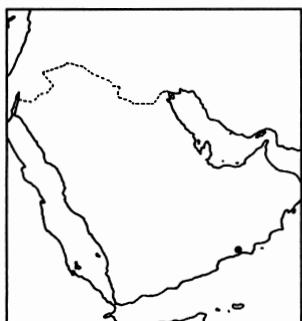
Map 7. *Psilotum nudum*



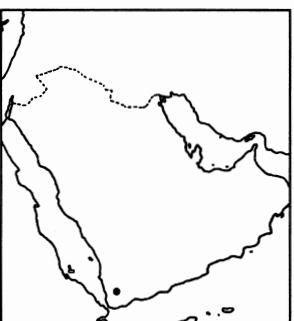
Map 8. *Selaginella imbricata*



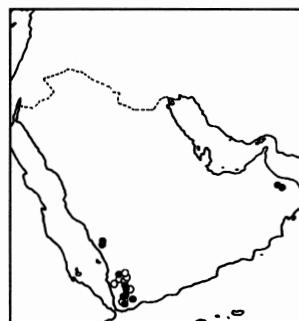
Map 9. *S. yemensis*



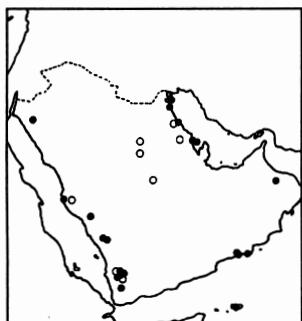
Map 10. *S. perpusilla*



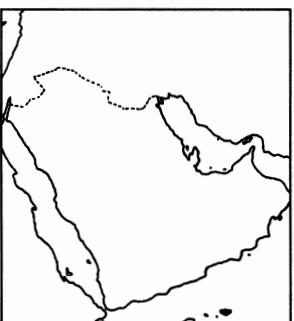
Map 11. *S. goudatana*



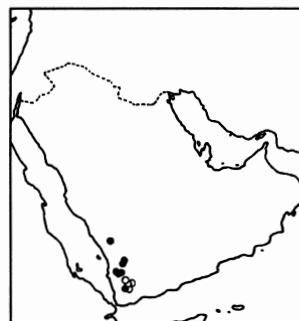
Map 12. *Equisetum ramosissimum*



Map 13. *Ophioglossum polyphyllum*

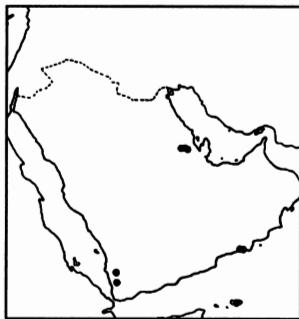


Map 14. *Marsilea coromandeliana*

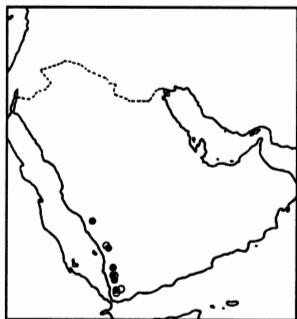


Map 15. *M. aegyptiaca*

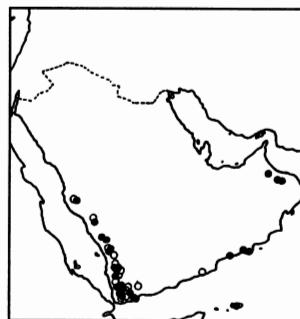
Distribution Maps



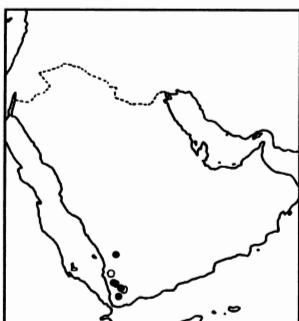
Map 16. *Ceratopteris cornuta*



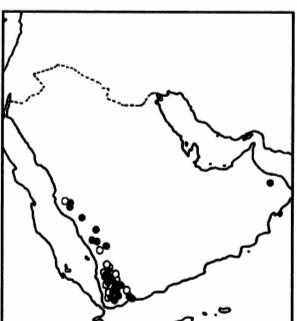
