

PTERIDOPHYTA

PTEROPSIDA

1. LYCOPODIACEAE

Herbs. Lvs small. Sporangia all alike, borne near the base of the upper surface of sporophylls, which vary from being like the foliage lvs and arranged among them to being strongly differentiated from the foliage lvs and arranged in terminal spikes. Sporangia unilocular, compressed, dehiscing by a split; spores numerous. Prothallus usually subterranean, saprophytic and with mycorrhiza; antheridia in the centre of the apical part of the prothallus, containing numerous biciliate spermatozoids; archegonia in a ring round the antheridia.

Six to eight or more genera. Temperate and tropical regions.

1 Stems ascending, divided dichotomously into branches of equal length; sporangia axillary.

3. HUPERZIA

Stems creeping and rooted, with short lateral branches; sporangia in terminal spikes.

2 Lvs 4-ranked (opposite and decussate); branches dorsiventral.

4. DIPHASIASTRUM

Lvs alternate or in whorls; branches radial.

3 Lvs subulate, curved upwards; sporophylls like lvs but rather wider and toothed at base.

2. LYCOPODIELLA

Lvs flat, lanceolate, appressed or deflexed; sporophylls unlike lvs, ovate to broadly lanceolate, the margin scarious, toothed.

1. LYCOPODIUM

1. LYCOPODIUM L.

Stems creeping and rooted, with short lateral branches. Lvs arranged spirally or in whorls, flat, linear to lanceolate, appressed or deflexed. Sporophylls unlike lvs, ovate to broadly lanceolate, with scarious, toothed margin, forming terminal spikes. Prothallus without chlorophyll, disciform or tuberous, without appendages. Over 100 spp., cosmopolitan.

Spikes sessile; sporophylls acute; lvs acuminate.

1. **annotinum**

Spikes pedunculate; sporophylls with long, white apical hair; lvs acute, with long, white, apical hair. 2. **clavatum**

1. **L. annotinum** L. Interrupted Clubmoss.

Stems 30–60 cm, moderately branched with many of the branches ascending. Lvs 4–6 mm, spirally arranged, denser on the branches than on the main stem, ± spreading, linear-lanceolate, acuminate, ending in a short stiff point, minutely serrulate or entire, dull green. Fertile branches 10–25 cm. Spikes 1.5–3 cm, sessile, solitary; sporophylls ovate, acuminate, with wide scarious denticulate margin. Spores ripe 6–8. $2n = c. 68^*$. Chh.

Native. Moors on mountains from 46 to 820 m, local; Cumberland, Mull, Argyll, Perth and Kincardine northwards, but not in the islands; extinct in Orkney and

Caernarvon. Arctic and north temperate zone extending southwards in the mountains to the Pyrenees, N. Apennines and S. Carpathians; Caucasus, Himalaya, Oregon, Colorado and Maryland.

2. **L. clavatum** L. Stag's-Horn Clubmoss.

Stems 30–100 cm, much-branched, the branches all (except the fertile ones) procumbent. Lvs 3–5 mm, spirally arranged, dense, somewhat appressed or incurved, linear, acuminate, with a long white apical hair, minutely serrulate, rather bright green. Fertile branches 10–25 cm. Spikes 1–2(–3), 2–5 cm, on long peduncles; peduncles with distant, pale, appressed, linear-subulate, scale-like lvs; sporophylls ovate with long, white apical hair, with scarious denticulate margin. Spores ripe 6–9, $2n = 68^*$. Chh.

2 Native. Heaths, moors and mountain grassland ascending to 840 m, common in mountain districts, rare and decreasing in lowland areas. Throughout the British Is., but absent or local in much of C. and E. England and C. and S. Ireland; N. and C. Europe, extending locally southwards to C. Spain and Portugal, C. Italy and Bulgaria.

2. LYCOPODIELLA Holub

Stems creeping and rooted, with short lateral branches. Lvs arranged spirally, subulate, curved upwards. Sporophylls like lvs but rather wider and toothed at base, forming terminal spikes. Prothallus with conical subterranean base and green leaf-like appendages at apex. About 50 spp.

1. **L. inundata** (L.) Holub Marsh Clubmoss.

Lycopodium inundatum L.

Stems 5–20 cm, closely prostrate, sparingly branched. Lvs 4–6 mm, spirally inserted but secund towards the upper side of the stem, linear-subulate, acute, entire, green. Fertile branches 3–10 cm, their lvs spirally arranged, suberect. Spikes 1–3 cm, sessile, solitary; sporophylls similar to the foliage lvs but more spreading, toothed, and somewhat wider at the base. Spores ripe 6–9. $2n = 156^*$. Chh.

Native. Wet heaths in the lowlands, local; from Cornwall to Surrey and E. Sussex, Buckingham, Norfolk, Lincoln, Pembroke, Merioneth, Cumberland, Scotland from the Clyde and Fife to Ross and Elgin; Mayo, Wicklow, Westmeath and Armagh. Most of Europe except the Mediterranean region and E. Russia; W. Caucasus; North America from Newfoundland and Alaska to Pennsylvania, Idaho and Oregon.

3. HUPERZIA Bernh.

Stems ascending, divided dichotomously into branches of equal length. Lvs imbricate, in many rows on stem. Sporangia axillary; sporophylls like foliage lvs. Prothallus without chlorophyll, subterranean, large and cylindrical. Over 100 spp., cosmopolitan.

1. *H. selago* (L.) Bernh. ex Schrank & Mart.

Fir Clubmoss.

Lycopodium selago L.

Stems 5–25 cm, erect from a decumbent base. Lvs 4–8 mm, suberect to spreading, linear- to ovate-lanceolate, acute, entire or very minutely serrulate, dull green, often bearing in their axils bud-like gemmae. Sporangia borne in the axils of many of the lvs, not forming a terminal spike but usually in fertile zones alternating with sterile ones on the stem. Spores ripe 6–8, but not functional, reproduction probably only by gemmae. $2n = 264^*$. Chh.

Native. Heaths, moors, mountain grassland, rock ledges and mountain tops, ascending to nearly 1310 m, usually in open habitats; common in the mountains, very rare and decreasing in lowland areas; throughout the British Is., but absent from most counties in S., E. and C. England. Most of Europe, but only on higher mountains in the south; Himalaya. North America, southern South America and adjacent islands.

4. DIPHASIASTRUM Holub

Stems long, creeping, dorsiventral; branches forked several times, forming caespitose tufts. Lvs in 4 rows, opposite and decussate, somewhat scale-like, those of the lateral rows keeled. Sporophylls unlike lvs, forming terminal spikes. Prothallus without chlorophyll, with conical subterranean base bearing a subglobose apical appendage. About 30 spp., North America, Europe, C. and E. Asia.

Finer branches cylindrical or slightly flattened; ventral lvs of vegetative branches 0.5 mm wide, lanceolate, petiolate.

1. *alpinum*

Finer branches distinctly flattened; ventral lvs of vegeta-

tive branches 1–1.25 mm wide, elliptic-lanceolate, sessile.