Map 17. *Actiniopteris radiata*



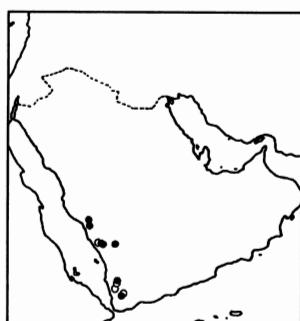
Map 18. *A. semiflabellata*



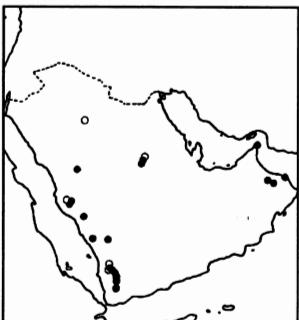
Map 19. *Cheilanthes farinosa*



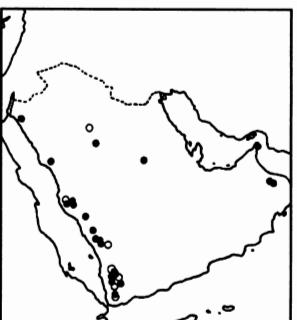
Map 20. *C. coriacea*



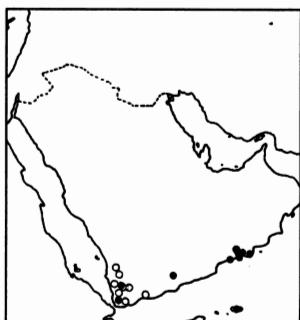
Map 21. *C. marantae*



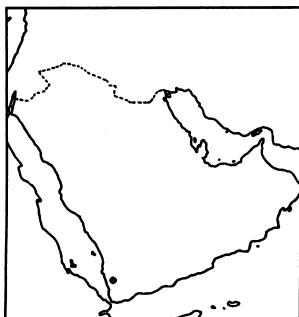
Map 22. *C. vellea*



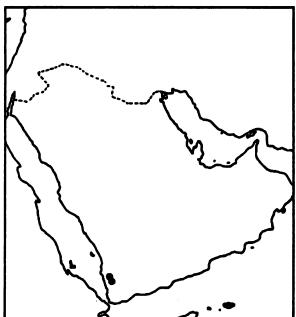
Map 23. *C. pteridoides*



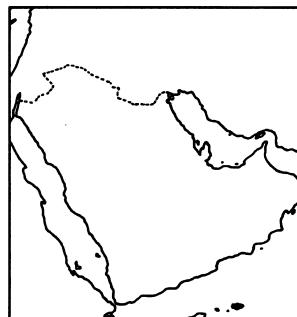
Map 24. *Negripteris sciona*



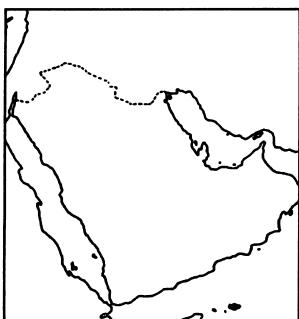
Map 25. *Pellaea quadripinnata*



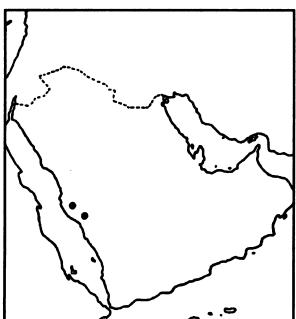
Map 26. *P. viridis*



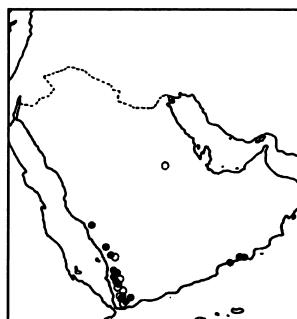
Map 27. *P. involuta*



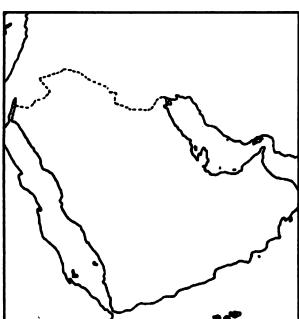
Map 28. *Doryopteris concolor*