2. *× issleri*1. *D. alpinum* (L.) Holub

Alpine Clubmoss.

Diphasium alpinum (L.) Rothm.; *Lycopodium alpinum* L.

Stems 15–50 cm, much-branched; branches mostly suberect, densely tufted. Lvs 2–4 mm, distant on the main stems, appressed and strongly 4-ranked on the branches, becoming ± equal, the ventral row well-developed, 0.5 mm wide, oblong-lanceolate, acute or acuminate, petiolate, often with a short wide hyaline point, concave, entire, *glaucous*. Fertile branches 4–7 cm. Spikes 1–2 cm, sessile, solitary; sporophylls lanceolate or ovate-lanceolate, acute or acuminate, gradually tapering, with narrow scarious denticulate margin. Spores ripe 6–8. $2n = c. 48^*$. Chh.

Native. Moors, mountain grassland and mountain tops, ascending to 1220 m, rather common; C. and N. Wales, Derby and from Westmorland and S. Northumberland northwards; N. and W. Ireland; Wicklow. N. and C. Europe, extending to the Pyrenees, N. Apennines, Bulgaria and Urals; Asia Minor, Caucasus, Altai, Japan, British Columbia and Quebec.

2. *D. × issleri* (Rouy) Holub

D. alpinum × *D. complanatum* (L.) Holub; *Lycopodium issleri* (Rouy) Lawalrée; *L. alpinum* var. *decipiens* Syme ex Druce; *L. complanatum* auct. brit.

Like *D. alpinum* but more robust and less caespitose; finer branches distinctly flattened, 2–2.5 mm wide; ventral lvs of vegetative branches 1–1.25 mm wide, elliptic-lanceolate, sessile, green; sporophylls ovate, abruptly acuminate. Partly fertile.

Native. Heaths and moors, very rare. Scattered stations in N. Devon, Hampshire, Gloucester, Worcester and Caernarvon, but perhaps extinct, C. and S. Scotland; C. Europe, C. France, Ardennes.

Southern English material, described above, is ± intermediate between the presumed parents but many of the Scottish records seem to apply to atypical forms of *D. alpinum*.

2. SELAGINELLACEAE

Herbs with long, usually creeping stems producing lfless branches (rhizophores) which bear the roots. Lvs small with a minute ligule at the base, spirally arranged or 4-ranked and of two kinds. Sporangia of two kinds borne near the base of the upper-surface of sporophylls forming terminal spikes, usually with the megasporangia in the lower, the microsporangia in the upper part. Megaspores (1–)4(–42). Microspores numerous. Male prothallus contained in the microspore until maturity, with a vegetative cell and an antheridium containing numerous biciliate spermatozooids. Female prothallus many-celled, filling the megaspore and protruding from its split top; archegonia several, at the top of the prothallus. Fertili-

zation occasionally taking place before the shedding of the megaspore.

One genus.

1. SELAGINELLA Beauv.

The only genus. About 700 spp., cosmopolitan, but mainly tropical.

Lvs all similar, spirally arranged.

1. *selaginoides*

Lvs of 2 sizes in 4 rows.

2. *kraussiana*1. *S. selaginoides* (L.) Link

Lesser Clubmoss.

S. spinosa Beauv.; *S. spinulosa* A. Braun

Stems 3–15 cm decumbent, slender, with short, vegeta-

1. ISOETES

3

tive and long, ascending, more robust fertile branches. Lvs 2–4 mm, spirally arranged, spreading or somewhat appressed, lanceolate, acute, spinulose-ciliate, *all alike*. Fertile branches 2–6 cm, suberect, their lvs larger than those of the stems and vegetative branches. Spikes sessile, solitary, 1–1.5 cm; sporophylls similar to the lvs but larger; megasporangia occupying the greater part of the spike; microsporangia few, in the upper part of spike, often 0. Spores ripe 6–8. $2n = 18^*$. Chh.

Native. Damp grassy or mossy ground, mainly on mountains, ascending to 1085 m, rather common; Merioneth to Yorkshire northwards; Clare, Tipperary and Wexford northwards. N. and C. Europe, Pyrenees; arctic and north temperate Asia and America, south to Caucasus, Colorado and New Hampshire.

2. *S. kraussiana (G. Kunze) A. Braun

Stems creeping, jointed at the nodes, flattened and dorsoventral. Lvs in 4 rows; those on the upper side of the stem c. 1 mm, unequal at base, with rounded auricle on outer margin, appressed; lateral lvs c. 2 mm, ovate-lanceolate, acute, spreading laterally, rounded at base. Spikes sessile, up to c. 2 cm, 4-sided; sporophylls ovate, cuspidate, keeled. $2n = 20$. Chh.

Introduced. Commonly grown as ground cover in greenhouses and conservatories; escaped and locally naturalized in Jersey, Cornwall, Dorset, Kent, Hertford, Berkshire, Cardigan, Caernarvon, Anglesey and oceanic sites in S. Ireland from Kerry to Dublin and in Mayo. Native of tropical and S. Africa and the Azores.

3. ISOETACEAE

Aquatic or terrestrial perennial heterosporous plants with short stout stems. Roots arising from the 2- or 3-lobed stem-base, slender, dichotomously branched. Stems with 1, rarely 2, rings of meristematic cells producing secondary tissue. Lvs crowded in a dense rosette, subulate or filiform, usually terete or subterete, often tubular and septate, sheathing at base. Ligule present. The first-produced lvs in any season bearing megasporangia, the next microsporangia, and the last sterile. Sporangia sessile, \pm embedded in the lf-base below the ligule, usually covered by an indusium formed from the lf-base. Megasporangia traversed by strands of tissue. Outer layers of spore wall impregnated with silica. Spores on germination giving rise to prothalli. Male prothallus (from microspore) of 1 vegetative cell and an antheridium with a 4-celled wall surrounding 2 cells which give rise to 4 spermatozooids. The multiciliate spermatozooids liberated by the dehiscence of the spore and the breaking down of the antheridium wall. Female prothallus (from megaspore) many-celled, filling megaspore and bearing archegonia the necks of which protrude from the split top of the megaspore. The young plant developing without a resting stage from the fertilized archegonium.

Two genera and about 75 spp., distributed throughout the world.

1. ISOETES L.

The only genus, except for the monotypic *Stylites* from the Andes of Peru.

1 Plant aquatic, never completely dormant and lfless; stem without persistent lf-bases; lvs 4–20 cm \times 2–3 mm.

Plant terrestrial, dormant and lfless in summer; stem \pm covered by persistent lf-bases; lvs up to c. 3 cm, \times 1 mm.

2 Lvs very stiff; megaspores 530–700 μ m, with short blunt tubercles.

Lvs rather flaccid; megaspores 440–550 μ m, with long sharp spines.

3. *histris*1. *lacustris*2. *echinospora*1. *I. lacustris* L.

Quillwort.