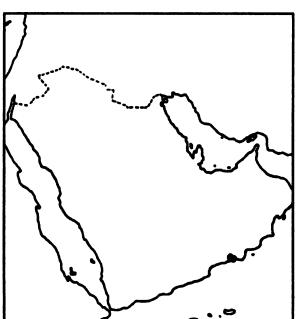
Map 29. *Anogramma leptophylla*



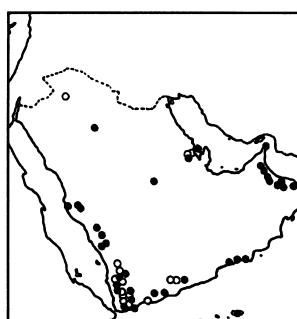
Map 30. *Adiantum incisum*



Map 31. *A. balfourii*

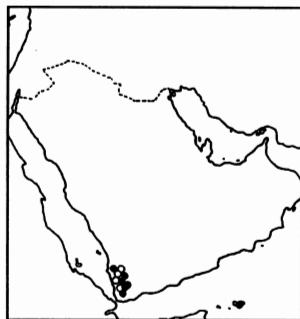


Map 32. *A. philippense*

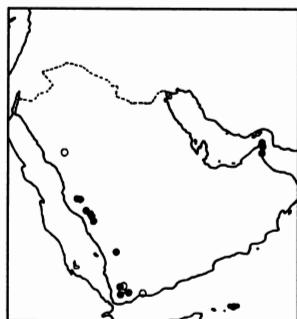


Map 33. *A. capillus-veneris*

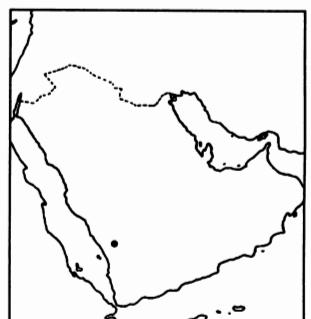
Distribution Maps



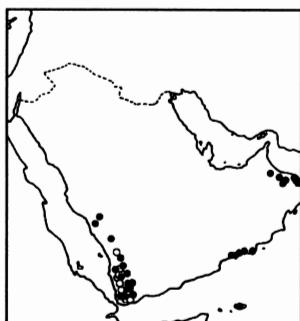
Map 34. *A. poiretii*



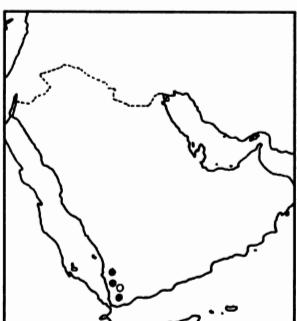
Map 35. *Onychium divaricatum*



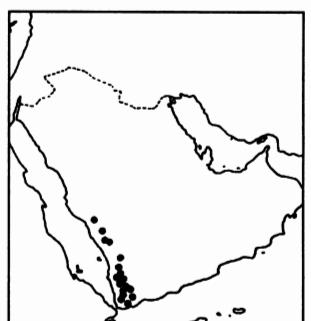
Map 36. *Acrostichum aureum*



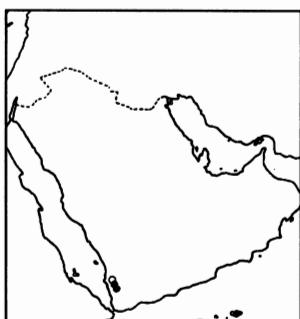
Map 37. *Pteris vittata*



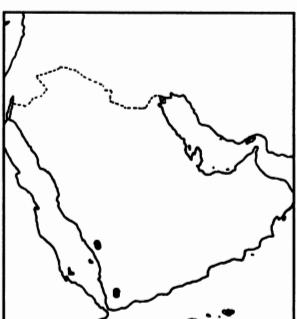
Map 38. *P. cretica*



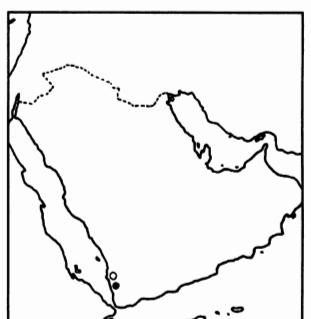
Map 39. *P. dentata*