A submerged aquatic. Stem without persistent lf-bases, 2-lobed. Lvs 8–20(–45) cm \times 3–5 mm, subulate, subterete, with 4 longitudinal septate tubes, *stiff*, dark green. Stomata 0. *Megaspores* 530–700 μ m, yellowish, rarely white, *covered with short blunt tubercles*. Microspores smooth or finely furrowed. Spores ripe 5–7. $2n = c. 110^*$. Hyd.

Native. In lakes and tarns with water poor in dissolved salts, on substrata of stones with little silt, boulder clay, sand, or rarely thin peat, locally abundant. S. Devon; mountain districts of Wales; Shropshire, S.E. Yorks, Lake District; scattered throughout Scotland and Ireland north to Shetland. N. and C. Europe.

2. *I. echinospora* Durieu

Spring Quillwort.

Like *I. lacustris* but usually smaller. Lvs 4–12 cm \times 2 mm, *rather flaccid*, pale green. *Megaspores* 440–550 μ m, white or yellowish, *covered with long sharp fragile spines*. Spores ripe 5–7. $2n = 22$; c. 100*. Hyd.

Native. In lakes and tarns, usually on peaty substrata, local. E. Cornwall, S. Devon, Dorset, Glamorgan, Merioneth, Caernarvon, Cumberland; scattered throughout Scotland from Perth northward to Shetland and outer Hebrides; Ireland, mainly in the west. N. and C. Europe, southwards to N. Italy and Spain.

3. *I. histris* Bory

Land Quillwort

Terrestrial. Stem 3-lobed, *covered with persistent* short blackish lf-bases each with 2 long points. Lvs 1–3 cm \times 1 mm, $\frac{1}{2}$ -terete, dark green, shiny. Stomata present. *Megaspores* 400–560 μ m, *ornamented with a regular net-like pattern*. Spores ripe 4–5. Period of vegetative growth 10–4. $2n = 20^*$. Hr.

Native. In peaty and sandy places, damp in winter but dry in summer, very local. Lizard district. W. Cornwall; Channel Is. Atlantic coast of Europe; Mediterranean region.

SPHENOPSIDA

4. EUISETACEAE

Perennial herbs with creeping rhizome, bearing aerial stems at intervals. Stems all green and assimilating or the fertile stems without chlorophyll; all stems grooved, simple or branched from near the base, the branches resembling the stem, or with whorls of slender green branches from the nodes, with a central cavity surrounded by 2 rings of smaller cavities, the inner ring of 'carinal canals' alternating with the larger, outermost 'vallecular canals'. Lvs very small, usually not green, in whorls united into sheaths above the nodes, the sheaths ending in free teeth, usually of the same number as the grooves on the stem; sheaths of the branches much smaller, with fewer teeth. Spores all alike, overlaid by two spiral bands ('elaters') which show hygroscopic movement, numerous, in sporangia borne several together round the under surface of a peltate sporangiophore. Sporangiohores in whorls, closely aggregated together to form a spike ('cone') terminal on the main stem and occasionally on the branches also. Archegonia and antheridia borne on separate prothalli, the female being larger, or successively on the same prothallus. Prothalli with a cushion-like base having lobed green flat structures arising from the upper surface. Sex organs borne on the upper surface of the cushion. Spermatozoids multiciliate.

A single living genus.

1. EUISETUM L.

About 23 spp., almost cosmopolitan, but absent from Australia, New Zealand, etc.

- 1 At least the green or whitish vegetative stems with whorls of green branches. 2
No stems with whorls of branches. 9
2 Branches of vegetative stems branched. 6. **sylvaticum** 3
Branches of vegetative stems not branched. 4
3 Fertile stems white, without whorls of branches. 6
Fertile stems green, with whorls of branches. 5
4 Main internodes 10–30 mm in diam.; sheaths with long fine teeth c. 5 mm. 9. **telmateia** 5
Main internodes up to 4 mm in diam., sheaths with triangular or fine teeth c. 2.5 mm. 5
5 Branch-internodes 1–2 mm in diam., with (3)4 prominent narrow ridges, sheaths with triangular teeth. 5. **arvense** 5
Branch-internodes 0.5–1 mm in diam., 3-angled; sheaths with lanceolate teeth. 7. **pratense** 5
6 Central cavity at least $\frac{2}{3}$ diam. of stem; sheath-teeth without ribs. 4. **fluviatile** 5
Central cavity not more than $\frac{2}{3}$ diam. of stem; sheath-teeth with ribs. 7
7 Lowest internode of branches at least as long as adjacent stem-sheath; branches solid. 7. **pratense** 5
Lowest internode of branches shorter than adjacent stem-sheath; branches hollow. 8
8 Central cavity more than $\frac{1}{2}$ diam. of stem; spikes apiculate, 6–12 mm (Lincoln). 2. **ramosissimum** 5

Central cavity not more than $\frac{1}{2}$ diam. of stem; spikes obtuse. 20–35 mm or more (widespread).

8. **palustre**
9 Sheaths shallowly lobed, the teeth present only on juvenile stems or stems on some stunted plants of exposed places; internodes somewhat swollen. 1. **hyemale**
Sheaths with persistent teeth; internodes not swollen. 10
10 Sheath-teeth with narrow dark centres and very wide, white, scarious margin. 3. **variegatum** 11
Sheath-teeth without conspicuous, white margin. 11
11 Central cavity at least $\frac{2}{3}$ diam. of stem; sheath-teeth without ribs. 4. **fluviatile**
Central cavity not more than $\frac{2}{3}$ diam. of stem; sheath-teeth with ribs. 12
12 Central cavity more than $\frac{1}{2}$ diam. of stem; spikes apiculate, 6–12 mm (Lincoln). 2. **ramosissimum**
Central cavity not more than $\frac{1}{2}$ diam. of stem; spikes obtuse. 20–35 mm (widespread). 8. **palustre**

Subgenus 1. HIPPOCHAETE (Milde) Baker

Stomata sunk below level of other epidermal cells. Spikes apiculate. Stems all alike, hard, usually persisting through winter.

1. *E. hyemale* L. Rough Horsetail

Stems (30–)70–100 cm, erect, 4–6 mm diam., glaucous-green, simple, persisting through the winter; internodes somewhat swollen; ridges rough, with 2 regular rows of conspicuous, angular tubercles; grooves 10–30, moderate; sheaths 3–9 mm, about as long as wide, soon whitish with a black band at top and bottom, appressed; teeth as many as the grooves, very quickly detached as a ring and carried up at tip of elongating shoot, leaving a crenulate upper edge to the sheath, sometimes persisting on some stems of depauperate plants; central cavity c. $\frac{2}{3}$ or more diam. of stem. Spike 8–15 mm. Spores ripe 7–8. $2n = 216^*$. Grh.

Native. Shady valley-sides and river banks, etc., ascending to 535 m. Hampshire, Glamorgan, Bedford and Norfolk northwards to Outer Hebrides, formerly much commoner in the south; E. Ireland from Wexford to Antrim and Fermanagh, Sligo, formerly in south and west. Most of Europe but rare in the Mediterranean region; Caucasus; N. and C. Asia; western North America southwards to California and New Mexico.