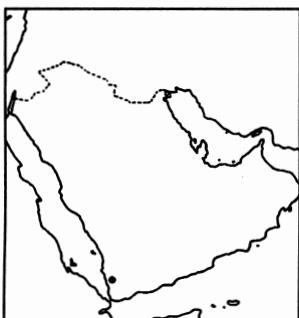
Map 40. *P. quadriaurita*



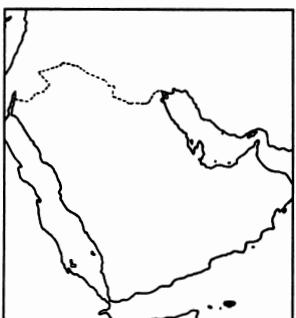
Map 41. *Pleopeltis macrocarpa*



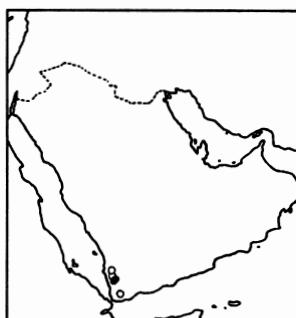
Map 42. *Loxogramme lanceolata*



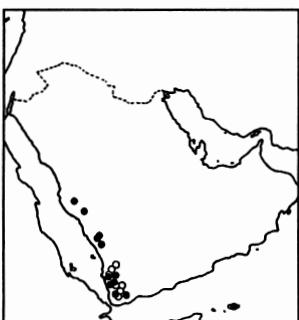
Map 43. *Pteridium aquilinum*



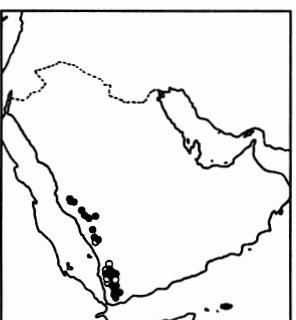
Map 44. *Nephrolepis undulata*



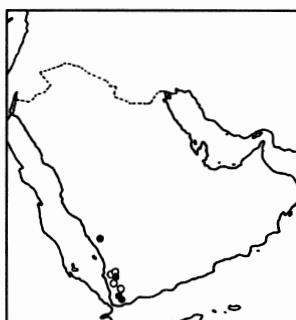
Map 45. *Arthropteris orientalis*



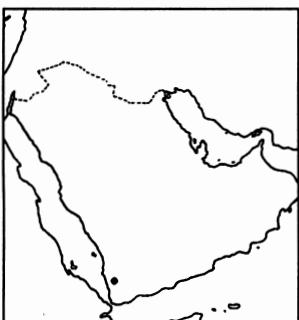
Map 46. *Asplenium trichomanes*



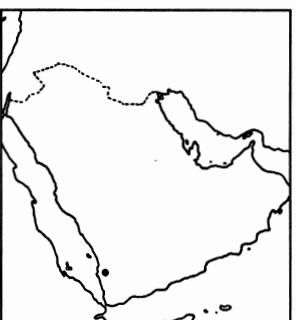
Map 47. *A. aethiopicum*



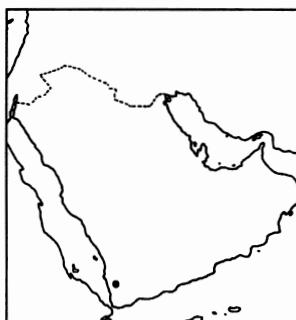
Map 48. *A. adiantum-nigrum*



Map 49. *A. varians*

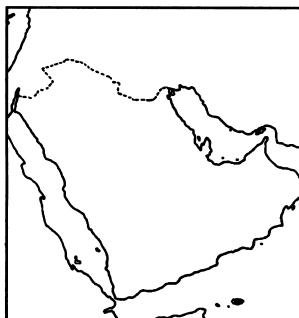


Map 50. *A. protensum*