- E.* × **moorei** Newman (*E. hyemale* × *ramosissimum*; *E. occidentale* (Hy) Coste), differing from *E. hyemale* in its more slender, yellowish-green stems which die down in autumn, at least to near the base, non-swollen internodes, sheaths about twice as long as wide, and dark brown or black, usually persistent teeth, rarely producing small black spikes with abortive spores, occurs on low sandy and clayey banks near the sea between Wexford Harbour (Co. Wexford) and Ardmore Point (Co. Wicklow).

***2. *E. ramosissimum* Desf,**

Stems 50–75 cm, *greyish-green*, usually dying in autumn, usually with axillary whorls of branches in lower half, sometimes whorls only partial or absent, rough with scattered tubercles; *grooves* 8–20, moderate; sheaths c. 8 mm, green, becoming brown with a black band at the bottom; teeth black with narrow white margins and a \pm persistent hair-like apex; *central cavity* $\frac{1}{2}$ – $\frac{5}{8}$ diam. of stem. *Branches* hollow; *lowest internode* c. $\frac{1}{3}$ length of adjacent stem sheath. Spike 6–12 mm. Spores ripe 5–8. $2n = c. 216^*$. Grh.

Introduced, probably with soil. Long grass by River Witham (S. Lincoln); first found 1947. C. and S. Europe, extending locally northwards to the Netherlands, Latvia and C. Russia; Asia; Africa; America.

E. \times trachyodon A. Braun (*E. hyemale* \times *E. variegatum*), Mackay's Horsetail, is generally intermediate between the parents. The dark green stems are 30–60(–90) cm, with non-swollen internodes; the sheaths are longer than wide, more so than in either parent, and the teeth are long, black, sometimes with narrow, white, scarios margin towards base, and mostly persist throughout the first season; the spikes are 4–5 mm, black or orange-tinged and contain abortive spores. This natural hybrid occurs on damp areas in calcareous coastal dunes and sandy river banks. It is local in Kincardine, Rhum, Skye and Harris, but more frequent in Ireland from Clare and Mayo to Donegal, Down and Antrim. It is recorded from many parts of N. and C. Europe, Greenland and North America.

3. *E. variegatum* Schleicher ex Weber & Mohr

Variiegated Horsetail.

Stems 15–80 cm, decumbent or less often erect, up to 4 mm diam., green, *simple or rarely branched at the base, without axillary whorls*, persisting through the winter; *grooves* 4–10, moderate; *ridges* shallowly 1-grooved, rough, with 2 regular rows of minute tubercles; *sheaths* c. 2–4 mm, green with a black band at the top, rather loose; *teeth* as many as the grooves, with narrow dark centre and very wide, white, scarios margin, *triangular-ovate or triangular-lanceolate*, at first subulate, the tip falling and leaving an *obtuse* apex, 4-ribbed; *central cavity* c. $\frac{1}{3}$ diam. of stem. Spike 5–7 \times c. 3–4 mm. Spores ripe 7–8. $2n = 216^*$. Grh.

Native. Dunes, river-banks, wet ground on mountains, etc., ascending to 490 m in Kerry. Hampshire, Somerset, Berks, Wales; Cheshire and Yorks to Sutherland and Outer Hebrides, very local; widespread in C. Ireland, from Clare and Kilkenny to Donegal and Louth, Derry; var. *wilsonii* in Kerry only, usually in shallow water. N. and C. Europe, extending southwards to the Pyrenees, N. Apennines and S. Ural; N. Asia and North America.

A variable sp., which has been variously subdivided. Var. *variegatum*, the most frequent form in Britain, usually has stems 15–25 cm tall and c. 2 mm diam. Most Irish populations belong to var. *majus* Syme, in which the plants are more vigorous, with stems up to 40(–80) cm tall and 4 mm diam. Var. *wilsonii* Newman, described from Co. Kerry, was distinguished by stems,

up to 100 cm, with completely smooth internodes.

Subgenus 2. EQUISETUM.

Stomata not sunk below level of other epidermal cells. Spikes obtuse. Fertile and vegetative stems sometimes dissimilar, dying down in autumn.

4. *E. fluviatile* L.

Water Horsetail.

E. limosum L.; *E. heleocharis* Ehrh.

Rhizome glabrous. *Stems* 50–150 cm, \pm erect, 2–12 mm diam., green, *simple or with irregular whorls of branches in the middle, smooth; grooves* 10–30, very fine; sheaths 5–10 mm, green, tight; *teeth* as many as the grooves, subulate, c. 1 mm, black, with inconspicuous pale margin, *not ribbed*; *central cavity* $\frac{3}{8}$ – $\frac{9}{10}$ diam. of stem. *Branches* ascending, slender, simple, usually 5-angled, hollow; *lowest internode* about as long as stem sheath or shorter; sheaths with 4–5 moderate, subulate, green or blackish teeth. Spike 1–2 cm. Spores ripe 6–7. $2n = 216^*$. Hel.

Native. In shallow water at the edges of lakes, ponds and ditches, frequently dominant in these swamp communities; less often in marshes and fens, ascending to 915 m. Common throughout the British Is. Most of Europe; Caucasus; temperate Asia; North America from Labrador and Alaska to Virginia and Oregon.

E. \times litorale Kühlew. ex Rupr. (*E. arvense* \times *fluviatile*). Stems all alike, resembling those of *E. fluviatile* but more deeply grooved, and with twice the number of green bands, more branches and with loose sheaths. Teeth appressed, with minute black apex. Central hollow $\frac{1}{2}$ – $\frac{2}{3}$ diam. of stem. Spike short; spores abortive. $2n = 216$. Scattered throughout British Is., especially in high rainfall districts, particularly common in Ireland.

E. \times dycei C. N. Page (*E. fluviatile* \times *palustre*) has been recorded from wet ditches in the Outer Hebrides (Harris, Lewis) and Perthshire. It is morphologically intermediate between the parents, but may be confused with *E. \times litorale*, from which it can be distinguished by the lowest internode of the branches being about as long as the adjacent sheath, and the c. 9 shallow stem-furrows.

5. *E. arvense* L.

Field Horsetail.

Rhizome pubescent, with ovoid tubers. Vegetative stems 20–80 cm, erect or decumbent, c. 3–5 mm diam., green, slightly rough; *grooves* 6–19, deep; sheaths 3–8 mm, green; teeth as many as grooves, subulate, acute, green below with blackish tips, 1-ribbed, often adhering together in pairs or threes; *central hollow* less than $\frac{1}{2}$ diam. of stem. *Branches* spreading, numerous, usually simple, solid, regular, (3–)4-grooved, the ridges prominent, narrow; *lowest internode* longer than adjacent stem sheath; sheaths pale, 4-toothed; *teeth triangular-lanceolate, acuminate*, somewhat spreading, pale. Fertile stem 10–25 cm, simple, brown; *sheaths* loose, pale brown, with 6–12 darker teeth, few (4–6), distant. Spikes 1–4 cm. Spores ripe 4. $2n = c. 216^*$. Grh.

Native. Fields, hedgebanks, waste places, dune-slacks, etc., ascending to over 900 m. Common throughout the British Is. Throughout Europe; C. China; North America, Greenland.

6. *E. sylvaticum* L.

Wood Horsetail.

Vegetative stems 10–50(80) cm, erect, 3–6 mm diam., green, rather rough; grooves 10–18; sheaths 10–15(–20) mm, green below; *teeth united into 3–6, broad, subacute, brown lobes*, each with 2–3 ribs; central cavity $\frac{1}{4}$ – $\frac{1}{3}$ diam. of stem. *Branches drooping at ends*, numerous, *branched* except in small plants, regular, 3–4-grooved, solid; lowest internode longer than adjacent stem sheath; sheaths with 3–4 long subulate teeth. Fertile stem 10–40 cm, pale green, usually with short branches when the spores are ripe; sheaths loose, numerous, greenish below, brown above, with 3–6 broad brown teeth. Spike 1.5–2.5 cm. Spores ripe 4–5. $2n = 216^*$. Grh.

Native. Damp woods on acid soils, moors, etc., ascending to 915 m, throughout the British Is., common in Scotland, N. England, Wales and N. Ireland, becoming very local southwards and absent from several midland and southern counties and from the Channel Is. Most of Europe except S. Russia, but rare in the Mediterranean region; Caucasus; temperate Asia; North America from Newfoundland and Alaska to Virginia and Iowa; S. Greenland.

7. *E. pratense* Ehrh.

Shady Horsetail.

Vegetative stems (2–)10–30(–60) cm, erect, c. 1–2 mm diam., green, rough; *grooves 8–20, deep*; sheaths 3–8 mm; teeth as many as the grooves, brown with a blackish rib, subulate, acute; central cavity c. $\frac{1}{2}$ diam. of stem or rather more. *Branches* spreading or sometimes somewhat drooping, numerous, simple, regular, solid, 3(–4)-grooved; *lowest internode longer than adjacent stem sheath* (sometimes shorter in the lower part of stem); sheaths pale, 3(–4)-toothed; *teeth deltate, acute*. Fertile stem 10–25 cm, simple or with short branches when the spores are ripe, pale green; sheaths loose, numerous, yellowish-white with 10–20 pale teeth, the ribs dark. Spike 1.5–4 cm. Spores ripe 4. $2n = c. 216^*$. Grh.

Native. Grassy stream banks, etc., ascending to over 900 m. In scattered localities from Yorks and Westmorland to Orkney, very local and mainly in the east; Down, Derry and Tyrone. N., C. and E. Europe; Caucasus; N. and C. Asia; North America from Nova Scotia and Alaska to New Jersey and Colorado.

8. *E. palustre* L.

Marsh Horsetail.

Rhizome glabrous. Stems 10–60 cm, erect or decum-

bent, 1–3 mm diam., green, usually branched, often rather irregularly, occasionally simple, slightly rough; *grooves 4–8, deep*; sheaths 4–12 mm, green, loose; *teeth 4–8, triangular-subulate, blackish with wide whitish scarios margin, 1-ribbed*; *central cavity small, scarcely larger than the outer ones*. Branches spreading to sub-erect, often short, simple, 4–5-grooved, hollow; *lowest internode much shorter than the adjacent stem sheath*; sheaths with 4 short appressed black-tipped teeth. Spike 1–3.5 cm. Spores ripe 5–7. $2n = c. 216^*$. Grh.

Native. Bogs, fens, marshes and wet heaths, woods and meadows, ascending to 915 m. Common throughout the British Is. Almost throughout Europe; Caucasus; temperate Asia; North America from Newfoundland and Alaska to Connecticut and Oregon.

E. × rothmaleri C. N. Page (*E. arvense* × *palustre*) which resembles a yellow-green *E. palustre* with more conspicuously angled branches, is known from marshy fields and ditches in the Isle of Skye.

9. *E. telmateia* Ehrh.

Great Horsetail.

E. maximum auct.

Rhizome pubescent, often with pyriform tubers. *Vegetative stems* 1–2 m, erect, c. 10–30 mm diam., *ivory white, smooth*; *grooves 20–40, fine*; sheaths 1.5–4 cm, ± appressed, greyish-green, blackish above; teeth c. 5 mm or more, as many as the grooves, blackish, subulate, 2-ribbed; central cavity $\frac{1}{2}$ – $\frac{1}{3}$ diam. of stem. *Branches* bright green, spreading, *numerous, simple, regular, 4-grooved*; lowest internode shorter than adjacent stem sheath; sheaths short, pale, 4-toothed. Fertile stem 15–25(–40) cm, simple, ivory white; *sheaths* loose, *numerous*, close together, pale brown with 20–30 dark teeth. Spike 4–8 cm. Spores ripe 4. $2n = 216^*$. Grh.

Native. Damp shady banks, etc., ascending to 365 m. Throughout England, Wales and Ireland, rather local; more local in Scotland and absent from much of the north, apart from the Inner and Outer Hebrides, Ross, Sutherland, Caithness and Aberdeen; Alderney. Europe except the extreme north and much of the USSR; Asia Minor and Caucasus; N. Africa; Azores, Madeira; W. America from British Columbia to California.

E. × font-queri Rothm. (*E. palustre* × *telmateia*), which resembles a rather slender form of *E. telmateia*, but has a long branchless part at the stem apex and the fertile stems resemble the vegetative stems of *E. telmateia*, is known as an extensive colony in the Isle of Skye and on a railway embankment in Worcester.

FILICOPSIDA

5. OPHIOGLOSSACEAE

Terrestrial (rarely epiphytic) herbs with short, usually erect, rhizome without scales; roots fleshy. Lvs one or more, stalked, not circinate in bud. Fertile lvs consisting of a sterile blade and one or more fertile spikes or a

fertile panicle; (in our species the fertile spike or panicle appears as if terminal on a stem on which the sterile blade is borne laterally). Sporangia all alike, borne in 2 rows on the margins of the fertile spike or panicle-

2. OPHIOGLOSSUM

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branches, sessile or nearly so, each derived from a group of cells; wall of several layers of cells; annulus 0; spores very numerous (1500–15 000). Prothallus usually subterranean, massive, without chlorophyll but with endotrophic mycorrhiza, bearing organs of both sexes, the antheridia sunk in the tissues.

Four genera, the two following the monotypic *Helminthostachys* Kaulf. from tropical Asia and Australia and *Rhizoglossum* Presl from S. Africa.

Sterile blade pinnate; fertile portion a panicle.

1. BOTRYCHIUM

Sterile blade simple, entire; fertile portion a spike.

2. OPHIOGLOSSUM

1. BOTRYCHIUM Swartz

Sterile blade pinnately lobed or *pinnate* (sometimes several times); veins free. *Sporangia subsessile, arranged in a panicle*, opening by a transverse slit.

About 40 spp., cosmopolitan, mainly north temperate regions.