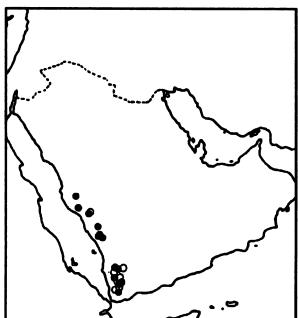


Map 51. *A. rutifolium*

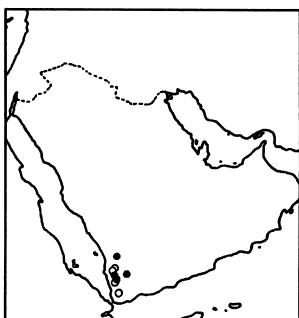
Distribution Maps



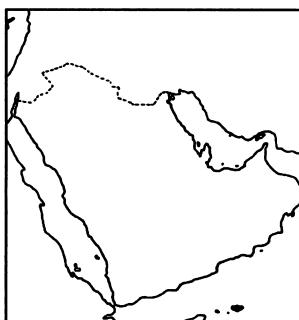
Map 52. *A. schweinfurthii*



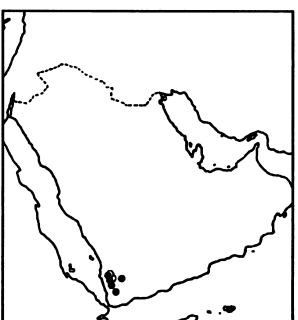
Map 53. *Ceterach officinarum*



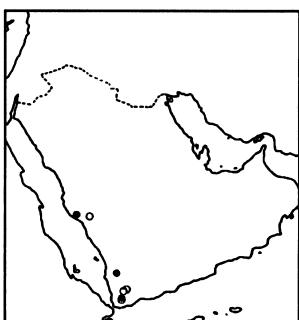
Map 54. *C. dalhousiae*



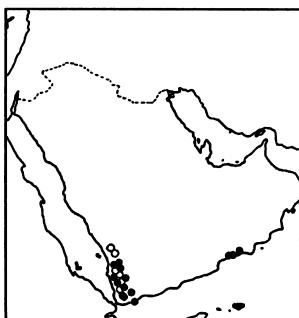
Map 55. *C. phillipsianum*



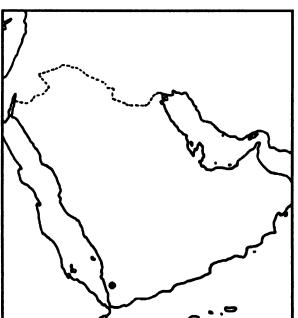
Map 56. *Christella dentata*



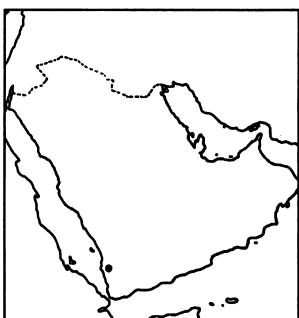
Map 57. *Cystopteris fragilis*



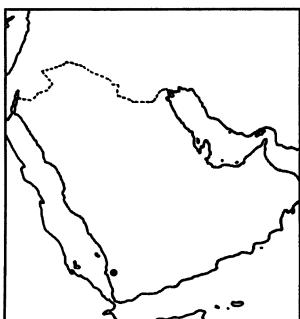
Map 58. *Hypodematum crenatum*



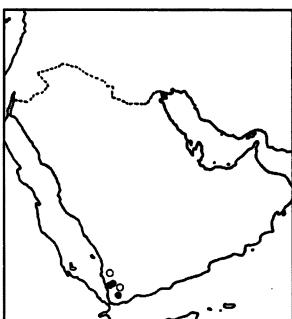
Map 59. *Tectaria gemmifera*



Map 60. *Polystichium fuscopaleacum*



Map 61. *P. sp. A*



Map 62. *Dryopteris schimperiana*