1. *B. lunaria* (L.) Swartz

Moonwort.

Rhizome underground, ascending or creeping, very short, usually unbranched. Lvs (2–)5–15(–30) cm, solitary, rarely 2, erect, sheathed at the base by the brown remains of the previous year's lvs; sterile blade (1–)2–5(–12) cm, usually inserted about the middle of the lf, oblong in outline, pinnate; pinnae (2–)4–7(–9) pairs, fan-shaped, entire or shallowly and irregularly (rarely deeply) crenate, without midrib; fertile panicle (0.5–)1–5 cm (excluding stalk), overtopping sterile blade, 1–3 times branched. Spores ripe 6–8. $2n = 90^*$. Grh.

Native. Dry grassland and rock ledges throughout the British Is., ascending to 1020 m in Perth, rather local, more frequent in Scotland and N. England, becoming scarce southwards and in much of C. and S. Ireland. Almost throughout Europe, but rare in the Mediterranean region; Morocco (Atlas); Asia Minor, Himalaya, California and New York; Australia, Tasmania, New Zealand.

Reports of *B. matricariifolium* A. Braun ex Koch and *B. multifidum* (S. G. Gmelin) Rupr. in Scotland refer to aberrant forms of this sp.

2 OPHIOGLOSSUM L.

Sterile blade simple (rarely palmately lobed); veins reticulate. *Sporangia sunken, arranged in a simple spike* (or spikes), opening by a transverse slit.

About 30–50 spp., cosmopolitan.

1 Lvs single, rarely 2; blade more than 3.5 cm.

1. *vulgatum*

Lvs often 2–3 together; blade less than 3.5 cm.

2 Plant not more than 2 cm; sterile blade attenuate at base; spike 3–6 mm; sporangia c. 6–10.

3. *lusitanicum*

Plant usually 3–8 cm; sterile blade cuneate to rounded at base; spike 8–20 mm; sporangia 12–28(–40).

2. *azoricum*1. *O. vulgatum* L.

Adder's-tongue.

Rhizome underground, erect, very short. Roots producing new plants from adventitious buds. Lvs 1(–2), 8–20(–45) cm, erect; *sterile blade* 4–15 cm, *ovate to ovate-lanceolate or oblong*, entire, obtuse or acute, sheathing the stalk of the fertile spike at the base, *with free vein endings inside the meshes of the network*; epidermal cells with sinuate walls; fertile spike 2–5(–7) cm (excluding stalk), overtopping sterile blade at maturity, with 10–40 sporangia on each side; apex sterile, acute. Spores with blunt tubercles. Spores ripe 5–8. $2n = 480–520^*$. Grh.

Native. Damp grassland, fens and dune-slacks. Throughout the British Is., but local or absent from much of mainland Scotland and C. and S. Ireland. Most of Europe, but rare in the Mediterranean region; Caucasus; Madeira; N. and W. Asia; N. Africa; North America.

2. *O. azoricum* C. Presl

Small Adder's-tongue.

O. vulgatum subsp. *ambiguum* (Cosson & Germ.) E. F. Warburg;

O. vulgatum subsp. *polyphyllum* auct., non A. Braun

Like *O. vulgatum* but smaller, usually 3–8 cm high; lvs (1)2–3 together; sterile blade 3–3.5 cm, lanceolate to ovate, usually acute, with free vein endings inside network, tapered at base or contracted so as to appear stalked. Spike 8–20 mm, with 6–14(–20) sporangia on each side. Spores moderately tuberculate. $2n = c. 720$. Grh.

Native. Dune-slacks and short coastal turf, very local; Scilly and Channel Is., Dorset, Lundy I., Pembroke, N. Wales, Cumberland, Northumberland; Caithness, Orkney and Shetland; Kerry, Galway, Mayo and Donegal. W. Europe, Azores.

3. *O. lusitanicum* L.

Like *O. vulgatum* but much smaller, not higher than 2 cm; lvs 1–3 together; sterile blade 1–3 cm., lanceolate to linear-lanceolate, obtuse, without free vein endings inside network, attenuate at base. Spike 3–6 mm, with 3–5 sporangia on each side. Spores smooth. $2n = 250^*–260^*$. Grh.

Native. Very local and rare in short turf on cliff-tops and rocky slopes in the Isles of Scilly and Guernsey. Mediterranean region and W. Europe.

6. OSMUNDACEAE

Rhizome large, erect, not scaly. Lvs pinnately divided, expanded at the base, the expansions covered with glandular hairs; veins free. Sporangia marginal or superficial, all alike and developing simultaneously; indusium 0; annulus consisting of a group of thick-walled cells near the apex; sporangia dehiscing by a slit running from the annulus across the apex. Spores rather numerous (up to 500), green. Prothallus green, cordate, fleshy.

Three genera and about 19 spp., cosmopolitan.

1. OSMUNDA L.

Sporangia marginal on reduced pinnules without chlorophyll or flat blade, the fertile pinnae usually occupying the top or middle portion of the lf or the whole lf. Outer lvs vegetative.

12 spp., absent from Australia.

1. *O. regalis* L.

Royal Fern.

Rhizome short, ascending or suberect, massive. Lvs 30–120(–400) cm, tufted, 2-pinnate, the outer vegetative, the inner with the lower pinnae vegetative, the upper fertile (often with a transition region with pinnae with some vegetative and some fertile pinnules); blade glabrous, ± lanceolate in outline, in the fertile lvs with c. 2–3 pairs of vegetative pinnae and 5–14 pairs of fertile

ones markedly decreasing in size upwards; petiole hairy when very young, soon glabrous; vegetative pinnae with 5–13 pairs of pinnules; rhachis narrowly winged; pinnules 2–6.5 cm, ± oblong, subobtuse, ± truncate at the base, often with a rounded lobe on the lower side at the base and occasionally shallowly crenately lobed on both sides, minutely and irregularly crenulate-serrulate, the veins prominent on both surfaces and repeatedly dichotomously branched, reaching the margin; fertile pinnules up to 3 cm, 2–4 mm wide, without blade, densely covered with clusters of brown sporangia. Spores ripe 6–8. $2n = 44^*$. H.

Native. Fens, bogs, wet heaths and woods, on peaty soil but in well-drained places, ascending to 365 m. Throughout the British Is., local, most frequent in W. Britain and, especially W. Ireland, rarer eastwards and much reduced by drainage, now almost extinct in most heavily populated areas owing to the depredations of collectors. Widespread in W. Europe, extending locally eastwards to E. Sweden, Poland and Turkey; Asia Minor, Transcaucasia; N. Africa; India, etc.; S. Africa, Madagascar, etc.; eastern North America from Newfoundland and Saskatchewan southwards; Central and South America to Uruguay.

7. ADIANTACEAE

Rhizome usually short, creeping or ascending, with hairs or scales. Lvs pinnately divided; veins free; petiole with 1 or 2 vascular strands. Sori on lower surface, without indusia but often protected by the reflexed lf-margin, not borne on a vein connecting the other vein endings. Spores tetrahedral.

About 3 genera and 220 spp. Cosmopolitan.

1 Sori on lower surface of lf, not covered by the margin.

2. ANOGRAMMA

Sori on or near margin of lower lf-surface, covered by inrolled indusium-like margin or apparent margin.

2 Lf-segments fan-shaped; recurved margin interrupted.

3. ADIANTUM

Lf-segments ± oblong; recurved margin continuous along segment.

1. CRYPTOGRAMMA

1. CRYPTOGRAMMA R.Br.

Rhizome scaly. Fertile and vegetative lvs differing, 2- or more pinnate. Sori borne on the apical part of the veins, ± oblong, protected by the reflexed, continuous lf-margin.

Four spp. North temperate zone, temperate South America, S. Africa.

1. *C. crispa* (L.) Hooker

Parsley Fern.

Allosorus crispus (L.) Röhl.

Rhizome short, creeping or ascending, branched. Lvs densely tufted, bright green; outer vegetative; inner fer-

tile. Vegetative lvs 5–20 cm, 3-pinnatisect, naked except for a few brownish scales at the base of the petiole which is about as long as blade; blade triangular-ovate, pinnate; pinnae 3–7 on each side, usually 2-pinnatisect; segments c. 5–10 mm, obovate, obtuse, cuneate at base, pinnately lobed or toothed. Fertile lvs 10–25 cm (the blade about the same size as in the vegetative lvs, the petiole much longer); blade ovate, 3–4 pinnate; segments oblong-linear, stalked, appearing entire, the margins recurved, shallowly sinuately lobed, at first almost meeting and hiding the sori. Sori oblong, at first distinct but appearing to form a continuous band when mature. Spores ripe 6–8. $2n = 120^*$. H.

Native. Screes, etc., on acid soils on mountains from 90 to 1220 m; Devon, Somerset (artificial habitats, very rare); Wales; Yorks to Caithness, the Outer Hebrides and Orkney; locally abundant but absent from some areas; very rare in Ireland, (Galway, Down, Antrim). Mountains of Europe, at lower elevations in the extreme north, the Caucasus; W. Siberia (Ob region).

2. ANOGRAMMA Link

Small annuals but with perennial prothallus. *Rhizome very short with few scales. Fertile and sterile lvs somewhat different, thin, 2–3 pinnate. Sori linear, running along the length of the veins; lf-margin flat.*

Seven spp. scattered through the tropics and south

1. HYMENOPHYLLUM

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temperate zone, only the following reaching the north temperate zone.

1. A. leptophylla (L.) Link Jersey Fern.
Gymnogramma leptophylla (L.) Desv.; *Grammitis leptophylla* (L.) Swartz

Rhizome very short, with a few narrow scales when young. Lvs few, slightly hairy when young, soon glabrous; outer vegetative, 7(–10) cm or less, pinnate; pinnae c. 1 cm long and almost as wide, deeply pinnatifid or almost palmatifid; segments lobed; inner lvs fertile, but not clearly marked off from the vegetative ones, 3–20 cm, ovate-oblong, 2–3-pinnate; pinnules or segments c. 5–10 mm, obovate, obtuse, cuneate at base, pinnately lobed or pinnatifid. Sori linear, along the ultimate veins, appearing confluent at maturity. Spores ripe 3–5. $2n = 58^*$. Th.

Native. Hedgebanks in the Channel Is (Guernsey and Jersey), rare. Mediterranean region and W. coast of Europe, Crimea; Macaronesia; Abyssinia, S. Africa, Madagascar; India; Australia, New Zealand; America from Mexico to Argentina.

3. ADIANTUM L.

Rhizome scaly. Lvs all alike, thin and translucent, usually with black glossy petiole and broad \pm fan-shaped segments. Sori close to the ends of the veins borne on the reflexed lf-margins.

About 200 spp., tropical and warm temperate, only the following in Europe.

1. A. capillus-veneris L. Maidenhair Fern

Rhizome creeping, densely covered with narrow brown scales. Lvs close together, 6–40 cm, 2–3-pinnate; petiole (and rhachis) black and shining, as long as or shorter

than blade; blade \pm ovate in outline; pinnae and pinnules 5–30 mm, fan-shaped, often wider than long, crenately lobed in the upper part with wide rounded or truncate lobes which are recurved on the fertile pinnules; veins dichotomously branched, free; midrib 0. Sori borne close together along the veins of the recurved part of the lobes, 2–10 on each lobe. Spores ripe 5–9. $2n = 60^*$. H.

Native. Damp crevices of sea-cliffs and basic rocks, almost always near the sea, very local and rare. Cornwall, Devon, Glamorgan, Westmorland, Isle of Man; Cork, Clare, Galway, Donegal; Scilly and Channel Is.; also found rarely as an escape on walls, etc., elsewhere. Tropical and warm temperate zones of nearly the whole world; north in Europe to Caucasus, Crimea, S. Switzerland and W. France.

4. PTERIS L.

Lvs all alike; segments long, linear-lanceolate. Sori covered by scarious, deflexed lf-margin.

Two spp., natives of S. Europe, grown as house plants have spread to warm locations on walls in parts of S. and W. Britain: **P. cretica** L., with the blade ovate in outline, and up to 7 pairs of serrulate pinnae; **P. vittata** L., with the blade lanceolate in outline, and 10 or more pairs of entire pinnae, also seems to have been established on a slag-heap in the Forest of Dean (Gloucester).

Dicksonia antarctica R.Br., a 'tree-fern' from Australia, is cultivated in the mildest parts of S.W. Britain and W. Ireland and persists in abandoned gardens, as on Valencia Island (S. Kerry), Cornwall and the Isles of Scilly. The 2–3 pinnate lvs are borne on a 'stem' up to 2 m, high, the sori being borne on terminal pinnules of several lvs. Ripe spores sometimes produced.

8. HYMENOPHYLLACEAE

Rhizome usually creeping. Lvs thin and translucent, of 1 layer of cells without stomata, entire or divided, with the ultimate segments 1-veined. Sori marginal on the vein endings, often projecting from the lf; indusium \pm cup-like, entire or 2-lipped or 2-valved, surrounding the base or whole of the sorus; sporangia all alike, shortly stalked, developed successively from apex to base; annulus oblique, without definite stomium, the sporangia opening laterally by a long slit. Spores 32–420. Prothallus green, either filamentous or strap-like.

Thirty-four genera and about 600 spp., mostly tropical, a few in moist parts of the temperate zones, absent from dry areas.

Indusium narrowly campanulate, not valved, the receptacle projecting from it as a long bristle; pinnae 1–2-pinnatisect; ultimate lobes short; lvs mostly over 10 cm; rhizome 2–4 mm diam.

2. TRICHOMANES

Indusium 2-valved, the receptacle not projecting; pinnae irregularly dichotomously divided, the ultimate lobes oblong; lvs rarely reaching 10 cm, usually much less; rhizome c. 1 mm diam.

1. HYMENOPHYLLUM

1. HYMENOPHYLLUM Sm.

Plants with habit of bryophytes, with which they often grow. Rhizomes filiform, less than 1 mm diam., smooth. Lvs \pm procumbent, persistent after withering, deeply pinnatisect; segments asymmetrical, deeply lobed on side towards apex. Sori solitary, \pm globose, near the base of distal segments of lvs. *Indusium of 2 ovate to suborbicular valves, united only at base.* Receptacle included. *Prothallus flat.*

About 25 spp., mostly temperate.

Valves of indusium orbicular, toothed; lf \pm flat.

1. tunbrigense

Valves of indusium ovate, entire; pinnae bent back from the rhachis.

2. wilsonii

1. H. tunbrigense (L.) Sm. Tunbridge Filmy-fern.

Rhizome creeping. Lvs 2.5–8(–12) cm, pinnate, the pinnae divided \pm dichotomously but very irregularly into oblong segments, \pm flat, persistent for some years; petiole occupying $\frac{1}{3}$ – $\frac{1}{2}$ length, wiry, naked or with a few hairs; blade oblong or ovate-oblong in outline,

12–20 mm wide; rhachis winged; segments up to 3 mm, oblong, sharply and remotely serrulate, 1-veined, *the vein ceasing slightly below the apex*. Sori marginal on the tips of the segments, mostly near the rhachis of the lf; *indusium* c. 1 mm, flattened, *the valves ±orbicular, with a wide irregularly and sharply toothed mouth*. Spores ripe 6–7. $2n = 26^*$. Chh.

Native. Rocks, tree trunks, etc., in a moist atmosphere, ascending to 300 m. in Wales, local but often abundant where it occurs. Cornwall to Somerset; Sussex, Kent; S. and W. Wales; Lancashire to W. Inverness and Skye, east to Yorks, Peebles and Linlithgow; W. Ireland from Cork to Donegal, Waterford, Antrim. Locally in W. Europe southwards to Pyrenees, N. Italy, E. Germany; Macaronesia. The same or related spp. in North America, Australia, etc.

2. *H. wilsonii* Hooker Wilson's Filmy-fern.
H. peltatum auct., vix Desv.; *H. unilaterale* auct.

Differs from *H. tunbrigense* as follows: Lvs usually narrower and appearing considerably so because the *pinnae* are *bent back from the rhachis*; *pinnae* usually with fewer and more unilateral segments; *vein reaching apex of segments*. Sorus somewhat projecting; *indusium ovoid*, not flattened, *the valves entire*. Spores ripe 6–7. $2n = 36^*$. Chh.

Native. In similar places to *H. tunbrigense*, requiring, in general, less sheltered conditions, and thus commoner, though in some places extending less far east, ascending to 1005 m in Kerry; Cornwall, Devon, Derby, Wales, Isle of Man; Lancashire and Yorks to Fair Is. (absent from N.E. Scotland and from several other eas-

tern counties); throughout Ireland but absent from much of the centre and east. N.W. Europe; Azores.

2. TRICHOMANES L.

Like *Hymenophyllum*, but with stouter, hairy rhizomes; lvs erect, 1–2-pinnatisect; sori cylindrical; *indusium* tubular, slightly 2-lipped, enclosing basal part of sorus; receptacle exserted; prothallus filamentous.

About 25 spp., mostly temperate.

1. *T. speciosum* Willd. Killarney Fern.
T. radicans auct.

Rhizome creeping, 2–4 mm diam., clothed with blackish hair-like scales. Lvs (7–)20–45 cm., ±irregularly 2–3-pinnatisect, persistent for some years; petiole occupying $\frac{1}{3}$ – $\frac{1}{2}$ length, naked, winged above; blade ovate-triangular in outline, dark green, the rhachis winged; *pinnae* ±lanceolate in outline, the rhachis winged; *pinnules* or segments rather irregularly pinnatifid or pinnately lobed; lobes c. 1 mm or less, 1-veined, entire. Sori projecting from the margins of the upper *pinnae*; *indusium* 1–2 mm, narrowly campanulate; receptacle bristle-like, exserted. Spores ripe 7–9. $2n = 144^*$. Chh.

Native. Among shady rocks in places with a very humid atmosphere, ascending to 460 m in Kerry; very rare in Great Britain; Merioneth, probably extinct in Yorks, Westmorland, Cumberland, Arran and Argyll; more widespread in Ireland and formerly abundant in some places but now rare owing to the depredations of collectors; Kerry, Cork, Waterford, Kilkenny, Limerick, Tyrone, Antrim. W. French Pyrenees, W. Spain, Portugal (very rare in all); Macaronesia.

9. POLYPODIACEAE

Rhizome with thin-walled scales. Lvs in 2 ranks on upper side of rhizome; petioles with 1–3 main vascular strands. Sori orbicular to oblong, on lower surface of lf, near ends of veins if these are free; *indusium* 0; spores bilateral.

1. POLYPODIUM L.

Rhizome creeping, fleshy, with opaque scales. Lvs usually pinnatifid or 1-pinnate; veins usually regularly anastomosing with free endings inside the loops, sometimes free. Sori terminal on the veins, in 1(–3) rows on each side of the midrib.

About 75 spp., cosmopolitan, mainly tropical America, Asia and Polynesia.

1 Lvs ±oblong; sori orbicular when young, reddish-brown or bright orange when mature; annulus of sporangium dark reddish-brown. **1. vulgare**

Lvs oval to triangular-deltate; at least some sori oval when young, yellow to yellow-brown when mature; annulus of sporangium yellow to golden brown.

2 Sori containing long branched paraphyses; scales of rhizome lanceolate. **3. australe**

Sori without paraphyses; scales of rhizome abruptly narrowed above the wide base. **2. interjectum**

1. *P. vulgare* L. Polypody.

Rhizome creeping on or below the surface, rather stout, densely clothed when young with reddish-brown, ovate-lanceolate scales up to 6 mm. Lvs solitary, pinnatifid nearly to the rhachis or pinnate, persistent; petiole from about $\frac{1}{3}$ to nearly as long as blade, naked, ±erect; blade 10–25 cm, narrowly ovate to oblong or linear-lanceolate the lower $\frac{1}{3}$ – $\frac{1}{2}$ with ±parallel sides, suberect, somewhat coriaceous, dull green; *pinnae* or segments c. 5–25 on each side, (10–)15–35(–45) mm, the lowest somewhat shorter, oblong to linear-lanceolate, obtuse, wide-based, entire to somewhat serrate; veins free. Sori on the ends of the lowest fork on the upper side of the main veins, about midway between the midrib and the margin, 1.5–3 mm, orbicular when young, reddish-brown or bright orange when mature. Annulus of sporangium dark reddish-brown, with 7–17 thick-walled cells, with 1 cell between its base and sporangium-stalk. $2n = 148^*$. Grh. or Ch.

Native. Woods, often on trees but also on the ground, rocks and walls, ascending to 855 m in Kerry; throughout the British Is., but absent from parts of C. and E. England, common in the wetter districts, less so in